Greater sandhill crane
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Appendices

Refuge staff conducting research
©Barbara Wheeler

Appendix A
Appropriate Use Findings

The Appropriate Refuge Uses Policy (603 FW 1), finalized in 2006, outlines the process that the Service uses to determine when general public uses on refuges may be considered. Uses proposed for a National Wildlife Refuge must first be found appropriate and compatible. The appropriate use review occurs prior to applying the compatibility screening. Compatibility determinations are found in Appendix B.

Public uses previously defined as wildlife-dependent uses under the National Wildlife Refuge System Improvement Act of 1997 (hunting, fishing, wildlife observation and photography and environmental education and interpretation) are generally exempt from appropriate use review. Other exempt uses include refuge management activities and situations where the Service does not have adequate jurisdiction to control the activity. State fish and wildlife agency activities are not subject to this policy when they:

1. Directly contribute to the achievement of refuge purpose(s), refuge goals, and the Refuge System mission, as determined by the refuge manager in writing,
2. Are addressed in a document such as a Regional or California/Nevada Operations Office (CNO) memorandum of understanding or a comprehensive conservation plan (CCP), or
3. Are approved under national policy.

Other existing, proposed, or requested public uses are required to undergo the appropriateness screen. Appropriate use policy provides refuge managers with a consistent procedure to screen and document decisions concerning public uses, with the use of the following questions:

(a) Do we have jurisdiction over the use?
(b) Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?
(c) Is the use consistent with applicable executive orders and department and Service policies?
(d) Is the use consistent with public safety?
(e) Is the use consistent with goals and objectives in an approved management plan or other document?
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
(g) Is the use manageable within the available budget and staff?
(h) Will this be manageable in the future within existing resources?
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality, compatible, wildlife-dependent recreation into the future?

Uses marked "no" for questions (a) or (b) are not evaluated further. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate.

When a use is determined to be appropriate, a refuge manager must then decide if the use is compatible before allowing it on a refuge.

The following forms show which uses have been determined appropriate and which have been determined not appropriate. Narrative answers for findings follow each form. Interpretation of two of the questions on the form, (e) and (f), are explained below:

- Question (e) on the appropriate uses form (Is the use consistent with goals and objectives in an approved management plan or other document?) is interpreted as follows: The approved management plan in question is interpreted as the CCP.
- Question (f) (Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?) was checked yes if this is the first time the use has been formally considered in a planning process. Question (f) was also checked yes if there is no documentation of the use being denied in an earlier planning process.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Malheur National Wildlife Refuge

Use: Commercial Tours and Photography

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___ **Appropriate** ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: ______ Date: 1-24-13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Uses Justification, Attachment 1

Date: November 2, 2011

Refuge: Malheur National Wildlife Refuge (Refuge)

Use: Commercial Tours and Photography

Summary: Commercial tours and photography uses on the Refuge cover a broad range of resource-based activities, including birding, geology, plant identification, art and visual interpretation, music, sound recording, and other similar non-consumptive activities. These uses usually occur in areas open to the public, using the same facilities associated with non-commercial recreational uses.

For findings listed on FWS Form 3-2319, and if deemed necessary, a justification has been provided below.

a. Do we have jurisdiction over the use?

All of the proposed activities would take place within Refuge boundaries. The Refuge has jurisdiction over collections within Refuge boundaries.

b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?

Any proposed activities would comply with all applicable laws and regulations and any restrictions or qualifications that are required to comply with law and regulations would be specified in the special use permit (SUP).

c. Is the use consistent with applicable executive orders and department and Service policies?

Under U.S. Fish and Wildlife Service (USFWS) Policy (50 CFR 29.1), a commercial recreational use is a use that generates revenue or that results in a commodity that is or can be sold for income or revenue.

The Appropriate Use Policy (603 FW 1) specifically references commercial uses of this kind. The policy states that "Commercial uses of a refuge may be considered appropriate if they are a refuge management economic activity (see 50 CFR 25.12), if they directly support a priority general public use, or if they are specifically authorized by statute … An example of a commercial use that may be appropriate is a concession-operated boat tour that facilitates wildlife observation and interpretation."

d. Is the use consistent with public safety?

Through SUP review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project's SUP.

e. Is the use consistent with goals and objectives in an approved management plan or other document?

The use is consistent with Goal 7 in the CCP. Requests would be approved in instances where they can provide meaningful biological and cultural significance and public appreciation of natural resources.

f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?

This use had a determination completed in 1994. Use was determined to be compatible.

g. Is the use manageable within available budget and staff?

The use is manageable with available budget and staff.

h. Will this be manageable in the future within existing resources?

The proposed activity at current levels would be manageable in the future with existing resources (see above).

i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

The proposed use would contribute to the public's understanding and appreciation of natural and/or cultural resources.

j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

The Refuge will ensure that the activities will not impair existing or future wildlife-dependent recreational use of the Refuge during individual project review, prior to issuing SUPs.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Malheur National Wildlife Refuge

Use: Grazing and Haying

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate___ **Appropriate** ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: ____________ Date: 1-24-13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Uses Finding, Attachment 1

Date: November 2, 2011

Refuge: Malheur National Wildlife Refuge

Project: Grazing and Haying.

Summary: Livestock grazing and haying have occurred in the past at Malheur Refuge and are proposed to be used in the future as tools to provide optimum conditions for wildlife (specifically, foraging areas for waterfowl, waterbirds, and shorebirds; pairing habitat for waterfowl; nesting habitat for shorebirds; and nesting habitat for certain passerines) and, where possible, to improve biological integrity (native plant diversity; hereafter, restoration) in Refuge plant communities. These actions would be undertaken by private parties under cooperative agreement.

For each of the findings listed on FWS Form 3-2319, a brief narrative response has been provided below.

a. Do we have jurisdiction over the use?

All proposed activities would take place within Refuge boundaries and under the supervision of Refuge staff.

b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?

The proposed activities would comply with all applicable laws and regulations and would be spelled out in each Cooperative Land Management Agreement (CLMA).

c. Is the use consistent with applicable executive orders and department and Service policies?

Under USFWS Policy (50 CFR 29.1), grazing and haying under the circumstances applicable at the Refuge are considered refuge management economic activities. "Refuge management economic activity" refers to a refuge management activity on a National Wildlife Refuge, which results in generation of a commodity that is or can be sold for income or revenue or traded for goods or services. Examples include farming, grazing, haying, timber harvesting, and trapping.

The Appropriate Use Policy (603 FW 1) specifically states that "Commercial uses of a refuge may be considered appropriate if they are a refuge management economic activity …."

The proposed use would provide high-quality forage for migrating waterfowl and cranes within close proximity to high-quality roosting habitat. The use of a private cooperator to graze Refuge meadows helps provide high-quality forage and removes thatch that would be left behind if mowing were used as the only management technique. Other methods such as prescribed fire may remove thatch and mimic natural processes. Given the difficulty in using prescribed fire for meadow management, grazing is consistent with the Service's Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3).

d. Is the use consistent with public safety?

The proposed use is consistent with public safety and generally occurs in areas not accessible to the public. Some waterfowl/upland bird hunting does take place in areas where livestock are being used, but hunters are advised to avoid these highly visible treatment areas.

e. Is the use consistent with goals and objectives in an approved management plan or other document?

The proposed use is consistent with Goal 4 of the CCP; recommendations in the 2009 Wildlife and Habitat Management Review (USFWS 2010); and the 1990 Blitzen Valley Management Plan (Rule 1990).

f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?

This use had a determination completed in 1994. Use was determined to be compatible.

g. Is the use manageable within available budget and staff?

The proposed use is manageable with available budget and staff. The use of cooperators may save staff time and resources. Force account management of this nature would prove to be highly cost-prohibitive to the Service.

h. Will this be manageable in the future within existing resources?

The proposed use would be manageable in the future with existing resources and may save staff time and resources (see above).

i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

The proposed use is beneficial to the Refuge's natural resources because haying and grazing would help achieve Refuge purposes by providing many waterfowl, waterbird, shorebird, and landbird with high-quality food sources as well as nesting and fledging habitat.

j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

Haying and grazing operations may occasionally conflict with the experiences of some Refuge visitors. However, such impacts would be expected to be minor to moderate at the Refuge due to the seasonal differences in uses. Refuge visitation peaks during spring, when little grazing or haying will likely occur. Growing-season mowing and grazing will not occur at a scale that would disrupt or significantly impact wildlife viewing opportunities enjoyed by Refuge visitors. During the fall when haying and rake-bunch grazing operations are active, wildlife observation and photography visitation drops. Hunting use increases during this season but is concentrated in the Buena Vista Unit and around Malheur Lake, where little or no haying or grazing occurs.

References

Rule, M., G. Ivey, and D. Paullin. 1990. Blitzen Valley Management Plan. Malheur National Wildlife Refuge. Princeton, OR. 169 pp.

USFWS (U.S. Fish and Wildlife Service). 2010. Malheur National Wildlife Refuge, Wildlife and Habitat Management Review. June 1-5, 2009. Unpublished report. Available at Refuge Headquarters. 52 pp.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Malheur National Wildlife Refuge

Use: Plant Gathering of Culturally Important Plants

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___ **Appropriate** ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: ____________ Date: 1-24-13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Uses Finding, Attachment 1

Date: November 2, 2011

Refuge: Malheur National Wildlife Refuge

Use: Plant Gathering of Culturally Important Plants

Summary: Culturally important plants that grow in the wetlands, marshes, and riparian areas have been collected by members of the Burns Paiute Tribe for generations. Culturally important plant collection involves taking hand cuttings from live plants (e.g., willow whips) or plants that have reached senescence (cattails and bulrush). Plant materials are collected in small amounts and plant mortality does not occur as a result of these activities.

For findings listed on FWS Form 3-2319, and if deemed necessary, a brief narrative response has been provided below.

a. Do we have jurisdiction over the use?

All of the proposed activities would take place within Refuge boundaries. The Refuge has jurisdiction over collections within Refuge boundaries.

b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?

Any proposed collection activities would comply with all applicable laws and regulations and any restrictions or qualifications required to comply with law and regulations would be specified in an SUP.

c. Is the use consistent with applicable executive orders and department and Service policies?

The Appropriate Use Policy (603 FW 1) specifically references Native American ceremonial, religious, medicinal, and traditional gathering of plants. The policy states that the Service "will review specific requests and provide reasonable access to Native Americans to refuge lands and waters for gathering plants for ceremonial, religious, medicinal, and traditional purposes when the activity is appropriate and compatible or when existing treaties allow or require such access."

d. Is the use consistent with public safety?

Through individual project review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project's SUP.

e. Is the use consistent with goals and objectives in an approved management plan or other document?

Plant gathering by tribal members is consistent with Goal 10 in the CCP.

f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?

This use had a determination completed in 1994. Use was determined to be compatible because of the infrequent use.

g. Is the use manageable within available budget and staff?

Currently, the Refuge receives fewer than six requests per year for this activity, and it is manageable with available budget and staff.

h. Will this be manageable in the future within existing resources?

If use remains at current levels, the use would be manageable in the future with existing resources (see above).

i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

Collection activities would be approved in instances where they can provide meaningful cultural significance and public appreciation of natural resources.

j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

Persons collecting plants may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or environmental education groups, but this conflict would be expected to be minimal. The Refuge will ensure that collection activities would not significantly impair existing or future wildlife-dependent recreational use of the Refuge during individual project review, prior to issuing each SUP.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Malheur National Wildlife Refuge

Use: Research, Scientific Collecting, and Surveys

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate____ **Appropriate** ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: [signature] Date: 1-24-13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Uses Finding, Attachment 1

Date: November 2, 2011

Refuge: Malheur National Wildlife Refuge

Project: Research, scientific collecting, and surveys

Summary: The Refuge receives or initiates requests for scientific research on Refuge lands and waters. Research topics cover a variety of biological, physical, archeological, and social issues and concerns to address Refuge management information needs or other issues not related to refuge management. This compatibility determination refers to research, collecting, or surveys conducted by non-USFWS entities. This may include other Federal, state, tribal, and private entities, or their contractors. Research proposals must be accompanied by a detailed study plan. Proposals will be reviewed and granted special use permits on a case-by-case basis.

For each of the findings listed on FWS Form 3-2319, a brief narrative response has been provided below.

a. Do we have jurisdiction over the use?

The Refuge has jurisdiction over those research projects that are sited within Refuge boundaries.

b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?

Any proposed research activity would comply with all applicable laws and regulations and any restrictions or qualifications that are required to comply with laws and regulations would be specified in the SUP.

c. Is the use consistent with applicable executive orders and department and Service policies?

The Appropriate Use Policy (603 FW 1) specifically references research. Under this policy, the Service actively encourages cooperative natural and cultural research activities that address Service management needs, and encourages research related to the management of priority general public uses. According to the policy, research that directly benefits refuge management has priority over other research.

Through the review of individual projects, the Refuge would ensure that project proposals are consistent with other applicable policies.

d. Is the use consistent with public safety?

Through individual project review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project plan.

e. Is the use consistent with goals and objectives in an approved management plan or other document?

The proposed use is consistent with Goal 13 of the CCP. Research activities would be approved in instances where they can provide meaningful data that may contribute to Refuge management and public appreciation of natural resources.

f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?

This use had a determination completed in 1994. The use was determined to be compatible.

g. Is the use manageable within available budget and staff?

Currently, the Refuge typically receives fewer than six requests per year for this activity, and it is manageable with available budget and staff.

h. Will this be manageable in the future within existing resources?

Research activity is expected to increase over the next 15 years. Projected levels of research activity would be manageable in the future with existing resources.

i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

Completed research projects would provide information useful for the management of the Refuge's natural or cultural resources.

j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

Researchers may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or environmental education groups, but this conflict would be expected to be minimal.

The Refuge will ensure that research activities would not significantly impair existing or future wildlife-dependent recreational use of the Refuge through SUP stipulations, as needed for each project.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Malheur National Wildlife Refuge

Use: Farming

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?		✓
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___ **Appropriate** ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: ___________ Date: 1-24-13

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Uses Finding, Attachment 1

Date: November 2, 2011

Refuge: Malheur National Wildlife Refuge (Refuge)

Project: Farming

Summary: The cooperative program would include between 80 to 1,000 acres to support objectives described in the CCP using appropriate farming practices. Crops would include wheat, barley, rye, oats, or similar crops known to have wildlife forage value.

Cropland management would be carried out by cooperative farmers under agreement with the Refuge. The resulting crop would be shared by the cooperator and the government. To benefit wildlife, the Refuge share would be left in the field where it would be available to wildlife.

Since cereal grains are favored by cranes and some waterfowl as a high-carbohydrate food, the 2009 Wildlife and Habitat Management Review (USFWS 2010) recommended continuing crop production to benefit cranes.

For each of the findings listed on FWS Form 3-2319, a brief narrative response has been provided below.

a. Do we have jurisdiction over the use?

All proposed activities would take place within Refuge boundaries and under the supervision of Refuge staff.

b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?

The proposed activities would comply with all applicable laws and regulations and would be spelled out in the Cooperative Farming Agreement (CFA).

c. Is the use consistent with applicable executive orders and department and Service policies?

Under USFWS Policy (50 CFR 29.1), farming under the circumstances applicable at the Refuge are considered refuge management economic activities. “Refuge management economic activity” refers to a refuge management activity on a national wildlife refuge that results in generation of a commodity that is or can be sold for income or revenue or traded for goods or services. Examples include farming, grazing, haying, timber harvesting, and trapping.

The Appropriate Use Policy (603 FW 1) specifically states that “Commercial uses of a refuge may be considered appropriate if they are a refuge management economic activity ….”

The proposed use would provide high-energy and readily available foods for migrating waterfowl and cranes within close proximity to other natural food sources and high-quality roosting habitat. Crops provide wildlife with easily accessible high-energy foods, are more digestible than many native plants, and can reduce foraging time required to meet caloric demands (Alisauskas and Ankney 1992; Baldassare and Bolen 2006). Because these conditions cannot be met by singularly managing natural foods, the production of non-genetically modified crops is consistent with the

Service's Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3) and will help achieve Refuge purposes.

d. Is the use consistent with public safety?

The proposed use is consistent with public safety and would be sited in areas closed to the general public.

e. Is the use consistent with goals and objectives in an approved management plan or other document?

The proposed use is consistent with Goal 3 in the CCP and with recommendations in the 2009 Wildlife and Habitat Management Review conducted by the Service (USFWS 2010) and the 1990 Blitzen Valley Management Plan (Rule 1990).

f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?

The use has been ongoing for many years.

g. Is the use manageable within available budget and staff?

The proposed use is manageable with available budget and staff. The use of cooperators may save staff time and resources and increase the reliability of successful crop production.

h. Will this be manageable in the future within existing resources?

The proposed use would be manageable in the future with existing resources and may save staff time and resources (see above).

i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

The proposed use is beneficial to the Refuge's natural resources because crop production would help achieve Refuge purposes by providing migrating waterfowl and cranes with a high-energy, easily accessible food source in close proximity to natural foods and roosting sites.

j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

The proposed use will not impair existing or future wildlife-dependent recreational use of the Refuge. A maximum of 1,000 acres (approximately 0.5percent of the Refuge area) would be used for crop production.

References

Alisauskas, R.T. and C.D. Ankney. 1992. The cost of egg laying and its relationship to nutritional reserves in waterfowl. Pages 30-61 in: B.D.J. Batt, A.D. Afton, M.G. Anderson, C.D. Ankney, D.H. Johnson, J.A. Kadlec, and G.L. Krapu, eds. Ecology and management of breeding waterfowl. Minneapolis: University of Minnesota Press.

Baldassare, G.A and E.G. Bolen. 2006. Waterfowl ecology and management. Hoboken, NJ: John Wiley and Sons, Inc.

Rule, M., G. Ivey, and D. Paullin. 1990. Blitzen Valley Management Plan. Malheur National Wildlife Refuge. Princeton, OR. 169 pp.

USFWS. 2010. Malheur National Wildlife Refuge, Wildlife and Habitat Management Review. June 1-5, 2009. Unpublished report. Available at Refuge Headquarters. 52 pp.

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Anglers on Blitzen River
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Appendix B
Compatibility Determinations

Introduction

The compatibility determinations (CDs) developed during the comprehensive conservation plan (CCP) planning process evaluate uses as projected to occur under the management direction described in the CCP. The evaluation of funds needed for management and implementation of each use also assumes implementation as described under the management direction.

Uses Evaluated at This Time

The following section includes full CDs for all refuge uses that are required to be evaluated at this time. According to Service policy, CDs will be completed for all uses proposed under a CCP that have been determined to be appropriate. Existing wildlife-dependent recreational uses must also be reevaluated and new CDs prepared during development of a CCP. According to the Service's compatibility policy, uses other than wildlife-dependent recreational uses are not explicitly required to be reevaluated in concert with the preparation of a CCP, unless the conditions of the use have changed or unless significant new information related to the use and its effects has become available, or the existing CDs are more than 10 years old. However, the Service planning policy recommends preparing CDs for all individual uses, specific use programs, or groups of related uses associated with the management direction. Accordingly, the following CDs are included in this document for public review.

Table B-1. Summary of Compatible Use Determinations

#	Refuge Use	Page	Appropriate?	Compatible?	Year Due for Reevaluation
B.1	Wildlife Observation, Photography, and Interpretation	B-4	N/A	Yes	2027
B.2	Environmental Education	B-20	N/A	Yes	2027
B.3	Waterfowl Hunting	B-29	N/A	Yes	2027
B.4	Upland Game Hunting	B-44	N/A	Yes	2027
B.5	Fishing	B-61	N/A	Yes	2027
B.6	Commercial Tours and Photography	B-72	Yes	Yes	2022
B.7	Grazing and Haying	B-80	Yes	Yes	2022
B.8	Plant Gathering of Culturally Important Plants	B-109	Yes	Yes	2022
B.9	Research, Scientific Collecting, and Surveys	B-114	Yes	Yes	2022
B.10	Farming	B-121	Yes	Yes	2022

Compatibility: Legal and Historical Context

Compatibility is a tool refuge managers use to ensure that recreational and other uses do not interfere with wildlife conservation, the primary focus of refuges. Compatibility is not new to the Refuge

System and dates back to 1918 as a concept. As policy, it has been used since 1962. The Refuge Recreation Act of 1962 directed the Secretary of the Interior to allow only those public uses of refuge lands that were “compatible with the primary purposes for which the area was established.”

Legally, refuges are closed to all public uses until officially opened through various administrative actions, including CDs. Regulations require that adequate funds be available for administration and protection of refuges before opening them to any public uses. However, wildlife-dependent recreational uses (hunting, fishing, wildlife observation, photography, interpretation, and environmental education) are to receive enhanced consideration and cannot be rejected simply for lack of funding, unless the refuge has made a concerted effort to seek out funds from all potential partners. Once found compatible, wildlife-dependent recreational uses are deemed the priority public uses at a refuge. If a proposed use is found not compatible, the refuge manager is legally precluded from approving it. However, a use found not compatible may be modified such that it can be found compatible. Economic uses that are conducted or authorized by the refuge also require CDs.

Under compatibility policy, uses are defined as recreational, economic/commercial, or management-related uses of a refuge by the public or a non–Refuge System entity. Uses generally providing an economic return (even if conducted for the purposes of habitat management) are also subject to CDs. The Service does not prepare CDs for uses where the Service does not have jurisdiction. For example, the Service may have limited jurisdiction over refuge areas where property rights are vested by others; where legally binding agreements exist; or where there are treaty rights held by tribes. In addition, aircraft overflights, emergency actions, some activities on navigable waters, and activities by other Federal agencies on “overlay Refuges” are exempt from the compatibility review process.

New compatibility regulations, required by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), were adopted by the Service in October 2000 (U.S. Fish and Wildlife Service [USFWS] 2000). The regulations require that a use must be compatible with both the mission of the System and the purposes of the individual refuge. This standard helps to ensure consistency in application across the Refuge System. The Act also requires that CDs be in writing and that the public have an opportunity to comment on most use evaluations.

The Refuge System mission emphasizes that the needs of fish, wildlife, and plants must be of primary consideration. The Improvement Act defined a compatible use as one that “ … in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the Refuge.” Sound professional judgment is defined under the Improvement Act as “ … a finding, determination, or decision, that is consistent with principles of sound fish and wildlife management and administration, available science and resources ….” Compatibility for priority wildlife-dependent uses may depend on the level or extent of a use.

Court interpretations of the compatibility standard have found that compatibility is a biological standard and cannot be used to balance or weigh economic, political, or recreational interests against the primary purpose of the Refuge (Defenders of Wildlife v. Andrus [Ruby Lake Refuge]).

The Service recognizes that CDs are complex. For this reason, refuge managers are required to consider “principles of sound fish and wildlife management” and “best available science” in making these determinations (House of Representatives 1997). Evaluations of the existing uses on Malheur National Wildlife Refuge are based on the professional judgment of Refuge and planning personnel including observations of Refuge uses and reviews of appropriate scientific literature.

In July 2006, the Service published its Appropriate Refuge Uses Policy (603 FW 1). Under this policy, most proposed uses must also undergo a review prior to compatibility. Uses excepted from the policy include the Big Six uses and uses under reserved rights—see the policy for more detail. Appropriate uses reviews are included in Appendix A.

References

Defenders of Wildlife v. Andrus (Ruby Lake Refuge I). Case 2098 (D.D.C. 1978). Environmental Reporter 11:873.

House of Representatives. 1997. Report 105-106 on National Wildlife Refuge System Improvement Act. Available at: http://www.fws.gov/Refuges/policiesandbudget/HR1420_part1.html.

USFWS (U.S. Fish and Wildlife Service). 2000. Compatibility regulations. Available at: http://www.fws.gov/Refuges/policymakers/nwrpolicies.html. Accessed June 23, 2011.

B.1 Wildlife Observation, Photography, and Interpretation Compatibility Determination

RMIS Database Uses: Wildlife Observation; Photography (wildlife); Interpretation

Refuge Name: Malheur National Wildlife Refuge

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use

This CD examines wildlife observation, wildlife photography, and interpretation as described under the management direction of the Malheur Refuge CCP. There is substantial overlap between activities associated with wildlife observation, wildlife photography, and interpretation on the Refuge, and as such these uses are evaluated together in this CD. Associated uses include hiking, motorized boating (electric), and non-motorized boating. Horseback riding, cross-country skiing, and bicycling also may occur incidental to these uses, but at very low levels (<5 visits per year per activity); they are analyzed as part of this CD.

Program Offerings: Under the management direction, the uses will continue to occur primarily informally as self-guided activities. However, in addition, monthly, docent-led tours will be established to diversify the visitor experience and opportunities for these uses, including kayaking or canoeing tours on Malheur Lake by Refuge staff and/or qualified volunteers.

Location of Use: Visitors typically engage in wildlife observation, wildlife photography, and interpretation uses at the Refuge Headquarters, along Center Patrol Road on the Auto Tour Route, and at a number of historic and interpretive sites, including Benson Pond, the historic Sodhouse Ranch, Buena Vista Overlook, Krumbo Reservoir, and the historic P Ranch. The historic Sodhouse Ranch is a significant resource for colonial nesting great blue herons and cormorants and winter roosting for bald eagles; the site will continue to be closed for the majority of the year to prevent disturbance, but it is open to the public from August 15 through October 15, after peak wildlife activity has subsided and before bald eagles roost in the winter. Krumbo Reservoir provides habitat for migrating loons in early spring and fall, and eared grebes during winter nesting season. Under the management direction, Krumbo Reservoir will be opened to year-round wildlife observation, photography, and interpretation. Non-motorized boats or boats with electric motors will be allowed on Krumbo Reservoir to support these uses. Other areas on the Refuge will be occasionally visited during docent-led tours.

Associated Facilities: A network of pull-offs, viewpoints, kiosks, overlooks, and hiking trails that vary in length from less than 1 mile to 11 miles will support these uses. The management direction provides more opportunities for developed wildlife observation, photography, and interpretation programs and structured visitor experiences with enhanced facilities and improved access. An enlarged visitor contact station/gift shop and office will be developed at Refuge Headquarters, as well as a seasonal contact station at the P Ranch. Additional developed visitor amenities (including restrooms, vault toilets, picnic tables, and shelters), new interpretive panels, vehicle pull-outs, viewing overlooks and elevated viewing platforms, and permanent photography blinds will be constructed throughout the Refuge at specific strategic public use locations.

Access: As is the case currently, use will be permitted for vehicles on public roads; on foot along roads open to motorized vehicles and designated hiking trails; and, occasionally, for boats. Except for docent-led tours (which will occur monthly and during special events), which may venture farther afield, public access will remain confined to roads and trails. Road access will be expanded by opening the Boat Landing Road to the Malheur Lake airboat launch site near Refuge Headquarters and the East Canal Road to the confluence of Bridge Creek with the East Canal. Additional loop, spur, and Americans with Disabilities Act (ADA) trails will be created, resulting in a total of 44 miles of roads and 17 miles of trails open to public access under the CCP. In contrast to current management, occasional canoe/kayak access via docent-led tours will be encouraged on Malheur Lake.

Number of Visitors and Seasonal Patterns: Wildlife observation, photography, and interpretation are expected to remain the most popular activities on Malheur Refuge over the life of the CCP. An estimated 93 percent of Refuge visitors engage in bird-watching and other forms of wildlife observation. Current annual visits associated with wildlife observation are estimated at 61,000. Annual visits associated with interpretation are estimated at 52,000, and annual visits associated with wildlife photography are also estimated at 52,000 (visits are tabulated separately). Wildlife observation, photography, and interpretation occur year-round on the Refuge, but peak during spring migration (March to May) and fall migration (September). The remainder of the year, the Refuge may see less than 100 visitors per month. As a result of the emphasis on enhanced facilities, expanded access, and more special events and programs under the CCP, these uses will be expected to grow over 15 years to 82,000 visits per year for wildlife observation, 71,000 visits per year for photography, and 71,000 visits per year for interpretation (visits are tabulated separately).

Availability of Resources

Availability of resources for administering and managing wildlife observation, photography, and interpretation under the CCP are detailed in Table B-2.

Table B-2. Costs to Implement the Use

Category	One-time Expenses ($)	Recurring Expenses ($/year)
Welcome and Orientation (W&O)		
Update existing W&O panels and develop new panels at four locations	$120,000	$500
Maintain existing and develop two new vault toilets	$50,000	$5,000
Maintain existing and develop new visitor amenities, including accessible picnic tables, trash cans, and shelters	$7,500	$5,000
Construct enlarged visitor contact station and gift shop	$250,000	$10,000
Rehabilitate George Benson Memorial Museum facility	$50,000	
Establish seasonal contact station at P Ranch	$45,000	$3,000
Develop modern media W&O materials, maintain website, etc.		$1,000
Wildlife Observation, Photography, Interpretation		
Conduct docent-led canoe/kayak tours on Malheur Lake	$100,000	$15,000
Advertise, train volunteers, and conduct other monthly land-based docent tours monthly, plus special events	$50,000	$5,000
Provide new non-ADA trails and develop new trail signage	$72,000	$2,000
Provide new ADA trails at Sodhouse Ranch, Benson Pond, P Ranch	$225,000	$2,000
Construct wildlife-viewing overlook at Krumbo Reservoir	$40,000	$1,000
Construct four elevated viewing platforms	$220,000	$4,000
Provide three photography blinds	$30,000	$1,000
Maintain historical landscapes for birding		$1,000
Develop new interpretive panels	$45,000	$1,000
Administer and manage programs		$55,000
Transportation		
Raise and surface Center Patrol Road	$1,200,000	$100,000
Develop additional vehicle pull-offs	$52,500	
Improve vehicle access along East Canal Road	$90,000	
Improve vehicle access at Boat Landing Road, including pull-offs	$45,000	
Maintain Krumbo Lane		$10,000
Develop parking areas to assist with public use programs	$150,000	

Category	One-time Expenses ($)	Recurring Expenses ($/year)
Overall road maintenance (public roads, pull-offs, parking areas)		$20,000
Total	$2,792,000	$241,500

Wildlife observation, photography, and interpretation are the biggest programs on the Refuge and attract the most visitors and visits. The Refuge has one full-time equivalent (FTE) position dedicated to the visitor services program as a Visitor Services Manager, with a majority of time spent on administering and managing the wildlife observation, photography, and interpretation program. There are two additional FTE positions supporting cultural resources programs and law enforcement needs. Other Refuge staff assist in trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects. The Refuge has a strong volunteer base, and the visitor center and tours are generally staffed by volunteers during the high visitation months from May to September.

Some capital projects may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of uses associated with wildlife observation, photography, and interpretation. Exact costs will be developed during design and implementation.

Welcome and orientation facilities, signage, access trails, and other transportation resources are used for multiple purposes across programs, including environmental education, hunting, and fishing. Program-specific facilities and resources are included in the appropriate CDs.

Anticipated Impacts of the Uses

<u>General Impacts Expected from the Scientific Literature</u>

A general assessment of impacts resulting from wildlife observation, photography, and interpretation uses has been compiled from the literature and is briefly summarized below.

Disturbance Intensity (Frequency, Distance, etc.): Human activities on recreational lands, trails, and other access points can result in direct effects on wildlife. Disturbance responses can depend upon the activity type, recreationists' behavior, and the distance, duration, frequency, predictability, timing, and visibility of the use (Knight and Cole 1995). Disturbance to migrant shorebirds on eastern coastal bays was found to increase as the total number of disturbances and recreationists increased and the distance from the disturbance decreased (Burger 1986). Flushing, especially repetitive flushing, can strongly impact patterns of many bird species. Migratory birds have been observed to be more sensitive than resident species to disturbance (Klein 1989), and in the case of the eastern coastal migrant shorebirds, the percentage of observed shorebirds that were flushed and did not return increased by 53 percent from 1982-2002, suggesting that the birds were not adapting to the presence of people by habituation and were being affected in the long-term (Burger et al. 2004).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people, where disturbance flushes birds away from their nests and creates vulnerabilities during nesting seasons. Frequency is a major factor, and songbirds have been found to alter behavior after repeated human disturbance, particularly red-winged blackbirds, goldfinches, and American robins, which became much more aggressive toward humans who repeatedly visited their nests (Knight and Temple 1986a, 1986b, 1986c).

Set-back distances for public use facilities have been found to be important in limiting human disturbance to wildlife. In Florida, 15 species of colonial waterbirds nesting at 17 colonies were exposed to three different human disturbance mechanisms in order to determine recommended set-back distances for protecting mixed-species nesting assemblages (Rodgers and Smith 1995). In general, a recommended set-back distance of about 100 meters (328 feet) for wading bird colonies and 180 meters (590 feet) for mixed tern/skimmer colonies was found to be adequate to effectively buffer sites from human disturbance caused by approach of pedestrians and motor boats (Rodgers and Smith 1995). In Nebraska, roosting sandhill cranes avoided sites near human disturbance features at 500 meters (m [1,640 feet]) from nearest paved road, 400 m from nearest gravel road, and 400 m from a single dwelling structure (Norling et al. 1992). Conversely, wildlife tends to habituate best to disturbance that is predictable, as indicated by sandhill cranes in Florida and in Nebraska that nested within 400 m of highways, railroads, mines, and power lines, which provided predictable background disturbance (Dwyer and Tanner 1992; Norling et al. 1992).

Group Size: Disturbance impacts to wildlife related to visitor group size is not a well-documented research area; however, a few studies have analyzed these impacts. Most animals flee from humans, and large groups of people may represent greater perceived risk of predation (Geist et al. 2005). Remacha et al. (2011) analyzed visitor group size influences on the number and variety of birds observed during guided educational tours in a forested area in central Spain, with group sizes ranging from 7 to 20 people. The study showed that increasing visitors’ group size has an impact on wildlife, as large groups were associated with decreased bird numbers; additionally, the study found that birds may demonstrate reduced tolerance not only by reducing their frequency of occurrence but also by reducing the number of individuals when faced with large groups of visitors. The study concluded that reducing the size of visitors’ groups helps to minimize the negative impacts on wildlife and also allows visitors to watch more wildlife (Remacha et al. 2011).

Another study by Beale and Monaghan (2004) on human disturbance effects to seabird colonies at St. Abbs Head National Nature Reserve in Scotland examined the variation in nesting success for two birds, kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*), as a function of different disturbance regimes, including varying the average number of people per hour and people load, which takes into consideration the number of visitors and their distance from the nest. Human disturbance was found to have a significant negative effect on the nesting success in both species of birds. Increasing visitor numbers by 8.5 percent resulted in a 22 percent increase in the failure rate of kittiwakes, and a 13 percent increase in the failure rate for guillemots. Beale and Monaghan concluded that perhaps the most likely explanation is that nesting birds perceive people to be a potential predator and show appropriate anti-predator physiological responses, which interfere with energy resources available for nesting. The results showed that safe distances, or buffer zones, depend on the numbers of people visiting an area, and that both numbers and distance matter in determining disturbance effects.

In addition to group size, loudness has also been found to be an important variable in determining whether birds altered their behavior. A study was conducted at the Arthur B. Marshall Loxahatchee National Wildlife Refuge in Florida between 1992 and 1994 to observe how people affect foraging birds at the Refuge (Burger and Gochfeld 1991). Variation in feeding behavior was largely explained by whether people were present, the number of people present, and the amount of noise made by the people (Burger and Gochfeld 1991). For all species, time devoted to feeding and number of strikes or pecks decreased while people were present and as the noise made by people increased; interestingly, loudness was found to be more important than the number of people present (Burger and Gochfeld 1991). Noise level is not necessarily correlated with number of people present, but larger groups might be more prone to producing noise than small groups or individuals.

Conversely, a study analyzing the impacts of groups of cross-country skiers to elk in Yellowstone National Park found that the number of skiers did not impact the elk once they were already disturbed by the first skier, and instead the amount of winter range used by skiers and the number of days involved seemed to be more important than skier numbers (Cassierer et al. 1992). Literature suggests that organizing visitors in small numbers is recommended for groups, but also spreading out visits and locations of visits is recommended to mitigate disturbance across the landscape.

Impacts of Pedestrian (Hiking) vs. Vehicular Access: It is widely accepted that wildlife is frequently more sensitive to disturbance from people on foot than in vehicles (Skagen 1980; Grubb and King 1991; MacArthur et al. 1982; Pease et al. 2005). Numerous studies have confirmed that people on foot can cause a variety of disturbance reactions in wildlife, including flushing or displacement (Erwin 1989; Fraser et al. 1985; Freddy 1986; Pease et al. 2005), heart rate increases (MacArthur et al. 1982), altered foraging patterns (Burger and Gochfeld 1991), and even, in some cases, diminished reproductive success (Boyle and Samson 1985).

A study on seven species of dabbling ducks at the Back Bay National Wildlife Refuge found a significant difference between vehicular (diesel truck and electric passenger tram) and non-vehicular (pedestrian and bicyclist) treatments in the number of ducks that were flushed. In this study, 90 percent of the birds showed an observable response to non-vehicular treatments, of which 43 percent flew; the proportion of ducks that flew was greatest when they were located less than 100 m from the disturbance (Pease et al. 2005). In a review of several studies of the reaction of waterfowl and other wetland birds to people on foot, it was found that distances greater than 100 m in general did not result in a behavioral response (DeLong 2002). Mule deer in sagebrush-grassland habitat in Utah showed a 96 percent probability of flushing at 100 m from the line of movement of off-trail recreationists, with the percentage not dropping to 70 percent until the perpendicular distance increased to 390 m (Taylor and Knight 2003).

Wildlife photography in particular can be a more disturbing activity because photographers are more likely to leave vehicles and wander off-trail, approach wildlife, and remain close for an extended period of time to capture a detailed photograph, as observed at Ding Darling National Wildlife Refuge and other places (Klein 1993; Morton 1995; Dobb 1998). This may also apply to the experience of the user, as avid wildlife viewers tend to intentionally seek out rare or spectacular species and/or are more eager to use the most viewing opportunities in the limited amount of time (e.g., bird listing) and thus potentially pose a larger negative impact to wildlife (Knight and Cole 1995). People engaged in wildlife observation and photography react to the presence of birds and thus are generally more unpredictable on foot depending on excitement level, curiosity, and desire to observe closely.

Impacts of Cross-country Skiing: In two different studies of winter recreation impacts to wildlife in Yellowstone National Park, Aune (1981) and Cassirer (1990) found that, except for coyotes, all wildlife species observed (mostly big game) reacted more quickly to an approaching skier than to a snowmobile, and the flight distance was generally greater from skiers. Bison were found to respond dramatically to skiers who were off established trails. In another study, elk began to move when skiers approached to within 15 m in an area heavily used by humans year-round, and within 400 m in an area where human activity is much lower (Cassirer et al. 1992).

Boating Impacts: Recreational boating can alter bird distribution, reduce the use of particular habitats or entire areas by waterfowl and other waterbirds, alter feeding behavior and nutritional status, and cause premature departure from areas due to the noise and speed of boats (Knight and Cole 1995; Knapton et al. 2000). Canoes and kayaks can cause significant disturbance effects based on their ability to penetrate into shallower marsh areas (Speight 1973; Knight and Cole 1995). In the Ozark National Scenic Riverway, green-backed heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow-moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985). Huffman (1999) found that non-motorized boats within 30 m (98 feet) of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964; Huffman 1999; DeLong 2002).

The total number of boats and people can be an inappropriate measure of recreational intensity because the presence of a single boat might be just as disturbing as that of many (Tuite et al. 1983; Knight and Knight 1984). Even a low level of boating activity affects the duration and pattern of use by wildlife (Bratton 1990).

Bicycling Impacts: In a Canyonlands National Park study comparing the effects of trail bikes, hikers, and vehicles to bighorn sheep behavioral responses, distances moved, and duration of responses, Papouchis et al. (2001) found that hikers caused the most severe responses in desert bighorn sheep (animals fled in 61 percent of encounters), followed by vehicles (17 percent fled) and mountain bikers (6 percent fled), apparently because hikers were more likely to be in unpredictable locations and often directly approached sheep. However, Taylor and Knight (2003), who found no difference in effects between hikers and bikers (see below), noted that Papouchis et al. compared the responses of sheep approached directly and off-trail by hikers with those of sheep approached tangentially on a road or trail by mountain bikers and vehicles. Generally, wildlife exhibit a stronger response to humans that approach them directly and to humans located off designated trails.

In a Utah study comparing mountain biking and hiking disturbance to mule deer, antelope, and bison, both on- and off-trail, Taylor and Knight (2003) found little difference between the responses to hiking or biking. However, their results did show differences in species and based on whether the activity takes place on or off the trail. They did suggest that, because bikers travel faster than hikers, they may cover more ground in a given time period than hikers, thus having the opportunity to disturb more wildlife per unit of time.

Horseback Riding Impacts: Impacts related to horseback riding include exotic plant seed dispersal in horse coats, forage, and manure (Beck 1993; Hammitt and Cole 1987); soil compaction and erosion (Bainbridge 1974; Hendee et al. 1990; Hammitt and Cole 1987); stream sedimentation (Wilson and Seney 1994); trail widening (Whittaker 1978); vegetation trampling (Nagy and Scotter 1974; Weaver and Dale 1978; Whittaker 1978); and direct wildlife disturbance (Owen 1973).

Vegetation and soil compaction and erosion impacts can be much more pronounced from horses than hikers (Bainbridge 1974; Hendee et al. 1990; Hammitt and Cole 1987), with soil compaction as much as 1,500 psi (pounds per square inch) exerted on the soil surface with each step (Hendee et al. 1990). Hikers tend to flatten vegetation while horses tend to chum up soil, thus cutting plants off at the rootstalk (Whittaker 1978). Hoof action tends to dig up and puncture the soil surface (McQuaid-Cook 1978), which could cause greater sediment loss than any other form of recreational trail use and increase the potential for disturbance-tolerant vegetation establishment. Trail widening is also a consideration as horses tend to walk on the down slope sides of trails (Whitson 1974), creating a much wider area of disturbance and increasing trail maintenance problems. This can increase the spread of previously established exotics by providing loose, disturbed soil for germination and spreading reproductive plant structures.

Wildlife disturbance relative to horseback riding has been poorly studied, with most references using other activities such as hiking and cross-country skiing to infer horseback riding impacts. Only one study identified disturbance tolerance of waterfowl to horseback riders and found that horseback riders could approach geese up to a distance of 150 feet. This is compared to suggested hiking trail distances of 250 feet (Miller et al. 1998) and boat buffers ranging from 250 to 900 feet (depending on type of boat, whether motorized, and species impacted; Burger et al. 1999). The 150-foot approach distance offered by Owen (1973) is consistent with observations suggesting that horseback wildlife observers can approach wildlife at closer distances than through other form of travel. Many wildlife species appear to be habituated to livestock and thus are less likely to flee when approached through this method. However, any form of approach is expected to cause some disturbance, which will vary according to the species affected and the type, level, frequency, and duration of disturbance, as well as the time of day or year that it occurs.

Disturbance from Dogs: Dogs elicit a greater response from wildlife than people on foot alone (MacArthur et al. 1982; Hoopes 1993). In the case of birds, the presence of dogs may flush incubating birds from nests (Yalden and Yalden 1990), disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). For mule deer in Colorado, the presence of a dog resulted in a greater area of influence, alert and flush distance, and distance moved than when a pedestrian was alone (Miller et al. 2001). Many of these authors indicated that dogs with people, dogs on leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals. Indirectly, domestic dogs can potentially introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

Refuge-specific Impacts

This section evaluates the likely impact at the Refuge, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge.

Over 130 species of birds nest in the Refuge, and unusual or rare birds, particularly passerines, can often be seen during the spring migrations. Malheur Refuge provides some of the most significant habitat and resources for migratory birds on the Pacific Flyway. If not adequately protected, especially during the migration and nesting seasons, bird populations could be impacted by regular disturbance and flushing from feeding, resting, or nesting areas.

Loss of Habitat from Facility Construction: Under the management direction of this CCP, new facilities constructed for wildlife observation, photography, and interpretation, as well as facilities supporting welcome and orientation, will result in 10 acres of habitat loss, which is a fraction of a percentage of the Refuge. A large number of facilities will be associated with already developed sites, but as a result of enhanced opportunities in the P Ranch Unit, in particular, a majority of the habitat loss (approximately 6.5 acres) will be associated with wet meadow habitat. Overall, habitat loss from new facilities is considered negligible across the landscape.

Vegetation, Soil, and Water Impacts: Pedestrian access to the Refuge creates the highest potential for direct disturbance or damage to vegetation and soil, as foot travel associated with these uses could potentially result in temporary or minor vegetation trampling and soil compaction. People can also be vectors for invasive plants by moving seeds from one area to another. The threat of invasive plant establishment will always be an issue requiring regular monitoring and treatment. However, under the management direction of the CCP, self-guided visitor access for wildlife observation, photography, and interpretation will be limited to roads, 18 miles of trails, and developed sites. No impacts from these uses are expected to water resources. Habitat and soil impacts related to horseback riding will be minor, as the use is mostly incidental and occurs at very small numbers (<5 visits a year). Horseback riding is limited to Center Patrol Road.

In addition to the self-guided opportunities along trails, roads, and developed sites, the Refuge will offer up to 20 docent-led tours a year to areas that may be away from established public roads or trails, including tours for special events. Docent-led tours may create potential for additional impacts to vegetation and soil, but limitations on group size, the likelihood that tours will visit a variety of different locations over time, and the relatively infrequent offerings of these types of visits mean that the likely impacts to soils and vegetation will be minor within the context of the Refuge as a whole.

Disturbance-related Impacts: Many of the studies noted above analyze disturbance impacts to wildlife from human presence. However, at Malheur Refuge, visitors most often access and explore the Refuge by vehicle, thus minimizing pedestrian disturbance to resources, which as noted above, can be larger than disturbance from vehicles. Vehicles act as a blind, shielding wildlife from humans, and the Refuge encourages this practice in their visitor brochure and in visitor interactions with volunteers and staff. Center Patrol Road allows visitors to see a diversity of habitats and wildlife while largely concentrating the impacts of visitors to a single road through the Refuge. Given previously cited studies, wildlife tends to be most disturbed by human presence at distances less than 100 m (328 feet). Assuming a wildlife distance buffer zone of 200 m on all Refuge roads open to public use, the total impact of disturbance from visitors on open Refuge roads and trails is approximately 9,800 acres, or 5 percent of the Refuge. Disturbance to habitat will vary depending on the location of the road or trail, and, based on calculations, the majority of habitats that will be disturbed from Refuge roads and trails will be wet meadow at 28 percent, which includes a number of public use sites (salt desert scrub at 25 percent and sagebrush-steppe at 11 percent of total acreage disturbed). In the long-term, even if visitor numbers increase more than expected due to program and facility development, disturbance impacts from wildlife observation, photography, and interpretation will pose minimal impact to Refuge wildlife, because users will be concentrated on the designated roads, trails, and public facilities described above, leaving wildlife thousands of acres of undisturbed sanctuary.

Impacts at Specific Sites: Docent-led tours will also include opportunities for group kayaking or canoeing on Malheur Lake, which has the potential to cause disturbance to wildlife using this resource and habitat, including sandhill cranes using the lake as a staging area in the fall migration season. Careful scheduling of the tours around sensitive wildlife seasons and resource areas, limiting the group size to a manageable and sustainable size, and providing public education to inform visitors of ethical and least intrusive methods to wildlife viewing and photography will reduce impacts.

Under the management direction of the CCP, opportunities will also be expanded at Krumbo Reservoir for wildlife observation, including electric and non-motorized boating, outside of the fishing season, except when the water ices over. Increasing access to the Reservoir could have potential impacts to birds during the winter nesting season at Krumbo Reservoir as well as Krumbo Swamp and Otter Pond along the Krumbo Access Road. The number of birds using the Reservoir during the winter is less than 400 birds on any given day and less than 100 birds during the coldest part of the season; most birds have migrated farther south during the winter. The Reservoir is 184 acres, which is less than 20 percent of the total 1,004 acres of available open water wintering habitat in this part of the Refuge, leaving at least 820 acres of open water for wintering bird use including Boca Lake, Benson Pond, and East or West Knox Pond. Additionally, the number of visitors to the Reservoir during the winter months will be significantly lower than in the spring, summer, or fall months. With the low number of birds present, low visitor use levels, and availability of additional wintering habitat and sanctuary, it is expected that year-round access at Krumbo Reservoir will have minor impacts. Wildlife surveys and monitoring will be conducted to ensure disturbance stays at a minimum.

Pet Impacts: Pet impacts are expected to be minor in relation to wildlife observation, photography, and interpretation use, since all pets must be kept leashed and stay on designated public use roads and trails while on the Refuge. Horses must also stay on public use roads.

Impacts to Listed Species: There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; Oregon Department of Fish and Wildlife [ODFW] 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from wildlife observation, photography, and interpretation uses and facilities will be negligible. These uses will continue to occur at public sites and on designated roads and trails, away from sensitive habitat and resources and outside of breeding areas and seasons. The greater sage-grouse is not known to breed on the Refuge. Incidental use of the east side of the south Blitzen Valley by sage-grouse has been reported during the late summer when visitor numbers and activities are lower. Wildlife observation, photography, and interpretation uses will be minimal in the areas of Mud and Bridge Creek, where frog populations are known to occur and thus will not impact the spotted frog populations. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

Impacts to Other Priority Public Uses: Wildlife observation, photography, and interpretation generally result in little disturbance to other visitors. Conflicts between hunters and these activities will be minimal due to the seasonal differences in uses. Hunting on the Refuge occurs at a time of year when visitors engaged in wildlife observation, photography, and interpretation are fewer in number. Under the management direction of this CCP, hunting will be open on the southern portion of Malheur Lake at Boat Landing Road where docent-led kayaking or canoeing tours will also occur. To minimize safety conflicts between hunters and non-hunters, docent-led tours on the southern portion of Malheur Lake will occur prior to the hunting season so there is no overlap between uses. Other hunting areas are not open to self-guided wildlife observation, photography, or interpretation and thus this use should not conflict with hunting. There is no conflict expected between anglers or environmental education participants and wildlife observers or photographers.

Infrastructure: No significant effects to roads, trails, or other infrastructure from the wildlife observation, photography, and interpretation programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

Public Review and Comment

Extensive opportunities were provided for stakeholder engagement through the collaborative CCP planning process. Appendix J details the collaborative involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

- Visitors will be restricted to designated trails, sites, or facilities as determined by Refuge staff. Use is open daily from dawn to dusk. Camping, overnight use, swimming, and fires will be prohibited.
- Motorized vehicles, bicycles, horseback riding, and cross-country skiing will be authorized on Center Patrol Road and Krumbo Lane, and vehicles must observe posted speed limits.
- Pets must be kept leashed while on the Refuge, and will be only permitted on open Refuge roads. Pet owners will be expected to clean up after their pets and properly dispose of any waste.
- The Refuge will require advance reservations for groups in need of staff and volunteer participation to avoid conflicts with other groups and management activities.
- Docent-led tours will be limited to 20 tours a year and 15 participants maximum per group. All tours will be led by Refuge staff or qualified volunteers. Tour-goers will be instructed to stay on-trail, in designated program boundaries, and observe extra precautions if visiting closed areas.
- Improved trail signage will be developed to inform and guide visitors on name, length, difficulty, and destination.
- Seasonal closure at Sodhouse Ranch will be maintained.
- Elevated observation platforms, overlooks, trails, and blinds may be constructed to help reduce negative visitor impacts to wildlife, soils, vegetation, and hydrology.
- Collection of natural objects, such as plants, animals, minerals, antlers, and cultural resources are prohibited.
- If disturbance to wildlife or damage to habitat reaches unacceptable levels, the Refuge will limit uses in areas where unacceptable impacts occur. Monitoring will be conducted to ensure that high-quality habitat for wildlife feeding, resting, and breeding is maintained.

Justification

Wildlife observation, photography, and interpretation receive enhanced consideration in the CCP planning process, and are considered priority public uses when determined compatible. Although these activities can result in disturbance to wildlife, they will occur on a small percentage of Refuge acres. There is a sufficient amount of undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline. The physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing wildlife observation, photography, and interpretation to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge Mission. Wildlife observation, photography, and interpretation programs complement the Refuge Purpose, vision, and goals, and help fulfill the mission of the National Wildlife Refuge System.

Mandatory Reevaluation Date

__09/2027__ Mandatory 15-year Reevaluation Date (for priority public uses)

NEPA Compliance for Refuge Use Decision

____X____ Environmental Impact Statement and Record of Decision

References

Aune, K.E. 1981. Impacts of winter recreationists on wildlife in a portion of Yellowstone National Park, Wyoming. M.S. thesis. Montana State University, Bozeman, MT.

Baydack, R.K. 1986. Sharp-tailed grouse response to lek disturbance in the Carberry Sand Hills of Manitoba. Colorado State University. Ph.D. dissertation. Fort Collins, CO.

Bainbridge, D.A. 1974. Trail management. Ecological Society of America Bulletin 55:8-10.

Beale, C.M. and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335-343.

Beck, K.G. 1993. How do weeds affect us all? Proceedings of the Eighth Grazing Lands Forum December 2, 1993:5-13. Washington, D.C.

Boyle, S.A. and F.B. Samson. 1985. Effects of non-consumptive recreation on wildlife: A review. Wildlife Society Bulletin 13:110-116.

Bratton, S. 1990. Boat disturbance of ciconiiformes in Georgia estuaries. Colonial Waterbirds 13(2):124-128.

Buckley, P.A. and F.G. Buckley. 1976. Guidelines for protection and management of colonially nesting waterbirds. North Atlantic Regional Office, National Park Service. Boston, MA. 52 pp.

Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. Environmental Conservation 13:123-130.

Burger, J. and M. Gochfeld. 1991. Human activity influence and diurnal and nocturnal foraging of sanderlings (*Calidris alba*). Condor 93:259-265.

Burger, J., B. Harrington, J. Rodgers, and H. Smith. 1999. Minimum recommended set-back (RS) distances for various disturbances approaching directly towards waterbirds to prevent flushing.

Burger, J., C. Jeitner, K. Clark, and L.J. Niles. 2004. The effect of human activities on migrant shorebirds: successful adaptive management. Environmental Conservation 31 (4):283-288.

Cassirer, E.F. 1990. Responses of elk to disturbance by cross-country skiers in northern Yellowstone National Park. M.S. thesis. University of Idaho, Moscow, ID.

Cassirer, E.F., D.J. Freddy, and E.D. Ables. 1992. Elk responses to disturbance by cross-country skiers in Yellowstone National Park. Wildlife Society Bulletin 20:375-381.

DeLong, A.K. 2002. Managing visitor use and disturbance in waterbirds—a literature review of impacts and mitigation measures. Appendix L (114 pp.) in: Stillwater National Wildlife Refuge Complex final environmental impact statement for the comprehensive conservation plan and boundary revision. Volume II. Department of the Interior, U.S. Fish and Wildlife Service, Region 1. Portland, OR.

Dobb, E. 1998. Reality check: The debate behind the lens. Audubon 100:44-51:98-99.

Dwyer, N.C. and G.W Tanner. 1992. Nesting success in Florida sandhill cranes. Wilson Bulletin 104:22-31.

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee uplands of southwest Idaho: Implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pp. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

Erwin, R.M. 1989. Responses to human intruders by birds nesting in colonies: Experimental results and management guidelines. Colonial Waterbirds 12:104-108.

Fraser, James D., L.D. Frenzel, and John E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49:585-592.

Freddy, D.J. 1986. Responses of adult mule deer to human harassment during winter. Pages 286 in: R.D. Comer, T.G. Baumann, P. Davis, J.W. Monarch, J. Todd, S. VanGytenbeek, D. Wills, and J. Woodling, eds. Issues and technology in the management of impacted western wildlife: Proceedings of a national symposium. Thorne Ecological Institute, Boulder, CO.

Geist, C., J. Liao, S. Libby, and D.T. Blumstein. 2005. Does intruder group size and orientation affect flight initiation distance in birds? Animal Biodiversity and Conservation 28.1:69-73.

Glinski, R.L. 1976. Birdwatching etiquette: The need for a developing philosophy. American Bird 30(3):655-657.

Grubb, T.G. and King, R.M. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Hammitt, W.E., and D.N. Cole. 1987. Wildland recreation: Ecology and management. New York: John Wiley.

Hendee, J.E., G.H. Stankey, and R.E. Lucas. 1990. Wilderness management. Golden, CO: North American Press.

Hoopes, E.M. 1993. Relationship between human recreation and piping plovar foraging ecology and chick survival. M.S. thesis. University of Massachusetts, Amherst, MA. 106 pp.

Huffman, K. 1999. San Diego South Bay survey report: Effects of human activity and watercraft on wintering birds in South San Diego Bay. USFWS report. San Diego, CA.

Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Wisconsin Conservation Department Technical Bulletin No. 33. 212 pp.

Kaiser, M.S. and E.K. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. Journal of Wildlife Management 48:561-567.

Keller, V. 1991. Effects of human disturbance on eider ducklings *Somateria mollissima* in an estuarine habitat in Scotland. Biological Conservation 58:213-228.

Klein, M. L. 1989. Effects of high levels of human visitation on foraging waterbirds at J. N. “Ding” Darling National Wildlife Refuge. Final research report. Cooperative Fish and Wildlife Research Unit. University of Florida, Gainesville.

Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. Wildlife Society Bulletin. 21:31-39.

Knapton, R., S. Petrie, and G. Herring. 2000. Human disturbance of diving ducks on Long Point Bay, Lake Erie. Wildlife Society Bulletin 28 (4):923-930.

Knight, R.L. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48(3):999-1004.

Knight, R.L. and S.A. Temple. 1986a. Methodological problems in studies of avian nest defense. Animal Behavior 34:561-566.

Knight, R.L. and S.A. Temple. 1986b. Nest defense in the American goldfinch. Animal Behavior 34:887-897.

Knight, R.L. and S.A. Temple. 1986c. Why does intensity of avian nest defense increase during the nesting cycle? Auk 103:318-327.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. Pages 51-69 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: Coexistence through management and research. Covelo, CA: Island Press.

MacArthur, R.A., V. Geist, and R.H. Johnston. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358.

McQuaid-Cook, J. 1978. Effects of hikers and horses on mountain trails. Journal of Environmental Management 6:209-212.

Miller, S.G., R.L. Knight, and C.K. Clinton. 2001. Wildlife responses to pedestrians and dogs. Wildlife Society Bulletin 29:124-132.

Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of recreational trails on breeding bird communities. Ecological Applications 8:162-169.

Morton, J.M. 1995. Management of human disturbance and its effects on waterfowl. Pages F59-F86 in: W.R. Whitman, T. Strange, L. Widjeskog, R. Whittemore, P. Kehoe, and L. Roberts, eds. Waterfowl habitat restoration, enhancement, and management in the Atlantic Flyway. Third edition. Environmental Management Committee, Atlantic Flyway Council Technical Section, and Delaware Division of Fish and Wildlife, Dover, DE. 1,114 pp.

Nagy, J.A.S. and G.W. Scotter. 1974. A quantitative assessment of the effects of human and horse trampling on natural areas, Waterton Lakes National Park. Canadian Wildlife Service. Edmonton, Alberta. 145 pp.

Norling, B.S., S.H. Anderson, and W.A. Hubert. 2002. Roost sites used by sandhill crane staging along the Platte River, Nebraska. Great Basin Naturalist 52(3):253-261.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Owen, M. 1973. The management of grassland areas for wintering geese. Wildfowl 24:123-130.

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Pease, M.L., R.K. Rose, and M.J. Butler. 2005. Effects of human disturbances on the behavior of wintering ducks. Wildlife Society Bulletin 33(1):103-112.

Papouchis, C.M., F.J. Singer, and W.B. Sloan. 2001. Responses of desert bighorn sheep to increased human recreation. Journal of Wildlife Management 65:573-582.

Remacha, C., J. Pérez-Tris, and J.A. Delgado. 2011. Reducing visitors' group size increases the number of birds during educational activities: Implications for management of nature-based recreation. Journal of Environmental Management 92(6):1564-1568.

Rodgers, Jr., J.A. and H.T. Smith. 1995. Set-back distances to protect nesting bird colonies from human disturbance in Florida. Conservation Biology 9(1):89-99.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Sime, C.A. 1999. Domestic dogs in wildlife habitats. Pages 8.1-8.17 in: G. Joslin and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A review for Montana. committee on effects of recreation on wildlife, Montana chapter of The Wildlife Society. 307 pp.

Skagen, S.S. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. Pages 231-241 in: R.L. Knight, G.T. Allen, M.V. Stalmaster, and C.W. Servheen, eds. 1980. Proceedings of the Washington Bald Eagle Symposium. Seattle, WA.

Speight, M.C.D. 1973. Outdoor recreation and its ecological effects: A bibliography and review. Discussion papers in conservation 4. University College London. 35 pp.

Taylor, Audrey R. and Richard L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951-963.

Tuite, C.H., M. Owen, and D. Paynther. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. Wildfowl 34:48-63.

Vos, D.K., R.A. Ryder, and W.D. Graul. 1985. Response of breeding great blue herons to human disturbance in north central Colorado. Colonial Waterbirds 8(1):13-22.

Weaver, T. and D. Dale. 1978. Trampling effects of hikers, motorcycles, and horses in meadows and forests. Journal of Applied Ecology 15:451-457.

Whitson, P.D. 1974. The impact of human use upon the Chisos Basin and adjacent lands. National Park Service (NPS) Scientific Monograph Series 4. NPS 117. (Supt. of Dots. no. 129.80:4). 92 pp.

Whittaker, P.L. 1978. Comparison of surface impact by hiking and horseback riding in the Great Smoky Mountain National Park. Report 24, Southeast Region. Atlanta, GA. 32 pp.

Wilson, J.P. and J.P. Seney. 1994. Erosional impact of hikers, horses, motorcycles, and off-road bicycles on mountain trails in Montana. Mountain Research and Development 14(1):77-88.

Yalden, P.E. and D. Yalden. 1990. Recreational disturbance of breeding golden plovers (*Pluvialis apricarious*). Biological Conservation 51:243-262.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Acting Refuge Manager/ Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	1-24-13 (Date)

B.2 Environmental Education Compatibility Determination

RMIS Database Uses: Environmental education (not conducted by Refuge System staff or authorized agents); Environmental Education (teaching teachers or group leaders); Environmental Education (teaching students)

Refuge Name: Malheur National Wildlife Refuge

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use

This CD examines environmental education (EE) on the Refuge as described in the management direction in this CCP. This CD addresses on-site EE programs and educational programs associated with non-profits and educational institutions.

Program Offerings: EE at the Refuge is currently conducted on- and off-site and is led by Refuge staff and qualified volunteers. The on-site EE program has been formally correlated with Oregon State Educational Standards and with local school district curricula for elementary levels kindergarten through fifth grade, as well as secondary and university levels. Under the management direction of the CCP, the program will continue with ongoing collaborative efforts with local and regional EE initiatives to facilitate on- and off- Refuge EE for over 500 students annually, with the focal audience of local first and third grade students.

In addition to supporting local schools, the Refuge will continue to support environmental education and natural resource–based programs on the Refuge led by a variety of non-profits and educational institutions. Currently, these groups include: Audubon Society chapters; high schools; public and private universities; and community colleges. The same or similar organizations will be expected to continue to participate in EE on the Refuge. Under the management direction in the CCP, non-profit groups and educational institutions will be required to apply for a special use permit before engaging in EE on the Refuge.

The off-site EE program will be associated with established events and special programs, and the Refuge will continue to participate in and support local, regional, and national events and education modules.

Location of Use and Associated Facilities: The on-site program for local schools occurs outdoors at the Refuge Headquarters and inside the George Benson Memorial Museum. Under the management direction of the CCP, an outdoor learning area and outdoor learning shelter at the Refuge Headquarters will be constructed to assist with existing EE program efforts, to provide the opportunity for more experiential learning, and to support EE programs during periods of inclement weather.

EE programs associated with non-profits and educational institutions occur on foot or in vehicles in areas open to the public, and use the same facilities as wildlife observation, photography, and interpretation programs. Due to the large size of the Refuge, these programs are mainly conducted in vehicles, with occasional stops at public sites to allow groups to observe and learn about wildlife outside the vehicle.

Number of Visits and Seasonal Patterns**:** An estimated 700 visits per year are made to the Refuge currently by local students for EE programs. EE for local students is currently facilitated by Refuge staff. EE activity conducted for non-local visitors (mostly adult visitors) is estimated to total approximately 6,700 visits per year. Most of the non-local EE is thought to be facilitated through universities, Malheur Field Station, or other non-profit groups. Based on past history, the majority of classes will be expected to visit the Refuge between April and June (spring migration season) under the CCP, although the classes may visit at any time of year. Groups may include up to 100 students. Class visits will be rotated to spread out the visits across different days and throughout the season to reduce the number of students on the Refuge at one time.

Non-profit groups and educational institutions will continue to conduct programs during the spring and fall migrations to make the most of the opportunity to observe and experience the wide variety of wildlife on the Refuge. Educational institutions occasionally bring groups during the summer for special programs, like geology and field biology classes. Due to the long distances travelled by many of these groups to get to the Refuge, the programs associated with these groups are generally multi-day and occur over the weekend, with groups staying overnight off-Refuge.

As a result of continued emphasis on EE under the management direction of the CCP, this use is be expected to grow over 15 years to 800 visits by local students and 9,000 visits by non-local persons per year.

Availability of Resources

Availability of resources for administering and managing EE under the CCP are detailed in Table B-3.

Table B-3. Costs to Implement the Use

Category	One-time Expense ($)	Annual Expense ($/year)
Construct outdoor EE shelter at Refuge Headquarters	$80,000	$1,000
Provide outdoor learning area at Refuge Headquarters	$25,000	$1,000
Administration and management of program (curriculum development, initiatives, special events, coordination)		$14,000
Equipment and materials		$2,000
Total	**$105,000**	**$18,000**

The EE program works closely with area schools and regional and statewide partners to teach and engage students of all ages on Refuge resources, both on-site and off-site. The Refuge has one FTE position dedicated to the EE program as a Visitor Services Manager. Additional Refuge staff supports topic-specific programs like carp awareness and cultural resources. Other Refuge staff assists in maintenance of EE facilities; the EE program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011).

Some EE projects may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of the EE program. Exact costs will be developed during design and implementation.

Anticipated Impacts of the Use

General Impacts Expected from the Scientific Literature

A general assessment of impacts resulting from EE uses has been compiled from the literature and is briefly summarized below.

Disturbance Impacts: In general, impacts that could occur from EE programs will be similar to those expected from wildlife observation, photography, or interpretation activities, especially those expected from larger groups using the site (USFWS 2011). Such impacts would be expected to include temporary damage to vegetation resulting from trampling, disturbance to nesting birds, and disturbance to feeding or resting birds or other wildlife in the proximity. EE programs generally accommodate groups of participants, and studies have shown that increasing group size has an impact on wildlife (Beale and Monaghan 2004; Remacha et al. 2011). In addition to group size, loudness has also been found to be an important variable to disturbance of wildlife, and loudness of people present can be more important than the number of people present (Burger and Gochfeld 1991. Studies showed that reducing group size, allowing safe distances, and reducing noise levels help minimize negative impacts on wildlife (Burger and Gochfeld 1991; Beale and Monaghan 2004; Remacha et al. 2011).

An unpublished study examined the effect of EE site activities at Blackhorse Lake on the Turnbull National Wildlife Refuge (Jose 1997). The study was designed to compare waterfowl presence and behavior patterns between the times EE activities were occurring and the times when EE classes were not on-site. The study results indicated that fewer waterfowl were present in the study area when EE classes were on-site as compared to the control times. The study also found more shore flights undertaken by birds when EE classes were on-site. Redheads displayed the highest number of flight responses, followed by mallards. Ruddy ducks almost never flew but had the highest increase in directional swimming away from the EE classes. The study recommended that sites heavily used by smaller-bodied birds, such as ruddy ducks, buffleheads, and teals, not be used as EE sites.

Conservation Benefits: EE provides indirect beneficial impacts for visitors engaged in EE programs and activities. One study found that animal-oriented activities have an impact on the knowledge and attitudes of students involved in EE. Direct instruction methods in which children examined the anatomical and behavioral characteristics of live spiders and snakes promoted a positive attitude toward these animals (Kress 1975; Kellert and Westervelt 1983). Eighth graders engaged in wildlife-oriented activities were found to be more likely to recognize the importance of lower forms of animal life and preserving endangered species, and to have greater tolerance for predators (LaHart 1978). Another study concluded, "If one were to try to change attitudes, education without an experiential component might not be very effective" (Baird and Tolamn 1982, p. 12).

<u>Refuge-Specific Impacts</u>

This section evaluates the likely impact at the Refuge itself, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge.

Loss of Habitat from Facility Construction: Under the CCP, new facilities constructed for EE will result in 0.25 acre of habitat loss, which is a fraction of a percentage of the Refuge; thus, habitat loss from new facilities is considered negligible.

Vegetation, Soil, and Water Impacts: Collection of resource samples for study (i.e., mud, water, plants) will be primarily focused at the Refuge Headquarters, and samples will be used on-site. Collection will be of materials needed to enhance hands-on learning and investigation and will be designed as part of structured activities and lessons guided by teachers and Refuge staff and volunteers. These activities will be an integral part of the EE philosophy, and their impacts will be minimal. Some additional trampling will also occur from larger group sizes, but impacts will be concentrated at public sites. To minimize trampling along the east side of the Display Pond, a hardened site may be developed. Impacts to water resources are expected to be negligible.

Disturbance Impacts: Under the management direction of the CCP, the construction of an outdoor learning area and shelter at the Refuge Headquarters will have short-term disturbance impacts. Maintenance of facilities and equipment related to EE could also result in very local disturbance depending on time and place of need.

Disturbance to wildlife could occur from EE programs, as with any group, if birds near EE activities will be disturbed by human presence. The EE program will continue to be small, and will generally support groups of 10 to 30 participants at any one time, although occasionally multiple groups visit the Refuge at the same time. A special use permit (SUP) will be required for EE programs on the Refuge to ensure groups understand Refuge regulations, the purpose and mission of the Refuge and Refuge System, and to help the Refuge gather use information. For special permission into closed habitat/wildlife areas, an SUP will be required, and will be approved on a case-by-case basis. All participants involved in EE will be instructed in ethical wildlife observation etiquette to view wildlife with minimal disturbance.

Table B-4 details the SUP requirements under the CCP for environmental education.

Table B-4. Special Use Requirements for Environmental Education

Access to Open Areas	Access to Closed Areas	Access to Hunting Areas	Access to Fishing Areas
• Special use permit • No fee	• Special use permit • No fee	• No entry during hunting season	• Special use permit • No fee
• Special use permit • No fee	• Special use permit • No fee	• No entry during hunting season	• Special use permit • No fee

Participation in EE programs is growing throughout Oregon, with the Service's *Connecting People with Nature* initiative, and nationally with the *America's Great Outdoors* initiative. With this growing emphasis, future program participation and associated effects will be expected to be higher than present. The EE program could have increased impacts on Refuge habitats and wildlife, but a majority of EE activities will be conducted at the Headquarters or along roads and trails open to the public.

It is not expected that EE will cause any additional short-term, long-term and/or cumulative and indirect/secondary impacts other than those detailed above.

Impacts to Listed Species: There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from EE uses and facilities will be negligible. These uses will continue to occur at public sites and on designated roads and trails, away from sensitive habitat and resources and outside of breeding areas and seasons. The greater sage-grouse is not known to breed on the Refuge. Incidental use of the east side of the south Blitzen Valley by sage-grouse has been reported during the late summer when visitor numbers and activities are lower. EE uses do not generally occur at Mud Creek and Bridge Creek outside of the fishing season and thus will not impact the spotted frog populations. Groups participating in EE on the Refuge will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. EE will also assist in raising awareness and preventing undue impacts to these species. If the use results in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

Impacts to Other Priority Public Uses: EE generally results in little disturbance to other visitors. Some additional crowding at the Refuge Headquarters or along public roads and trails may occur with EE groups, but the EE programs will consist of structured activities and will be carefully scheduled to ensure groups are spread out and not impacting other programs or events.

Infrastructure: No significant effects to roads, trails, or other infrastructure from EE programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade is addressed in the Availability of Resources section.

Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

Special Use Permit

- An SUP will be required for groups engaging in EE on the Refuge. No fee will be charged for EE groups.
- A standard permit form stipulating dates, times, and locations of use will be made available prior to the visit on the Refuge's website or by mail.
- SUPs for areas open to the public grant permissions to open areas for up to 1 year under the same use stipulations before renewal.
- Special permission requests to closed habitat/wildlife areas or other special considerations (e.g., access to Refuge after normal public visitation hours, setting up temporary equipment, requiring additional resources or staff) will be granted on a case-by-case basis with no renewal.
- The SUP is required to be readily available while conducting the permitted use on the Refuge.
- Requests must demonstrate intent to enhance education, appreciation, and/or understanding of the Refuge and the National Wildlife Refuge System. Failure to abide by any part of the SUP or regulations will be considered grounds for immediate revocation of the permit and could result in denial of future permit requests.

General Stipulations

- On-site EE programs will be conducted at Refuge Headquarters or along roads and trails open to the public.
- Class size will be limited to 30 participants at a time.
- Refuge staff will instruct all groups in behavior etiquette and ways to reduce wildlife and habitat disturbance during a "welcome" session.
- Collection of resource samples for study (i.e., mud, water, plants) will be restricted to the Refuge Headquarters, and samples will be used on-site. Collection will be of materials needed to enhance hands-on learning and investigation and will be designed as part of structured activities and lessons.

- Periodic monitoring and evaluation of Refuge Headquarters and EE programs will be conducted to assess if objectives are being met and the resource is not being unacceptably degraded.

Justification

EE receives enhanced consideration in the CCP process, and is considered a priority public use when determined compatible. By limiting the size of groups, providing structured activities, and providing closed areas for wildlife away from human disturbance, this program will limit disturbances to wildlife. There is sufficient undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. The use of SUPs allows the Refuge Manager to continually adjust the activity to any significant new or changing conditions on the Refuge as needed, and to facilitate outreach and coordination of activities with EE groups. Thus, allowing EE to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System mission.

EE contributes to the mission of the Refuge System by providing wildlife-oriented educational benefits to visitors. EE programs on Refuge lands are inherently valuable to the USFWS because they will enhance the public's knowledge of the Refuge and its resources, and expand the number of visitors who engage in the Refuge's conservation mission. EE on-site and off-site is an important part of the Refuge's vision and goals.

Mandatory Reevaluation Date

__09/2027__ Mandatory 15-year Reevaluation Date (for priority public uses)

NEPA Compliance for Refuge Use Decision

___X___ Environmental Impact Statement and Record of Decision

References

Baird, D.D. and R.R. Tolamn. 1982. Attitudes of high school students and biology teachers towards animals. Unpublished manuscript. Field Museum of Natural History, Division of Mammals. Chicago, IL.

Beale, C.M. and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335-343.

Burger, J. and M. Gochfeld. 1991. Human activity influence and diurnal and nocturnal foraging of sanderlings (*Calidris alba*). Condor 93:259-265.

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

Jose, J. 1997. Evaluation of the effect of environmental education classes on waterfowl behavior. Unpublished report. Biology 454 class, Eastern Washington University. Cheney, Washington.

Kellert, S.R. and M.O. Westervelt. 1983. Children's attitudes, knowledge, and behaviors towards animals. Washington, D.C.: U.S. Fish and Wildlife Service (U.S. Government Printing Office: 1983 0-405-522/1101).

Kress, S.W. 1975. A study of the modification of children's negative attitudes towards animals. Ph.D. dissertation. Cornell University, Ithaca.

LaHart, D.E. 1974. The influence of knowledge on young people's perceptions about wildlife. Final project report to the National Wildlife Federation, College of Education. Florida State University.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Remacha, C., J. Pérez-Tris, and J.A. Delgado. 2011. Reducing visitors' group size increases the number of birds during educational activities: Implications for management of nature-based recreation. Journal of Environmental Management 92(6):1564-1568.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

USFWS. 2011. Compatibility determination for wildlife observation, photography, and interpretation. Malheur National Wildlife Refuge. Princeton, OR.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Acting Refuge Manager/ Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	1-24-13 (Date)

B.3 Waterfowl Hunting Compatibility Determination

RMIS Database Use: Hunting (waterfowl)

Refuge Name: Malheur National Wildlife Refuge

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use

Program Offerings: This CD examines waterfowl hunting on designated units of the Refuge as described in the management direction of the CCP. Under the CCP, the Refuge would offer waterfowl hunting in two units: the Malheur Lake Unit and the Buena Vista Unit. The total waterfowl hunt area under the CCP will measure approximately 63,100 acres or 33 percent of the Refuge. Staggered hunt openings will provide the equivalent of two "opening weekends" at the Refuge.

A youth waterfowl hunt will be promoted, and the Refuge will support reasonable waterfowl hunting opportunities in the Buena Vista Unit for disabled hunters. Species available for take include ducks, geese, and coots. To increase hunter success during the hunting season, the use of well-trained hunting dogs will be encouraged by the Refuge for prey retrieval.

Location of Use, Associated Facilities, and Access:

Malheur Lake Unit: Malheur Lake Unit is currently located on the north side of Malheur Lake, east of Highway 205 and west of Cole Island Dike (approximately 26,000 acres or 14 percent of the Refuge).

Under the management direction of the CCP, the allowable hunt area on the lake will be expanded to include an area on the south side of Malheur Lake east of the Sodhouse Farms (a private inholding) eastern dike and west of Cole Island Dike (approximately 4,600 acres), creating two hunt units on the lake: the North Malheur Lake Unit and the South Malheur Lake Unit. The opening on the North Malheur Lake Unit will remain the same as the state waterfowl season, which is generally from the end of September to mid-October. Access will be improved to the North Malheur Lake Hunt Unit by refurbishing the Saddle Butte lake access with an all-weather road. Existing walk-in access from Highway 205 and the Lawen access will remain. The north hunt boundary will be redefined to reflect the actual huntable acreage west of Cole Island Dike, and to protect significant resources on Malheur Lake.

The South Malheur Lake Unit will have special date regulations from the fourth Saturday of October to the end of the regular state waterfowl season and will include a fourth access point at the airboat launch site near Refuge Headquarters with expanded parking and a refurbished boat launch. A no-hunt buffer zone around the airboat launch site and proposed observation tower will be enforced. This will bring the North and South Malheur Lake Units to a total of 27,100 acres under the CCP. See Map 3b.

Buena Vista Unit: The Buena Vista Hunt Unit, currently open only for upland game hunting, will also be opened to waterfowl hunting under the CCP, adding 36,000 acres of waterfowl hunt area to the waterfowl hunt program. A special date regulation will apply from the fourth Saturday of October to the end of the regular state pheasant season. Boats will not be permitted in this hunt unit; however, the hunt unit will provide a walk-in hunting experience where hunters could set up temporary decoys or jump-shoot if opportunities present themselves.

Like other Refuge users, hunters rely on roads, parking lots, pull-offs, trails, and dikes while using the Refuge.

Number of Visits and Seasonal Patterns: In 2010-2011, an estimated 85 visits were made to the Refuge to engage in waterfowl hunting activities. Waterfowl hunting is the smallest use of all the priority public uses on the Refuge. With improvements made to habitat management, access, and enhanced hunting opportunities, the number of waterfowl hunting visits is expected to grow over 15 years to 180 visits per year.

Availability of Resources

Availability of resources for administering and managing the waterfowl hunting program under the CCP are detailed in Table B-5.

Table B-5. Costs to Implement the Use

Category	One-time Expense ($)	Annual Expense ($/year)
Improve Saddle Butte access road	$130,000	
Open new ADA-accessible boat launch and parking area on Malheur Lake at the end of Boat Landing Road	$150,000	
Develop new publications and signage for hunt program	$2,000	$1,000

Table B-5. Costs to Implement the Use

Category	One-time Expense ($)	Annual Expense ($/year)
Staff administration and management (programmatic, law enforcement, regulations, and information)		$5,000
Facility maintenance		$2,000
Total	**$282,000**	**$8,000**

Administering the waterfowl hunt program does not require significant staff time, equipment, or funding. Still, to maintain a quality hunting experience, access trails, parking lots, signs, and other facilities are maintained annually. The Refuge has one FTE Visitor Services Manager and one FTE position for law enforcement that patrols the Refuge during hunting season to ensure compliance with Federal, state, and Refuge conditions. The majority of the staff time spent administering this program will fall mostly on the law enforcement position. Other Refuge staff assists in maintenance of hunting facilities like access roads and parking lots; in general, the waterfowl hunt program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011). Additional costs and staff time will include updating and printing hunting brochures and developing new publications for the hunt program.

Some hunt program enhancements may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of waterfowl hunting. Exact costs will be developed during design and implementation.

Anticipated Impacts of the Use

<u>General Impacts Expected from the Scientific Literature</u>

A general assessment of impacts resulting from waterfowl hunting uses has been compiled from the literature and is briefly summarized below.

Direct Impacts to Hunted Wildlife: Sport hunting involves the direct take of wildlife designated as huntable game species by regulation. In addition to loss of target individuals, additional birds are sometimes crippled or killed and not retrieved.

Hunting causes disturbance to feeding and resting waterfowl as well as non-target species due to noise (shotgun), movement, vehicular traffic, and use of dogs for hunting activities. It can also alter behavior, population, structure, and distribution patterns of wildlife (Owens 1977; Raveling 1979; White-Robinson 1982; Thomas 1983; Bartlet 1987; Madsen 1985; Cole and Knight 1990; Dooley et al. 2010). Disturbance levels from hunting activity outside Chincoteague NWR were found to be high enough to force wintering black ducks into a pattern of nocturnal feeding within surrounding salt marsh and diurnal resting within Refuge impoundments (Morton et al. 1989a, 1989b). Unhunted populations have been documented to behave differently from hunted ones (Wood 1993). Although disturbance from hunting is noted to have effects directly on wildlife, the U.S. Department of the

Interior (U.S. DOI) concluded that hunting disturbance has less of an impact compared to the direct mortality caused by hunting (2009).

There appears to be an inverse relationship between the number of birds using an area and hunting intensity (DeLong 2002). In California, the number of northern pintails on Sacramento NWR non-hunt areas increased after the first week of hunting and remained high until the hunt season was over in early January (Heitmeyer and Raveling 1988). Following the close of hunting season, ducks generally increased their use of the hunt area; however, use was lower than before the beginning of the hunting season. Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1995; Paulus 1984).

Sanctuaries or non-hunt areas have been identified as the most common solution to disturbance problems caused by hunting (Havera et al. 1992). In Denmark, hunting disturbance effects were experimentally tested by establishing two sanctuaries, and over a 5-year period, these sanctuaries became two of the most important staging areas for coastal waterfowl; numbers of dabbling ducks and geese increased 4- to 20-fold within the sanctuary (Madsen 1995).

Disturbance from Dogs: Dogs elicit a greater response from wildlife than people on foot alone (MacArthur et al. 1982; Hoopes 1993). The presence of dogs may disrupt foraging activity in shorebirds (Hoopes 1993) and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that dogs with people, dogs on leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals. In effect, off-leash dogs increase the radius of human recreational influence or disturbance beyond what it would be in the absence of a dog. Indirectly, domestic dogs can also potentially introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

Refuge-specific Impacts

This section evaluates the likely impact on Refuge resources specifically, considering the scientific studies discussed above and considering the use within the context of Malheur Refuge. It also considers the cumulative effect of Refuge hunts on regional and flyway populations of target species.

NEPA considerations by the Service for hunted migratory game bird species have been addressed nationally. In August 2009, a *Draft Supplemental Environmental Impact Statement: Issuance of Annual Regulations Permitting the Hunting of Migratory Birds* (hereafter abbreviated as SEIS 2009) was released (U.S. DOI 2009). Annual NEPA considerations for waterfowl hunting frameworks are covered under a separate Environmental Assessment and Finding of No Significant Impact.

Harvest Management—Regulatory Procedures: The hunting of waterfowl in the United States is based upon a thorough regulatory setting process that involves numerous sources of waterfowl population and harvest monitoring data. Waterfowl populations throughout the United States are managed through an administrative process known as flyways, of which there are four (Pacific, Central, Mississippi, and Atlantic). Oregon is included in the Pacific Flyway. A review of the policies, processes, and procedures for waterfowl hunting is covered in a number of documents.

Because the Migratory Bird Treaty Act stipulates that all hunting seasons for migratory game birds be closed unless specifically opened by the Secretary of the Interior, the Service annually promulgates regulations (50 Code of Federal Regulations [CFR] 20) establishing the Migratory Bird Hunting Frameworks. The frameworks are essentially permissive, in that hunting of migratory birds would not be permitted without them. Thus, in effect, annual Federal regulations both allow and limit the hunting of migratory birds.

The Migratory Bird Hunting Frameworks provide season dates, bag limits, and other options for states to select from, which should result in the level of harvest determined to be appropriate based upon Service-prepared annual biological assessments detailing the status of migratory game bird populations. In North America, the process for establishing waterfowl hunting regulations is conducted annually. In the United States, the process involves a number of scheduled meetings (Flyway Study Committees, Flyway Councils, Service Regulations Committee, etc.) in which information regarding the status of waterfowl populations and their habitats is presented to individuals within the agencies responsible for setting hunting regulations. In addition, public hearings are held and the proposed regulations are published in the Federal Register to allow public comment.

For waterfowl, annual assessments used in establishing the Frameworks include the Breeding Population and Habitat Survey, which is conducted throughout portions of the United States and Canada. This survey is used to establish an annual Waterfowl Population Status Report. In addition, the number of waterfowl hunters and resulting harvest are closely monitored through both the Harvest Information Program (HIP) and the Parts Survey (Wing Bee). Since 1995, such information has been used to support the adaptive harvest management (AHM) process for setting duck-hunting regulations. Under AHM, a number of decision-making protocols determine the choice (package) of pre-determined regulations (appropriate levels of harvest) that comprise the framework offered to states that year. Each state’s wildlife commission then selects season dates, bag limits, shooting hours, and other options from the Pacific Flyway package. Their selections can be more restrictive, but cannot be more liberal than AHM allows. Thus, the level of hunting opportunity afforded each state increases or decreases each year in accordance with the annual status of waterfowl populations.

Season dates and bag limits for National Wildlife Refuges open to hunting are never longer or larger than the state regulations. In fact, based upon the findings of an environmental assessment developed when a Refuge opens a new hunting activity, season dates and bag limits may be more restrictive than the state allows. Each National Wildlife Refuge considers the cumulative impacts to hunted migratory species through the Migratory Bird Frameworks published annually in the Service’s regulations on Migratory Bird Hunting.

Population and Harvest Data: The following analysis of hunting effects on the Refuge uses data on harvest and population, comparing the number of birds taken at various scales with the estimated population size. Since hunting occurs in the fall and winter, the mid-winter population index is used to compare take to population. The index is provided by the 2010 Pacific Flyway Data Book, which tracks waterfowl harvests and status, and hunter participation and success in the Pacific Flyway and United States (Collins and Trost 2010). The Pacific Flyway is one of the major north-south routes of travel for migratory birds in the Americas along the West Coast, and the Refuge is part of the flyway route. The data is provided at a variety of scales: Pacific Flyway, State of Oregon, and Survey Unit 69-3 S, which includes Klamath, Lake, and Harney counties, providing a good view of regional populations (Collins and Trost 2010). Although the Refuge receives the majority of its birds during the spring and fall migration months, the mid-winter index provides an example of bird populations that may be present regionally during the Refuge hunting season.

Wintering Populations: Recent mid-winter waterfowl survey counts for ducks and geese in the Pacific Flyway, the State of Oregon, and regional Survey Unit 69-3 S are presented in Table B-6.

These numbers only represent an index, not an absolute population number. Oregon hosts only a small percentage of wintering waterfowl; within the Pacific Flyway, the majority of waterfowl winter in California. At Malheur, the main wintering species include: Canada geese, mallards, common goldeneye, bufflehead, and common and hooded merganser; coots are smaller in number. Most waterfowl species migrate away from the Refuge by mid-November with peaks during October. The Refuge has a low number of wintering birds, usually less than 3,000 birds reported during counts. The mid-winter population index from the Pacific Flyway Council is not reported for Malheur Refuge.

Fall Populations: Counts were conducted on the Refuge during the 1970s to 1990s to gather information on fall use days of ducks and geese. Between 1975 and 1981, the counts captured ducks and geese on Malheur Lake only; counts were Refuge-wide between 1982 and 1990, which assumed 90 percent of fall use still on Malheur Lake. From 1991 to 1997, counts did not specify location of populations, so it is hard to determine if they represent Malheur Lake, Harney Lake, or Refuge-wide counts, and thus do not provide a reliable source. The fall population counts from the 1970s to 1990s represent population numbers from mid-September through mid-December on the Refuge. Although dated, the counts provide the best available data for fall bird populations over time on the Refuge. (Paullin et al. 1977; Horton et al. 1983; Littlefield 1983)

Area harvest information is not available at the regional or Refuge level, as it is not consistently tracked by the Pacific Flyway Council, ODFW, or the Refuge. The Pacific Flyway provides harvest data at the flyway, state, and regional levels. The Refuge harvest numbers are estimated by Refuge staff, but are only an estimate.

Estimated Harvest Mortality: Hunting results in mortality to waterfowl, and these numbers are tracked at different scales. See Table B-6 for harvest estimates at different scales in 2009. The estimated future harvest of ducks and geese on the Refuge due to hunting under current management and future CCP management is also captured.

Table B-6. Harvest and Population at Flyway, State, and Survey Unit Scales: Ducks, Geese[1], and Coots

Area	Area Harvest 2009	Breeding Population 2010	Mid-winter Population Index 2010	Average Fall Count 1982-1990[2]	Estimated Harvest[3]	
Ducks					**Current Management**	**Future Management**
Pacific Flyway	3,225,718	980,298	4,620,523		No change	
State of Oregon	422,001	219,876	349,654		No change	
Survey Unit 69-3 S[4]	Not available		14,173		No change	
Malheur NWR	Est. <100			25,593	<100	<250
Geese					**Current Management**	**Future Management**
Pacific Flyway	425,739		1,522,908		No change	
State of Oregon (total season)	60,901		125,447		No change	
Survey Unit 69-3 S[3]	Not available		13,024		No change	
Malheur NWR	Est. <150			6,253	<150	<200
Coots					**Current Management**	**Future Management**
Pacific Flyway	35,564		606,642		No change	
State of Oregon (total season)	2,124		13,585		No change	
Survey Unit 69-3 S[3]	Not available		100		No change	
Malheur NWR	Est. <50			Not available	<50	<100

[1] Source: Collins and Trost 2010.
[2] From Refuge-wide population counts, averaged from available data from Harney Basin Study Reports.
[3] Klus 2001; Megan and Bodeen 2011.
[4] Survey Unit 69-3 S is a unit that the Pacific Flyway Council uses for mid-winter surveys that includes Klamath, Lake, and Harney counties, which includes Malheur Refuge.

Although in Table B-6, harvest in 2009 appears to represent more than the actual mid-winter survey for ducks at the state level, it is important to remember that to make any kind of comparison between the seasonal harvest and some population level, an estimate of the number of birds available for harvest in Oregon would be needed. The mid-winter count represents simply a snapshot at one point during mid-winter, and thus can underestimate total wintering populations. The duck harvest in Oregon accounted for approximately 13 percent of the Pacific Flyway duck harvest in 2009. Similarly, the goose harvest in Oregon accounted for approximately 14 percent of the Pacific Flyway goose harvest in 2009.

Direct Mortality Stemming from Refuge Hunts: Refuge-specific harvest data is not available at this time, but per communication with Refuge staff and ODFW, hunter numbers and harvest numbers are generally very low and do not exceed more than 250 waterfowl harvested annually. With expanded access to the South Malheur Lake Unit and the opening of the Buena Vista Hunt Unit for waterfowl hunting under the CCP, the number of harvests will be expected to increase to 550 waterfowl annually. These estimated harvests represent a tiny fraction of a percent of the total mid-winter population of wintering waterfowl in the Survey Unit and State of Oregon, and an even smaller fraction of the Pacific Flyway population. Under the CCP harvest estimation, the waterfowl harvested will be less than 2 percent of the mid-winter survey population in the Survey Unit 69-3 S (Klamath, Lake, and Harney counties). From available data provided in the Harney Basin Study Reports, the duck and goose harvested will be between 1 percent and 4 percent of fall counts at average 1982-1990 levels. Coot populations have been increasing over the last 50 years, from 600,000 birds in 1955 to 1.6 million birds in 2005. American coot harvest in Oregon during 2005 was 1,500 birds taken by 200 hunters. As the flyway coot population continues to remain high, these birds are underutilized and, with liberal bag limits, can provide increased hunting opportunity. The overall impacts from the harvest estimates will be minor to negligible.

Historical data demonstrates that Malheur Lake was once an extremely productive area for waterfowl, with annual waterfowl production estimates from 1942 to 1980 averaging over 51,000 birds, of which ducks constituted over 95 percent, or over 48,000 ducks produced annually. In 1948 alone, 146,950 ducks were produced (Cornely 1982), suggesting that these high levels of production resulted in high-quality waterfowl hunting. After 1980, population data is not readily available; however, Refuge staff believe production has been decreasing over the years due to lake level fluctuations and invasive carp. As management activities work to control carp in Malheur Lake over the next 15 years, it is expected that the number of nesting birds in this area will increase and consequently the number of hunters and harvests will also increase. There are many unknowns in carp control, and an accurate estimate of waterfowl to be harvested under this scenario cannot be predicted at this time.

The Buena Vista Hunt Unit will considerably increase the acreage open to waterfowl hunting to 63,000 acres; however, the expected number of waterfowl hunters after opening weekend will be small, thus mitigating against hunter competition and disturbance issues. Additionally, spreading out opening weekend for waterfowl hunting between the hunt units over two weekends will help reduce conflicts between hunters and allows additional protection for staging sandhill cranes.

Given the small amount of the estimated take and the distribution of the hunt units, the hunt program as designed is not expected to adversely affect the Refuge's ability to sustain optimum population levels for maintaining populations of migratory waterfowl. As the health of Malheur Lake improves and the hunt program grows over the 15-year time frame of the CCP, the hunt program will be revisited with ODFW guidance to determine what the appropriate level of harvest would be with growing population projections.

***Disturbance to Target Wildlife*:** Hunting could result in redistribution of waterfowl and waterbirds at the Refuge. Disturbance effects associated with hunting were examined in the SEIS 2009 for waterfowl and some other migratory bird species. On the basis of a review by Dahlgren and Korschgen (1992), the SEIS 2009 noted that disturbance has its most pronounced detrimental effect during the nesting period. Hence the SEIS 2009 noted that hunting-related disturbance does not have any pronounced population level effects (U.S. DOI 2009).

Impacts to Non-Target Wildlife: Non-hunted wildlife would include any non-target waterfowl and other birds; small- and medium-sized mammals; reptiles; amphibians; and invertebrates. Occasionally, non-target species are illegally killed by hunters by accident or intentionally, or are disturbed by hunter presence or noise. The free-roam hunting opportunity and use of temporary blinds at the Buena Vista Unit could increase habitat disturbance in areas not currently accessed.

The cumulative effects of disturbance to non-hunted birds under the CCP management direction are expected to be moderate to minor for the following reasons. Hunter education courses are required for youths. Hunting seasons do not coincide with nesting seasons; thus, reproduction will not be reduced by hunting. Disturbance to the foraging or resting activities of migrating or resident birds might occur, and will increase with the new access for boats at the South Malheur Lake Unit and the opening of the Buena Vista Hunt Unit to waterfowl hunters. However, even with these changes, hunting is still expected to involve a small numbers of participants. On North Malheur Lake Unit, due to the long walk-in distances and difficulties and inconsistencies of getting boats out on the lake, many hunters hunt the shoreline rather than using boats on Malheur Lake, thus limiting the area disturbed on that side. The Buena Vista Unit will remain a walk-in hunt, but prohibiting overnight camping will decrease the likelihood of hunters roaming long distances in the Buena Vista Unit and other hunt units.

Waterfowl can be an important food resource for bald eagles in winter. On the Refuge, bald eagle presence is low during the winter, and the majority of the population is found during the spring. During waterfowl hunting season, there will be adequate food resources available on Malheur Lake and the wetlands for any bald eagles on the Refuge at this time. Furthermore, hunting pressure is generally low overall, and there will be no expected competition between hunters and bald eagles for waterfowl.

Disturbance to other taxa will be unlikely or negligible for the following reasons. Encounters with reptiles and amphibians, invertebrates, and small mammals in the early fall will be few and should not have cumulative negative effects on Refuge populations. Refuge regulations further mitigate possible disturbance by hunters to non-hunted wildlife. Vehicles will be restricted to public roads and the harassment or taking of any wildlife other than the game species legal for the season will not be permitted.

Dogs will increase the level of disturbance to target and non-target species, but this impact is expected to be minor, especially to migratory wildlife, and is encouraged to support the use. Dogs will be required to be under the close control of their owners while on the Refuge.

Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. Under the CCP, a late season opener for the southern portion of Malheur Lake and the

Buena Vista Unit will allow sufficient protection of the sandhill cranes until they migrate south, thus mitigating any hunting-related impacts to sandhill cranes. Other birds using the area may be disturbed by noise and human presence; however, since most birds will have already migrated through the area by the time hunting begins, disturbance levels will be expected to be minor overall. Outreach with hunting brochures and timely information on the website will help educate hunters on hunting opportunities, regulations, and ethical hunter behavior.

Loss of Habitat from Facility Construction: Saddle Butte access road will be upgraded but will follow the same route. Construction of the boat launch at Boat Landing Road will result in 0.5 acre of habitat loss, which is a fraction of a percentage of the Refuge. Thus, habitat loss from new facilities is considered negligible. No additional new facilities will be added to support this use separate from general visitor use facilities described in the CD for wildlife observation, photography, and interpretation.

Vegetation, Soil, and Water Impact: Since access to waterfowl hunting areas is walk-in, associated foot travel from accessing Malheur Lake and the Buena Vista Unit for hunting could potentially result in temporary and minor vegetation trampling.

Impacts to Listed Species: There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from waterfowl hunting uses and facilities will be negligible. The greater sage-grouse is not a hunted species on the Refuge. Hunting is not allowed south of the Buena Vista Unit where sage-grouse have been observed, and there have been no occurrences of spotted frogs in the area encompassed by the Buena Vista or Malheur Lake Hunt areas. Public education will assist in raising awareness and preventing undue impacts to these species. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

Impacts to Other Priority Public Uses: Hunting has the potential to disturb Refuge visitors engaged in other priority public uses; however, given the season during which hunting occurs, the likelihood of conflicts is low. The Malheur Lake airboat launch site near the Refuge will be opened to other uses during hunting season; however, the number of visitors to the Refuge during this season is drastically lower than in other seasons and hunting regulations will be established to provide a no-hunt buffer zone around the airboat launch site and observation tower. Although Center Patrol Road is the most popular attraction during the migration seasons, use is also very light during hunting season, and state regulations also prohibit shooting from, on, and across roads. Fishing along the Blitzen River from Sodhouse Lane to Boat Landing Road will conclude prior to the hunting season opening. Generally, winter use on the Refuge is only a fraction of the use during the spring and fall seasons.

Infrastructure*:* No significant effects to roads, trails, or other infrastructure from the hunting program are foreseen. Normal road, trail, and facility maintenance will continue to be necessary.

Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

Other Effects: There could be some indirect beneficial impacts of Refuge hunting. Refuge hunting can contribute to wildlife and habitat conservation and provide educational and sociological benefits. The hunting community in general remains the largest support base for funding land acquisitions in the Refuge System through the purchase of Duck Stamps. Waterfowl hunting at the Refuge is a “Big Six” use and helps meet the Refuge’s goals of wildlife-dependent recreation for all visitors. Additionally, providing youth hunting opportunities is an important initiative in the Fish and Wildlife Service, and enhancing this opportunity on the Refuge helps address a public desire to see more hunting opportunities for youth.

Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles will be allowed only on maintained public roadways. Parking will be allowed only within one vehicle length of the roadway. Hunters will be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires will not be permitted on the Refuge.
- Access will be walk-in only. Electric motorized boating or non-motorized boating will be permitted on Malheur Lake during the waterfowl hunt season.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Seasonal hunting closures may occur to protect waterfowl populations when the Malheur Lake water level drops below 10,000 acres.
- Hunting closures will be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. Shooting from or across public roads or road right-of-ways is prohibited.
- Law enforcement patrols will ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information will be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

Justification

Under the National Wildlife Refuge System Administration Act, as amended, waterfowl hunting is a wildlife-dependent recreational activity, which receives enhanced consideration in the CCP planning process and is to be encouraged on National Wildlife Refuges if compatible with refuge purposes.

Despite the direct and indirect impacts associated with sport hunting of waterfowl, waterfowl populations are unlikely to be affected significantly by the hunting program on the Refuge. Waterfowl population objectives and allowable harvests are determined on a flyway basis using an established annual regulatory process. Limited hunt seasons at the Refuge in significant wildlife areas, and no hunt zones, ensure that wintering and migrating waterfowl, as well as non-target species, will find adequate food and rest areas on the Refuge even in the midst of the hunting season. Thus, allowing waterfowl hunting to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System's mission.

Mandatory Reevaluation Date

__09/2027__ Mandatory 15-year Reevaluation Date (for priority public uses)

NEPA Compliance for Refuge Use Decision

___X___ Environmental Impact Statement and Record of Decision

References

Bartlet, G.A. 1987. Effects of disturbance and hunting on the behavior of Canada goose family groups in east central Wisconsin. Journal of Wildlife Management 51:517-522.

Cole, D.N. and R.L. Knight. 1990. Impacts of recreation on biodiversity in wilderness. Proceedings of Wilderness Areas: User Impacts, April 19-20, 1990; Utah State University. Logan, UT.

Collins, D. P. and R.E. Trost. 2010. 2010 Pacific Flyway data book: Waterfowl harvests and status, hunter participation and success in the Pacific Flyway and United States. U.S. Fish and Wildlife Service Division of Migratory Bird Management. Available at: http://www.pacificflyway.gov/Documents/Pf_databook.pdf.

Cornely, J.E. 1982. Waterfowl production at Malheur National Wildlife Refuge, 1942-1980. U.S. Fish and Wildlife Service. Pages 559-571 in: Kenneth Sabol, ed. Transactions of the Forty-Seventh North American Wildlife and Natural Resources Conferences. Washington, D.C.

Dahlgren, R.B. and Carl E. Korschgen. 1992. Human disturbances of waterfowl: an annotated bibliography. USFWS Resource Publication 188. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available at: http://www.npwrc.usgs.gov/resource/literatr/disturb/index.htm (Version 16 Jul 1997).

DeLong, A.K. 2002. Managing visitor use and disturbance in waterbirds—a literature review of impacts and mitigation measures. Appendix L (114 pp.) in: Stillwater National Wildlife Refuge Complex final environmental impact statement for the comprehensive conservation plan and boundary revision. Volume II. Department of the Interior, U.S. Fish and Wildlife Service, Region 1. Portland, OR.

Dooley, J.L., T.A. Sanders, and P.F. Doherty, Jr. 2010. Mallard response to experimental walk-in and shooting disturbance. Journal of Wildlife Management 74(8):1815-1824.

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

Havera, S.P., L.R. Boens, M.M. Georgi, and R.T. Shealy. 1992. Human disturbance of waterfowl on Keokuk Pool, Mississippi River. Wildlife Society Bulletin 20:290-298.

Heitmeyer, M.E. and D.G. Raveling. 1988. Winter resource use by three species of dabbling ducks in California. Unpublished final report to Delta Waterfowl and Wetlands Research Station, University of California-Davis. 201 pp.

Hoopes, E.M. 1993. Relationship between human recreation and piping plovar foraging ecology and chick survival. M.S. thesis. University of Massachusetts, Amherst, MA. 106 pp.

Horton, S.K., C.D. Littlefield, D.G. Paullin, and R.E. Vorderstrasse. 1983. Migratory bird populations and habitat relationships in Malheur-Harney lakes basin, Oregon: final report. U.S. Fish and Wildlife Service, Portland Field Office. Portland, OR.

Keller, V. 1991. Effects of human disturbance on eider ducklings *Somateria mollissima* in an estuarine habitat in Scotland. Biological Conservation 58:213-228.

Klus, R. 2011. Personal communication between Rod Klus, Oregon Department of Fish and Wildlife, and Maren Murphy, Conservation Planning Assistant, Division of Planning and Visitor Services, Region 1, USFWS. May, 2011.

Littlefield, C.D. 1983. Malheur-Harney lakes basin study, Oregon. Report No. 3:1979-1981.U.S. Fish and Wildlife Service and Malheur National Wildlife Refuge. Princeton, OR.

MacArthur, R.A., V. Geist, and R.H. Johnson. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358. C.W. Servheen, eds. 1980. Proceedings of the Washington bald eagle symposium; Seattle, WA.

Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33:53-63.

Madsen, J. 1995. Impacts of disturbance on migratory waterfowl. Ibis 137:S67-S74.

Megan, J. and T. Bodeen. 2011. Personal communication between John Megan, Law Enforcement Officer, Malheur National Wildlife Refuge, Tim Bodeen, Project Leader, Malheur National Wildlife Refuge, and Maren Murphy, Conservation Planning Assistant, Division of Planning and Visitor Services, Region 1, USFWS. May, 2011.

Morton, J.M., A.C. Fowler, and R.L. Kirkpatrick. 1989a. Time and energy budgets of American black ducks in winter. Journal of Wildlife Management 53(2):401-410.

Morton, J.M., R.L. Kirkpatrick, M.R. Vaughan, and D.F. Stauffer. 1989b. Habitat use and movements of American black ducks in winter. Journal of Wildlife Management 53:390-400.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Owens, N.W. 1977. Responses of wintering brant geese to human disturbance. Wildfowl 28:5-14.

Paulus, S.L. 1984. Activity budgets of nonbreeding gadwalls in Louisiana. Journal of Wildlife Management 48:371-380.

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Paullin, D.G., C.D. Littlefield, and R.E. Vorderstrasse. 1977. Malheur-Harney lakes basin study, Oregon. Report no. 1: A summary of biological data for calendar years 1975 and 1976. U.S. Fish and Wildlife Service. Portland, OR.

Raveling, D.G. 1979. The annual cycle of body composition of Canada geese with special reference to control of reproduction. Auk 96:234-252.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Sime, C.A. 1999. Domestic dogs in wildlife habitats. Pages 8.1-8.17 in: G. Joslin and H. Youmans, coordinators. Effects of recreation on wildlife, Montana chapter of The Wildlife Society. 307 pp.

Thomas, V.G. 1983. Spring migration: the prelude to goose reproduction and a review of its implication. Pages 73-81 in: H. Boyd, ed. Fourth Western Hemispheric Waterfowl and Waterbird Symposium. Ottawa, Canada: Canadian Wildlife Service.

U.S. DOI. 2009. Draft supplemental environmental impact statement: issuance of annual regulations permitting the hunting of migratory birds. Department of Migratory Bird Management, U.S. Fish and Wildlife Service. Portland, OR.

USFWS. 2011. Compatibility determination for wildlife observation, photography, and interpretation. Malheur National Wildlife Refuge. Princeton, OR.

White-Robinson, R. 1982. Inland and salt marsh feeding of wintering brent geese in Essex. Wildfowl 33:113-118.

Wood, A.K. 1993. Parallels between old-growth forest and wildlife population management. Wildlife Society Bulletin 21:91-95.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Acting Refuge Manager/ Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	Rob L. West (Signature)	1-24-13 (Date)

B.4 Upland Game Hunting Compatibility Determination

RMIS Database Use: Hunting (upland game)

Refuge Name: Malheur National Wildlife Refuge

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use

Program Offerings**:** This CD examines sport hunting for upland game on designated units of the Refuge as described in the management direction of the CCP (for more detail, see Hunt Plan, Appendix P). Under the CCP, the Refuge will offer upland game hunting in three units: the Malheur Lake Unit, the Buena Vista Unit, and the Boundary Hunt Unit.

The total acreage open to upland game hunting under the management direction will be 49,000 acres, or 27 percent of the Refuge; however, regulations will vary by unit, as described below.

Location of Use, Associated Facilities, and Access:

Malheur Lake Unit: Upland game hunting is currently open on the North Malheur Lake Unit, east of Highway 205 and west of Cole Island Dike. It currently measures 14,000 acres based on the average low water line of the lake. Current federal regulations (50 CFR 32.56) indicate that the Refuge allows hunting of pheasant, quail, partridge, chukar, and rabbit in accordance with State regulations, concurrent with the State pheasant season. Access is walk-in only from Lawen and Saddle Butte roads on the north side of the lake, and there is one access point on Highway 205 at the Narrows. Upland game hunting occurs on the edge of the lake and not on the actual lake itself.

Under the CCP, rabbit will be dropped from the species allowable; all other allowable species will remain the same. In addition, the boundary of the Malheur Lake Unit will be redefined to reflect the actual huntable acreage and to protect significant resources on the lake, reducing the unit to an average of 13,000 acres based on the typical low water line. Additionally, access will be improved by refurbishing the Saddle Butte lake access with an all-weather road. A youth upland game youth hunt will be promoted on the Malheur Lake Unit, on the State-designated weekend, generally in September each year. All other aspects of the hunt, including harvest season and other regulations, will remain the same.

Buena Vista Unit: The Buena Vista Hunt Unit, which totals 36,000 acres, is one of the most popular hunting areas in Harney County for ring-necked pheasants. Federal regulations (50 CFR 32.56) indicate that the Refuge allows hunting of pheasant, quail, partridge, chukar, and rabbit within this Unit. The State season opens in mid-October, but the Buena Vista Hunt Unit currently has a later season opening to reduce conflicts with fall staging sandhill cranes.

Under the CCP, rabbit will be dropped from the species allowable; all other allowable species will remain the same. In addition, the opening date will change from the current third Saturday of November to the fourth Saturday of October to provide more quality opportunities for upland game hunting earlier in the season while still ensuring a buffer for migrating sandhill cranes (sandhill cranes have usually migrated farther south by the middle of October). All other aspects of the upland game hunts will remain the same as they currently are.

Boundary Hunt Unit: The Boundary Hunt Unit includes the strip of land west of State Highway 205 and south of Foster Flat Road (2,122 acres), and an area bordering Krumbo Creek upstream of Krumbo Reservoir (504 acres). Both pieces of this unit border Bureau of Land Management (BLM) land. An uneven and generally unmarked boundary has contributed to difficulties in distinguishing the boundary between Refuge lands and BLM lands, so these areas have traditionally been managed to align with BLM hunt regulations (which conform to State regulations)[1]. Federal regulations (50 CFR 32.56) indicate that the Refuge allows hunting of “all upland game species” in the Boundary Unit section *west of Highway 205* during authorized State seasons; however, only deer and pronghorn are specifically mentioned in the regulations as allowable for this area, and the area identified for pronghorn and deer harvest includes only the western portion of the Boundary Unit (i.e., the Krumbo Creek area is excluded). Pheasant, quail, partridge, chukar, coyote, and rabbit are mentioned elsewhere in the regulations as upland game species available “in designated areas” but these areas are not described in the CFR. The Refuge has managed the hunt to include all of these species within the Boundary Unit.

State regulations define coyote and rabbit as predatory animals; coyotes are also defined as unprotected mammals. However, some rabbits are protected by the State and are not allowable for hunting.

Under the CCP, the Boundary Hunt Unit species allowable and areas will remain the same, with the following exceptions:

- Rabbit species allowable for take within this unit will be defined specifically as black-tailed jackrabbit (*Lepus californicus*) and Nuttall’s cottontail (*Sylvilagus nuttallii*).

[1] State regulations do treat Federal refuges differently from other federal lands in at least one way. State rules (OR 635-050-0210) specifically bar hunting or trapping of fur-bearing mammals or unprotected mammals (both are defined in OR 635-050-0050) on “Federal refuges.”

- The Krumbo Creek area will be included as an area where deer and pronghorn may be hunted.

Number of Visitors and Seasonal Patterns: In 2010-2011, an estimated 850 visits were made to the Refuge to engage in upland game hunting activities in all three units, which accounts for over 90 percent of Refuge hunting visits. With improvements made to habitat management and access, and enhanced hunting opportunities, the number of upland game hunting visits is expected to grow over 15 years to 1,000 visits per year.

Harvest Management: Harvest and season regulations for upland game will be fully consistent with the State's regulations, via ODFW's *2010-2015 Upland Game Bird Hunting Season Framework* (ODFW 2010c). Hunting seasons and daily bag/possession limits have been established to maximize hunting opportunities over the next 5 years. The Refuge may manage under stricter, but not under more liberal, regulations. Note that trapping (an allowable method under State rules to take coyote and rabbit) will not be permitted under this CD.

Availability of Resources

Availability of resources for administering and managing the upland game hunting program under the CCP are detailed in Table B-7.

Table B-7. Costs to Implement the Use

Category	**One-time Expense ($)**	**Annual Expense ($/year)**
Administration and management (programmatic, law enforcement, information)		$2,000
Total	**$0**	**$2,000**

Administering the upland game hunt program does not require significant staff time, equipment, or funding. The Refuge has one FTE Visitor Services Manager and one FTE position for law enforcement that patrols the Refuge during hunting season to ensure compliance with state and Federal regulations and Refuge conditions. The majority of the staff time spent administering this program will fall mostly on the law enforcement position. Other Refuge staff assists in maintenance of general hunting facilities like access roads and parking lots that are included under the waterfowl hunt program (USFWS 2011a); in general, the upland hunt program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011b). Additional costs and staff time will include updating and printing hunting brochures and developing new publications for the hunt program.

Some hunt program enhancements may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels for upland game hunting. Exact costs will be developed during design and implementation.

Anticipated Impacts of the Use

General Impacts Expected from the Scientific Literature

A general assessment of impacts resulting from upland game hunting uses has been compiled from the literature and is briefly summarized below.

***Direct Impacts to Hunted Wildlife*:** Sport hunting involves the direct take of wildlife that are designated as huntable game species by regulation. In addition to loss of individual target species, additional birds are sometimes crippled or killed and not retrieved.

Hunting causes disturbance to feeding and resting waterfowl as well as non-target species due to noise (shotgun), movement, vehicular activity, and use of dogs for hunting activities. It can also alter behavior, population, structure, and distribution patterns of wildlife (Owens 1977; Raveling 1979; White-Robinson 1982; Thomas 1983; Bartlet 1987; Madsen 1985; Cole and Knight 1990; Dooley et al. 2010).

***Disturbance from Dogs*:** Dogs elicit a greater response from wildlife than people on foot alone (MacArthur et al. 1982; Hoopes 1993). The presence of dogs may disrupt foraging activity in shorebirds (Hoopes 1993) and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that dogs with people, dogs on leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals. In effect, off-leash dogs increase the radius of human recreational influence or disturbance beyond what it would be in the absence of a dog. Indirectly, domestic dogs can also potentially introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

Species-specific Impacts: Upland Birds

This section evaluates the likely impact on Malheur Refuge resources specifically, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge. It also considers the effect of Refuge hunts on target species.

Population and Harvest Data: Population data of upland game birds is provided by ODFW through surveys of upland game bird production inventories. These inventories are typically conducted during the last half of July or the first half of August on established routes throughout Oregon. ODFW biologists record the species observed, the gender of birds observed (if possible), number of chicks observed, and number of chicks in complete broods, which produces a production index (number of chicks/adult). As they formulate an index and are not a full population sample, these survey techniques detect an unknown proportion of the population; consequently, the numbers cannot be used to provide an estimate of the total population. However, the data collected can be used to generate population trends, and the greater the increase in birds for a given year, the more likely ODFW biologists will be to count more birds (ODFW 2010a).

Harvest data of upland game birds is reported by hunters to ODFW annually, although harvest data at the Refuge level is not available. ODFW conducts annual harvest surveys to determine statewide hunter effort and take for upland birds. These surveys randomly select hunters for surveying and generally occur via telephone during hunting seasons. The hunters report by harvest unit, and Harney and Malheur counties are combined into one harvest unit, Area 7 (ODFW 2010b).

Estimated Harvest Mortality: The following analysis of upland bird game hunting uses data on population indices and harvests at a variety of scales. Species analyzed include ring-necked pheasants, California quail, and chukar partridge. Table B-8 captures ODFW's upland game bird production inventories for 2004-2008 and 2009, and the 2009-2010 season upland game harvest data from the random telephone survey. The estimated harvest of upland game birds on the Refuge due to hunting under current management and future (CCP) management is also captured.

Upland game bird populations can vary greatly from year to year, and the production indices only represent a proportion of known upland game birds. In 2009, the production indices for ring-necked pheasant, California quail, and chukar partridge were all near or above the previous 5-year average from 2004-2008, particularly pheasants and California quails (ODFW 2010a). This suggests that upland game bird populations are relatively stable.

Based on harvest data collected from ODFW's annual telephone survey from the 2009-2010 season, upland game bird harvest in Harney and Malheur counties included 39 percent of pheasant hunted statewide, 42 percent of California quail hunted statewide, and 59 percent of chukar partridges hunted statewide. As the surveys are recorded by harvest unit, it is impossible to disaggregate the harvest information to determine the number of harvests in Malheur County or Harney County alone, or even at the Refuge level (Budeau 2011, personal communication). Based on the availability of habitat to support upland game birds in Malheur County, particularly pheasants, it is highly likely that a majority of upland game birds harvested in this unit are actually in Malheur County rather than Harney County, which the Refuge is located in (Budeau 2011, personal communication). Still, pheasants harvested in Harney County are most likely harvested on the Refuge because of the high quality of hunt available on the Refuge and the limited suitable habitat off-Refuge (Budeau 2011, personal communication). This pattern is likely true for other upland game birds too. Based on this information, the number of harvests at the Refuge-scale is expected to be considerably less than harvests reported at the harvest unit scale.

Table B-8. Upland Game Bird Population Index and Estimated Harvest

Area	Production Index (chicks/adult) 2004-2008[1]	Production Index (chicks/adult) 2009[1]	Number of Harvests 2009-2010[2,5]	Estimated Refuge Harvest[3]	
Ring-necked Pheasant				**Current Management**	**Future Management**
Oregon State	3.6	3.6	33,720	No change	
High Desert[6]	3.3	3.8		No change	
Harney County	1.5[4]	0[4]	12,989	No change	
Malheur NWR	Not available	Not available		<250	<300
California Quail				**Current Management**	**Future Management**
Oregon State	2.2	2.1	38,684	No change	
High Desert[6]	1.9	1.8		No change	
Harney County	2.5[4]	4.2[4]	16,165	No change	
Malheur NWR	Not available	Not available		<150	<200

Area	Production Index (chicks/adult) 2004-2008[1]	Production Index (chicks/adult) 2009[1]	Number of Harvests 2009-2010[2,5]	Estimated Refuge Harvest[3]	
Chukar Partridge				**Current Management**	**Future Management**
Oregon State	2.4	2.7	57,628	No change	
High Desert[6]	2.0	2.1		No change	
Harney County	1.7[4]	1.7[4]	33,744	No change	
Malheur NWR	Not available	Not available		<75	<10[7]

[1] ODFW 2010a
[2] ODFW 2010b
[3] Klus 2011; Megan and Bodeen 2011
[4] Production index is for Harney County only.
[5] Number of harvests was reported for ODFW's Harvest Unit 7, which includes both Harney and Malheur counties combined.
[6] High Desert refers to the combined ODFW district/field offices for Mid-Columbia, Deschutes, Ochoco, Klamath, Lake, Harney, and Malheur.
[7] Chukar partridge hunt will essentially be eliminated on the Refuge due to the transfer of the Boundary Hunt Unit to Bureau of Land Management.

Under the CCP, estimated harvest for upland game birds will not likely increase from current levels because the program will not markedly increase. An earlier season opening (extended hunt season overall) will provide additional hunting opportunities during the season and may increase hunters' harvest rates, but the harvest is small overall. The estimated Refuge harvest of <510 upland game birds will constitute about 1 percent of the entire harvest in Harney and Malheur counties based on 2009-2010 season. Given the wide range of upland game birds and 49,000 acres available to hunt on the North Malheur Lake Unit and Buena Vista Unit, it is expected that the overall upland game bird hunting pressure under the CCP will be low; about 100 hunters come out for opening weekend and that number continues to drop throughout the season. Additionally, given the small number of the estimated take and the distribution of the hunt units, the hunt program as designed is not expected to adversely affect the Refuge's ability to sustain optimum population levels for maintaining populations of upland game birds.

Population-specific Impacts: Coyotes

Refuge-specific data on past coyote harvest are not available. According to a recent ODFW report (Hiller 2011), coyote populations have increased substantially in both abundance and distribution during the past several decades. Hiller further reports that southeastern Oregon leads harvest by both trappers and hunters, with Harney County having 486 coyotes taken by hunters and 276 coyotes taken by trappers in 2010 (Table B-9). However, by Oregon Revised Statute (ORS 610.002), coyotes are classified as predatory animals (which may be taken without permit, limits, or reporting on private lands); therefore, the report likely underestimates coyotes hunted or trapped for control purposes on private lands. In eastern Oregon, coyotes are the second-most common animal trapped, second only to muskrat (Hiller 2011).

Table B-9. Reported 2010 Coyote Harvest on the Refuge, County, Region, and State

Area	Trapping		Hunting	
	Number Reported as Taken	**Percent of State Reported Harvest**	**Number Reported as Taken**	**Percent of State Reported Harvest**
Refuge	Not allowable	0	Unknown[1]	Unknown
Harney County	276	9%	486	21%
Eastern Oregon	2,498	78%	1,997	83%
State of Oregon	3,220	100	2,277	100%

Source: Hiller 2011.
[1]Although the take rate is unknown, the Refuge law enforcement officer estimates that 10-12 hunters per year pursue coyote or rabbit within the Boundary Unit.

Gese (2005) examined a variety of coyote population parameter responses under exploitation and compared these with responses under no exploitation, as part of a 7-year study. In the experimental area, coyote removal rate was estimated at 44 percent to 61 percent and 51 percent to 75 percent, in each of 2 years of removal. The study found that home range sizes remained the same in both the experimental and control areas. Litter sizes increased significantly in the removal area 2 years after the beginning of the removal. However, litter sizes were confounded by changes in the prey base. Litter size was significantly related to rabbit abundance, while rodent abundance was less of a factor. Accounting for changes in both prey abundance and coyote density, litter size was significantly related to total prey abundance per coyote.

Given the data above and the study by Gese, it is unlikely that coyote harvest on Malheur Refuge is negatively impacting coyote populations.

Population-specific Impacts: Pronghorn

The Boundary Unit is located at the eastern edge of the State of Oregon Juniper Hunt Unit 71. Population data were not reported for 2009 or 2010, but in 2008, ODFW (2010d) reported that aerial counts averaged 2.1 pronghorn per mile for this unit. This compares with a statewide average of 2.8 pronghorn per mile for 2008.

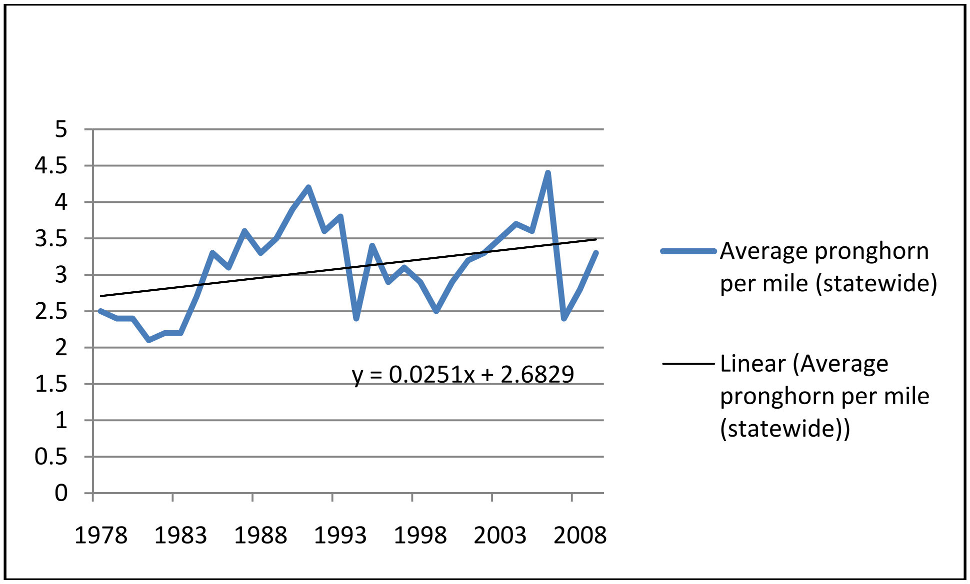
Hunt data are available for 2009 for both statewide harvest and local unit harvest and are presented in Table B-10.

Table B-10. Reported 2009 Pronghorn Harvest on the Refuge, State Hunting Unit, and State Scales

	Number Reported as Taken	Percent of State Reported Harvest
Refuge	Unknown[1]	Unknown
Juniper Unit	70[2]	5%
State of Oregon	1,424[3]	100%

[1] Although the Refuge harvest number is unknown, the Refuge law enforcement officer estimates that approximately half of the hunters with tags for the late-season muzzleloader hunt concentrate along the Boundary Unit.
[2] Pronghorn data from 2009 (ODFW 2010d).
[3] Pronghorn data from 2009 (ODFW 2010d). (Also available at: http://www.dfw.state.or.us/resources/hunting/big_game/controlled_hunts/docs/hunt_statistics/11/PRONGHORN_HARV_Trend_1950-2010.pdf.)

Data are not available at the Refuge or unit level to estimate population impact or trends from hunting. In addition, since population data are gathered and presented as a linear estimate (animals/mile), it is not possible to directly calculate the density of animals per unit area or the total number of animals within a unit. However, linear survey data for pronghorn presented back to 1945 (ODFW 2010d) allow trend analysis (at least at the State level), which permits some conclusion about whether populations may be increasing or decreasing. Since 1978, pronghorn at the State level have increased at an average rate of approximately 2 percent per year, as illustrated in Figure B-1.



Source: ODFW 2010d

Figure B-1. Pronghorn population trends for the State of Oregon, 1978-2009.

Given overall population trends as well as the percentage of pronghorn taken in the local State hunting unit, it is unlikely that Refuge harvest, if projected at current levels for the next 15 years, will negatively impact pronghorn populations.

Population-specific Impacts: Deer

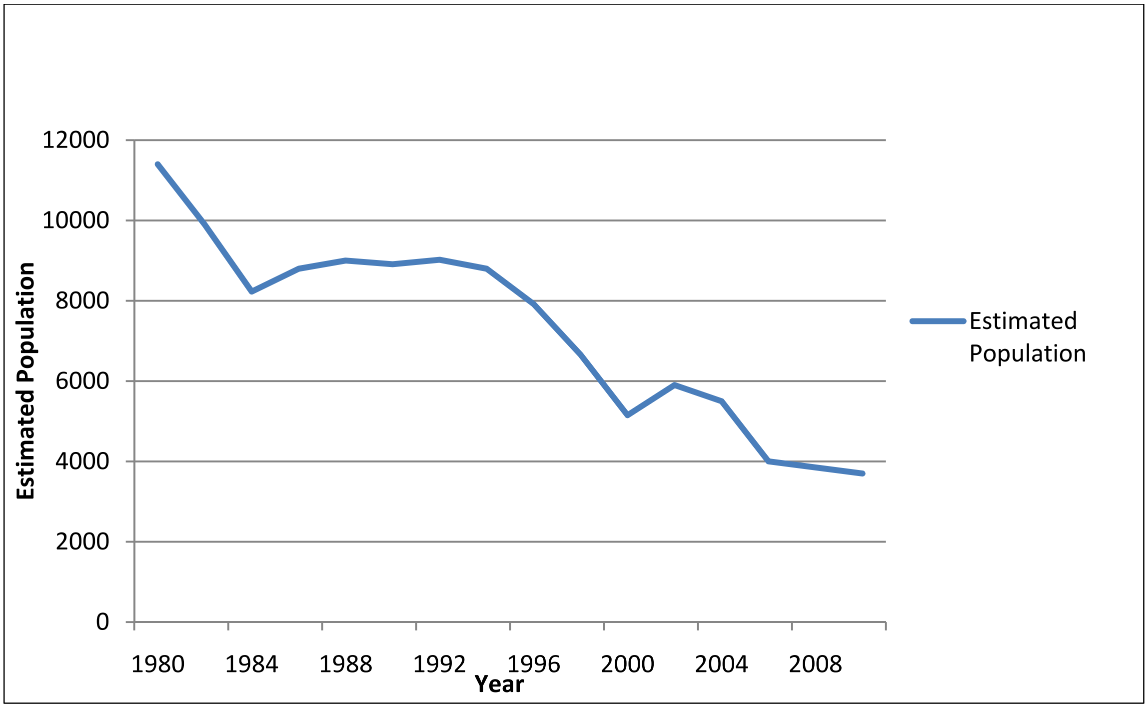
The Boundary Unit is located within the State of Oregon Juniper Unit. Although overall harvest of deer within the Boundary Unit area during the several open seasons is unknown, it is estimated that during one of the open hunts (the late-season muzzleloader hunt), approximately half of the 10 tag-holders use the Boundary Hunt Unit (Megan 2011) (Table B-11).

Table B-11. Reported 2009 Deer Harvest on the Refuge, State Hunting Unit, and State Scales

	Number Reported as Taken	Percent of State Reported Harvest
Refuge	Unknown[1]	Unknown
Juniper Unit	102[2]	0.5%
Eastern Oregon total	20,980[2]	100%

[1] Although the Refuge harvest number is unknown, the Refuge law enforcement officer estimates that approximately half of the hunters with tags for the late-season muzzleloader hunt concentrate along the Boundary Unit.
[2] Pronghorn data from 2009 (ODFW 2010d).

Mule deer across the West and in Oregon are declining in population, and are below current management objectives in Oregon. Populations have dropped by about a third statewide since 1980 (Whittaker 2011) after having reached a peak in the 1950s and 1960s (ODFW 2011b). Deer populations in the State unit encompassing the Refuge (Steens Mountain Unit) have dropped by approximately two-thirds in the last 30 years. Data for populations in the Steens Mountain Unit (which encompasses the Refuge and is just east of the Juniper Unit) are shown in Figure B-2. ODFW (2011b) attributes the primary causes of the observed decline to the combined effects of drought and severe winters, coinciding with an increased number of predators.



Source: ODFW 2011b.

Figure B-2. Mule deer population trend, Steens Mountain Unit, 1980-2009.

Continuing to allow mule deer harvest on the Boundary Hunt Unit will continue an incremental level of pressure on a declining population. However, given that the Boundary Unit constitutes a small fraction of the area of the Juniper Unit, and harvest within the Juniper Unit is less than 1 percent of the eastern Oregon harvest, the additional local and regional population pressure stemming from hunting on the Boundary Unit is expected to be negligible to minor. The State of Oregon (ODFW 2011b) has identified a number of strategies to boost mule deer populations, none of which include reduced hunting in the Juniper Hunt Unit.

<u>Population-specific Impacts: Nuttall's Cottontail and Jack-tailed Jackrabbit</u>

An estimated 10 to 12 hunters use the Boundary Hunt Unit to pursue rabbit and/or coyote each year (Megan 2011). Statewide statistics on rabbits harvested are not available; however, ODFW (date unknown) states that rabbit hunting is the third most popular type of hunting activity in the United States, behind wild turkey and deer hunting.

Population estimates for local rabbit populations are unavailable; however, a study done in Central Oregon in 1972-1973 that used monthly censuses in a shrub-juniper scabland habitat (McKay and Verts 1978) reported that Nuttall's cottontail population densities ranging from 6.6 to 254.4 animals per 100 ha (2.6 to 103 animals/100 acres), with marked seasonal fluctuations.

Lagomorphs are capable of extremely high productivity; a doe jackrabbit produces 2 to 6 young every 6 weeks during the breeding season, from February to June. The young born in February become sexually mature by early summer. As a result, lagomorphs are very important prey for a number of predators. Black-tailed jackrabbits naturally undergo 10- to 11-year population cycles.

Without better local data on harvest and population, only general conclusions are possible, based on reasonable assumptions and life history information. Currently, a small number of hunters is thought to hunt rabbits within the Boundary Hunt Unit, and hunting levels in the unit are expected to change little over the next 15 years. If habitat conditions remain stable (jackrabbits are sensitive to reduction in population with wildfire [Kochert et al. 1999]), hunting of jackrabbits and rabbits is likely to have a negligible effect on local or regional rabbit populations.

Other Refuge-specific Impacts

Impacts to Non-Target Wildlife: Non-hunted wildlife would include any non-target birds; small- and medium-sized mammals; reptiles; amphibians; and invertebrates. Occasionally, non-target species are illegally killed by hunters by accident or intentionally, or are disturbed by hunter presence or noise.

The cumulative effects of disturbance to non-hunted birds under the management direction are expected to be minor for the following reasons: hunter education courses are required for youths; hunting seasons do not coincide with the nesting season, so reproduction will not be reduced by hunting; and disturbance to the foraging or resting activities of migrating or resident birds might occur, but hunting is still expected to involve a small numbers of participants. The North Malheur Lake Unit and Buena Vista Unit will have walk-in access.

Disturbance to other taxa will be unlikely or negligible for the following reasons: encounters with reptiles and amphibians, invertebrates, and small mammals in the early fall will be few and should not have cumulative negative effects on Refuge populations; Refuge regulations further mitigate possible disturbance by hunters to non-hunted wildlife; and vehicles will be restricted to public roads and the harassment or taking of any wildlife other than the game species legal for the season will not be permitted.

Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. Under the CCP, a late season opening for the Buena Vista Unit will allow sufficient protection of the sandhill cranes until they migrate farther south, and thus mitigate any hunting-related impacts to sandhill cranes. Other birds using the area may be disturbed by noise and human presence; however, since most birds have already migrated during the fall, disturbance levels will be minor overall. Outreach with hunting brochures and timely information on the website will help educate hunters on hunting opportunities, regulations, and ethical hunter behavior.

Waterfowl can die from toxic lead shot if they eat even very small amounts of spent lead shots; shot pellets deposited during fall hunting seasons can later be ingested by waterfowl and other wildlife feeding in wetland areas where hunting occurs. On Malheur Refuge, only federally approved nontoxic shot is allowed for upland game hunting to eliminate this hazard for waterfowl. Nontoxic shot is defined by USFWS as any shot type that does not cause sickness and death when ingested by migratory birds, and includes shots made of steel, bismuth, tungsten-iron, or tungsten-polymer.

Dogs will increase the level of disturbance to target and non-target species, but this impact is expected to be minor, especially to migratory wildlife, and necessary to support the use and ensure successful harvests. Dogs will be required to be under the close control of their owners while on the Refuge.

Loss of Habitat from Facility Construction: No additional new facilities will be added to support this use in addition to the general visitor use facilities described in the CD for wildlife observation, photography, and interpretation.

Vegetation, Soil, and Water Impacts: Foot travel associated with accessing the hunt units could potentially result in temporary and minor vegetation trampling. Based on past Refuge history and trends, hunting usually involves very small numbers of hunters; thus, the effect to vegetation will likely be negligible. No impact is expected to soil or water resources as a result of this use.

Impacts to Listed Species: There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). However, it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from upland game hunting uses and facilities will be minor to negligible. The greater sage-grouse is not a hunted species on the Refuge, although disturbance may result from noise related to hunting activities during the hunting season, which overlaps with the most recent seasonal observations of sage-grouse on the Refuge. Hunting is not allowed south of the Buena Vista Unit, and there have been no occurrences of spotted frogs in the Blitzen River Valley north of Knox Ponds. Additionally, frogs will most likely be hibernating during the winter, and hunting season ends prior to breeding season. Public education will assist in raising awareness and preventing undue impacts to these species. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

Impacts to Other Priority Public Uses: The phased opening weekends between the north Malheur Lake Hunt Unit and the Buena Vista Hunt Unit will help reduce hunter competition and conflicts. Additionally, hunting numbers generally decrease over the hunting season after opening weekends, further reducing impacts of the hunting season.

Hunting has the potential to disturb Refuge visitors engaged in other priority public uses; however, given the season during which hunting occurs, the likelihood of conflicts is low. Although Center Patrol Road is the area most used by other visitors during the migration seasons, use is very light during hunting season. State regulations also prohibit shooting from on and across roads. This is expected to mitigate any overlap conflicts between hunting and other uses in the Buena Vista Unit.

Infrastructure: No significant effects to roads, trails, or other infrastructure from the hunting program are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

Other Effects: There could be some indirect beneficial impacts of Refuge hunting. Refuge hunting can contribute to wildlife and habitat conservation and provide educational and sociological benefits. The hunting community in general remains the largest support base for funding land acquisitions in the Refuge System through purchase of Duck Stamps. Upland game hunting at the Refuge provides a priority public use and helps meet the Refuge's goals of wildlife-dependent recreation for all visitors. Additionally, providing youth hunting opportunities is an important initiative in the USFWS, and enhancing this opportunity on the Refuge helps address a public desire to see more hunting opportunities for youth.

Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination:

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles will be allowed only on maintained public roadways. Parking is allowed only within one vehicle length of the roadway. Hunters will be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires will not be permitted on the Refuge.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Hunting closures will be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. Shooting from or across public roads or road right-of-ways will be prohibited.
- Law enforcement patrols will ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information will be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

Justification

Under the National Wildlife Refuge System Administration Act, as amended, upland game hunting is a wildlife-dependent recreational activity that receives enhanced consideration in the CCP planning process and is to be encouraged on National Wildlife Refuges if compatible with refuge purposes. Despite the direct and indirect impacts associated with sport upland game hunting, upland game populations are unlikely to be affected significantly by the hunting program on the Refuge. Upland game population objectives and allowable harvests are determined by the State of Oregon. Limited hunt seasons, two weekend openings, and no-hunt zones ensure that upland game, as well as non-target species, will find adequate food and rest areas on the Refuge even in the midst of the hunting season. Thus, allowing upland game hunting to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge's mission.

Mandatory Reevaluation Date

09/2027 Mandatory 15-year Reevaluation Date (for priority public uses)

NEPA Compliance for Refuge Use Decision

X Environmental Impact Statement and Record of Decision

References

Bartlet, G.A. 1987. Effects of disturbance and hunting on the behavior of Canada goose family groups in east central Wisconsin. Journal of Wildlife Management 51:517-522.

Budeau, D. 2011. Personal communication between Dave Budeau, Upland Game Bird Coordinator, ODFW, and Maren Murphy, Conservation Planning Assistant, Division of Planning and Visitor Services, Region 1, USFWS. May, 2011.

Cole, D.N. and R.L. Knight. 1990. Impacts of recreation on biodiversity in wilderness. Natural Resources and Environmental Issues. Vol. 0, Article 6. Available at: http://digitalcommons.usu.edu/nrei/vol0/iss1/6.

Dooley, J.L., T.A. Sanders, and P.F. Doherty, Jr. 2010. Mallard response to experimental walk-in and shooting disturbance. Journal of Wildlife Management 74(8):1815-1824.

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog.

Gese, E.M. 2005. Demographic and spatial response of coyotes to changes in food and exploitation. Proceedings of the Wildlife Damage Management Conferences 131. Available at: http://digitalcommons.unl.edu/icwdm_wdmconfproc/131.

Hiller, T. 2011. 2010-2011 Oregon furbearer program report. Oregon Department of Fish and Wildlife. Salem, OR. Available at: http://www.dfw.state.or.us/resources/hunting/small_game/docs/2011_furbearer_report.pdf.

Hoopes, E.M. 1993. Relationship between human recreation and piping plovar foraging ecology and chick survival. M.S. thesis. University of Massachusetts, Amherst, MA. 106 pp.

Keller, V. 1991. Effects of human disturbance on eider ducklings *Somateria mollissima* in an estuarine habitat in Scotland. Biological Conservation 58:213-228.

Klus, R. 2011. Personal communication between Rod Klus, Oregon Department of Fish and Wildlife, and Maren Murphy, Conservation Planning Assistant, Division of Planning and Visitor Services, Region 1, USFWS. May, 2011.

Kochert, M.N., K. Steenhof, L.B. Carpenter and J.M. Marzluff. 1999. Effects of fire on golden eagle territory occupancy and reproductive success. Journal of Wildlife Management 63:773-780.

MacArthur, R.A., V. Geist, and R.H. Johnson. 1982. Cardiac and behaviorial responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358.

McKay, D.O. and B.J. Verts. 1978. Estimates of some attributes of a population of Nuttall's cottontails. Journal of Wildlife Management 42(1):159-168.

Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33:53-63.

Megan, J. 2011. Personal communication between John Megan, Refuge Law Enforcement Officer, USFWS, and Sharon Selvaggio, Conservation Planner, Division of Planning and Visitor Services, Region 1, USFWS, December, 2011.

ODFW (Oregon Department of Fish and Wildlife). 2010a. 2009 Oregon upland game bird production inventories. Available at: http://www.dfw.state.or.us/resources/hunting/upland_bird/population/index.asp, http://www.dfw.state.or.us/resources/hunting/upland_bird/docs/2002-2009_population_inventory.pdf.

ODFW. 2010b. 2009-10 season Oregon upland game bird expanded harvest by harvest unit. Available at: http://www.dfw.state.or.us/resources/hunting/upland_bird/harvest/index.asp, http://www.dfw.state.or.us/resources/hunting/upland_bird/docs/2009_10_Upland_Harvest.pdf.

ODFW. 2010c. 2010-2015 Oregon upland game bird hunting season framework. Available at: http://www.dfw.state.or.us/resources/hunting/upland_bird/docs/2010-2015_Oregon_Upland_Game_Bird_Hunting_Season_Framework.pdf.

ODFW. 2010d. 2010 big game statistics. Oregon Department of Fish and Wildlife. Salem, OR. Available at: http://www.dfw.state.or.us/resources/hunting/big_game/controlled_hunts/docs/hunt_statistics/10/2010_big_game_statistics.pdf.

ODFW. 2011a. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

ODFW. 2011b. Mule deer initiative. Oregon Department of Fish and Wildlife. Salem, OR. Available at: http://www.dfw.state.or.us/resources/hunting/big_game/mule_deer/docs/Mule_Deer_Mgmt_Plan_Final.pdf.

ODFW. Date unknown. How to hunt rabbit. Available at: http://www.dfw.state.or.us/resources/hunting/docs/Howtohuntrabbit.pdf.

Owens, N.W. 1977. Responses of wintering brant geese to human disturbance. Wildfowl 28:5-14.

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Raveling, D.G. 1979. The annual cycle of body composition of Canada geese with special reference to control of reproduction. Auk 96:234-252.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Servheen, C.W, eds. 1980. Proceedings of the Washington Bald Eagle Symposium. Seattle, WA.

Sime, C.A. 1999. Domestic dogs in wildlife habitats. Pages 8.1-8.17 in: G. Joslin and H. Youmans, coordinators. Effects of recreation on wildlife, Montana chapter of The Wildlife Society. 307 pp.

Thomas, V.G. 1983. Spring migration: the prelude to goose reproduction and a review of its implication. Pages 73-81 in: H. Boyd, ed. Fourth Western Hemispheric Waterfowl and Waterbird Symposium. Canadian Wildlife Service, Ottawa, Canada.

USFWS. 2011a. Compatibility determination for waterfowl hunting. Malheur National Wildlife Refuge.

USFWS. 2011b. Compatibility determination for wildlife observation, photography, and interpretation. Malheur National Wildlife Refuge, Princeton, OR.

White-Robinson, R. 1982. Inland and salt marsh feeding of wintering brent geese in Essex. Wildfowl 33:113-118.

Whittaker, D. 2011. Management actions implementing Oregon's mule deer initiative. Oregon Department of Fish and Wildlife briefing. Available at:

http://www.dfw.state.or.us/resources/hunting/big_game/mule_deer/docs/January_2011_MDI_Briefing.pdf.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Acting Refuge Manager/ Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	1-24-13 (Date)

B.5 Fishing Compatibility Determination

RMIS Database Use: Fishing (general)

Refuge Name: Malheur National Wildlife Refuge

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use

This CD examines recreational fishing in designated areas of the Refuge as described in the management direction of the CCP. A commercial carp fishery was found compatible on the Refuge in 2009 and is not examined in this CD (USFWS 2009).

Program Offerings: Fishing currently occurs at Krumbo Reservoir and the South Loop along the Blitzen River and its tributaries. Species allowable for take are redband trout, rainbow trout, largemouth bass, and carp. Rainbow trout and largemouth bass occur in Krumbo Reservoir, and redband trout, other native fish, and carp occur in the Blitzen River. All fishing is permitted by angling only. Table B-12 shows the following regulations for sport fishing as related to the Refuge under the 2011 ODFW Sport Fishing Regulations.

Table B-12. ODFW Regulations for Sport Fishing for 2011[1]

Species	Regulations
Krumbo Reservoir[2]	
Trout (rainbow)	• Open fourth Saturday of April to October 31 • Catch: 5 per day, 2 daily limits in possession • Length: 8-inch minimum length • Bait: Artificial only
Largemouth bass	• Open fourth Saturday of April to October 31 • Catch: 5 per day, 2 daily limits in possession • Length: No more than 3 over 15 inches in length • Bait: Artificial only
Blitzen River Mainstem, East Canal, and Tributaries Upstream and Including Bridge Creek (South Fishing Loop)	
Trout (redband)	• Open May 28-Oct. 31, 2 per day • Open Jan. 1-May 27 and Nov. 1-Dec. 31, catch and release for trout

[1] Source: ODFW 2010.
[2] Krumbo Reservoir falls under the same ODFW regulations as lakes, except for its special fishing dates.

Location of Use, Associated Facilities, and Access

Krumbo Reservoir: Krumbo Reservoir is 184 acres in size. It is not a natural water body and has historically been managed for irrigation and fishing activities. ODFW annually stocks Krumbo Reservoir with sterilized rainbow trout; in 2010, ODFW stocked 13,100 rainbow trout in Krumbo Reservoir. The area is equipped with a number of public use facilities, including picnic tables for lunch-time activities, parking, and restrooms, making the Reservoir a big attraction for families with children. Access to the site is via vehicle by Krumbo Lane. Once at the Reservoir, anglers may fish from any shoreline area and an informal trail circles the reservoir for this purpose. In addition, a boat launch permits boating access on the Reservoir itself. Boats with electric motors and non-motorized boats will continue to be authorized for use on Krumbo Reservoir, except when the water begins to ice over.

South Fishing Loop: The South Fishing Loop near P Ranch includes the Blitzen River mainstem, East Canal, and tributaries upstream, including Bridge Creek. This unit is open year-round, although different regulations apply in different seasons, as indicated in Table B-12. This is a popular fly fishing area for locals and out-of-area users. Under the CCP, drive-in access along the East Canal Road to the confluence of the East Canal with Bridge Creek will be opened in order to improve fishing opportunities and to accommodate vehicle access to Granddad Reservoir on Bureau of Land Management lands. People may continue to use this road as a hiking trail if they wish. In addition, the River Trail, a pedestrian trail, is available to access this area. A new pedestrian crossing at Bridge Creek will be constructed to improve fishing access west of East Canal.

Headquarters Fishing Unit: Additionally, under the CCP, the Refuge will provide a new seasonal stream fishing opportunity at the Headquarters Fishing Unit along the Blitzen River from Sodhouse Lane north to the Boat Landing Road bridge near Refuge Headquarters, accessible by a fishing trail along the dike. At the new Headquarters Fishing Unit, use of bait will be allowed and regulations for catch limits will be defined by ODFW based on state regulations. At the Headquarters Unit, fishing will only be available August 1 to September 15 to mitigate conflicts with migrating birds.

Other Facilities: The Refuge will also provide informational kiosks at strategic entrance points and additional signage to enhance visitors' knowledge of fishing regulations and provide directional and program information.

***Number of Visitors and Seasonal Patterns*:** At Malheur National Wildlife Refuge, an estimated 1,300 visits in 2011 were for fishing activities. With increased fishing access and additional fishing opportunities, the number of fishing visits is expected to grow over 15 years to 1,750 visits per year.

Under the CCP, the Reservoir and Krumbo Lane will be opened year-round to access for fishing, wildlife observation, boating, and hiking, which represents a big increase from the current open season of April to October. However, the majority of the use will likely continue to occur during spring and fall when the weather and water are cool, and year-round fishing will eliminate any pressures and crowding associated with fishing season opening day. Fishing use on the South Loop of the Blitzen River typically peaks in late spring when the water runoff from Steens Mountain settles and the water clears. The South Loop Fishing Unit and the new Headquarters Fishing Unit will be seasonal fishing opportunities as outlined above.

Availability of Resources

Availability of resources for administering and managing the fishing program under the CCP are detailed in Table B-13.

Table B-13. Costs to Implement the Use

Category	One-time Expense ($)	Annual Expense ($/year)
Develop fishing brochure	$1,500	$2,000
Develop outdoor fishing information kiosks	$60,000	
Build 2-3 new pedestrian crossings and complete development of loop trail at South Fishing Loop	$275,000	
Open new seasonal bank fishing opportunity along the Lower Blitzen River with fishing trail, two bridges, parking, and portions that meet ADA standards	$275,000	
Replace Krumbo Reservoir floating platform and maintain facilities	$35,000	$2,000
Fishing program administration and management (programmatic, law enforcement, information)		$6,000
Total	**$646,500**	**$10,000**

Administering the fishing program does not require significant staff time, equipment, or funding. The Refuge has one FTE Visitor Services Manager, and one FTE position for law enforcement that patrols the Refuge during fishing season to ensure compliance with state and Federal regulations and

Refuge conditions. The majority of the staff time spent administering this program will fall mostly on the law enforcement position. Other Refuge staff assists in maintenance of fishing facilities like access roads, trails, kiosks, and platforms; in general, the fishing program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011b). Additional costs and staff time will include developing and printing fishing brochures and constructing new kiosks for the fishing program.

Some fishing program enhancements may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels for fishing. Exact costs will be developed during design and implementation.

Anticipated Impacts of the Use

<u>General Impacts Expected from the Scientific Literature</u>

A general assessment of impacts resulting from fishing uses has been compiled from the literature and is briefly summarized below.

Disturbance to Wildlife: Fishing as a solitary and stationary activity tends to be less disturbing to wildlife than hunting or motorized boating (Tuite et al. 1983). Fishing has the potential to cause disturbance to birds and other wildlife using open waters and tributaries where fishing occurs. Fishing activities may influence the composition of bird communities, as well as the distribution, abundance, and productivity of waterbirds (Tydeman 1977; Bouffard 1982; Bell and Austin 1985; Bordignon 1985; Edwards and Bell 1985; Cooke 1987; Bouffard and Hanson 1997). Anglers often fish in shallow, sheltered bays and creeks that birds prefer, which can negatively impact distribution and abundance of waterfowl, grebes, and coots (Cooke 1987). Increases in anglers and associated shoreline activity have been found to discourage waterfowl from using otherwise suitable habitat (Jahn and Hunt 1964). When compared to non-fishing days and/or non-fishing rivers, anglers influenced the numbers, behavior, and diurnal distribution of avian scavengers present at sites along the Skagit and Toutle rivers in Washington, disrupted feeding, and increased energy expenditure through avoidance flights (Knight and Knight 1984; Knight et al. 1991).

Stream Fishing Impacts: Shoreline activities related to stream fishing, such as human noise, will cause some birds to flush and go elsewhere. Waterbirds and waterfowl in particular use shorelines seasonally for resting, feeding, and nesting. Anglers often use vehicles to gain access to angling sites and remain there for long periods of time. Furthermore, anglers frequently show long periods of inactivity interspersed with short periods of rapid movements, which has the potential to disturb nearby wildlife (Bell and Austin 1985).

Boating Impacts: Boating associated with fishing can alter bird distribution, reduce the use of particular habitats or entire areas by waterfowl and other waterbirds, alter feeding behavior and nutritional status, and cause premature departure from areas due to the noise and speed of boats (Bouffard 1982; Kaiser and Fritzell 1984; Korschgen et al. 1985; Havera et al. 1992; Ward and Andrews 1993; Knight and Cole 1995; Knapton et al. 2000). On the Missouri’s Ozark Scenic Riverways, herons often left the river for areas of dense habitat or less productive tributaries when the number of recreationists increased (Kaiser and Fritzell 1984). The level of disturbance to waterfowl has been found to vary considerably based on watercraft type. A study by Havera et al. (1992) showed waterfowl took flight and flushed farther in response to hunting and fishing craft, while few flushed because of barges. On the Upper Mississippi River, which includes the Upper Mississippi River National Wildlife and Fish Refuge, birds were found to be more sensitive to boats with outboard motors (Korschgen et al. 1985). In addition, trampling of vegetation and deposition of sewage or other chemicals from recreation has been found to impact freshwater plants and wildlife (Liddle and Scorgie 1980).

Off-Road Vehicle Impacts*:* Wildlife can be impacted when they are disturbed and flushed from feeding, resting, or nesting areas vulnerable to loud noise and activity from off-road vehicles. In addition, temporary disturbance to habitat could impact nesting and foraging resources available for wildlife. In general, disturbance impacts of off-road vehicles are related to the intensity of use or use characteristics, in combination with the level of fragility of the affected environment. A majority of the off-road vehicle uses are in coordination with the grazing and haying program, and use for fishing is only a minor subset (USFWS 2011a).

<u>Refuge-specific Impacts</u>

This section evaluates the likely impact at the Refuge itself, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge.

Disturbance-related Impacts from Reservoir Fishing: Krumbo Reservoir is one of the most heavily used areas on the Refuge. During the spring and fall, disturbance, especially near the parking lot and boat launch, undoubtedly prevents use by a variety of waterfowl and waterbirds. However, the Refuge maintains numerous other ponds and flooded areas in the spring and into summer and therefore spring/summer disturbance is of negligible concern, given the Refuge context.

Previous research has shown that the level of disturbance to waterfowl varies considerably based on watercraft type. To limit disturbance impacts to wildlife, only non-motorized boating and electric motorized boating will be allowed on Krumbo Reservoir. The use of non-motorized and electric motorized boating minimizes noise associated with boating and prevents the spread of oil and gas residue associated with diesel- and gas-powered motorized boats. It also reduces the speed with which anglers can travel on the Reservoir.

Under the CCP, Krumbo Reservoir and Krumbo Lane will be opened year-round to access, except when the water ices over. A concern raised by some is that increasing wintertime access to the Reservoir could have potential impacts to wintering waterfowl that use Krumbo Reservoir and Krumbo Swamp and Otter Reservoir along Krumbo Lane. There are limited open-water resources available on the Refuge during winter as most areas are dry or have frozen. The number of birds using the Reservoir during the winter is typically less than 400 birds on any given day, and there are less than 100 birds during the coldest part of the season (J. Dastyck, personal communication); most birds have migrated farther south during the winter. The Reservoir comprises around 20 percent of the total 1,004 acres of available open water wintering habitat on the Refuge, leaving 820 acres (more than 80 percent) of open water wintering habitat including Boca Lake, Benson Reservoir, and East Knox Reservoir. Given this and the likelihood that the number of visitors to the Reservoir during the winter months will be significantly less than in the spring, summer, or fall months, the disturbance impact to wintering birds is expected to be minor.

ODFW annually stocks Krumbo Reservoir with triploid rainbow trout, meaning they are sterilized and never develop normal eggs or sperm and are unable to reproduce. This will continue under the CCP. Sterilization negates the risk of any genetic reproduction and modification with native redband trout, thus creating a negligible impact on the native fishery. Additionally, Krumbo Reservoir is dammed, which prevents rainbow trout from migrating into the Blitzen River. Largemouth bass are also present in Krumbo Reservoir from historical stocking, but are not currently stocked and are a self-sustaining population; native redband trout are not found in the Reservoir, as Krumbo Creek water levels are not high enough to maintain a sustainable native population for spawning. Genetic studies have occurred in the Blitzen River for any evidence of introgression of redband trout with hatchery rainbow trout and there has been no strong evidence indicating this in the Blitzen population of redband, specifically in Bridge and Mud creeks (ODFW 2005).

With the low number of birds present, low visitor use levels, and availability of additional wintering habitat and sanctuary, it is expected that year-round access at Krumbo Reservoir will have negligible impacts. Wildlife surveys and monitoring will be conducted to ensure disturbance stays at a minimum.

***Disturbance-related Impacts from Stream Fishing*:** Stream fishing allows anglers direct access to a portion of the Blitzen River, East Canal, and Mud and Bridge Creeks. Under the CCP, the South Loop along the East Canal will change from walk-in only access to include drive-in access up to the confluence of the East Canal with Bridge Creek. This has the potential to increase disturbance to wildlife to moderate levels, as it is expected this change will attract more anglers to the fishing area and disperse users across a wider stretch of the river (compared to present). The River Trail on the west bank of the Blitzen River will remain walk-in access.

Under the CCP, a new seasonal stream fishing opportunity at the Headquarters Fishing Unit from Sodhouse Lane to the Boat Landing Road bridge near Headquarters will be opened. This will increase the amount of stream fishing along the Blitzen River by nearly 1 mile for a total of 14 miles on the Refuge. This could increase the potential for disturbance to resting and feeding waterbirds and waterfowl, as well as impacts to shoreline habitat and vegetation. However, the new fishing area will only be open seasonally from August 1 to September 15 after birds have fledged and moved on. Given this, and because generally, the fishing pressure along the Blitzen River is low, it is anticipated that with the limitations included in the CCP, disturbance to wildlife will be minor.

A new pedestrian crossing at Bridge Creek will be constructed under the CCP to enhance access to fishing west of East Canal along Bridge Creek. The bridge will increase the number of anglers in an area that was previously hard to access. Construction of the trail enhancements will be done in a way to reduce impacts to wildlife and resources.

Direct Mortality to Target Species (Take): Fishing will result in direct take of target fish. Harvest is coordinated with ODFW to avoid excess pressure on populations. Fishing will be permitted by angling only and will be restricted to artificial flies and lures in streams, except in the Headquarters Fishing Unit where use of bait will be allowed.

Barbed hooks will be permitted to increase the success of take. Some impacts may come from barbed hooks to native redband trout populations, but this is expected to be minor as redband trout do not occur in Krumbo Reservoir and fishing pressure on the Blitzen River is generally low. Outreach with fishing brochures, informational panels, and public education on best fishing practices will help educate anglers on fishing regulations and ethical behavior.

Loss of Habitat from Facility Construction: Under the CCP, new panels constructed for fishing will result in 0.5 acre of habitat loss, which is a fraction of a percentage of the Refuge; thus, habitat loss from new facilities is considered negligible. No additional new facilities will be added to support this use separate from general visitor use facilities (USFWS 2011b).

***Vegetation, Soil, and Water Impacts*:** Some vegetation, soil, and water impacts will be anticipated from bank fishing and access to water along the Krumbo Reservoir and Blitzen River shorelines where anglers access the areas by foot. Impacts will also be anticipated as a result of allowing vehicle access on East Canal. However, trail enhancements along the South Loop may also benefit the surrounding habitat by concentrating users on a formal trail instead of social trails that are not regulated.

The developed parking and concrete boat ramp at Krumbo Reservoir potentially carries stormwater runoff and toxins from vehicles into the Reservoir, although these facilities also contribute positively to habitat conservation by concentrating visitors on hardened surfaces and decreasing impacts to vegetation and soil adjacent to the fishing area. An undeveloped pedestrian fishing trail circles the perimeter of the Reservoir, potentially causing impact to shoreline habitat (USFWS 2011b). Additional impacts related to public use at the Reservoir include a certain amount of litter and general garbage left at shoreline fishing sites.

Impacts to Listed Species: There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Impacts to Columbia spotted frogs will be expected to increase under the CCP with expanded stream fishing access for anglers along the South Fishing Loop of the Blitzen River and its tributaries, and the construction of a new pedestrian crossing at Bridge Creek to access a portion of fishable area west of East Canal. Public tramping along the shoreline during the April to May frog breeding season has the potential to disturb/dislodge egg masses. It is anticipated that disturbance from anglers accessing the shoreline will be sporadic, and impacts will be minor due to generally low levels of fishing activity and the patchy occurrences of Columbia spotted frogs on the Refuge. Public education or use of interpretation will assist in raising awareness and preventing undue impacts to this species. Informational panels and additional signage will also be posted at the South Fishing Loop to inform anglers of proper fishing practices. If stream fishing results in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions on stream fishing to mitigate disturbance.

Impacts to Other Priority Public Uses: Fishing generally results in little disturbance to other visitors. Both fishing and hunting will use Boat Landing Road to access the Blitzen River; however, the uses occur at different seasons, with fishing from August 1 to September 15 and hunting opening on the fourth Saturday of October.

Infrastructure: No significant effects to roads, trails, or other infrastructure from fishing are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

Public Review and Comment

Various opportunities were provided for the public to engage with the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination:

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

General Stipulations

- Use is open daily from dawn to dusk. Camping, overnight use, swimming, and fires are prohibited.
- All fishing on the Refuge will require an appropriate state license and tag, and all fishing will be consistent with applicable state and Refuge regulations.
- Fishing on the Refuge will be permitted by angling only and will be restricted to artificial flies and lures in streams, except in the Headquarters Fishing Unit where use of bait will be allowed. Only catch-and-release fishing is allowed in the South Fishing Loop from January 1 to May 27 and November 1 to December 31. No discharge of weapons will be allowed on the Refuge, and the use of bows and arrows, crossbows, and spear guns will be prohibited.
- The Refuge will provide information on fishing and access at appropriate sites and through printed brochures. Information will also include current migratory bird and Refuge regulations, as well as maps of closed areas.
- The Service shall maintain public use facilities to minimize waste problems on shorelines.
- ODFW will continue to monitor harvest by anglers and routinely adjust regulations to ensure that overall populations of game species remain healthy into the future.
- Law enforcement patrols will be conducted to ensure compliance with fishing regulations.

Justification

Fishing receives enhanced consideration in the CCP planning process and is considered a priority public use when determined compatible. Providing a quality fishing program contributes to achieving the Refuge's goals. The fishing opportunities and anticipated level of use, as described, were determined to not materially detract from the ability of the Refuge to meet its purposes, despite the potential impacts that fishing and supporting activities (boating) can have on wildlife and habitats. Only electric boating or non-motorized boating will be allowed for Reservoir fishing, thus lessening the disturbances to waterfowl and other wildlife. The combination of closed areas, seasonal use areas, minimally used areas, and seasonal high-use areas allows sport fishing and high-quality fish and wildlife habitat to co-exist on the Refuge by dispersing uses throughout different areas and different seasons.

It is anticipated that wildlife, primarily waterbirds, will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened; fishing pressure will not cause fish stocks to decline; fish stocking with sterilized triploid rainbow trout will not cause genetic modification to the native redband trout fishery; the physiological condition and production of waterfowl and other waterbirds will not be impaired; behavior and normal activity patterns will not be altered dramatically; and overall wildlife welfare will not be negatively impacted.

Mandatory Reevaluation Date

09/2027 Mandatory 15-year Reevaluation Date (for priority public uses)

NEPA Compliance for Refuge Use Decision:

X Environmental Impact Statement and Record of Decision

References

Bell, D.V. and L.W. Austin. 1985. The game-fishing season and its effects on overwintering wildfowl. Biological Conservation 33:65-80.

Bordignon, L. 1985. Effetti del disturb antropico su una popolazinoe di germane reale *Anas platyrhynchos*. (Effects of human disturbance on a population of mallard *Anas platyrhynchos.*) Avocetta 9:87-88.

Bouffard, S. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Transactions of the North American Wildlife and Natural Resources Conference 47:553-558.

Bouffard, S. and M.A. Hanson. 1997. Fish in waterfowl marshes: Waterfowl managers' perspective. Wildlife Society Bulletin 25:146-157.

Cooke, A.S. 1987. Disturbance by anglers of birds at Graftham Water. ITE Symposium 19:15-22.

Edwards, R.W. and D.V. Bell. 1985. Fishing in troubled waters. New Science 1446:19-21.

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

Havera, S., L. Boens, M. Georgi, and R. Shealy. 1992. Human disturbance of waterfowl on Keokuk Pool, Mississippi River. Wildlife Society Bulletin 20:290-298.

Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Wisconsin Conservation Department Technical Bulletin 33:1-212.

Kaiser, M. and E. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. Journal of Wildlife Management 48(2):561-567.

Korschgen, C., L. George, and W. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. Wildlife Society Bulletin 13:290-296.

Knapton, R., S. Petrie, and G. Herring. 2000. Human disturbance of diving ducks on Long Point Bay, Lake Erie. Wildlife Society Bulletin 28 (4):923-930.

Knight, R.L. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48(3):999-1004.

Knight, R.L., D.P. Anderson, and N.V. Marr. 1991. Responses of avian scavenging guild to anglers. Biological Conservation 56:195-205.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. In: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists. Covelo, California: Island Press.

Liddle, M.J. and H.R.A. Scorgie. 1980. The effects of recreation on freshwater plants and animals: A review. Biologlical Conservation 17:183-206.

ODFW. 2005. 2005 Oregon native fish status report, Volumes I and II. Available at: http://www.dfw.state.or.us/fish/ONFSR/report.asp.

ODFW. 2010. 2011 Oregon sport fishing regulations: Southeast zone. Available at: http://www.dfw.state.or.us/resources/fishing/.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Tuite, C.H., M. Owen, and D. Paynther. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. Wildfowl 34:48-63.

Tydeman, C.F. 1977. The importance of the close fishing season to breeding bird communities. Journal of Environmental Management 5:289-296.

USFWS. 2009. Compatibility determination fishing-commercial (common carp). Malheur National Wildlife Refuge. Princeton, OR.

USFWS. 2011a. Compatibility determination for grazing and haying. Malheur National Wildlife Refuge. Princeton, OR.

USFWS. 2011b. Compatibility determination for wildlife observation, Photography, Interpretation. Malheur National Wildlife Refuge, Princeton, OR

Ward, D. and J. Andrews. 1993. Waterfowl and recreational disturbance on inland waters. Upper Mississippi National Waterfowl Refuge. British Wildlife 4 (4):221- 229**.**

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Acting Refuge Manager/ Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	1-24-13 (Date)

B.6 Commercial Tours and Photography Compatibility Determination

RMIS Database Uses: Photo/Video/Film or Audio Recording (commercial); Wildlife Observation Guiding/Outfitting

Refuge Name: Malheur National Wildlife Refuge

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use

This CD addresses non-consumptive commercial uses related to photography and wildlife/nature observation. This determination does not address consumptive uses such as commercial guiding for hunting and fishing, nor activities *not* related to natural, historical, or cultural subjects. Additionally, a variety of non-profits and educational institutions engage in natural resource– and EE-based activities on the Refuge. Although this use is similar in nature to the commercial recreational use, non-profit and EE-based activities are covered under the CD for EE (USFWS 2011a).

By regulation, the Service may only authorize public or private economic use of the natural resources of any National Wildlife Refuge where it is determined that the use contributes to the achievement of the National Wildlife Refuge's purposes or the National Wildlife Refuge System's mission (50 CFR 29.1). Refuge System policy on management of specialized uses (5 RM 17) states that when monetary gain (profit) is the objective of a refuge recreational use, the use is to be managed as an economic use.

Commercial photography is a visual recording (motion or still) by firms or individuals (other than news media representatives) who intend to distribute their photographic content for money or other consideration, including the creation of educational, entertainment, or commercial enterprises as well as advertising audio-visuals for the purpose of paid product or services, publicity, and commercially oriented photo contests (Service Manual 605 FW 5). This typically involves taking still photographs or recording wildlife sounds and images related to a Refuge's wildlife and resources. Commercial tours and guiding are activities conducted by private organizations or businesses using National Wildlife Refuges. These uses are considered beneficial when they support and extend public appreciation and understanding of wildlife, natural habitats, and the mission of a Refuge and the National Wildlife Refuge System.

Commercial photography and observation uses on Malheur National Wildlife Refuge cover a broad range of resource-based activities and tours, including birding, geology, plant identification, art and visual interpretation, music, sound recording, and other similar non-consumptive activities. These uses will usually occur in areas open to the public, using the same facilities associated with non-commercial recreational uses (USFWS 2011b). Users typically engage in guiding and commercial photography at Refuge Headquarters, along Center Patrol Road and at a number of historical and interpretive sites, including Benson Pond, the historic Sodhouse Ranch (when opened), Buena Vista Overlook, Krumbo Reservoir, and the historic P Ranch.

Commercial photography on the Refuge is most often conducted by individuals, while commercial tours are generally conducted in groups; both uses will be expected to occur at smaller levels than non-commercial photography and wildlife observation. These uses may occur year-round on the Refuge, although the best time of year for wildlife photography and observation is during the spring and fall migrations (March to May and September). Activities related to other natural resources (e.g., geology) may occur at other times of the year depending on the program. These uses may be conducted in vehicles on public roads and on foot on designated hiking trails and roads. Due to the large size of the Refuge, uses are mainly conducted in vehicles with occasional stops at public sites to allow users to photograph or view outside the vehicle.

Under the CCP, an SUP will be required for all commercial uses on the Refuge as described under the Stipulations Necessary to Ensure Compatibility section in this document.

Availability of Resources

Under the CCP, user fees will be collected for issuing SUPs to commercial photographers and commercial tours requesting permission to go into a closed habitat/wildlife sanctuary. If any special resources (such as transportation, access to restricted areas, or guide service) are provided by the Refuge staff, these costs will be added to the standard fee for issuing an SUP. Availability of resources for administering and managing commercial recreational uses under the CCP are detailed in Table B-14.

Table B-14. Costs to Implement the Use

Category	One-time Expense ($)	Annual Expense ($/year)
Administration and management of SUPs		$5,000
Offsetting revenues ($100 for SUP into closed areas)		($2,400)
Total		**$2,600**

Commercial photography and wildlife guiding use the same facilities and resources as the non-commercial wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011b). The Refuge has one FTE position dedicated to administering the commercial recreational uses program as a Visitor Services Manager, in addition to the Refuge Manager who has to approve the SUPs. There is an additional FTE position for any law enforcement needs. Other Refuge staff assists maintenance and construction. The majority of the costs associated with the commercial recreational uses program will be administrative time and costs for SUPs; SUPs are also included under EE but total cost for permits is reflected here. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of these uses associated with wildlife observation, photography, and interpretation. Exact costs will be developed during design and implementation.

Anticipated Impacts of the Use

General Impacts

In general, impacts that will occur from commercial recreational uses will be similar to those expected from non-commercial uses; however, commercial recreational uses could be more disturbing than non-commercial uses because commercial uses tend to occur in groups of people. This effect is explored in this CD.

Impacts that could occur from commercial recreational uses will be similar to those expected from non-commercial wildlife observation and photography activities, especially those expected from larger groups (USFWS 2011b). Such impacts will be expected to include temporary damage to vegetation resulting from trampling, disturbance to nesting birds, and disturbance to feeding or resting birds or other wildlife in the proximity. Commercial recreational uses generally accommodate groups of participants, and studies have shown that increasing group size has an impact on wildlife (Beale and Monaghan 2004; Remacha et al. 2011). In addition to group size, loudness has also been found as an important variable to disturbance of wildlife, and the loudness of people present can be more important than the number of people present (Burger and Gochfeld 1991). Studies showed that reducing group size, allowing safe distances, and reducing noise levels helps minimize negative impacts on wildlife (Burger and Gochfeld 1991; Beale and Monaghan 2004; Remacha et al. 2011).

Refuge-specific Impacts

Commercial recreational uses at the Refuge occur in areas open to the public and, for the most part, are expected to use the same facilities and resources as non-commercial uses (USFWS 2011b). The administration of this use will allow occasional access into closed areas, subject to review and approval of an SUP.

As the literature demonstrates, the number of people visiting a site can influence disturbance to wildlife. Larger group sizes customary of tours will likely increase some disturbance to wildlife on the Refuge during sensitive times of the day or seasons, particularly during the spring and fall migrations when the Refuge supports substantially more wildlife. There could be additional crowding along Center Patrol Road or at public use sites, which will increase vegetation trampling and localized impacts to habitats. Groups requesting special permission to access a habitat/wildlife sanctuary area not normally visited by the public could further increase impacts to sensitive wildlife. Individual commercial photographers will be expected to have the same minor impacts as non-commercial photographers, although filming or recording that involves additional equipment and set-up could have additional impacts on habitats and wildlife due to heavy equipment and/or increased sound levels. Overall the impacts are expected to be minor due to the large size of the Refuge, the availability of sanctuary closed to the public, and the small number of commercial groups and commercial photographers that visit the Refuge throughout the year.

To ensure commercial recreational uses are conducted in a manner compatible with the Refuge's purposes and the National Wildlife Refuge System's mission, an SUP will be required for all for-profit commercial uses occurring on the Refuge. This is expected to benefit both the users and the Refuge as it will aid users in understanding Refuge regulations and the purpose and mission of the Refuge and Refuge System. At the same time, it will provide the Refuge a tool for managing uses; protecting natural and cultural resources; reducing user conflicts; and gathering use information. The SUP will also create an opportunity for communication and outreach between the Refuge staff and commercial photographers or tour groups to increase knowledge and awareness of the Refuge's habitat and wildlife, and disseminate information to users on ethical photography and wildlife observation behavior. Table B-15 details the special use permit requirements under the CCP.

Table B-15. Special Use Requirements for Commercial Recreational Uses

Who	Access to Open Areas	Access to Closed Areas	Access to Hunting Areas	Access to Fishing Areas
Commercial Photographers	• SUP • No fee	• SUP • *Fee required*	• No entry during hunting season	• SUP • No fee
Commercial Tour Groups	• SUP • No fee	• SUP • *Fee required*	• No entry during hunting season	• SUP • No fee

It is not expected that commercial photography and wildlife observation will cause any additional short-term, long-term and/or cumulative and indirect/secondary impacts other than those detailed above.

***Impacts to Listed Species*:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from commercial recreational uses will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. Uses will continue to occur primarily at public sites and on designated roads and trails away from sensitive habitat and resources, and outside of breeding areas and seasons. Users will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. Public education or use of interpretation will assist in raising awareness and preventing undue impacts to these species. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Other Priority Public Uses*:** Commercial recreational uses generally result in little disturbance to other visitors. However, larger groups may cause crowding on roads and at public sites, which could impact the experiences of individuals and non-commercial users. Some tours may inadvertently flush game being pursued by bird hunters, but this conflict will be expected to be minimal as hunting areas will not be open to non-hunters during hunting seasons. There will be no conflict expected between anglers, non-commercial wildlife observers, or photographers. Careful scheduling with EE groups will be done to reduce any conflicts between groups and uses.

Impacts to Infrastructure: No significant effects to roads, trails, or other infrastructure from commercial photography and wildlife observation programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

Public Review and Comment

Various opportunities were provided for the public to engage with the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

General Stipulations

- Visitors are restricted to designated trails, sites, or facilities as determined by Refuge staff. Use is open daily from dawn to dusk. Camping, overnight use, swimming, and fires are prohibited.
- Motorized vehicles will be limited to designated public roads and parking lots and must observe posted speed limits.
- Commercial photographers should ensure proper credit is given to the Refuge and the Service.
- Collection of natural objects such as plants, animals, minerals, antlers, and cultural resources are prohibited.
- If disturbance to wildlife or damage to habitat reaches unacceptable levels, the Refuge will limit uses in areas where unacceptable impacts occur. Monitoring will be conducted to ensure that high-quality habitat for wildlife feeding, resting, and breeding is maintained.

Special Use Permit

- An SUP will be required for all commercial photography and wildlife/nature tours and guiding on the Refuge. Guiding for hunting and fishing is not allowed on the Refuge.
- A standard permit form stipulating dates, times, and locations of use will be made available prior to the visit on the Refuge's website or by mail.
- SUPs for areas open to the public grant permissions to open areas for up to 1 year under the same use stipulations before renewal, and no fee is charged for the permit.
- Special permission requests to closed habitat/wildlife sanctuary areas or other special considerations (e.g., access to the Refuge after normal public visitation hours, setting up temporary equipment, requiring additional resources or staff) will require an SUP and permit fee, and will be granted on a case-by-case basis with no renewal.
- The SUP will be required to be readily available while conducting the permitted use on the Refuge.
- Requests must demonstrate a means to enhance education, appreciation, and/or understanding of the Refuge and the National Wildlife Refuge System. Failure to abide by any part of the SUP or regulations will be considered grounds for immediate revocation of the permit and could result in denial of future permit requests.

Justification

By allowing commercial guiding and photography uses to occur under the stipulations described above, it is anticipated that wildlife species that could be disturbed during the use will find sufficient resources and resting places such that their abundance and use of the Refuge will not be measurably lessened. Additionally, it is anticipated that use of SUPs will provide the Refuge a tool for managing uses, protecting natural and cultural resources, reducing user conflicts, and mitigating disturbance impacts. The SUP will also create an opportunity for communication and outreach between the Refuge staff and commercial photographers or tour groups to increase knowledge and awareness of Refuge regulations and ethical photography and wildlife observation behavior. Thus, the use will not materially interfere with or detract from the Refuge System's mission or the purposes for which the Refuge was established.

This activity contributes to the mission of the USFWS. Commercial guiding provides visitors an organized and educational opportunity to view wildlife safely under the use stipulations. Additionally, commercial photography, through educational wildlife media, creates end products that may provide an educational opportunity to a much broader distribution of people who may not have the opportunity to visit and personally view the Refuge's wildlife and resources. The media products produced by these commercial operations will also be beneficial in promoting the mission of the National Wildlife Refuge System.

It is determined that commercial photography and wildlife observation within the Refuge as described herein, will not materially interfere with or detract from the purposes of the Refuge or the mission of the National Wildlife Refuge System. The stipulations outlined above will minimize potential impacts relative to wildlife/human interactions. The commercial recreational uses program is intended to foster a better understanding of Refuge wildlife and resources, and in turn build a public that is more knowledgeable about, and involved in, resource stewardship.

Mandatory Reevaluation Date

09/2022 Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision

X Environmental Impact Statement and Record of Decision

References

Beale, C.M. and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335-343.

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

ODFW (Oregon Department of Fish and Wildlife). 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Remacha, C., J. Pérez-Tris, and J.A. Delgado. 2011. Reducing visitors' group size increases the number of birds during educational activities: Implications for management of nature-based recreation. Journal of Environmental Management 92(6):1564-1568.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

USFWS (U.S. Fish and Wildlife Service). 2011a. Compatibility determination for environmental education. Malheur National Wildlife Refuge. Princeton, OR.

USFWS. 2011b. Compatibility determination for wildlife observation, photography, and interpretation. Malheur National Wildlife Refuge. Princeton, OR.

Signatures:

Prepared by: ______________________ 1/24/13
(Signature) (Date)

Acting Refuge Manager/
Project Leader
Approval: ______________________ 1/24/13
(Signature) (Date)

Concurrence:

Refuge Supervisor: ______________________ 1-24-13
(Signature) (Date)

Regional Chief,
National Wildlife
Refuge System: ______________________ 1-24-13
(Signature) (Date)

B.7 Grazing and Haying Compatibility Determination

RMIS Database Uses: Grazing; Haying or Ensilage

Refuge Name: Malheur National Wildlife Refuge

Establishing and Acquisition Authorities and Refuge Purposes

- " … a refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of the Use

<u>Purpose and Intent of Haying and Grazing as a Management Tool at Malheur Refuge</u>

This CD examines haying and grazing as described in the management direction of the CCP. Livestock grazing and haying have been used in the past at Malheur Refuge and will be used in the future as tools to provide optimum conditions for wildlife (specifically, foraging areas for waterfowl, waterbirds, and shorebirds; pairing habitat for waterfowl; nesting habitat for shorebirds; and nesting habitat for certain passerines) and, where possible, to improve biological integrity (native plant diversity; hereafter, restoration) in Refuge plant communities. A complete description of how grazing and/or haying is likely to result in these outcomes is contained in the section of this CD titled Anticipated Impacts of the Use.

<u>Policies Pertaining to Use of Haying and Grazing on National Wildlife Refuges</u>

Administration Act: Almost one hundred years after its establishment, the U.S. Fish and Wildlife Service's National Wildlife Refuge System received organic (i.e., foundational) legislation that provided policy direction and management standards applicable to all refuges. This statute, the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) amended the National

Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee). In sharp contrast to the organic legislation of other Federal land management systems (e.g., National Forests administered by the U.S. Forest Service and Public Lands administered by the U.S. Bureau of Land Management), legislation pertaining to the NWR System states that it is not a multiple-use management system and is not managed for commodity production or on the basis of sustained-yield economic principles. Refuges are managed first and foremost for fish, wildlife, plants, and their habitats (Section 5, House Report 105-106). This is often referred to as the "Wildlife First" management mandate.

The Improvement Act also established a three-tiered hierarchy for management activities that occur on Refuge System lands. The first tier involves management actions that specifically assist the Refuge in fulfilling the purpose for which it was established (e.g., for migratory birds and other wildlife) and the Refuge System mission, including the conservation, management, and restoration of fish, wildlife, plants, and their habitats. The second and third tiers involve wildlife-dependent public uses (i.e., hunting, fishing, wildlife observation and photography, and environmental education and interpretation) and general public uses.

Management tools (such as grazing, haying, pest management, or burning) that help refuges achieve established refuge purposes become first-tier management priorities, when properly authorized through signed management plans and CDs. When management tools such as grazing and haying are not specifically used on a refuge to help achieve established refuge purposes, then these activities fall into the third, lowest priority tier.

Compatibility: All uses on National Wildlife Refuges must be deemed "compatible." A compatible use is one that in the " … sound professional judgment [of the Refuge Manager], will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the Refuge" (603 FW 2.6 B). Among other things, a CD involves evaluation of a proposed use's effects upon refuge fish, wildlife, plants, and their habitats; potential conflicts with other refuge uses, especially wildlife-dependent public uses; indirect, future, and cumulative effects; precedent-setting implications; maintenance and monitoring costs; and off-refuge opportunities to exercise the use in question.

Regulations: There are specific USFWS regulations that address economic uses of refuges. In 50 CFR 29.1, it is stated, in part, that " … we may only authorize public or private economic use of the natural resources of any national wildlife refuge, in accordance with 16 U.S.C. 715s, where we determine that the use contributes to the achievement of the national wildlife refuge purposes or the National Wildlife Refuge System mission." This regulatory standard is in addition to the compatibility requirement. Grazing livestock and harvesting hay are listed in the regulations as example uses to which this provision applies.

Use Details

Habitats Subject to These Tools: The primary habitat types where grazing and haying will be used are wet meadows (meadow habitats with standing surface water during the growing season), and reed canarygrass areas (an undesirable exotic wet meadow grass that has spread to dominate some Refuge fields). Livestock grazing may also be used when necessary to maintain or restore[2] other habitat

[2] The term "restoration" is used generally in this document to specify an alteration of plant community dynamics such as plant species diversity, composition, etc., in order to meet wildlife habitat needs. It does not necessarily mean a return to conditions that may have existed at a certain time in history. Because many communities are novel

types (e.g., to transition undesirable plant communities to more native species and improve future habitat conditions).[3]

Area Treated Annually: As a starting point of implementing the CCP, approximately 12,000 to 15,000 acres across the Refuge's 20,000 to 25,000 acres of wet meadow habitat type (see Appendix K) will be treated in initial calendar years. Actual treatment levels will vary on a field-to-field basis depending on area-specific objectives of focal species. For example, higher levels of treatment will typically occur to provide conditions most favorable for sandhill crane foraging and bobolink nesting (e.g., southern Blitzen Valley) and idle conditions will dominate where use of grass meadows for waterfowl nesting is emphasized (e.g., north of Warbler Pond in the Double-O Unit). Application of these treatments may be adjusted as more information is gleaned through inventory and monitoring activities and analyzed by Refuge staff, the Ecology Work Group, and other collaborators (Appendix I).

Habitats that will not be Subject to Grazing/Haying and/or Will be Protected from Grazing/Haying: Objectives developed for cold and hot spring, dune, playa, riparian shrub, riverine and associated riparian zone, sagebrush lowland, sagebrush-steppe, and salt desert scrub habitat types do not include strategies recommending the use of haying and/or grazing as a part of land management within the CCP. The exception to this could be when a shift in community attributes is desired within a specific area of a particular habitat to meet overall wildlife objectives. One example may be the use of early growing season livestock grazing as a tool to reduce reproduction and influence the soil seed bank of cheatgrass before conducting a seeding effort to enhance native plant diversity on-site.[4]

<u>Overview of the Four Treatment Types</u>

Four treatment types will take place on the Refuge (i.e., rake-bunch grazing (RBG), grazing, haying, and mowing) during two pronounced periods (dormant versus growing season). Mowing is a pre-treatment that occurs prior to both RBG and haying.

a) Dormant Season Haying and Rake-bunch Grazing

Desired Vegetation Condition: Dormant season hay only (HO) grazing and RBG will be used to meet desired characteristics of wet meadows across the Refuge as specified in Objective 4a (see Chapter 2), with grass/sedge/rush stubble heights of less than 6 inches by October 1. Haying and RBG treatments during this time also play a vital role in maintaining site vigor by preventing excessive litter accumulation from hindering plant species diversity and expression (Foster and Gross 1998; Xiong et al. 2003). Plant species composition and the response of those species to site-specific conditions that may change annually due to climate or refuge management have a significant influence on biomass production and subsequent litter production. Spatial RBG and HO treatments will be adjusted on an annual basis to account for these dynamics according to information gleaned from inventory and monitoring efforts.

(i.e., made up of either native and non-native species or native species outside historical spatial distributions), a return to such a state may not be preferable to the Service or the Pacific Flyway because such a shift may compromise the regional availability of suitable wetlands for waterfowl, waterbirds, etc.

[3] See Appendix K for further discussion on the decision-making process for habitat manipulation within the CCP.

[4] Interested public are encouraged to provide input and participate in discussions with the Ecology Work Group. Semi-annual meetings discussing habitat management and associated inventory, monitoring, and research are open to the public (Appendix K).

Timing of Treatment: The majority of wet meadow habitats under the "dormant season" program will be mowed beginning August 10 when most meadow plant species are mature (quiescent) and preparing to enter into senescence (when aboveground biomass dies). From a wildlife standpoint, postponing mowing until this time reduces mortality rates of crane colts and other late-maturing species; mowing before this date is discouraged under the Greater Sandhill Crane Management Plan (Central Valley Population) (Pacific Flyway Council 1997).

Mowing will be followed either by RBG or HO treatment. RBG is a form of treatment where meadow hay is mowed and raked into windrows, but left in place to be consumed by livestock during the late fall and winter. RBG will take place beginning September 1 and may continue through January 31. Refuge staff will annually direct permittees in the amount of rake-bunch feed to prepare and its location before or during the August haying season. No windrows remain under HO, as all mowed vegetation is baled and removed from the Refuge.

Ancillary Equipment and Infrastructure Necessary for the Use: HO and RBG treatments require the use of equipment normally used for general haying activities (e.g., tractor, swather or rotary mower, rake) with the addition of balers for HO and specialized rakes for bunching windrows for RBG. All-terrain vehicles (ATVs) and horses are necessary for moving cattle efficiently across designated fields. RBG and experimental grazing treatments also require necessary infrastructure for livestock management, including permanent wells and associated stock tanks and permanent/temporary fences. Additional fencing requirements are expected to be minimal. Power lines are currently specifically associated with two wells in the northern Double-O Unit and two wells in Diamond Swamp. All other wells are serviced via generators or power lines serving outlying residences (e.g., Diamond, Frenchglen).

b) Short-duration, High-intensity Experimental Dormant Season Grazing

This treatment may take place in fields that would otherwise be rake-bunch grazed or mowed. In recent discussions with past refuge biologists[5] it was expressed that this may be useful in providing litter management necessary for species such as the bobolink while retaining some vertical structure. Timing and equipment used will be similar to RBG (except that no mowing equipment will be used). Any haying or grazing prior to these dates will be pursued under the growing season program.

c) Growing Season Hay Only and Growing Season Grazing Treatments

Desired Vegetative Condition: Growing season HO and the use of livestock in treating uncut vegetation (grazing) will be used to meet desired characteristics of wet meadows across the Refuge as specified in Objective 4a (see Chapter 2) by encouraging successional shifts in plant community composition where designated attributes (i.e., >75% cover of perennial grasses, rushes, and sedges; 15-20% cover of forbs such as lupine, clover, and cinquefoils; <20% cover of reed canarygrass; <5% cover of noxious weeds) are not being met and maintaining desired habitat heterogeneity at larger spatial scales (e.g., conditioning reed canarygrass monocultures for fall migrating waterfowl or encouraging a compositional shift from a reed canarygrass association to that of aquatic sedge). Growing season HO will be used as needed in an effort to control/eradicate noxious weed populations in meadows that have exceeded designated site-specific thresholds based on plant community attributes and associated abiotic resources (e.g., soil type). HO will be effective in

[5] This conversation took place during an organized Refuge management review involving current Refuge staff and the following former biologists: John Cornely, Gary Ivey, David Johnson, David Paullin, and Michael Rule.

preventing the maturation of viable weed seed (e.g., mid-June), thus reducing further enhancement of the soil seed bank in this instance. An example of this is the mowing of pepperweed in mid-June, prior to the production of viable seed.

Timing of Treatment: "Growing season" treatments will typically occur April through August, but may extend past the period of senescence depending on site-specific objectives. Manipulation of vegetation during the growing season can have negative effects on wildlife due to disturbance/displacement. Littlefield (1989) documented sandhill crane nest desertion and trampling with spring and summer grazing. Therefore, growing season treatments will be pursued when the need for a shift in vegetative community attributes or structural heterogeneity is necessary within a particular unit to meet overall long-term meadow habitat objectives.

Ancillary Equipment and Infrastructure Necessary for the Use**:** Growing season grazing may use existing dormant season infrastructure, but will most commonly use electric fencing and/or other temporary fencing to control livestock movement. Temporary water will be provided as needed.

Livestock Trailing

When the movement of livestock is necessary, routes will be carefully selected to prevent damage to cultural resources, sensitive soils, wildlife habitat availability and integrity, and plant community health. A description of prescribed livestock movement will be included within individual cooperative land management agreements (CLMAs) (see below).

Corrals

Corrals facilitating livestock movement on- and off-Refuge (Diamond and Nine Mile) by Refuge permittees are also used by BLM permittees using neighboring BLM allotments. The existing cooperative agreement placing responsibility of all maintenance of related infrastructure on the BLM will be extended.

Administration of the Use

Cooperative Land Management Agreements*:* The two programs using haying and grazing (dormant season and growing season) will be treated separately and will differ in the types of agreements that are used. Both programs will use CLMAs as authorized under 50 CFR 29.2. These agreements will allow Refuge staff and permittees to effectively work together to meet habitat objectives (e.g., feeder ditch maintenance, noxious weed management).

Dormant Season CLMAs: The CLMAs for dormant season treatments (i.e., haying and RBG) will be 5 years in duration,[6] will designate acreages of use, and will allow payment in the form of services (permittee labor and equipment or cost of contractor) or the financing of field management activities such as noxious weed control. The labor involved in installing and maintaining field fences (permanent or electric) is a condition of the permit and will not be deducted from the bill, although materials will be provided by the Refuge. A percentage of each invoice will go toward funding (1) noxious weed management and (2) a third-party entity that will be active in Refuge land management research, inventory, and monitoring. Designated acres will involve target habitats within field

[6] The duration of dormant season CLMAs may be adjusted in subsequent agreement cycles on a case-by-case basis if it is demonstrated that the 5-year timeframe does not prove adequate (either too short or too long) in understanding plant community trends and the Refuge's ability to respond appropriately to community dynamics.

management units (e.g., Oliver Springs Field) and CLMAs will designate necessary rotations if a complex of fields is included in the agreement.

Existing permittees[7] will be provided an identified acreage in which vegetation management activities will take place. If objectives pertaining to individual units within this acreage are not being achieved as determined through the state-and-transition model (STM) process, adjustments will be made within the areas included in the agreements.

The overall treatment of each CLMA land base will be analyzed annually by the Ecology Work Group, and appropriate changes to the CLMA agreement will be made at the end of the contract period. This provides opportunities each year to make changes based on habitat trends within the conditions expressed in the CLMA. If inventory, monitoring, and analysis reveal that the conditions of individual agreements are not sufficient for meeting or maintaining habitat objectives at the conclusion of the 5-year CLMA time frame, then the nature of the specific CLMAs may either be altered (e.g., replacing RBG with HO) upon renewal or the Refuge may choose not to renew them. This 5-year timeline recognizes the need to observe plant community trends in order to gain deeper understanding of treatment effects. Considerations involving operational changes within CLMAs may necessitate an alteration of this time frame. An example of operational considerations includes whether the physical management of individual CLMAs is consistent with habitat objectives (e.g., are non-target habitats being impacted?). Changes based on physical management can take place at any time during the life of the CLMA if problems are not able to be readily addressed within the conditions expressed in individual CLMAs. Permittees and interested public will have the opportunity to participate in semiannual Ecology Group reviews of the Inventory and Monitoring Program, thus enabling all interested parties to fully engage.

Growing Season CLMAs: Growing season treatments (e.g., successional plant community management, creation of shifting mosaic of successional stages) will use annual CLMAs to maximize flexibility in response to changing needs as driven by research or specific management goals addressing particular management issues (e.g., encouraging one suite of plant species at the expense of another). Annual CLMAs will be applied in designated areas, will specify the objective vegetation condition, and will be subject to monitoring to evaluate the treatment prior to renewal. Exchange of services and other aspects of annual CLMAs are the same as those of 5-year CLMAs. Cooperators who are able to demonstrate flexibility in providing livestock and associated labor (intensive herding, etc.) to allow site-specific treatments on an annual basis will be sought for annual CLMAs. If unforeseen circumstances take place (e.g., weather-related phenomena), mid-year modifications to CLMAs may take place if the rationale is documented through the Ecology Work Group process. Further information regarding oversight of habitat responses related to CLMAs through the state-and-transition model and the Ecology Work Group is found in Appendix L. The costs of administering and managing the haying and grazing program under the CCP are detailed in Table B-16.

[7] Permittees currently possessing annual haying and grazing Special Use Permits (SUPs) will be issued 5-year CLMAs upon implementation of the CCP.

Table B-16. Costs to Implement the Use

Category and Itemization	One-time Expenses($)	Recurring Expenses ($/yr)
Administrative support	$0	$35,000
Materials and equipment	$0	$0
Offsetting revenues/services	$0	$170,000
Total expenses for the complex	$0	−($135,000)

Ecology Work Group Role: As discussed in Chapter 2 of the Refuge's CCP, regular assessment and modification will be made possible through the Malheur STM framework. This involves the development of site-specific management strategies (using a combination of tools) to meet vegetative objectives (such as desired structural and successional characteristics) as laid out in the STM. The Ecology Work Group, consisting of ecologists and wildlife biologists representing agencies, academia, and other ecologists, will assist the Service in the development of the model and will provide recommendations for annual modifications to the model and associated habitat management strategies based on continuous inventory and monitoring. The structure of this information gathering and land management decision process is designed to provide transparency in the Refuge's decision-making process.

Anticipated Impacts of the Uses

<u>Grazing/Haying Effects to Wildlife</u>

Table B-17 lists the wildlife species that depend on treated meadows for particular life history stages. Wet meadows can provide both nesting and foraging sites for avian species. Both are discussed below.

Spring Foraging Habitat During Migration: The primary reason for treating wet meadows is to improve foraging conditions, especially during the pairing season. Wet meadows receive high use by foraging birds in the spring when they are treated with grazing, haying, or burning. These treatments provide short-stubble habitat, which allows early warming of soil and water and early availability of new green sprouts and invertebrates for birds to eat in the spring. This short structure proves valuable as a foraging area for waterfowl, waterbirds, and shorebirds. Important species such as sandhill cranes, white-faced ibises, and many waterfowl focus their foraging on these areas.

While much of the migrant waterfowl use occurs on the Refuge lakes, many migrant birds are attracted to the hayed and grazed meadows after they are flooded in the spring. Treated meadow vegetation (mowed, grazed, burned) provides high-protein browse and invertebrate foods for a large variety of birds and other wildlife during the early spring period, when high-protein foods are needed for egg-laying. Theoretically, treated meadow sites receive more solar radiation, resulting in early warming of soils and earlier availability of important invertebrates for food (Rule et al. 1990). These treated meadow sites on Malheur Refuge generally support high waterfowl and crane use during the early spring period. In particular, the Double-O Unit receives very high use in March and April by migrating snow geese, Ross' geese, ducks, and sandhill cranes, and is very important to these species during dry years, because little feeding habitat is available elsewhere in the basin (David and Ivey 1995). Therefore, Malheur Refuge plays a critical role in providing energy for migrating birds within the Pacific Flyway, and management of wet meadows by haying and grazing is a means of providing much needed energy for these birds to continue migration and replenish their nutritional reserves. Successful reproduction upon arriving at breeding grounds depends on the quality and quantity of food acquired at such stopovers (Davidson and Evans 1988; Ricklefs 1974).

Nesting Habitat for Waterfowl and Waterbirds: Pairing and Pre-Nesting: A study of Malheur Refuge land use in relation to spring waterfowl pair use was initiated by Gary Ivey in 1988. Paired plots of different land use were established, and waterfowl were counted weekly during April and May using a four-wheeled motorcycle, which flushed nearly all birds within each transect; therefore, detectability was considered close to 100 percent for all land use types. One set of plots comparing RBG and idle management was established in 1990. A preliminary analysis of data from these two paired, 800-heactare plots showed duck numbers to be, on average, six times higher in April and two times higher in May on the grazed plot in comparison to the idle plot. Also, Canada goose counts were 17 times higher on the grazed plot versus the idle plot (Ivey, unpublished data). Duck pairs used wetlands that had been treated (burned, grazed, or mowed) earlier in the season than wetlands with idle vegetation, which showed increased pair use later in the season. Theoretically, treated areas receive more solar radiation, and therefore, frozen soils thaw much earlier than non-treated areas, resulting in earlier plant growth and earlier availability of invertebrate foods (Rule et al. 1990). The new plant growth and invertebrates are sources of protein, which is very important to breeding waterfowl and other birds for egg-laying, as described by Eldridge and Krapu (1988).

The past Refuge strategy has been to treat most of the wet meadow habitat with haying and/or winter livestock grazing to reduce the attractiveness of these habitats for nesting ducks, because early nesting species like mallards often nest in wet meadows before irrigation water is present and many of their nests get flooded during irrigation and with flood events—as such, nests generally don’t float like they do in marsh vegetation. Often, mallards will select alternate overwater nesting sites and build floating nests in marsh vegetation. Most ducks, geese, and cranes select marsh sites for nesting within large, wet meadow areas of the Refuge (e.g., Units 11 and 12). Refuge studies of duck nest success have documented much higher success for ducks nesting over water in marsh plant communities than for ducks nesting in meadows or uplands (Malheur Refuge, unpublished data). Although some species focus primarily on nesting in meadow habitats (e.g., cinnamon teal, northern pintail, short-eared owl), treating the wet meadow sites encourages these species to nest in dry meadow (which are sub-irrigated), upland (e.g., sagebrush lowlands, salt desert scrub), or marsh habitats by managing wet meadows for low structure in early spring.

Shorebird Nesting and Migratory Habitat: Shorebirds and other migratory species that depend on wetland stopovers in North America are being challenged by a rapidly changing landscape. For example, in the Great Plains of North America, 90 percent of the wetlands in some areas have been lost to agricultural development since the early 1900s (Ducks Unlimited 1994; U.S. Department of the Interior 1994). Furthermore, wetlands may be altered in the future by global warming (Houghton et al. 1990; Poiani and Johnson 1991). Such large-scale habitat changes raise concerns about maintaining an adequate network of stopover habitats in the future (Farmer and Parent 1996).

Nine species of shorebirds regularly breed at Malheur Refuge, including snowy plovers, long-billed curlews, Wilson’s phalaropes, American avocets, and black-necked stilts, which are all priority species in the Intermountain West Regional Shorebird Plan (Oring et al. 2000). Estimates of breeding populations of common species in the Harney Basin from 1975 to 1978 are provided by Horton et al. (1983).

The short structure of treated meadows is attractive to nesting shorebirds such as Wilson's snipe, Wilson's phalarope, American avocet, and black-necked stilts, as well as some ground-nesting passerine birds such as bobolink and savannah sparrow.

Most shorebird species select very short cover or barren sites for nesting (Eldridge 1992). Little information has been published on management of breeding shorebirds in the Intermountain West. However, a Malheur Refuge study of ground-nesting birds in the Double-O Unit found that in all cases, shorebirds used shorter and sparser vegetation than ducks, primarily nesting in bluegrass/creeping wildrye associations (Foster 1985). In these habitats, Foster found high densities of nesting shorebirds when they were livestock-grazed and high densities of nesting ducks when they were untreated; he recommended using livestock grazing or mowing to enhance attractiveness of that vegetation type to nesting shorebirds. Other authors have also identified that essential habitat for breeding shorebirds can be provided through grazing, mowing, or prescribed burning (Eldridge 1992; Helmers 1992). Therefore, to provide short cover needs in areas of the Refuge important for shorebird nesting (e.g., the north end of the Double-O Unit), wet meadow vegetation should be treated with livestock grazing, mowing, or burning after the breeding season (Ivey et al. in prep.).

Greater Sandhill Cranes: Greater sandhill cranes are considered a "Sensitive Species" in Oregon and are also a "Strategy" species in the Oregon Conservation Strategy (ODFW 2006). These birds are members of the Central Valley Population and their management needs are addressed in a Pacific Flyway plan (Pacific Flyway Council 1997). They are also identified as a priority species in the Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006). Malheur Refuge supports a significant portion of Oregon's population of breeding greater sandhill cranes, with over 20 percent of the state's pairs found there during surveys in 1999 (Ivey and Herziger 2000).

Three essential ingredients for a crane nesting territory were outlined by Littlefield and Ryder (1968); a feeding meadow, nesting cover, and water. Territories averaged 43 acres at Malheur Refuge and contained irrigated meadow for feeding and flooded marsh cover for nesting. An ideal territory contains a shallow marsh with residual emergents in close proximity to foraging meadows (Littlefield and Ryder 1968). Feeding cranes have a preference for mowed meadow habitats when compared with unmowed (Littlefield 1975).

Only 8 percent of the crane nests documented on the Refuge have been in meadow vegetation (Rule et al. 1990). The primary importance of meadows to cranes is for feeding and brooding young. Radio telemetry studies conducted on the Refuge showed that the wet meadow zone adjacent to uplands is a preferred area for crane chick brooding (Littlefield 1985). This preference is assumed to be associated with invertebrate abundance and availability. Generally, cranes are attracted to intensely treated meadows (mowed, burned, or rake-bunched grazed) for feeding during early spring. These intensive treatments remove ground cover, allowing solar radiation to warm the soil, causing earlier green-up of vegetation and earlier invertebrate availability (Epperson et al. 1999; Rule et al. 1990).

Cranes initiate nesting when their territories are adequately flooded and the females have consumed enough protein to begin egg-laying. Cranes nest early in fields that are irrigated early and later in fields that are flooded late. Nest initiation is also affected by land use treatments because treatments that remove ground cover (burning, grazing, haying) result in earlier soil warm-up and availability of protein-rich invertebrate foods. Cranes nest earliest in burned areas, followed by mowed and grazed areas, and they nest latest in idle areas (Littlefield 2010, personal communication). A study was conducted at Ash Creek Wildlife Area in California, where habitat is similar to the Blitzen Valley's (Epperson et al. 1999). That study compared bird use on hayed (previous summer) versus idle plots and documented significantly higher numbers of individuals and species of birds as well as significantly higher numbers of sandhill cranes on hayed plots during June and July. The study also reported that cranes in hayed plots spent significantly more time foraging and less time in vigilant behaviors as haying likely increased their ability to see approaching predators. They reported that because vegetation was less dense in the hayed plots, travel, foraging, and vigilance by cranes would be more efficient and the reduced litter and vegetation cover enhanced the ability of cranes to find and capture prey, supporting the idea that providing short-stubble habitat benefits cranes and other wildlife foraging.

An evaluation of Refuge crane nest success from 1990 to 1998 revealed that success was lower the season following a burn, declined with nest initiation date, and was higher in deeper water sites. It also revealed that haying, livestock grazing, or predator control did not influence success during those years (Ivey and Dugger 2008). The study found no evidence for haying, grazing, or idle treatment effects on crane nest success, which is similar to the findings of a study at Grays Lake National Wildlife Refuge in Idaho (Austin et al. 2002). The significance of higher nest success for early nests suggests that providing early water and ideal foraging habitats (treated meadows) can encourage early nesting, leading to increased success. Also, haying and grazing of wet meadows can encourage cranes to nest in the deeper marsh sites, where success is higher.

Bobolink Habitat: Bobolinks are identified as a focal species in the Partners in Flight conservation plan for eastern Oregon and Washington (Altman and Holmes 2000), and Malheur Refuge supports the largest local breeding population of bobolinks in the western United States. Bobolinks are a wet meadow–dependent landbird species and tend to nest in shorter vegetation types.

Malheur Refuge bobolink populations were monitored annually from 1984 to 1998 (Malheur Refuge, unpublished data). A preliminary review of the data indicates that bobolinks select treated wet meadows in suitable areas of the Refuge with a high composition of forbs such as cinquefoils and clovers. Such fields that were placed in idle status were abandoned by bobolinks, and the data suggest that they respond positively to haying, grazing (dormant season), and burning treatments. Other studies support their preference for grazed or hayed areas. Johnson (1997) reported that if habitat is not maintained, use by bobolinks significantly declines, and that bobolink use peaked 1 to 3 years after burns and began to decline about 5 years post-burn. Several authors report that bobolinks respond positively to burning or mowing treatments (Bollinger and Gavin 1992; Dechant et al. 2003; Herkert 1991, 1994; Johnson 1997; Madden 1996; Madden et al. 1999; Renfrew and Ribic 2001). A Saskatchewan study reported that bobolink abundance was higher in mowed tame hayland than in idle native grassland (Dale et al. 1997). Recommendations for bobolinks in the Great Plains provided by Dechant et al. (1999) include providing hayland areas and delaying mowing as much as possible. Therefore, managing Refuge wet meadow sites where habitat is suitable for bobolinks (based on past surveys) using haying, RBG, and burning is appropriate to provide breeding habitat for this species.

Table B-17. Wildlife Species that Depend on Treated Meadows for Particular Life History Stages

Wildlife Species	Use of Treated Wet Meadow
American avocet	Nesting/foraging
Black-necked stilt	Nesting/foraging
Bobolink	Nesting/foraging

Wildlife Species	Use of Treated Wet Meadow
Canada goose	Foraging
Mallard	Foraging
Sandhill crane	Foraging
Savannah sparrow	Nesting
White-faced ibis	Foraging
Wilson’s phalarope	Nesting/foraging
Wilson’s snipe	Nesting/foraging

Effects of Treatment Timing to Breeding Birds: Early mowing of vegetation has conflicted with production and maintenance objectives by destroying nests, killing incubating hens, killing young before fledging, and exposing nests and young to predators. Mowing could potentially impact any bird that nests or rears young in wet meadow habitats. Young cranes have the habit of lying still in meadow vegetation rather than moving away at the approach of a swather. Delaying Refuge haying dates until August 10 (as is practiced currently) will minimize mowing conflicts.

Grazing livestock, haying, and mowing during the growing season may disturb/displace nesting activity for that year from a particular field unit, but at any one time will only impact a small percentage of the available wet meadow habitats available within the Refuge.[8]

Reed Canarygrass: Although this species actually occurs in plant communities within the wet meadow habitat type, it is significant enough to merit attention in this discussion. Large areas of robust reed canarygrass stands are essentially biological deserts in terms of wildlife use, as they quickly become too tall and rank and exclude most species. Currently about 6,000 acres[9] of the Refuge wet meadow communities are dominated by such stands. Intensive treatments such as haying and grazing to keep the stubble height as short as possible will greatly improve wildlife use of these areas, and they should be treated annually until they are restored to more desirable and diverse communities.

Effects from Fences and Infrastructure: Electrical lines are a direct mortality source for cranes and other wildlife. Power line strikes are a major mortality factor for larger birds such as cranes and trumpeter swans as well as many other birds.

The Refuge has removed a vast majority of lines not associated with rural power distribution. Orange plastic spheres and reflective tags placed on some existing power lines where mortalities have occurred in the past have reduced collisions significantly. The stipulation below to bury the electric lines should mitigate somewhat against these hazards.

Fencing can interfere with the movement of wildlife or create entanglements, leading to mortality or altered movements for birds and mammals (Christianson 2009). In a 1-year study in Colorado and Utah surveying 1,046 kilometers (km) of fences, Harrington and Conover (2010) measured ungulate

[8] If a 500-acre wet meadow is used for habitat treatment within the growing season, this only accounts for 2 percent of this meadow habitat type being impacted.
[9] Locations of reed canarygrass monocultures is being mapped during the 2011 field season as specific wet meadow plant communities are identified spatially.

mortality rates at 0.25 mortalities/km for the wire fences studied, with 0.08 mule deer mortalities/km, 0.11 pronghorn mortalities/km, and 0.06 elk mortalities/km. Mortalities were highest in August, when fawns were weaned, and juveniles were eight times as likely as adults to suffer mortality.

In past years, biologists have found several chicks killed from fence entanglement, as well as many deer and antelope, at Malheur Refuge (Ivey 2011). Avian fence collisions are most common in areas where fences cross marshes. However, the Refuge now uses smooth wire as the bottom wire on all fences, and this is placed at a standard height to minimize impacts to pronghorn antelope. Observations at the Refuge have confirmed that with these adaptations most pronghorn cross under the fences rather than through them. In addition, bird flight patterns have been considered when building fences, and many fence lines have been moved or removed to minimize the number of bird strikes. Therefore, though some fence impacts should be expected, overall, infrastructure effects from grazing will be relatively minor.

Effects to Other Wildlife (small mammals, large mammals, fish, herps, inverts): There will be negative impacts to some small mammals, reptiles, and amphibians. Not only are these species subject to mortality from machinery, but the conversion of tall pasture grasses to mowed grasses results in habitat loss. However, at any one time, approximately 40 percent of the wet meadow habitat will be in an idle (untreated) condition, which allows for habitat use by species dependent on this condition.

Disturbance Effects: The use of noise-producing equipment such as ATVs, tractors, swather or rotary mowers, rakes, and other potential equipment may cause localized disturbance to wildlife during the period of the equipment use. Oregon law restricts noise emissions from ATVs to 99 dB (OPRD 2011). In general, use of equipment will occur in the fall and thus occurs outside of the sensitive breeding period. In addition, most of the areas that will be accessed with equipment will be dry at this time of year, with reduced wildlife densities.

Potential for Injury: Based on Malheur data, 75 percent of sandhill crane chicks are fledged by August 10. The remaining 25 percent unfledged chicks (typically five chicks per year) are vulnerable to haying mortality. Haying attracts coyotes and other predators, and unfledged chicks around hayed fields tend to be taken by predators (Ivey 2011). The stipulations outlined below should help reduce risk of mortality for the remaining chicks.

Effects to Vegetation: Short-term and Long-term

Wet Meadow Plant Community Composition: Wet meadows are ideally dominated by native grasses (e.g., American sloughgrass, spike bentgrass), sedges, rushes, and native forbs and are commonly found interspersed within marsh and upland complexes. On the Refuge, wet meadows are currently dominated by introduced pasture species such as smooth brome, meadow foxtail, orchardgrass, reed canarygrass, and various clovers. Because meadows hosting a larger percentage of grasses provide more tonnage and higher nutrition for livestock, forage species such as timothy and smooth brome were introduced (decades ago). Other species were either introduced to the area in contaminated hay grown in other areas (e.g., meadow foxtail) or were purposefully planted because native meadow plants were generally believed to be less resilient, productive, and responsive to intensive land management. As a result, the diversity of native plants in some of these areas has decreased substantially, and restoration is emphasized in land management objectives 4A, 4B, and 4D, which strive to improve the biological integrity of plant communities.[10]

Differentiating between Riparian and Wet Meadow Habitats: The CCP distinguishes between riparian and wetland habitat management. As laid out in Goal 3 of Chapter 2, livestock grazing will not generally occur in areas designated "riparian" (e.g., streamside riparian zones and riparian woodlands). For this reason, issues such as stream bank integrity, willow propagation and enhancement, cattle distribution concerns relating to the inclusion of riparian areas in upland paddocks, and so on, are not addressed in this analysis.

Wet meadows and woody riparian areas are managed for different wildlife objectives. The former provides habitat for pairing/nesting/foraging waterfowl, waterbirds, shorebirds, and so on, while the latter is managed for willow-dependent landbirds. The different habitat requirements of yellow warblers and bobolinks illustrate this point well. Yellow warblers require large, dense willow stands while bobolinks seek out large, open, treated meadows for nesting. Wet meadow and riparian habitat types do have much in common, however, and these commonalities (e.g., plant community composition, plant species response to defoliation) will be addressed below.

How a plant community responds to defoliation is greatly affected by the compounding influences of its environment (e.g., climate) as well as the physiology of individual plant species and the influence this has on fitness at the individual plant and community levels. Unfortunately, as discussed earlier, many individual species have not been studied to an extent that would be helpful in truly comprehending how individuals and composite communities will respond to various management scenarios.

It is also important to note that studies pertaining to rangelands, mixed-grass and tall-grass prairies, woodlands, and narrow riparian meadows may or may not be relevant to the habitats being considered at Malheur Refuge. Basic principles can and do apply to all the above-mentioned systems, but one must be careful how conclusions are drawn when premises are built on habitat types that are different than the Refuge's wet meadows. A vast majority of the research that is cited below has taken place in riparian areas adjacent to streams or in small riparian meadows west of the Rocky Mountains or within laboratory environments.

The Dominant Role of Hydrology in the Expression of Plant Communities: A driving factor that separates wet meadows from other habitat types often discussed in grazing-related literature is hydrology. An overview of existing literature indicates that water table characteristics (i.e., soil moisture availability) are the most important factors influencing the composition and distribution of plant species in mesic and wet meadows (e.g., Allen-Diaz 1991; Dwire et al. 2006; Henszey et al 1991; Martin and Chambers 2001, 2002; Perata and Alpi 1993; Rumburg and Sawyer 1965; Stringham et al. 2001). Thus it is critical to consider the underlying influence of hydrology whenever plant community responses to livestock grazing are being considered. Ultimately, the net effect of any disturbance (e.g., flood irrigation, grazing) is often a function of its interaction with other disturbances.

Considering the influence of anaerobic conditions on plant communities, Dwire et al. (2006) found that small changes in water-table depth could result in either a short-term shift in species dominance or the ultimate replacement or loss of certain species. Water sedge (*Carex aquatilis*) can readily

[10] The reader is referred to Chapter 2 of the Refuge CCP for further elaboration of these objectives.

transport oxygen through aerenchyma (Perata and Alpi 1993) and can persist in anaerobic conditions that would exclude other sedge species over time (Gomm 1979). Baltic rush (*Juncus balticus*) has a greater range of drought tolerance than many other rushes, and may not be as negatively impacted by long-term drying trends that would exclude other rush species.

Unfortunately, with a few noted exceptions such as those found above, there is a considerable knowledge gap regarding a majority of individual species' tolerance to water-table depth and associated anaerobic conditions. It is also difficult to categorize level of water tolerance by genus or other human-made classifications because of significant differences between species (e.g., aquatic versus Nebraska sedges). Many species have broad ecological amplitudes and do quite well in typical wetland settings as well as more "terrestrial" habitats (Tiner 1991).

There is, however, enough existing data to begin addressing Refuge management strategies from a scientific basis. It has been observed that timing and duration of soil saturation during the growing season can determine the distribution and abundance of Nebraska sedge (*Carex nebraskensis*) and Kentucky bluegrass (*Poa pratensis*) in riparian meadows (Kluse and Allen-Diaz 2005; Martin and Chambers 2001). There is also a positive correlation between soil aeration and species abundance, and anaerobic conditions can negatively influence total plant cover and species diversity (Dwire et al. 2006). Stem density of some wetland obligates may decrease without adequate soil aeration during the growing season (e.g., beaked sedge in Mornsjo 1969). Flooding depth and duration may negatively impact sedges and grasses, while allowing rush populations to expand (Gomm 1979; Rumburg and Sawyer 1965). Henszey et al. (1991) found that 7 to 10 cm (2-4 inches) of standing water during spring flooding, with a maximum water-table depth of −30 to −90 cm (−11 to −35 inches), was enough to create a shift to a wetter meadow plant community and a decrease in the presence of tufted hairgrass (*Deschampsia caespitosa*).

Water-table–driven thresholds are particularly difficult to determine, partially due to a general lack of species-specific data and the large degree of overlap that can occur among species (Dwire et al. 2006). Summarizing existing data and knowledge about the physiology and response of specific plant species (i.e., presence or absence of aerenchyma) may assist in the creation of general water management guidelines. This could serve as a foundation for managing water-table depths at the peak of growing season according to requirements of dominant species within particular guilds.

Because water table and topography play such a decisive role in determining the composition and dynamics of meadow and wetland habitats on the Refuge, the Ecology Work Group has already begun constructing the STM using hydrology as its foundation. Depending on the availability of water, one soil type may host either a hemi-marsh or a mesic meadow. The key to understanding the roles and impacts of haying and grazing during the life of the CCP is remaining mindful that these treatments interact strongly with site-specific hydrological regimes.

How the Use of Grazing During the Growing Season can be Valuable in Meeting or Maintaining Wildlife Habitat Objectives: The concept of scale is critical in discussing the role livestock play in managing biodiversity within the Refuge's wet meadow habitats. Taken as a whole, these meadows encompass a diverse assemblage of plant community types consisting primarily of novel communities.[11] Within specific areas, however, a lack of species diversity is often problematic,

[11] Novel plant communities consist of species assemblages that did not naturally occur prior to the introduction of desirable and undesirable exotics. Many novel communities are able to function in a similar manner to native communities (e.g., promotion of soil stability, watershed function, distribution of nutrients and energy) and provide

especially for wildlife such as the bobolink, which depends on a wide assortment of plant species to carry out their annual reproductive cycles (Wittenberger 1978, 1980). As discussed earlier, topography plays a significant role in determining depth to water table and provides a foundational template in guiding the potential expression of multiple grass, sedge, rush, and forb species. Within the wet meadow complex we discover the highest potential for diversity within mesic areas that are subirrigated for a majority of the growing season. Lower-lying areas are negatively predisposed to diversity due to extended anaerobic conditions and the limited number of species that are able to cope with an oxygen-limited environment. The following discussion is primarily mindful of mesic sites within this habitat type, although some points are relevant to sedge- and rush-dominated communities where introduced forage species such as reed canarygrass overtake desirable natives.

When let loose to graze on actively growing vegetation, livestock are capable of inducing a series of biological and physiological modifications that can drive changes in function at the individual plant scale. Grazing can also alter the expression of plant populations, leading either to an increase or decrease of biomass production at the community or ecosystem scale (Dyer et al. 1993) or in the number of plant species that are expressed (Leege et al. 1981). Cattle effects on vegetation should always be examined at various scales, including (1) the effect upon continuous changes in resource allocation and the phenological/morphological/physiological[12] responses and adaptations of individual plants; and (2) the effect upon plant community attributes such as plant species abundance, distribution, diversity, and overall habitat structure. These considerations should take place in a context that recognizes the influence of local hydrological dynamics and prevailing soil properties (e.g., depth to restrictive layer, pH, texture). Such an approach will allow Refuge staff and partners such as the Ecology Work Group to establish management strategies that are likely to succeed in attaining or maintaining desired conditions.

It is important to remain mindful that overarching conclusions are difficult to apply across the landscape because herbivory affects the same species differently across various sites and any generalizations would require an attempt to replicate responses in different areas (Belsky 1992). Kauffman et al. (1983) stressed the importance of recognizing and differentiating between plant community types: "Because of the great community diversity and differing ecological tolerances of riparian plant communities, a management practice that may be beneficial for one community may not be beneficial to another community in the same area."

Physiological Responses of Vegetation to Grazing During the Growing Season: Research conducted on numerous forage grasses has demonstrated that herbivory has an immediate effect on the functionality of individual plants during the growing season. A temporary cessation of root elongation (Crider 1955) and decreases in root respiration and nutrient acquisition (Davidson and Milthorpe 1966) can occur within 24 hours. Crider (1955) noted that there was a relationship between the percentage of foliage removed and the percentage of roots that ceased growing for a time. Richards (1984) concluded that a "reduction of root growth following defoliation appears to be an effective mechanism to aid reestablishment of the photosynthetic canopy and the root:shoot balance." Briske and Richards (1995) believed that such alterations and reductions are an important adaptation to chronic defoliation and associated reduced entire-plant photosynthetic rates. The findings of Kauffman et al. (2004) illustrate this overall concept well. They examined the overall

satisfactory habitat for wildlife. Others become monotypic over time and become less diverse than site potential would otherwise merit.

[12] Physiology refers to how a plant functions at various levels (e.g., growth rate, hormone production). Phenology examines the relationship between a plant's growth and reproductive cycle in response to environmental conditions. Morphology considers the various forms and structural components of plants.

impact of belowground root biomass in response to herbivory and found that although there was no difference between plots in the distribution of root biomass by depth, root biomass was consistently higher in volume in non-grazed sites. Similar research conducted on aquatic sedge in a tundra setting yielded different results, finding that two or more defoliation events were required before root growth was reduced. Respiration and nutrient absorption rates were either maintained or increased for this species in relatively infertile conditions (Chapin and Slack 1979).

The complex relationship between physiological responses to defoliation and the overlying influence of temporal and spatial scales give testimony to the nonlinear nature of these interactions. In addressing the nonlinearity of these responses, Dyer et al. (1993) noted that metabolic activity and growth and development rates initially increase directly following a defoliation event until a maximum level of all three characteristics is attained. Once this level is reached, production potential decreases with sustained or increased levels of grazing (see also De Angelis 1992; Dyer et al. 1986; Dyer et al. 1991). Competitive interactions between species could be influenced by the level at which individual species would plateau in this way. These findings suggest that the desirable timing, duration, and location of prescribed grazing will differ dramatically based on the treatment's effect on the competitive abilities of desirable and undesirable plant species.

Considering Plant Morphology: Belsky (1992) confirmed the importance of plant morphological expression in determining the influence of grazing upon plant competition in a diversity of Tanzania grasslands. She noted that tall perennial species increased and short perennial species decreased when grazing was removed from her plots. Across all plots, cessation of grazing led to an increase in species dominance and a decrease in species diversity. She concluded that short, sexually reproducing species were overtopped and crowded out by tall, vegetatively reproducing species. When grazing effects were examined, she found that the reverse was true.

This research is consistent with the general understanding that has been developed regarding plant morphological relationships with defoliation as related to tillering rates, shoot length (and associated meristematic tissues),[13] and the presence or absence of asexual reproduction (rhizomes and stolons). Considering such holistic relationships, Belsky concluded that herbivory response is different when one plant is affected versus multiple plants and that intraspecific and interspecific competition are critical components of the outcome of these interactions.

Responses of Plant Communities to Grazing: Research has demonstrated that grazing may encourage competition by reducing enough biomass (cover and density of prevailing vegetation) to release available resources (Briske 1991; Damhoureyeh and Hartnett 1997; Kluse and Allen-Diaz 2005) or may be able to maintain current levels of competition by favoring the growth of disturbance-adapted species (Chesson and Huntly 1997). Shifting the intensity and duration of grazing has also been demonstrated to alter species composition, distribution, and productivity (Crawley 1987).

Plants compete for resources both spatially and temporally. The phenology of some species, such as Nevada bluegrass, will allow them to compete more readily early in the growing season while other species have not yet emerged from dormancy. Others, such as smooth brome, have the ability to readily respond to autumn moisture when neighboring species have already entered quiescence. In this same manner, plant species have been observed to respond differently physiologically to

[13] Meristematic tissue simply refers to groups of cells that are densely packed and able to divide, thus providing the growth and elongation of plant parts (e.g., leaves).

herbivory. Those species that are able to reallocate resources quickly, have developed mechanisms to protect meristematic tissue, or have reduced the overall likelihood of being defoliated will have a competitive advantage over their neighbors. Differences in the response to herbivory not only occur among various plant species, but among various genotypes of the same species as well.

In addition, cattle and other livestock are not indiscriminate in their grazing behaviors. Therefore their presence can influence plant community composition by providing a competitive edge to untargeted plants. The individual plants cattle will likely prefer include those lowest in structural carbohydrates and providing the highest, most available amount of nutrients such as nitrogen for the production of protein via rumen microorganisms.

Leege et al. (1981) addressed the impact of grazing versus rest on mountain meadow sites that had either experienced or were protected from heavy grazing for over 10 years. They observed that redtop, rushes, timothy, dandelion, and clover increased and sedges and aster decreased in grazed moist meadow communities. In wet meadows they discovered that redtop, tufted hairgrass, bulrush, timothy, and clover increased while sedges were more common in protected areas. Jackson and Allen-Diaz (2006) conducted a study on spring-fed wetlands in northern California (which more closely resemble conditions found on Refuge meadows), and found that herbaceous cover and diversity were maintained under light to moderate grazing regimes. Kauffman et al. (1983) discovered that lineleaf Indian lettuce (*Montia linearis*), various willowweeds (*Epilobium* spp.), and sedges were favored while meadow timothy, leafy-bract aster (*Aster foliacens*), and northwest cinquefoil decreased with a 3-year rest from grazing in eastern Oregon. These studies do not necessarily conflict with one another, but point out that species' responses to grazing not only differ between type of use (heavy versus moderate being an extremely coarse description of use) and composition of plant species, but also across individual populations within a species.

Prescriptions are easiest to meet when target vegetation is also the most preferred by livestock (e.g., reed canarygrass during spring green-up). Flexibility and continuous monitoring is required, however, to ensure that non-target vegetation is not impacted enough to compromise specific grazing objectives. This is important because the vegetation most preferred by livestock would likely shift during designated treatment windows.

When considering the use of grazing in a specific area, first-hand knowledge of local cattle behavior and an awareness of studies conducted on comparable sites are very helpful. Most grazing research does not provide enough information to fully understand the overall role that livestock played in study results and how their impact may be replicated or avoided in other situations.

The studies discussed above are helpful in understanding how grazing behavior and competitive interspecific relationships within different plant communities have influenced plant community characteristics over time. They also provide things to look out for or to be particularly cognizant of when creating treatment strategies in similar communities. They do not, however, provide a reliable mechanism for predicting vegetation response across the landscape. Use of the best science available, continuous inventory and monitoring associated with adaptive management, and management flexibility will provide the best results over time as methods and approaches are refined through site-specific experience.

Responses of Plant Communities to Dormant Season HO/RBG: Haying may be used in the pursuit of directional change (replacement of one community by another) when conducted within the growing season (e.g., cattail abatement in encroached wet meadows), but such a use is more appropriately placed alongside growing season treatments as discussed above. The overall concept of haying and RBG treatment is to provide non-directional management[14] on wet meadow habitat. The purpose of this section is to evaluate the scientific literature to determine what impacts haying and RBG may have on plant communities as structural objectives (e.g., for migratory and shorebird habitat) are met.

Traditionally, the haying of native meadows within the Harney Basin begins in early July when plants have reached maturity and before a decline in forage quality takes place. Over the last 20 years, the Refuge adjusted its haying practices by delaying cutting until August 10 because collected data revealed that a much higher mortality rate of nesting and fledged birds takes place before then (Rule et al. 1990). Although a later haying date does decrease the value of forage harvested by cooperating permittees, this practice is consistent with meeting wildlife production objectives across the Refuge's wet meadow areas. Because wildlife depend on specific habitat attributes in order to successfully propagate, it is important to consider vegetative impacts alongside reproductive chronologies.

A review of available research generally supports the practice of delayed mowing as valuable in maintaining meadow diversity.[15] Martin and Chambers (2001, 2002) concluded that biomass was not affected by clippings conducted in late July and that late season herbage removal had few effects on the vegetation because it had already begun to senesce. This is consistent with other studies such as Critchley et al. (2009), who noted that late cutting (associated with senescence) was most likely to aid in the reestablishment of target species–rich communities.

Discussion of HO versus RBG: Both RBG and HO treatments can provide benefits to wildlife. HO can provide a higher level of control by working with permittees to treat only target areas, thus ensuring that non-target plant communities remain unimpacted. RBG targets mowed vegetation that offers nearly twice the level of crude protein for livestock than that which is left standing (Turner 1987),[16] thus ensuring that livestock will focus on treated acres as well. However, it is possible for fall rains to provide green-up that may attract livestock to non-mowed areas within the overall treatment boundary, thus causing unintentional grazing outside of the designated treatment area. Shifts in management from RBG to HO have already taken place across the Refuge in areas where this has commonly occurred to prevent the future occurrence of this.

Even though RBG and HO are both used to meet the same meadow prescriptions, there are several reasons why the Refuge anticipates continuing to use RBG as a habitat management tool. First, the presence of noxious weeds on Refuge meadows is a considerable problem. HO involves the transport of hay and associated weed seeds from the Refuge to private lands. The more HO is used, the greater the spread of weeds such as perennial pepperweed will be across the county and beyond. Because all Refuge meadows host pepperweed and other problem plants at various levels of infestation, current weed control efforts primarily target existing HO fields in order to retard the spread of invasive plants onto other lands. (Priorities are necessary as it will cost over $1.5 million for initial treatment

[14] Non-directional management strives to maintain the long-term equilibrium of a site where changes in plant composition is temporary and reversible.
[15] Cited research does not, however, directly address the Refuge's practice of coinciding prolonged irrigation with delayed mowing.
[16] Turner (1987) found that the average crude protein content of rake-bunch versus standing crop was 7.5 percent and 4.3 percent, respectively, over a 3-year period within the Harney Basin. Because pregnant, mature cows require approximately 8 percent crude protein to maintain condition, they will seek available forage that is highest in nutritional value.

of all impacted areas on the Refuge). Herbicides in current use are restricted from use along waterways, which prevents full resolution of the problem. In addition, the soil seed bank will likely require this level of treatment to continue indefinitely. The spread of weeds to private lands is less of a concern when livestock are grazed directly on the Refuge using RBG, because livestock can be quarantined when leaving the Refuge, thus preventing additional expansion of noxious weeds across land management boundaries.

Second, many fields require the mowing of vegetation such as cattail and common reed to prevent or halt the encroachment of emergent marsh vegetation into the wet meadows. Emergent vegetation is generally not palatable to livestock. Nonetheless, HO permittees are required to pay for the tonnage that is hauled off the Refuge, and they are required to bale what is cut in order to achieve litter management objectives for wildlife species the following season. When mowing is conducted in association with RBG, piles are spread out by livestock as they seek nutritious, digestible feed. Any remaining emergent plant litter then becomes disseminated by cattle, which assists in its breakdown prior to the following spring growing season, ultimately promoting the vigor of desirable meadow species.[17]

If piled RBG-treated vegetation remains on the field at the start of the next growing season, it is possible for sandhill cranes and other birds to contract a potentially lethal fungal infection called Aspergillosis. This can occur either under natural conditions or when piled vegetation becomes wet and moldy. Adequate use of vegetation by livestock in RBG-treated meadows has been successful at preventing avian mortality.

Effects to Soils

Soils play a critical role in the management of wildlife habitat because they provide the substrate by which plant communities express themselves. Consideration of soil resources is not only important for the production of vegetation, but also to meet water quality and geomorphic objectives as well. Concerns related to soil resources relative to the use of grazing and haying include the potential for increased erosion, compaction, and/or changes in fertility.

Within the Refuge’s wet meadows, two soils dominate the areas targeted for haying or RBG. The Skidoosprings series consists of sandy loam within 11 inches of the soil surface, while the Fury series consists of silty-clay loam within the top 10 inches. More attention is merited for the Fury series because of its finer texture class. Typical of mollisols, however, this soil type is high in organic matter content and also hosts plant species that are high in root length density (RLD) (see discussion below) and biomass. Finer textured soils such as this across the Refuge where haying or grazing treatments are occurring will be prioritized in annual monitoring efforts.

Erosion: The Refuge’s wet meadows are located on relatively flat topography within the Blitzen and Double-O valleys and are able to rapidly dissipate the energy of potentially destructive flood waters. Because they do not host stream channels and are not found on slopes, erosion caused by water is not a large concern. Impacts caused by wind erosion are also negated by the extensive fibrous root systems of vegetation found just below the surface of the soil within this habitat type. The potential for soil erosion is greatest along dikes, but most of these areas fall outside designated rake-bunch

[17] A third reason that may be argued is the impact repeated use of HO may have on meadow systems via nutrient mining. How long can a site remain productive if nutrients aren’t returned to the system from which they came? There is no research to back up this hypothesis, however, although soil testing may be conducted comparing HO and RBG fields to determine if this concern is merited.

areas and the exclusion of cattle from all canal systems is expected to be completed in the next few years.

Livestock management and associated inventory and monitoring activities will seek to prevent the creation of bare soil in wet meadows by not impacting isolated areas to the point where vegetation is removed and large areas of bare soil are exposed (e.g., regular movement of mineral tubs, adequate graveling of the immediate area of stock tanks, routing tank overflows to nearby emergent stands).

Compaction: The dominant concern regarding the relationship between soils and haying/grazing treatments is compaction. The way soils respond to the presence of machinery or livestock depends on the following prevailing factors: soil texture, on-site soil conditions (wet versus dry, frozen versus thawed), and plant community type (e.g., sedges versus bunchgrasses).

Influence of Soil Texture*:* Fine-textured soils (clay, clay-loam, etc.) have high plasticity and cohesion properties. When they are disturbed under moist conditions, their aggregates are easily broken down. When this occurs, macropores within the soil profile can be greatly diminished. If the impact (i.e., compaction) is extensive enough the soil can become puddled.[18] Because of this, issues regarding compaction and infiltration cannot be separated. Fortunately, there are mitigating factors that influence whether and to what extent such “restructuring” takes place under moist conditions. Soils high in organic matter in the O and A horizons are much more stable than those that are not.

Soil organic matter can consist either of detritus/humus or living vegetative root masses. In riparian studies, RLD has been found to greatly influence site stability. RLDs were found to be especially high in communities dominated by Nebraska sedge, Douglas sedge, and Baltic rush (Manning et al. 1989). Although Manning et al. (1989) associated RLD with the control of erosion in riparian systems, a link can be made between community type and likely compaction issues within wet meadows. Warren et al. (1986) observed that degree of compaction was at least partially influenced by relative sparseness of vegetation in upland sites.

Research conducted on moderately fine soils (silt loam/loam) subjected to season-long and deferred (rotating early/late summer use) grazing treatments found that bulk density (a measure of compaction) was significantly lower and infiltration rates were consistently higher in exclosed plots within both dry and wet meadow sites (Kauffman et al. 2004). Results from a Kentucky bluegrass community study stated that the amount of compaction varied according to soil texture and only impacted the upper 4 inches of the profile. Sites highest in silt and clay had significantly reduced pore space and higher bulk density on grazed areas (treated annually June 1 through October 31) than within exclosures. Where soil texture was more coarse (slightly less clay and more sand), only the first 2 inches displayed these properties (Orr 1960).

Comparable observations were made by other studies examining the relationship of treatment duration/timing and various soils along a texture gradient. The conclusion of a study conducted on fine-textured soil hosting newly seeded alfalfa (*Medicago sativa*) and bromegrass (*Bromus biebersteinii*) revealed that increases in cattle stocking rates during the winter significantly increased soil bulk density (Stephensen and Veigel 1987). Plots within a blue grama (*Bouteloua gracilis*) and buffalograss (*Buchloe dactyloides*) site consisting of rough-textured soil revealed no significant differences between treatments,[19] while bulk density significantly increased in fine-textured soils

[18] Puddling is a term used to express a state of relative impermeability of the soil to air and water.
[19] The grazing treatment took place from May 1 to October 31 for a period of 30 years.

(Van Haveren 1983). No compaction was found to occur on gravelly/sandy loam soils in a riparian area in northeastern Oregon (Bohn and Buckhouse 1985).

Of particular interest is a study conducted by Wheeler et al. (2002) in a plant community that consisted primarily of Kentucky bluegrass, water sedge, beaked sedge, tufted hairgrass, and dandelion, similar in nature to the hydrologically driven plant community gradient found within the Refuge's wet meadows. The study found that although bulk density increased at a depth of 5 to 15 cm (2-6 inches) in grazed treatments occurring in early spring and late summer, the highly organic surface area (0-5 cm [0-2 inches]) did not experience compaction. Of additional interest in this study was the discovery that the bulk density and infiltration rate impacts observed at lower soil depth recovered within 1 year after grazing ceased, which was mainly attributed to frequent freeze–thaw events and high soil organic matter. Similarly, Stephensen and Veigel (1987) observed that recovery of impacted soils on their plots was nearing completion after two growing seasons following their full range of stocking intensities.

Effects to Surface and Groundwater Resources

Under the CCP, cattle grazing will not be permitted in riparian or riverine habitats without site-specific management prescriptions created with input provided by the Ecology Work Group. Such prescriptions will clearly state the rationale for livestock use as well as timing, stocking rate, and other thresholds used in meeting specific plant community attributes. A minimum buffer of 20 meters (65 feet) will protect river and creek channels from haying and grazing treatments. Water delivery canals will not fall under this buffer requirement with the exception of East Canal, which is managed as a fishery for redband trout.

Surface Water: A study assessing the water quality impacts associated with Refuge water and habitat management (irrigation of hay and rake-bunch meadows, grazing, surface and subsurface return from wetlands and agricultural fields) was conducted in the mid-2000s (Mayer et al. 2007). The study investigated a variety of water quality parameters, including water temperature, conductivity, pH, dissolved oxygen, turbidity, nutrients, E. coli, and total coliform between April and September. Grazing has the potential to influence bacteria and nutrients in surface water.

Bacteria: *E. coli* and total coliform samples were collected at numerous stations from Page Springs (southern boundary of the Refuge) to below Sodhouse Dam (near Malheur Lake). The state standard for *E. coli* is that the geometric mean of five samples collected over a 1-month period cannot exceed 126 organisms per 100 mL and no single sample can exceed 406 organisms per 100 mL.

Samples from Station 1 (Blitzen River below Page Springs Dam) were very low (geometric mean of 1 organism/100 mL). Numbers increased slightly downstream at Station 10 (Blitzen River near Grain Camp Dam) and Station 12 (Blitzen River below Sodhouse Dam), but they were still quite low (geometric means of 10 organisms/100 mL or less). The highest numbers of *E. coli* were found at the confluence of McCoy Creek and the Blitzen River, but the numbers were still well below the standard (<50 organisms/100 mL).

Nutrients: The study also examined nutrient loading for irrigated wet meadow areas. Based on the Westside P Ranch area examined in the study, the authors concluded that return flows from seasonally flooded wet meadow habitat contribute to phosphorus concentrations in the river, and possibly to nitrogen. However, the study authors did not identify cattle to be the source of this nutrient loading. It could be the wetting/drying cycle and/or the prevalence of thousands of defecating waterbirds and waterfowl associated with these wetlands.

Groundwater: Stock tanks are used to supply livestock with water sufficient to meet their needs while on the Refuge. Water for the stock tanks comes from wells. Because stock tanks use a minimal amount of water drawn from wells with 2 hp pumps, groundwater levels will not be likely to be significantly impacted.

Other Effects

Loss of Habitat from Facility Construction: Under the CCP, no new facilities will be constructed for haying and grazing activities.

Impacts to Priority Public Uses: Haying and grazing operations may occasionally conflict with the experiences of some Refuge visitors. However, such impact will be expected to be moderate to minor at the Refuge due to the seasonal differences in uses. Refuge visitation peaks during spring, when little grazing or haying will likely occur. Growing season mowing and grazing will not occur at a scale that will disrupt or significantly impact wildlife viewing opportunities enjoyed by Refuge visitors. During the fall when haying and RBG operations are active, wildlife observation and photography visitation falls off. Hunting use increases during this season but is concentrated in the Buena Vista Unit and around Malheur Lake, where little or no haying or grazing occurs.

Impacts from Horses and ATVs: Livestock trailing will continue to occur on the Refuge. ATVs and horses are permissible for use in trailing activities and ATVs may be used in providing supplement tubs in RBG areas. The impacts of horses are considered in the Wildlife Observation, Photography, and Interpretation Compatibility Determination.

Negative impacts will be avoided or minimized by considering specific routes, timing, and other factors on a case-by-case basis.

Infrastructure: Regular, semiannual road maintenance activities cover the minimal disturbance that livestock trailing and equipment/hay hauling activities may cause. Livestock activities have not harmed, nor are they predicted to harm, public use trails on the Refuge.

Use of Diamond and Nine Mile corrals impacts less than 2 acres of Refuge land. Therefore, impacts from this use are negligible.

Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

General

- Use shall be administered as described in the Description of Use above.
- Neighboring habitat boundaries and large mosaics of upland areas (e.g., dry meadow, sagebrush lowland) found within wet meadow treatments will either be excluded by means of fencing or monitored annually to ensure that these areas are not negatively impacted by grazing treatments. Parameters for monitoring will include desirable attributes associated with pertinent habitat types.
- Class 1 ATVs with Oregon permits will be allowed at Malheur Refuge in association with grazing and haying. Class 1 includes ATVs and three-wheelers, are vehicles 50 inches wide or less, have a dry weight of 800 pounds or less, have a saddle or seat, and travel on three or four tires (OPRD 2011). ATVs may only be used in trailing livestock along designated routes to prescribed treatment areas and when necessary to maintain herd health (e.g., feed supplementation) and maintain fence lines (e.g., stringing wire). ATV use is restricted to the fields subject to the use or the designated routes for trailing. ATVs must be weed-free upon entering the Refuge.
- A pre-treatment inventory of local wildlife populations within the propsed warm season treatment area(s) will take place prior to the initiation of treatments.

Grazing

- Permittee has the responsibility to ensure that all fences are intact and gates closed before turning out livestock.

Haying

- All haying operations must be conducted from dawn to dusk only.
- Hay cannot be fed out on the Refuge unless authorized by the Refuge Manager for the purpose of weed prevention. Quarantines will last no longer than 5 days.

Justification

The haying and grazing cooperative land management program contributes to achieving Refuge purposes and goals as identified in the CCP and the Refuge System mission by providing valuable foraging, resting, pairing, nesting, and brood-rearing areas and conditions for the sandhill crane, bobolink, cinnamon teal, and other meadow-dependent species. It also contributes by economically providing weed control and other habitat maintenance functions that are not feasible for limited Refuge staff to accomplish. Grazing and haying are desirable means of maintaining this type of habitat because its area is too large for annual prescribed burning and repeated mowing of the meadows is beyond the capability of the Refuge staff. Haying and Grazing could have adverse impacts including potential disturbance to wildlife, trampling of nests, water quality impacts and introduction of invasive species. In addition auxiliary components of the grazing program such as introduction of fence lines and use of ATVs can also have adverse impacts on wildlife. Although allowing haying and cattle grazing on the Refuge can result in the above described disturbances to wildlife, disturbance will be intermittent and short term, particularly since wildlife disturbance concerns are primarily associated with warm season treatments, which are experimental in nature when initiated. The efficacy of this strategy will be rigorously reviewed on an annual basis by the ecology working group to ensure that in fact ecological targets are being achieved, adverse impacts are being minimized, and that the most effective overall strategies are being employed. Because a majority of haying and grazing treatments that will take place occur late in the season when most birds are capable of avoiding disturbance (i.e., dormant season), the relatively limited number of individuals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. The goal of both dormant and growing season treatments is to improve habitat for wildlife and rigorous annual review and revision by the ecology working group will help ensure that short-term tradeoffs are good investments for the birds. Thus Malheur National Wildlife Refuge CCP Appendix B Compatibility Determinations B-103 allowing haying and cattle grazing on the Refuge in conjunction with rigorous annual review and revision (as necessary) is found to be in support of and compatible with the purposes for establishment of the Refuge and the mission of the Refuge System.

Mandatory Reevaluation Date

__09/2022__ Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision

__X__ Environmental Impact Statement and Record of Decision

References

Allen-Diaz, B.H. 1991. Water table and plant species relationships in Sierra Nevada meadows. American Midland Naturalist 126:30-43.

Altman, B. and A.L. Holmes. 2000. Conservation strategy for landbirds in the Columbia Plateau of eastern Oregon and Washington. Prepared for Oregon and Washington Partners in Flight. American Bird Conservancy and Point Reyes Bird Observatory. Petaluma, CA.

Austin, J.E., W.H. Pyle, J.R. Keough, and D.H. Johnson. 2002. Evaluation of management practices in wetland meadows at Grays Lake National Wildlife Refuge, Idaho, 1997-2000. U.S. Geological Survey, Northern Prairie Wildlife Research Center. Jamestown, ND.

Belsky, A.J. 1992. Effects of grazing, competition, disturbance and fire on species composition and diversity in grassland communities. Journal of Vegetation Science 3:187-200.

Bohn, C.C. and J.C. Buckhouse. 1985. Some responses of riparian soils to grazing management in northeastern Oregon. Journal of Range Management 38(4):378-381.

Bollinger, E.K., and T.A. Gavin. 1992. Eastern bobolink populations: ecology and conservation in an agricultural landscape. Pages 497-506 in: J.M. Hagan, III, and D.W. Johnston, eds. Ecology and conservation of Neotropical migrant landbirds. Washington, D.C.: Smithsonian Institute Press.

Briske, D.D. 1991. Developmental morphology and physiology of grasses. Pages 85-108 in: R.K. Heitshmidt, and J.W. Stuth, eds. Grazing management: an ecological perspective. Portland, OR: Timber Press.

Briske, D.D. and J.H. Richards. 1995. Plant responses to defoliation: a physiological, morphological, and demographic evaluation. Pages 635-710 in: Wildland plants: physiological ecology and developmental morphology. D.J. Bedunah and R.E. Sosebee, eds. Denver, CO: Society for Range Management.

Brooks, M.D.J. and M. Lusk. 2008. Fire management and invasive plants: a handbook. United States Fish and Wildlife Service. Arlington, VA. 27 pp.

Chapin III, S.F. and M. Slack. 1979. Effect of defoliation upon root growth, phosphate absorption and respiration in nutrient-limited tundra graminoids. Oecologia 42:67-79.

Chesson, P. and N. Huntley. 1997. The roles of harsh and fluctuating conditions in the dynamics of ecological communities. American Naturalist 150:519-553.

Christianson T. 2009. Fence marking to reduce greater sage-gouse (*Centrocercus urophasianus*) collisions and mortality near Farson, Wyoming – summary of interim results. Wyoming Game and Fish Department.

Crawley, M.J. 1987. What makes a community invasible? Pages 429-453 in: A.J. Gray, M.J. Crawley, and P.J. Edwards, eds. Colonization, succession and stability. Oxford, UK: Blackwell Scientific.

Crider, F.J. 1955. Root growth stoppage resulting from defoliation of grass. U.S. Department of Agriculture Technical Bulletin 1102:23.

Critchley, C.N.R., J.A. Fowbert, and B. Wright. 2009. Dynamics of species-rich upland hay meadows over 15 years and their relation with agricultural management practices. Applied Vegetation Science 10(3):307-314.

Dale, B.C., P.A. Martin, and P.S. Taylor. 1997. Effects of hay management on grassland songbirds in Saskatchewan. Wildlife Society Bulletin 25:616-626.

Damhoureyeh, C.M. and D.C. Hartnett. 1997. Effects of bison and cattle on the growth, reproduction, and abundances of five tallgrass prairie forbs. American Journal of Botany 84:1719-1728.

David, J. and G. Ivey. 1995. Double-O habitat management plan, Malheur National Wildlife Refuge. U.S. Fish and Wildlife Service. Princeton, OR. 88 pp.

Davidson, J.L. and F.L. Milthorpe. 1966. Leaf growth in *Dacylis glomerata* following defoliation. Annals of Botany 30(118):173-184.

Davidson, N.C. and P.R. Evans. 1988. Prebreeding accumulation of fat and muscle protein by arctic-breeding shorebirds. Proceedings of the Nineteenth International Ornithological Congress, Ottawa 342-352.

DeAngeles, D.L. 1992. Dynamics of nutrient cycling and food webs. London: Chapman and Hall.

Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, A.L. Zimmerman, and B.R. Euliss. 1999 (Revised 2001). Effects of management practices on grassland birds: bobolink. Northern Prairie Research Center, Jamestown, ND. 24 pp.

Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, M.P. Nenneman, and B.R. Euliss. 2003. Effects of management practices on grassland birds: short-eared owl. Northern Prairie Wildlife Research Center, Jamestown, ND. Available at: http://www.npwrc.usgs.gov/resource/literatr/grasbird/seow/seow.htm (Version 12 Dec 2003).

Ducks Unlimited. 1994. Continental conservation plan: an analysis of North American waterfowl populations and a plan to guide conservation programs of Ducks Unlimited. Ducks Unlimited, Inc., Washington, D.C.

Dwire, K.A., J.B. Kauffman, and J.E. Baham. 2006. Plant species distribution in relation to water-table depth and soil redox potential in montane riparian meadows. Wetlands 26(1):131-146.

Dyer, M.I., C.L. Turner, and T.R. Seastedt. 1993. Herbivory and its consequences. Ecological Applications 3(1):10-16

Dyer, M.I., M.A. Acra, G.M. Wang, D.C. Coleman, D.W. Freckman, S.J. McNaughton, and B.R. Strain. 1991. Source-sink relations in two *Panicum coloratum* ecotypes in response to herbivory. Ecology 72:1472-1483.

Dyer, M.I., D.L. De Angelis, and W.M. Post. 1986. A model of herbivore feedback on plant productivity. Mathematical Biosciences 79:171-184.

Eldridge, J. 1992. Management of habitat for breeding and migrating shorebirds in the Midwest. Fish and Wildlife Leaflet 13.2.14. 6 pp.

Eldridge, J.L. and G.L. Krapu. 1988. The influence of diet quality on clutch size and laying pattern in mallards. The Auk 105:102-110.

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

Epperson, W.L., J.M. Eadie, D.B. Marcum, E.L. Fitzhugh, and R.E. Delmas. 1999. Late season hay harvest provides habitat for marshland birds. California Agriculture 53:12-17.

Farmer, A.H. and A.H Parent. 1996. Effects of the landscape on shorebird movements at spring migration stopovers. Condor 99:698-707.

Foster, C.L. 1985. Habitat definition of nesting birds in the Double-O Unit, Malheur National Wildlife Refuge, OR. M.S. thesis. Humboldt State University, Arcata, CA. 111 pp.

Foster, B.L. and K.L. Gross. 1998. Species richness in a successional grassland: effects of nitrogen enrichment and plant litter. Ecology 79(8):2593-2602.

Gomm, F.B. 1979. Management alternatives for native meadows. Special Report 532, December. Agricultural Experiment Station, Oregon State University. Corvallis, OR.

Harrington, J.L. and M. R. Conover. 2010. Characteristics of ungulate behavior and mortality associated with wire fences. Wildlife Society Bulletin 34:1295-1305.

Helmers, D.L. 1992. Shorebird management manual. Western Hemisphere Shorebird Reserve Network. Manomet, MA. 58 pp.

Henszey, R.J., Q.D. Skinner, and T.A. Wesche. 1991. Response of montane meadow vegetation after two years of streamflow augmentation. Regulated Rivers: Research and Management 6:29-38.

Herkert, J.R. 1991. An ecological study of the breeding birds of grassland habitats within Illinois. Ph.D. dissertation. University of Illinois, Urbana. 115 pp.

Herkert, J.R. 1994. Breeding bird communities of midwestern prairie fragments: the effects of prescribed burning and habitat-area. Natural Areas Journal 14:128-135.

Horton, S.K., C.D. Littlefield, D.G. Paullin, and R.E. Vorderstrasse. 1983. Migratory bird populations and habitat relationships in Malheur-Harney lakes basin, Oregon. Unpublished Report. U.S. Fish and Wildlife Service. Portland, OR.

Houghton, J.T., G.J. Jenkins, J.J. Ephraums, eds. 1990. 1990 Intergovernmental panel on climate change. Cambridge, UK: Cambridge University Press.

Ivey, Gary. 2011. Personal communication between Gary Ivey, Wildlife and Wetlands Consultant, and Refuge staff, U.S. Fish and Wildlife Service, August 2011.

Ivey, G.L, C.F. Foster, and D.G. Paullin. in prep. Abundance and migration patterns of migrant shorebirds in the Harney Basin, Oregon. Unpublished report.

Ivey, G.L. and B.E. Dugger. 2008. Factors influencing nest success of greater sandhill cranes at Malheur National Wildlife Refuge, Oregon. Waterbirds 31:52-61.

Ivey, G.L. and C.P. Herziger. 2000. Distribution of greater sandhill crane pairs in Oregon, 1999/2000. Oregon Department of Fish and Wildlife Nongame Technical Report #03-01-00. Salem, OR.

Ivey, G.L. and C.P. Herziger. 2006. Intermountain west waterbird conservation plan, version 1.2. A plan associated with the Waterbird Conservation for the Americas Initiative. U.S. Fish and Wildlife Service Pacific Region, Portland, OR. Available at: http://www.fws.gov/birds/waterbirds/intermountainwest/MainTextV12nocover.pdf

Jackson, R.D. and B. Allen-Diaz. 2006. Spring-fed wetland and riparian plant communities respond differently to altered grazing intensity. Journal of Applied Ecology 43(3):485-498.

Johnson, D.H. 1997. Effects of fire on bird populations in mixed-grass prairie. Pages 181-206 in: F.L. Knopf and F.B. Samson, eds. Ecology and conservation of Great Plains vertebrates. New York: Springer. Bozeman, MT: Mountain Prairie Information Node.

Kauffman, J.B., W.C. Krueger, and M. Vavra. 1983. Effects of late season cattle grazing on riparian plant communities. Journal of Range Management 36(6):685-691.

Kauffman, J.B., A.S. Thorpe, and E.N.J. Brookshire. 2004. Livestock exclusion and belowground ecosystem responses in riparian meadows of Eastern Oregon. Ecological Applications 14(6):1671-1679.

Kluse, J.S. and B.H. Allen-Diaz. 2005. Importance of soil moisture and its interaction with competition and clipping for two montane meadow grasses. Plant Ecology 176:87-99.

Leege, T.A., D.J. Herman, and B. Zamora. 1981. Effects of cattle grazing on mountain meadows in Idaho. Journal of Range Management 34(4):324-327.

Littlefield, C.D. 1975. Greater sandhill crane management plan for Malheur National Wildlife Refuge, Harney County, Oregon. Station Library, Malheur National Wildlife Refuge. 42 pp.

Littlefield, C.D. 1985. Radio-telemetry studies of juvenile greater sandhill cranes on Malheur National Wildlife Refuge, Oregon. Final Rep. Contract No. 10181-4594. U.S. Fish Wildlife Service, Malheur National Wildlife Refuge. Princeton, OR. 31 pp.

Littlefield, C.D. 1989. Status of greater sandhill crane breeding populations in California, 1988. California Department of Fish and Game, Nongame Bird and Mammal Section Report. Sacramento, CA.

Littlefield, C.D. 2010. Personal communication between Jess Wenick, Ecologist, Malheur Refuge, and Carroll D. Littlefield, the Bioresearch Ranch.

Littlefield, C.D. and R.A. Ryder. 1968. Breeding biology of the greater sandhill crane on Malheur National Wildlife Refuge. Colorado State University. Fort Collins, CO. 19 pp.

Madden, E.M. 1996. Passerine communities and bird-habitat relationships on prescribe-burned, mixed-grass prairie in North Dakota. M.S. thesis. Montana State University, Bozeman, MT. 153 pp.

Madden, E.M., A.J. Hansen, and R.K. Murphy. 1999. Influence of prescribed fire history on habitat and abundance of passerine birds in northern mixed-grass prairie. Canadian Field-Naturalist 113:627-640.

Manning, M.E., S.R. Swanson, T. Svejar, and J. Trent. 1989. Rooting characteristics of four intermountain meadow community types. Journal of Range Management 42(4):309-312.

Martin, D.W. and J.C. Chambers. 2001. Effects of water table, clipping, and species interactions on *Carex nebrascensis* and *Poa pratensis* in riparian areas. Wetlands 21(3):422-430.

Martin, D.W. and J.C. Chambers. 2002. Restoration of riparian meadows degraded by livestock grazing: above- and belowground responses. Plant Ecology 163:77-91.

Mayer, T., R. Roy, T. Hallock, and K. Janssen. 2007. Hydrology and water quality at Malheur National Wildlife Refuge. U.S. Fish and Wildlife Service. Unpublished report on file at the Refuge office.

Mornsjo T. 1969. Studies on vegetation and development of a peatland in Scania, south Sweden. Opera Botanica 24:187.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

ODFW. 2006. Oregon Conservation Strategy. Salem, OR.

OPRD (Oregon Parks and Recreation Department). 2011. ATV permits. Available at: http://www.oregon.gov/OPRD/ATV/Permits.shtml.

Oring, L.W, L. Neel, and K.E. Oring. 2000. Intermountain west regional shorebird plan. Available at: http://www.fws.gov/shorebirdplan/regionalshorebird/downloads/IMWEST4.pdf.

Orr, H.W. 1960. Soil porosity and bulk density on grazed and protected Kentucky bluegrass range in the Black Hills. Society for Range Management 13(2):80-86.

Pacific Flyway Council. 1997. Pacific Flyway management plan for the central valley population of greater sandhill cranes. Pacific Flyway Study Committee. Portland, OR.

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: a survey of historical localities, 2009. U.S. Geological Survey Open-File Report 2010-1235. LaGrande, OR. 96 pp.

Perata, P. and A. Alpi. 1993. Plant responses to anaerobiosis. Plant Science 93:1-17.

Poiani, K.A. and Johnson, W.C. 1991. Global warming and prairie wetlands: potential consequences for waterfowl habitat. BioScience 41:611-618.

Renfrew, R.B. and C.A. Ribic. 2001. Grassland birds associated with agricultural riparian practices in southwestern Wisconsin. Journal of Range Management 54:566-552.

Richards, J.H. 1984. Root growth response to defoliation in two Agropyron bunchgrasses: field observations with an improved periscope. Oecologia 64:21-25.

Ricklefs, R.E. 1974. Energetics of reproduction in birds. Pages 152-297 in: R.A. Paynter, Jr., ed., Avian energetics. Cambridge, MA: Nuttall Ornithology Club No. 15.

Rule, M., G. Ivey, D. Johnson, and D. Paullin. 1990. Blitzen Valley management plan. Malheur National Wildlife Refuge. Princeton, OR. 169 pp.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Rumburg, C.B. and W.A. Sawyer. 1965. Response of wet-meadow vegetation to length and depth of surface water from wild-flood irrigation. Agronomy Journal 57:245-247.

Stephenson, G.R. and A. Veigel. 1987. Recovery of compacted soil on pastures used for winter cattle feeding. Journal of Range Management 40(1):46-48.

Stringham, T.S., W.C. Krueger, and D.R. Thomas. 2001. Application of non-equilibrium ecology to rangeland riparian zones. Journal of Range Management 54(3):210-217.

Tiner, R.W. 1991. The concept of a hydrophyte for wetland identification. BioScience 41(4):236-247.

Turner, H.A. 1987. Utilizing rake-bunched hay for wintering mature cows. Oregon Agricultural Experiment Station Special Report 801:1-7. Corvallis, OR.

U.S. Department of the Interior. 1994. The impact of Federal programs on wetlands, Vol. II. A report to the Congress by the Secretary of the Interior. U.S. Department of the Interior. Washington, D.C.

Van Haveren, B.P. 1983. Soil bulk density as influenced by grazing intensity and soil type on a shortgrass prairie site. Journal of Range Management 36(5):586-588.

Warren, S.D., T.L. Thurow, W.H. Blackburn, and N.E. Garza. 1986. The influence of livestock trampling under intensive rotation grazing on soil hydrologic characteristics. Journal of Range Management 39(6):491-495.

Wheeler, M.A., M.J. Trlica, G.W. Frasier, and J.D. Reeder. 2002. Seasonal grazing affects soil physical properties of a montane riparian community. Journal of Range Management 55(1):49-56.

Wittenberger, J.F. 1978. The breeding biology of an isolated bobolink population in Oregon. Condor 80:355-371.

Wittenberger, J.F. 1980. Vegetation structure, food supply, and polygyny in bobolinks. Ecology 61(1):140-150.

Xiong, S., M.E. Johansson, F.M.R. Hughes, A. Hayes, K.S. Richards, and C. Nilsson. 2003. Interactive effects of soil moisture, vegetation canopy, plant litter, and seed addition on plant diversity in a wetland community. Journal of Ecology 91(6):976-986.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Refuge Manager/ Acting Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	1-24-13 (Date)

B.8 Plant Gathering of Culturally Important Plants Compatibility Determination

RMIS Database Use: Plant Gathering

Refuge Name: Malheur National Wildlife Refuge

City/County and State: Princeton, Harney County, Oregon

Establishing and Acquisition Authorities and Refuge Purposes:

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the [National Wildlife Refuge] System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use

Malheur Refuge is the ancestral home of the Burns Paiute Tribe. Culturally important plants that grow in the wetlands, marshes, and riparian areas have been collected by members of the Tribe for generations. Culturally important plant collection involves taking hand cuttings from live plants (e.g., willow whips) or plants that have reached senescence (cattails and bulrush). Plant materials are collected in small amounts and plant mortality does not occur as a result of these activities. Collection typically occurs in areas closed to all public access.

Culturally important plants collected on the Refuge are used by Tribal members in a non-commercial way to obtain materials used to perpetuate traditional weaving techniques, and as an educational opportunity used to introduce Tribal youth to an important aspect of their heritage. Tribal elders have been involved in the development of a native plant list that is consulted by Refuge staff when habitat restoration projects are being planned on the Refuge.

The occurrence of this activity is infrequent and is not expected to grow significantly in the near future. Tribal members prefer to collect plant materials on the Refuge because of their abundance, ease of access, and the absence of herbicide use. Selection of collection areas occurs in coordination with Refuge staff and typically occurs where access for elders is easy, where plants are abundant, where collection has occurred in the past and plants have responded positively (e.g., willow growth is enhanced by cutting), and where conflicts with wildlife will be minimal or absent. Collection typically occurs from late summer through the winter when plants are dormant and when fields and ponds are dry.

The opportunity for Tribal members to collect culturally important plants on the Refuge has resulted in the development of a positive and collaborative relationship between the Burns Paiute Tribe and Malheur Refuge. Continuation of this culturally important opportunity will ensure that the relationship continues and matures in the future.

Plant Materials: Plants typically collected include cattails (*Typha* spp.), bulrush (*Scirpus* spp.), sedges (*Carex* spp.), redosier dogwood (*Cornus sericea*), various willows (*Salix* spp.), milkweed (*Asclepias* spp.), and seepweed (*Suaeda* spp.).

Availability of Resources

Adequate Refuge personnel and base operational funds are available to manage this activity at existing and projected levels. Staff time (less than 1 day per year) primarily involves phone conversations, email correspondence, and preparation of SUPs.

Anticipated Impacts of the Use

Non-commercial collection of culturally important plants at current levels is not expected to incur more than negligible short-term or long-term impacts to natural resources. These will involve localized and temporary vegetation trampling and localized and temporary wildlife disturbance. Sites will be monitored by Refuge staff to ensure that plant gathering does not result in depletion of the harvested resource. Under these conditions, no long-term impacts will be expected.

***Impacts to Listed Species*:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from plant collecting will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. Persons engaging in plant collecting will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

Impacts to Other Priority Public Uses**:** Persons collecting plants may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or EE groups, but this conflict will be expected to be minimal.

Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

- An SUP will be issued for the collection of culturally important plants by Burns Paiute Tribe members. The SUP will indicate the plant collection locations, dates of access, and quantity of materials that may be harvested.
- Collection sites shall be monitored by Refuge staff to ensure that plant gathering does not result in depletion of the harvested resource.

Justification

Although collection of plants can result in vegetation modification and disturbance to wildlife, this activity will occur on a small percentage of Refuge acres. There is sufficient undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing this use to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System’s mission.

Issuance of an SUP eliminates the potential for overcollection of culturally important plants, guarantees that collectors have authorization to be in areas closed to public access, and ensures that Refuge staff are aware of collection activities.

Mandatory Reevaluation Date

__09/2022__ Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision

____X____ Environmental Impact Statement and Record of Decision

References

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pacific Flyway Council. 1997. Pacific Flyway management plan for the Central Valley Population of Greater Sandhill Cranes, Pacific Flyway Study Committee. Unpublished report. Portland, OR 44 pp. + appendices.

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Acting Refuge Manager/ Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	Rob L. West (Signature)	1-24-13 (Date)

B.9 Research, Scientific Collecting, and Surveys Compatibility Determination

RMIS Database Use: Research; Scientific Collecting; Surveys

Refuge Name: Malheur National Wildlife Refuge

City/County and State: Princeton/Harney, Oregon

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the Unites States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 USC 668dd-668ee]).

Description of Use

Program: The Refuge allows research on a variety of biological, physical, archeological, and social issues and concerns to address Refuge management information needs or other issues not related to Refuge management. This CD refers to research, collecting, or surveys conducted by non-USFWS entities. This may include other Federal, state, tribal, and private entities, or their contractors.

Location of Use: Research, scientific collecting, and surveys may occur at any location on the Refuge. Location will depend on the research objectives.

The Refuge has numerous archaeological and paleontological sites. All research conducted on the Refuge must take this into consideration. All laws and Refuge policy associated with artifacts must be followed when gaining access to closed sites on the Refuge for research.

Associated Facilities and Access*:* Although no facilities at the Refuge will be maintained expressly for this use, the use may involve temporary use of some facilities. Research study sites, sampling locations, and transects shall be temporarily marked by highly visible wooden or metal posts, and/or flagging that must be removed when research ceases.

Access to study sites shall be by foot, truck, all-terrain vehicle, boat, airboat, canoe, other approved watercraft, and aircraft. Vehicle use is allowed on Refuge roads normally open to the public. Researchers may not enter closed areas, unless specifically authorized access in the SUP.

Administration of the Use: The use will be conducted on an as-needed basis, subject to SUP approval. Prior to initiating the project, research applicants must submit a proposal outlining: 1) objectives of the study; 2) justification for the study; 3) detailed methodology and schedule; 4) potential impacts on Refuge wildlife and/or habitat, including disturbance (short and long term), injury, or mortality; 5) potential impacts to wilderness natural areas; 6) personnel required; 7) costs to Refuge, if any; and 8) end products (i.e., reports, publications).

Proposals will be reviewed by Refuge staff, the Regional Office Branch of Refuge Biology, and others as appropriate. Evaluation criteria will include, but not be limited to, the following: 1) research that will contribute to management will have higher priority than other requests; 2) research that will conflict with higher priority research, monitoring, or management programs may not be granted; 3) research projects that can be reasonably conducted off-Refuge are less likely to be approved; 4) research that causes undue disturbance or is intrusive will likely not be granted. Level and type of disturbance will be carefully weighed when evaluating a request. All requests will be carefully considered because some species are very sensitive to disturbance; 5) research evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.; 6) if staffing or logistics make it impossible for the Refuge to monitor researcher activity in a sensitive area, this may be reason to deny the request; 7) the length of the project will be considered and agreed upon before approval. Projects will not be open-ended and will be reviewed annually at a minimum.

If no conflicts to the Refuge’s mission are determined and an SUP is written, then the study will be conducted. At any time if the research is in violation of the terms and agreement of the SUP, the Refuge can terminate access.

Number of Projects and Seasonal Patterns: The number of projects is expected to vary but based upon current experience, may range from 2 to 12 projects per year. Chapter 4 in the CCP describes the kinds of research projects that have occurred in the past.

The season of use may be at any time of the year. This use will only be permitted when conflicts did not occur with natural resources. This will be detailed in the permit’s Special Conditions section. For example, Malheur Lake access with an airboat will not be granted to researchers if a disruption of breeding and nesting birds occurs.

Availability of Resources

Resources Involved in the Administration and Management of Use: Time will be required by office staff to prepare and issue SUPs. Designated research areas will need to be monitored by staff within the Biology, Visitor Services, or Archaeological programs and Refuge law enforcement to ensure permit conditions are met.

Special Equipment, Facilities, or Improvements Necessary to Support the Use*:* The demand for Refuge equipment and facilities will be considered on a case-by-case basis depending on research study objectives. Arrangements will have to be made between the Refuge and researchers to determine if support is needed. If so, the researcher will have to provide grant money to cover costs or the Refuge will donate in-kind to the project.

Maintenance Costs: Maintenance costs will be considered on a case-by-case basis depending on the research study objectives. The specific use will have to provide grant money to cover costs or the Refuge will donate in-kind to the project.

Monitoring Costs*:* No monitoring costs will occur. The researchers will be responsible for monitoring.

Offsetting Revenues: Because this usage aids the Refuge in understanding specific objectives and projects in addition to staff activities, research results provide the potential for overall cost savings for Refuge management activities. Since research represents a cost saving to the Refuge, there will be no fee for the issuance of permits.

Anticipated Impact of the Use(s)

Given the stipulations listed below, some short-term impacts can be expected, but no long-term or cumulative effects are anticipated because of the specifications in the SUP.

Short-term Impacts: Research activities may disturb fish and wildlife and their aquatic and terrestrial habitats in the short term. For example, the presence of researchers can cause waterfowl to flush from resting and feeding areas, or cause disruption of birds in nests or breeding territories. Efforts to capture animals can cause disturbance or injury. To wildlife, the energy cost of disturbance may be appreciable in terms of disruption of feeding, displacement from preferred habitat, and the added energy expended to avoid disturbance.

Sampling activities can cause compaction of soils and the trampling of vegetation, the establishment of temporary foot trails and boat trails through vegetation beds, disruption of aquatic sediments, and minor tree damage when tree climbers access bird nests. This may lead to avenues of predation and predator habituation. The removal of vegetation or sediments by core sampling methods can cause increased localized turbidity and disrupt non-target plants and animals. Installation of posts, equipment platforms, collection devices and other research equipment in open water may present a hazard to boaters if said items are not adequately marked and/or removed at appropriate times or upon completion of the project. Research efforts may also discover methods that result in a reduction in impacts described above.

Adverse impacts of research will be minimized through stipulations described below. Vehicular access will be allowed only on roads and mowed dike tops, thus resulting in no net increase in vehicular impact. Access into any closed areas will only be permitted under terms specifically described in the SUP, thus avoiding and minimizing human disturbance to feeding and resting waterfowl. Researchers will also be required to observe public use regulations to avoid disturbance of fish and wildlife and provide areas of quiet and solitude sought by many users of the Refuge. Any research equipment that remains in the field for the duration of the project will be clearly marked to avoid potential hazards presented to other Refuge users.

Long-term Impacts: The long-term impacts of research may include injury or death to groups of wildlife or to individuals during efforts to capture samples. Continual disruption could cause expenditure of energy, decreased immunity to pathogens, nest abandonment, displacement in less than optimal habitat, and nest swamping from wave action. However, given the stipulations listed below, no or very minimal impacts will be expected in the long term. Research efforts may also discover methods that result in a reduction in impacts described above.

Cumulative and Indirect/Secondary Impacts*:* Because continuous, long-term research will rarely be allowed at one site, long-term cumulative impacts such as poor water quality, benthic disturbances, wildlife disturbance, and/or vegetation trampling will be negligible. SUP conditions will include special conditions to ensure that impacts to wildlife and habitats are kept to a minimum and are short term.

Impacts to Listed Species**:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from research will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. Persons engaging in research will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

Impacts to Priority Public Uses**:** Researchers may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or EE groups, but this conflict will be expected to be minimal.

Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

This activity will only be allowed in designated areas and specific terms will be established in associated SUPs regarding designated research areas, permissible dates, conditions of research, off-road use of vehicles, and acceptable research procedures. Permit conditions are likely to change from project to project depending on study objectives. These conditions may include, but are not limited to, the following:

- If the proposed research methods will impact or potentially impact Refuge resources (habitat or wildlife), it must be demonstrated that the research is essential (i.e., critical to survival of a species; critical habitat for a species; or assessment and/or restoration after cataclysmic events) and the researcher must identify the issues in advance of the impact. Highly intrusive or manipulative research is generally not permitted in order to protect our natural resource.
- Prior to conducting investigations, researchers will submit a written study proposal with their request to obtain an SUP from the Refuge that makes specific stipulations related to when, where, and how the research will be conducted (see Description Of Use section). Managers retain the option to prohibit research on the Refuge that does not contribute to the purposes of the Refuge or the mission of the Refuge System, or that causes undue resource disturbance or harm.
- Approved research projects will be conducted under a Refuge-issued SUP, which will have additional project-specific stipulations.
- Researchers must possess all applicable state and Federal permits for the capture and possession of protected species for conducting regulated activities in wetlands and for other regulated activities.
- Research must adhere to current species protocols for data collection.
- Researchers must clearly mark posts, equipment platforms, fencing material, and other equipment left unattended in open water so as to not pose a navigation hazard to boaters. Such items shall be removed from the river as soon as practicable upon completion of the research.
- SUPs will be valid for 1 year only. Renewals will be subject to the Refuge Manager’s review of research data, status reports, compliance with the CD and permit stipulations, and permits.
- Off-road access is only allowed when soils are frozen or dry in areas where native vegetation will not be impacted, within specific boundaries.
- Research must be during hours when appropriate staff are available to monitor conduct and permit compliance.
- Inspection and washing of research equipment to decrease the spread of invasive species is required.
- Activities are allowed only where minimal impacts to wildlife may occur.
- Periodic evaluation of research projects will be held to assess if objectives are being met and ensure that resources are not being degraded.
- Regulations to ensure the safety of all participants must be followed.
- Law enforcement patrols are conducted to ensure compliance with state and Refuge regulations.
- The Refuge Manager can suspend/modify conditions/terminate on-Refuge research that is already permitted and in progress, should unacceptable impacts or issues arise or be noted.

Justification

Research by third parties plays an integral role in Refuge management by providing information needed to manage the Refuge on a sound scientific basis. Investigations into the biological, physical, archeological, and social components of the Refuge provide a means to analyze management actions, impacts from internal and outside forces, and ongoing natural processes on the Refuge environment. Research provides scientific evidence as to whether the Refuge is functioning as intended when established by Congress.

Although these activities can result in disturbance to wildlife, these activities will occur on a small percentage of Refuge acres. There is sufficient undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing research, scientific collecting, and survey activities to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System's mission.

Mandatory Reevaluation Date

__09/2022__ Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision

____X____ Environmental Impact Statement and Record of Decision

References

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Acting Refuge Manager/ Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	1-24-13 (Date)

B.10 Farming Compatibility Determination

RMIS Database Use: Farming

Refuge Name: Malheur National Wildlife Refuge

City/County and State: Princeton/Harney, Oregon

Establishing and Acquisition Authorities and Refuge Purposes

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the Unites States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 USC 668dd-668ee]).

Description of Use(s)

Acres and Crops Grown: The cooperative program will include between 80 to 1,000 acres to support objectives described in the CCP using appropriate farming practices. Crops will include wheat, barley, rye, oats, or similar crops known to have wildlife forage value. Crops will generally be grown under non-irrigated or sub-irrigated conditions; however, in some years spring runoff and rainfall during the growing season are insufficient to produce a successful crop.

Location of Use: The use will take place in areas deemed advantageous to target wildlife species per the goals and objectives listed in various Refuge plans. Initially, the farming program will focus on areas in the vicinity of Center Patrol Road near Refuge Headquarters north of Rattlesnake Butte.

Timing of Use: Depending on the target crop, seed bed preparation and seeding will take place in late winter/early spring with associated soil amendments and herbicide being applied in spring and summer, respectively. Mowing will occur in the summer or early fall, depending on the crop. Harvesting of the crop will occur as soon as the crop has matured and ripened and before the fall hunting season.

Equipment, Facilities and Improvements: To support this use, standard crop farming equipment will be used such as tractors, plows, disks, seeders, trucks, wagons, spray rigs, and combines. The cooperator will not use any on-Refuge facilities for seed or harvested grain storage. Minimal access road improvements and maintenance will be needed for farming equipment ingress/egress.

Administration of the Use: Cropland management will be carried out by private parties on Refuge lands under the terms of cooperative agreement. The agreement could take the form of either a Cooperative Farming Agreement (CFA) or a Cooperative Land Management Agreement (CLMA). Under either scenario, the farmer will receive an 80 percent share of the crop and the remaining 20 percent is left in the field for wildlife. Under this scenario, approximately 950 acres of grain will be needed. The two types of cooperative agreements are described below:

- **CFA:** Within such agreements, the cooperator will provide labor, equipment, and materials and the government will provide the land base unless other arrangements are made between the Refuge Manager and cooperator(s). The resulting crop will be shared by the cooperator and the government.

- **CLMA:** The CLMA is an in-kind program, which means that both parties receive benefits from the land. In this case, the cooperator and Refuge both receive a portion of the crop, and the Service receives management actions that enhance habitat condition through activities such as weed control and prevention strategies incorporated into the program.

  The CLMA will be an annual agreement composed of: 1) objectives of the program; 2) commitment and responsibilities of each partner under the contract; 3) description and map of the area affected by the agreement; 4) details on the techniques, schedules, strategies, and methods to be used in the cooperative agreement; 5) crop or other products produced under the agreement; and 6) delineation of shares. The CLMA will be reviewed and updated annually. The CLMA will not express or describe any permanent or long-term agreement between the cooperator and the Refuge.

The cooperator (farmer) will be selected based on his or her ability to: 1) adapt and meet the changing conditions of the program; 2) apply best land management practices to selected land tracts; 3) use best management practices of an integrated pest management (IPM) plan; 4) meet the special conditions outline in the CLMA; 5) sustain an operation under potential impacts of wildlife depredation and changing habitat conditions; and 6) be economically capable of operating under the conditions of the program.

Rationale for the Use: The purpose of developing a cooperative farming program is to manage high-carbohydrate autumn foraging habitat for sandhill cranes, waterfowl, and other migratory and resident wildlife species. The Refuge (together with cereal grains then grown on the Refuge) was identified as one of four autumn staging and migration stopover sites in the Greater Sandhill Crane (Central Valley Population) Pacific Flyway Plan (Pacific Flyway Council 1997). The plan noted that the Malheur fields had been used for several decades. Grain farming will support greater sandhill crane use during the fall staging period, when a large percentage of the Central Valley population uses the Refuge. The Pacific Flyway Management Plan (Pacific Flyway Council 1997) recommended up to 400 acres of cereal grain production at Malheur Refuge to provide for staging cranes. The plan also noted that autumn roosting habitat (large isolated wetlands, secure from human disturbance) should be maintained at Malheur Refuge.

This level was established with the assumption that grain farming will continue on the Refuge. Canada geese, dabbling ducks, and migratory grassland birds also benefit from grain farming since they use grain to build their fat reserves. Grain production also increases the Refuge's carrying capacity for wintering Canada geese.

An additional purpose of the program is to limit the presence of invasive species by providing a mechanical tool to set back infestations and develop a stage for the restoration of native plant communities. Farming cultivation practices such as mowing, haying, and chemical application have been recognized as viable means to control invasive plant species and discourage the proliferation of non-beneficial plants.

Over the next several years the cropland farming program will be the main instrument for implementing Objective 4j in the CCP for Malheur Refuge. This action will support the goals and objectives outlined in the CCP for Malheur Refuge and the Pacific Flyway Council Management Plan for Sandhill Cranes (Pacific Flyway Council 1997).

Availability of Resources

Special equipment, facilities, or improvements necessary to support the use and maintenance costs are the responsibility of the cooperator with no associated expenses to the Refuge.

Offsetting Revenues: Because this use aids the Refuge in specific wildlife and habitat objectives and frees up maintenance staff equipment, materials, and personnel for other projects, there is the potential for overall cost savings for Refuge management activities. Since cooperative farming could represent a cost saving to the Refuge, there will be no fee associated with the agreement. The costs of administering and managing this use under the CCP are detailed in Table B-18.

Table B-18. Cost to Implement the Use

Category and Itemization	One-time Cost	Annual ($/yr)
Administration and management	$2,000	$2,000
Maintenance	$0	$0
Monitoring	$1,000	$1,000
Special equipment, facilities, or improvements	$0	$0
Offsetting revenues	$0	$0

Anticipated Impact of the Use

Short-term Impacts: Farming activities in proposed areas are currently taking place by force account (conducted by Refuge staff), so the nature of the disturbance will not be significantly different. The activity may cause some degree of disturbance to wildlife, including negative impacts on fauna that are not able to emigrate off-site during soil-disturbing activities. Any hydrologic impacts will be minimal (water needs of the actual crops will be served primarily through sub-irrigation). Wind erosion will be marginalized by instituting best management practices such as crop residue management, eliminating or reducing fall cultivation practices. The sites already host significant invasive plant species and are currently being treated in cooperation with force account farming activities; thus, cultivation practices will have minimal impacts to native plant communities. With the size of the fields 50 acres or less, farming activities will have negligible effects to invertebrate, reptile, and amphibian populations and their movements. Disturbance to ground nesting birds should be minimal by delaying any mowing operations to after the nesting season.

Sandhill cranes, Canada geese, dabbling ducks, and grassland passerines benefit from grain farming since they use grain to build their fat reserves. Grain production also increases the Refuge's carrying capacity for wintering Canada geese. This activity provides for the early detection and treatment of invasive species, thereby creating a healthier environment for native plant communities. This is particularly important in areas targeted for native plant restoration.

Long-term Impacts*:* Farming activities may deplete the soil seed bank of native species over time, but due to the fact that these areas currently contain high percentages of noxious weeds in existing seed banks, the negative impact is offset by an increased level of control of non-desirable vegetation over time.

Cultivating annual crops may alter soil structure and wind erosion may occur. Whenever possible, cooperators will seek strategies to minimize this occurrence, such as timing and manner of tilling. The acreage being converted to farming is currently being farmed by force account and consists of 0.01 percent of Refuge lands. Therefore, the impacts noted above are expected to be negligible. Because farming is already taking place on these acres, this practice will likely have a neutral impact within the structure of the program.

Positive long-term benefits result in providing food/habitat for birds during critical migration period and minimizing crop depredation on neighboring lands.

Cumulative Impacts: Farming will only be practiced on lands that have been previously farmed. The management direction is not expected to incrementally add to any other actions that are planned or currently occurring in the area. The proposal benefits numerous wildlife species. This activity will not significantly impact other Refuge activities or actions and will not affect Refuge-wide or nationwide wildlife populations.

Impacts to Listed Species**:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from farming will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

Impacts to Priority Public Uses**:** During operations, farming cooperators may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or EE groups, but this conflict will be expected to be minimal. The presence of the crops, which may attract a variety of species, may support hunting, wildlife observation, wildlife photography, environmental education, and interpretation

Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

Determination

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility

- This activity will be conducted under an annual CLMA or CFA specifying roles and responsibilities of the Service and each cooperator.
- Cooperators will only apply herbicides and fertilizers with prior Refuge approval.
- All weed control strategies and associated herbicides must be approved by the FWS and Pesticide Use Proposal procedures.
- Seeds must be certified weed free.
- Equipment must be thoroughly cleansed before entering the Refuge to prevent the introduction of new weed species or populations to the Refuge.

Justification

Crop production has been shown to provide a cost-effective means of providing high-quality food source for target wildlife species at the Refuge. Specifically, crop production provides high-energy grain and forage crops, as well as green forage crops that are highly digestible and easily accessible. Wintering and migrating waterfowl and cranes readily use agricultural crop fields to help meet their energy needs. The use of a cooperator to produce grain crops may facilitate the management of croplands by increasing the reliability of a successful crop.

In addition, the food support crop production provides for target wildlife species and indirectly supports several wildlife-dependent recreational activities such as wildlife observation and photography.

By conducting the crop production program under the practices and stipulations described above, it is anticipated that wildlife species that could be adversely affected will find sufficient food resources and resting places so their abundance and use will not be measurably lessened on the Refuge. Additionally, it is anticipated that monitoring, as needed, will prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats.

The cooperative farming program will contribute to achieving Refuge purposes and goals as identified in the 1990 Blitzen Valley Management Plan (Rule et al. 1990) and the Refuge System mission by providing valuable foraging areas and conditions for sandhill cranes, waterfowl, and other wildlife. It also benefits other Refuge management actions by providing weed control and other habitat-maintenance functions.

The combination of management practices and stipulations identified above will ensure that crop production contributes to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the Refuge. As a result, crop production contributes to achieving Refuge purposes; contributes to the mission of the National Wildlife Refuge System; and helps maintain the biological integrity, diversity, and environmental health of the Refuge.

Mandatory Reevaluation Date

__09/2022__ Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision

____X____ Environmental Impact Statement and Record of Decision

References

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pacific Flyway Council. 1997. Pacific Flyway management plan for the Central Valley Population of Greater Sandhill Cranes, Pacific Flyway Study Committee. Unpublished report. Portland, OR 44 pp. + appendices.

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

Rule, M., G. Ivey, D. Johnson, and D. Paullin. 1990. Blitzen Valley management plan. Malheur National Wildlife Refuge. Princeton, OR. 169 pp.

Signatures:

Prepared by:	(Signature)	1/24/13 (Date)
Refuge Manager/ Acting Project Leader Approval:	(Signature)	1/24/13 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	1-24-13 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	1-24-13 (Date)

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Full moon over East Canal
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Appendix C
Implementation

C.1 Overview

Implementation of the management direction of the Comprehensive Conservation Plan (CCP) will require increased staffing and funding levels to successfully accomplish the planned actions, which will depend upon additional Congressional allocations, partnerships, and grants. There are no guarantees that additional federal funds will be made available to implement any of these projects. We will seek to develop innovative and committed partnerships with a variety of public and private entities. The identified activities and projects will be implemented as funds become available.

This Refuge has one of the largest infrastructures in the National Wildlife Refuge System, with approximately 200 miles of public roads; 2,000 miles of waterways/dikes; 5 dams; 1,000 water control structures; 6 automated fish screens; 27 administrative, 7 quarters, and 25 visitor services facilities; 4 historic building sites; and a large fleet of heavy/light vehicles and equipment. This extensive infrastructure requires a high degree of routine maintenance/repair to efficiently and effectively support the various Refuge programs and maintain tens of thousands of acres of wetlands, 30 miles of rivers/creeks, and 16,000 acres of irrigated meadow. At the current staffing level, a vast majority of routine maintenance/repair needs are addressed reactively. Additional staff and/or funding are needed to proactively address the maintenance/repair backlog and move this Refuge forward to its full ecological potential and ensure biological integrity.

The CCP describes activities and projects to be implemented over the next 15 years. Many of these projects are included in the Refuge Operational Needs System (RONS-new staff), or Service Asset Maintenance and Management System (SAMMS-deferred maintenance projects), which are used to request funding from Congress. Currently, a very large backlog of maintenance needs exists for the Refuge. In 2011, the deferred maintenance backlog for the Refuge was approximately $48 million, with more projects needing to be added annually. An attempt to reduce this backlog needs to be addressed and is included here in the analysis of staffing and funding needs. Prioritized staffing needs identified in the RONS will be necessary to implement the CCP to meet Refuge goals, objectives, and legal mandates.

Annual revenue-sharing payments, associated with the Refuge in Harney County, may continue. Total payments made in 2011 were $75,842.00 to Harney County.

Inventory and monitoring activities will be conducted on new and existing projects and activities to document changes across time, habitat conditions, and responses to management practices. The adaptive management process will be employed to address new information that may show the need for management adjustments, confirm existing strategies, or identify additional information needs. Based on the best information available at the time, the Refuge with feedback from partners and interested parties will make decisions for future management actions.

As with the sharing/learning aspects of adaptive management, the Refuge recognizes the importance for transparency of decision making. The Refuge is committed to bringing together interested parties to assist with evaluation of available information and consultation about management options and their implications prior to course-changing decisions being made. This process does not diminish the Refuge’s legal authority to make decisions but, rather, serves to enhance the decision-making process by enabling the Refuge to approach issues from multiple perspectives, thereby finding creative solutions to complex challenges.

C.2 Costs to Implement the CCP

The following sections detail both one-time and recurring costs for needed projects. One-time costs reflect the initial costs associated with a project, whether it is purchase of equipment, contracting services, construction, a research project, etc. Recurring costs reflect the future operational and maintenance costs associated with the project. The following tables primarily document projects with a physically visible, track-able, "on-the-ground" component, such as structures, habitat restoration, research, and monitoring and surveys. The scope and costs for "administrative" activities such as memoranda of understanding (MOUs), reporting, and establishment of partnerships are difficult to estimate in advance and thus are not accounted for in the tables below.

C.2.1 One-time Costs

One-time costs are project costs that have a start-up cost associated with them, such as purchasing a new vehicle for wildlife and habitat monitoring, or designing and installing an interpretive sign. Some are full project costs for projects that can be completed in 3 years or less. One-time costs can include the cost of temporary or term salary associated with a short-term project. Salary for existing and new positions, and operational costs, are reflected in operational (or recurring) costs.

Funds for one-time costs will be sought through increases in Refuge base funding, special project funds, and grants. Projects listed in Table C-2 show one-time costs, such as those associated with building and facility needs including offices, public use facilities, road improvements, and new signs. One-time costs are also associated with projects such as habitat restoration, invasive plant and animal control, and research. New research projects, because of their short-term nature, are considered one-time projects and include costs of contracting services or hiring temporary staff for the short-term project. Some project costs are taken from RONS or SAMMS proposals; others are not yet in any project database and their costs have been estimated, particularly if the scope of the project is unknown at this time due to lack of baseline data.

C.2.2 Annual Operational (Recurring) Costs

Operational costs reflect Refuge spending of base funds allocated each year. These are also known as recurring costs and are usually associated with day-to-day operations and projects that last longer than 3 years. Operational costs use base funding in Service fund code 1260.

Table C-1 highlights the current and future staff needed to accomplish the activities forecast in the CCP.

Table C-2 highlights projected one-time and recurring costs for new or expanded visitor service opportunities and facilities, aquatic and terrestrial habitat restoration, conservation activities, and inventory and monitoring needs. This table includes such things as implementation and operational expenditures such as supplies, materials, utilities, and maintenance costs.

Maintenance Costs: The maintenance need over the next 15 years is defined as funds needed to repair or replace buildings, equipment, and facilities. Maintenance includes preventative maintenance; cyclic maintenance; repairs; replacement of parts, components, or items of equipment; adjustments, lubrication, and cleaning (non-janitorial) of equipment; painting; resurfacing; rehabilitation; special safety inspections; and other actions that ensure continuing service and prevent breakdown. Maintenance costs include the maintenance "backlog"—maintenance needs that have come due but are as yet unfunded, as well as the increased maintenance need associated with new facilities, infrastructure needing updating or rehabilitation, moving to a carbon negative status, and employing facility greening measures.

The facilities associated with the Refuge that require maintenance include trails, interpretive panels, regulatory signs, roads, water delivery system, and structures. Major equipment includes airboats, vehicles, heavy equipment, firefighting equipment, all-terrain vehicles (ATVs), and utility terrain vehicle UTVs.

Staffing: Table C-1 illustrates the staffing costs. One column shows the current estimated expenditure on the Refuge, in FY 2011 dollars. The next column reflects costs associated with increased staffing needs under the CCP.

Table C-1. Current and Future Staffing

Current Staff Positions	Series and Grade[1]	Annual Salary Cost	Expenditure Under Current Management	Expenditure Under Future Management
Wildlife Refuge Manager	GS-0485-14	138,330	138,330	138,330
Wildlife Refuge Manager	GS-0485-13	132,270	132,270	132,270
Wildlife Biologist	GS-0486-12	97,660	97,660	97,660
Fish Biologist	GS-0482-11	93,000	93,000	93,000
Archaeologist	GS-0193-11	96,410	96,410	96,410
Ecologist	GS-0408-11	87,240	87,240	87,240
Park Ranger	GS-0025-11	93,150	93,150	93,150
Fire Management Officer	GS-0401-11	94,290	94,290	94,290
Park Ranger (LEO)	GL-0025-9	88,660	88,660	88,660
Prescribed Fire Specialist	GS-0455-9	40,000	40,000	40,000
Administrative Officer	GS-0341-9	71,680	71,680	71,680
Supervisory Range Technician	GS-0462-8	71,740	71,740	71,740
Office Assistant	GS-0303-6	49,340	49,340	49,340
Forestry Technician	GS-0462-5	50,270	50,270	50,270
Range Technician	GS-0455-5	14,930	14,930	14,930
Biological Technician (fisheries)	GS-0404-4	27,000	27,000	27,000
Forestry Aide Fire	GS-0462-3	13,910	13,910	13,910
Range Technician	GS-0455-3	15,410	15,410	15,410
Supervisory Engineering Equipment Operator	WS-5716-9	97,480	97,480	97,480
Engineering Equipment Operator	WG-5716-10	77,860	77,860	77,860
Engineering Equipment Operator	WG-5716-10	78,640	78,640	78,640
Engineering Equipment Operator	WG-5716-10	78,680	78,680	78,680
Maintenance Mechanic	WG-4749-9	70,600	70,600	70,600
Engineering Equipment Operator	WG-5716-8	61,910	61,910	61,910
Total Annual Cost for Current Staff		**1,740,460**	**1,740,460**	**1,740,460**

Future Staff Positions in the Refuge Operational Needs System (RONS) + Project # and 2008 Ultimate Organizational Chart	Series and Grade	Annual Salary Cost	Current Management	Future Management
Geographic Information System Specialist, FY08-5019	GS-0150-11	104,480		104,480
Natural Resource Specialist, FY08-5005	GS-0401-11	104,480		104,480
Private Lands Biologist, FY08-5016	GS-0401-11	104,480		104,480
Refuge Operations Specialist, FY08-5013	GS-0485-9	86,360		86,360
Park Ranger (Volunteer Coordinator), FY08-5008	GS-0025-9	86,360		86,360
Park Ranger (Interpretive), FY10-1303	GS-0025-7	70,600		70,600
Range Technician, FY08-5004	GS-0455-7	70,600		70,600
Hydrological Technician, FY08-5007	GS-1317-7	70,600		70,600
Biological Technician (Habitat), FY08-5018	GS-0404-6	63,530		63,530
Biological Technician (Facilities), FY08-5015	GS-0404-6	63,530		63,530
Maintenance Mechanic, FY08-5009	WS-4749-10	121,970		121,970
Engineering Equipment Operator, FY08-5017	WG-5716-8	82,190		82,190
Engineering Equipment Operator, FY08-5003	WG-5716-8	82,190		82,190
Maintenance Mechanic, FY08-5006	WG-4749-8	82,190		82,190
Maintenance Worker, FY08-5011	WG-4749-6	70,490		70,490
Park Ranger (Law Enforcement), FY10-2173	GL-0025-11	80,370		80,370
Park Ranger (Law Enforcement), FY10-2174	GL-0025-9	68,640		
Total Annual Cost for Future Staff				**1,344,420**
Grand Totals				**3,084,880**

[1]GS/GL: General Schedule, Federal Employee, WG/WS: Wage Grade Scale, Federal Employee

Costs are based on FY 2011 Full-Time Equivalent (FTE) utilization plan for the Refuge and the Office of Personnel Management (OPM) General Schedule FY 2011 plus 40 percent benefits. For the proposed positions, the cost is the grade level at step one plus 40 percent for benefits.

Table C-1 illustrates an increase of 16.0 FTE staff positions over the current staffing level for the management direction. At the current staffing level, action items that need immediate attention can be addressed, but the Refuge does not have the capacity to be proactive in addressing items before they reach the critical threshold. To have the Refuge reach its full potential, it needs additional staff to move its operational level from reactive to proactive.

The **Geographic Information System (GIS) Specialist** position is needed to improve and build the capacity of the aquatic health and habitat management programs by coordinating the development of needed resource geospatial databases, including design, data collection, data storage, and resource data implementation. The GIS information will enable the Refuge to effectively track climate change, improve inventory and monitoring data, communicate geospatial information, and enhance decision making. Geospatial information is critical to effectively implementing the actions outlined in this plan. RONS Project No. FY08-5019

The **Natural Resources Specialist** position is needed to develop and implement CCP step-down management plans, compatibility determinations, habitat management plans, environmental assessments, environmental management system protocols, and other strategic habitat conservation plans. RONS Project No. FY08-5005

The **Private Lands Biologist** position is needed to develop the necessary private landowner relationships to address the variety of natural resources issues impacting Harney County, such as watershed connectivity, aquatic health, fish passage/screening, and migratory bird habitat conservation. RONS Project No. FY08-5016

The **Refuge Operations Specialist** is needed to conduct environmental compliance, safety programs, permitting, infrastructure "greening" activities, sustainable practices, RONS input, SAMMS input, database management, and facility maintenance/repair planning activities. RONS Project No. FY08-5013

Park Rangers (4) are needed for the following:

1. The **Park Ranger** will serve as the much-needed volunteer coordinator. He/she will recruit, coordinate, orient, train, and support volunteers for a variety of Refuge programs such as visitor services, maintenance, administration, and fish/wildlife management. This position is critical for the Refuge to continue moving forward with citizen science opportunities for inventory/monitoring, visitor contact/bookstore operations, special events assistance, and visitor services programming. RONS Project No. FY08-5008

2. The **Park Ranger** will assist the visitor services manager in providing high-quality wildlife-dependent recreational programming for the visiting public, schools, special events, and organized groups. The position will also assist with visitor services program assessment, social media development, docent training, and event planning. RONS Project No. FY10-1303

3. The **Park Ranger, Law Enforcement Officer** will assist in protecting wildlife, lands, facilities, employees, and the general public. This position will serve as the liaison for canoe/kayak tours of Malheur Lake. RONS Project No. FY10-2173

4. The **Park Ranger, Law Enforcement Officer** will assist in protecting wildlife, lands, facilities, employees, and the general public. RONS Project No. FY10-2174

The **Range Technician** will assist with livestock-related issues, field and geospatial data collection, plant community monitoring and enhancement, the development of cooperative land management agreements, invasive species control, boundary fence inspection and repair, and coordinating with the haying/grazing program permittees. RONS Project No. FY08-5004

Biological Technicians (2) are needed for the following:

1. The **Biological Technician** will be responsible for mowing the hundreds of miles of dike tops and road ways and removing beaver/muskrat debris from water control structures and dams. RONS Project No. FY08-5015

2. The **Biological Technician** will assist with aquatic health and fisheries programs, biological inventory and monitoring programs, and other habitat-management activities. RONS Project No. FY08-5018

The **Hydrological Technician** will collect the necessary water flow data to protect Refuge water rights, enabling the Refuge to accurately meet legal requirements critical to protecting water rights. RONS Project No. FY08-5007

Engineering Equipment Operators (2) will be responsible for:

1. The **Engineering Equipment Operator** will meet the needs of an increased maintenance program by assisting with the maintenance/repair of the water delivery system, roads, dikes, and habitat enhancement projects. RONS Project No. FY08-5017

2. The **Engineering Equipment Operator** will meet the needs of an increased maintenance program by assisting with the maintenance/repair of the water delivery system, roads, dikes, and habitat enhancement projects. RONS Project No. FY08-5003

Maintenance Mechanics (2) will be responsible for:

1. The **Maintenance Mechanic, Work Leader** will supervise facility maintenance to ensure the necessary level of coordination, administration, and workforce planning is in place for an efficient and effective maintenance program. RONS Project No. FY08-5009

2. The **Maintenance Mechanic** will maintain/repair facilities' infrastructure. RONS Project No. FY08-5004

The **Maintenance Worker** will assist with the maintenance of facilities and infrastructure, health and safety program, grounds keeping, and trail and sign maintenance. RONS Project No. FY08-5011

C.2.3 Partnership Opportunities

Partnerships are critically important to the implementation of this plan, which is reflected in Chapter 2's goals, objectives, and strategies. The Refuge's ecological significance, reputation for being a leader in field research, and location facilitate many opportunities for partnerships. Current and past partners include federal and state agencies, tribes, non-governmental organizations, volunteers, and individuals.

Coordinated partnership efforts will focus on habitat restoration, land protection, environmental education, fish and wildlife monitoring, outreach, and quality wildlife-dependent recreation. Refuge staff will work to strengthen existing partnerships and will actively look for new partnerships to assist in achieving the goals, objectives, and strategies in this CCP/WSP.

This is a general list of partners we have established working relationships with through past efforts or in the formulation of this collaborative CCP. These partners support this plan's vision and have committed to working with the Refuge to implement the plan's prescribed actions and activities to ensure programmatic integrity for biological, visitor services, sustainable practices, and cultural resource programs. For a complete list of CCP collaborators and partners, see Appendix I.

- Burns Paiute Tribe
- Audubon Society of Portland and other Audubon chapters
- Malheur Wildlife Associates
- Bureau of Land Management

- Ducks Unlimited
- Eastern Oregon Agriculture Research Station
- Harney County Chamber of Commerce
- Harney County Historical Society
- Harney County Soil and Water Conservation District
- Harney County Watershed Council
- High Desert Partnership
- Intermountain Joint Venture
- The Nature Conservancy
- Natural Resources Conservation Service
- Oregon Defenders of Wildlife
- Oregon Department of Fish and Wildlife
- Oregon Joint Venture
- Oregon Natural Desert Association
- Private landowners
- U.S. Geological Survey
- U.S. Forest Service
- U.S. Army Corps of Engineers
- Universities (University of Wisconsin-River Falls, University of Minnesota, Oregon State University, and Iowa State University)
- Wetlands Conservancy
- Private citizens

Table C-2. Budget Summary for Implementation and Inventory and Monitoring (I&M) Activities (Wildlife and Habitat, Sustainable Practices Programs)

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
Goal 1. Lacustrine									
1a	Aquatic: I&M	Conduct baseline inventories of aquatic vertebrates/invertebrates to guide future management actions	Fish assemblage and Tui Chub production (includes riverine) (each 3 years)	3	3,000		VH	500	x
			Macroinvertebrate assemblage			16,000	VH	200	x
			Native mussel distribution	1	500		M	300	x
			Immigration, emigration, mortality, spawning, and juvenile rearing (see RONS)	3		500,000	VH	500	x
	Aquatic: Research	Surveys, inventories, and assessments pre- and post-carp control aquatic habitats	Water quality monitoring (turbidity, etc.)	1	3,000	1,000	VH	1,500	x
			Carp population dynamics (age and growth)			125,000	VH	10,000	x
		Research carp population dynamics and movements	Carp mark and recapture			50,000	VH		x
			Carp telemetry	Initial 5	48,000	54,000	VH	24,000	78,000
	Aquatic: Management Action	Conduct research to investigate and implement aggressive control strategies	Statistical analysis and model construction			206,000	VH	-	x
			Rotenone			200,000	M		
			Attractants, repellents			47,000	H	12,000	35,000
			Barriers, traps, and screens			300,000	VH	-	x
			Harvesting			900,000	H	-	x
	Aquatic: Habit	Enhance emergent	Wind breaks and carp exclosures	1	21,400	5,000	VH	-	x

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
	Management	vegetation within the lake system	to promote colonization/expansion of emergent/submergent vegetation						
		Understand relationships among water chemistry, lake levels, and habitat/migratory bird responses in lakes	Development of lacustrine section of State-and-Transition Model	1	3,200		VH	-	x
		Develop a model to predict habitat response to carp control	Establishment of an Aquatic Health Assessment and Implementation Plan for the Malheur Wetlands; collaboration with Oregon State University (OSU), Harney County Soil and Water Conservation District (HCSWCD), Ducks Unlimited (DU)			422,000	VH	-	x
	Habitat: I&M	Lacustrine emergent trend (cost covered in telemetry)		1	-	-	H	-	x
		Lacustrine submergent trend		1	800		H	-	x
	Habitat: Management	Use Integrated Pest Management (IPM) strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)		1	25,000		M	-	x
	Wildlife: I&M	Conduct baseline/ongoing inventories of wildlife to guide future management actions	Waterfowl production survey (also includes 4a, 4b, 4c, and 4d)	1	900	3,000	H	x	x
			Colonial waterbird production survey	1	300	600	H	x	x
			Muskrat lodge count	1	1,000		L		x
Goal 2. Riverine									
2a	Aquatic:	Screens, barriers, fish wheel, weirs, passage, and traps		each	10,000	800,000	VH	-	x

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
	Management	Initiate small in-stream strategic pilot projects in tributaries or reaches of the Blitzen River in response to assessment results		each		500,000	L in 2, H in 3		x
		Dikes, water control structures, and roads		1	500,000	500,000	VH	x	x
	Habitat: I&M	Wetland/riverine strategic plan and associated studies and National Environmental Policy Act (NEPA)	Assorted studies, inventories, pilot projects, and studies identified by Utah State Report			3,000,000	L in 2, H in 3		x
			Floodplain topography (Lidar, other methods)			1,000,000	L in 2, H in 3	-	x
			Cultural resources inventory and mitigation			2,000,000	L in 2, H in 3		x
	Administration	Adjudicate riverine water rights, continued gauging of flows (water supply, potential climate change, channel and floodplain change)		1		5,000	VH	x	x
2b	Aquatic: I&M	Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions.		5	30,000		VH	x	x
		Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats.		each study	30,000		VH	x	x
	Aquatic: Research	Conduct research to understand carp population dynamics and seasonal movements.		1		30,000	VH	x	x
		Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type.		2	800	1,000	VH	x	x
Goal 3. Woody Riparian									
	Habitat: I&M	Woody riparian trend (validation monitoring of objective)		5	500		M		x

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
3a	Habitat: Management	Active planting or seeding appropriate native species	Propagating and planting shrub species	each	2,000	30,000	M		x
		Exclude livestock from riparian habitats	Construct/ maintain 4-strand fence	1	5,000	40,000	VH	x	x
		Promote riparian shrub health	Use of disturbance (fire) (~5% of habitat total)			22,000	H		x
		Permanently exclude grazing from streamside corridors	Construct fence	1	1,500	60,000	VH	x	x
		Manipulate soil moisture in riparian areas outside of the naturally occurring floodplain	Maintain irrigation infrastructure (folded into costs in 4a)				H		
		Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) (200 acre/year @ $80.00/acre)		1	16,000		H	x	x
	Wildlife: I&M	Woodland bird survey (equipment costs covered in other survey costs)		1	400		M		x
Goal 4. Wet Meadow									
4a	Aquatic: I&M	Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions.		5	30,000		VH	x	x
		Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats.		each study	30,000		VH	x	x
	Aquatic: Research	Conduct research to understand carp population dynamics and seasonal movements.		1		30,000	VH	x	x
		Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses		2	800	1,000	VH	x	x

Objective	Program	Strategy / Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
		in this habitat type.						
	Aquatic Habitat: Management	Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type.	1		50,000	VH	x	x
	Habitat: I&M	Wet meadow trend (validation monitoring of objective)	1	36,000		H		x
	Habitat: Research	Plant community–specific research and associated wildlife response	1	36,000		H		x
	Habitat: Management	Water delivery and management through maintenance or enhancement of infrastructure (e.g., delivery ditches, water control structures)	1	350,000		H	x	x
		Modify dikes, ditches, and other infrastructure as needed to reclaim acres lost to cattail encroachment (e.g., Northwest big sagebrush field).		250,000	M		x	x
		Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants	1	350,000		H	x	x
		Prescribed fire, discing, herbicides, and mowing to reduce extensive emergent cover	1	10,000		H		x
	Wildlife: I&M	Migratory bird survey (includes 4b–j as well)	1	10,000		H	x	x
		Passerine bird survey (includes 4b, 4d–i as well)	1	10,000		H	x	x
		Waterfowl/waterbird production survey (includes 4b–c as well)	1	10,000		H	x	x
Goal 4. Emergent Marsh								
4b	Aquatic: I&M	Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions.	5	30,000		VH	x	x
		Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats.	each study	30,000		VH	x	x

Objective	Program	Strategy / Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
	Aquatic: Research	Conduct research to understand carp population dynamics and seasonal movements.	1		30,000	VH	x	x
		Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type.	2	800	1,000	VH	x	x
	Aquatic Habitat: Management	Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type.	1		50,000	VH	x	x
	Habitat: I&M	Emergent marsh trend	1	2,000		H		x
	Habitat: Research	Experiment with grazing as a tool in monotypic stands of emergent cover to set back succession		Covered in 4a research		H		x
	Habitat: Management	Prescribed fire to remove extensive emergent cover	2	192,000		M	x	x
		Discing to remove extensive emergent cover	1	400		M		x
		Mowing to remove extensive emergent cover	1	400		M		x
		Herbicide applications to control emergent plants	5	45,000		M	x	x
		Flood up and drawdowns (water level management)		Covered in 4a Management		H		
		Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)	4	20,000		M	x	x
Goal 4. Palustrine Open Water/Emergent								
4c	Aquatic: I&M	Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions.	5	30,000		VH	x	x
		Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats.	each study	30,000		VH	x	x
	Aquatic:	Conduct research to understand carp population dynamics	1		30,000	VH	x	x

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
	Research	and seasonal movements.							
		Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type.		2	800	1,000	VH	x	x
	Aquatic Habitat: Management	Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type.		1		50,000	VH	x	x
	Habitat: I&M	Palustrine Open Water/Emergent Trend		1	400		H		x
	Habitat: Management	Water delivery and management through maintenance or enhancement of infrastructure (e.g., delivery ditches, water control structures). Needs associated with spotted frog refugia will be addressed in identified areas (e.g., East Canal, Five Mile Spring within West Canal, etc.)			Covered in 4a Management		H	x	x
		Prescribed fire to remove extensive emergent cover		5	3,600		M	x	x
		Discing to remove extensive emergent cover		1	400		M	x	x
		Mowing to remove extensive emergent cover		1	400		M	x	x
		Flood up and drawdowns (water level management)			Covered in 4a Management		H		
		Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)			Covered in 4a Management		M		
Goal 4. Dry Meadow									
4d	Habitat: I&M	Dry meadow trend		1	400		M	x	x
	Habitat: Management	Use agricultural practices (e.g., haying, grazing, etc.) to maintain/enhance fields			Covered in 4a Management		M		

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
		Use burning regimes where feasible		3	12,000		M	x	x
		Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)			Covered in 4a Management		M		
	Wildlife: I&M	Grassland breeding bird survey		1	600		H		x
Goal 4. Salt Desert Scrub									
4e	Habitat: I&M	Salt desert scrub trend		1	400		L		x
	Habitat: Management	Protect existing sensitive sites with microbiotic crusts		1	10,000		M	x	x
		Use of prescribed fire depending on site-specific factors		5	20,000		L		x
		Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)			Covered in 4a Management		L		
	Wildlife: I&M	Passerine breeding bird survey (includes 4f–h)		1	700		M		x
Goal 4. Sagebrush Lowlands									
4f	Habitat: I&M	Sagebrush lowland trend		1	400		M		x
	Habitat: Management	Prescribed fire				15,000	M		x
		Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)			Covered in 4a Management		M		
Goal 4. Sagebrush Steppe									
4g	Habitat: I&M	Sagebrush steppe trend		1	400		M		x
	Habitat: Management	Add diversity to crested wheatgrass monocultures using best science practices (i.e., Krumbo Unit research from Eastern Oregon Agricultural Research Station)		?	?	?	M	x	x
		Use IPM strategies including chemical, mechanical,			Covered in		L		

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
		horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)			4a Management				
Goal 4. Dune									
4h	Habitat: I&M	Dune trend		1	400		L		x
4h	Habitat: Management	Protect dune areas from disturbance			Covered in 4e Management		M		
4h	Habitat: Management	Use IPM strategies (chemical, mechanical, horticultural, and/or biological control) for invasive plants (Appendix G)			Covered in 4a Management		L		
Goal 4. Playa									
4i	Habitat: I&M	Playa trend		1	200		L		x
4i	Habitat: Management	Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)			Covered in 4a Management		L		
4i	Wildlife: I&M	Shorebird breeding survey		1	400		H	x	x
Goal 4. Crop Land									
4j	Habitat: I&M	Crop land trend		1	200		L		x
4j	Habitat: Management	Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G)			Covered in 4a Management		L		
Goal 5. Cold and Hot Springs									
5a	Aquatic: I&M	Spotted frog population			Covered in 1a		VH	x	x
	Aquatic: Research	Carp control			Covered in Goals 1 and		VH		x

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
					2				
	Aquatic: Management	Aquatic assemblages		5	30,000		H		x
	Habitat: I&M	Cold and hot spring trends		1	400		M		x
	Habitat: Management	Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive species (see Appendix G)		1	1,000		VH	x	x
	Administration	Adjudicate ground water rights		1		5,000	VH		x
Goal 5. Cliff, Rimrock, and Lava Flows									
5b	Habitat: Management	Continued use of existing Refuge gravel/rock pits. Upon closure of gravel rock pits remediation will occur					L	x	x
	Administration	Continue to restrict access to rimrock areas for the benefit of wildlife		1	100		L	x	x
	Wildlife: I&M	Raptor wintering and nesting surveys		1	400		M	x	x
Goal 13. Assessments of Hydrological Features									
13 b		Water allocation (water budget, habitat use, and availability surveys)		1	5,000	130,000	VH		x
Goal 13. Scientific Assessments									
13 e		Assess avian predation on carp				200,000	VH		x
		Assess carp control study areas pre- and post-treatment		each study		30,000	VH	x	x
Goal 14. Sustainability									
14 a		Establish Refuge program benchmarks for sustainability-based practices				25,000	H		x
		Provide staff training for the implementation of		1	1,000		H		x

Objective	Program	Strategy	Project/Methodology	Recurrence interval	Recurring Cost	One-time Cost	Priority[1]	Current Management	Future Management
		sustainability-based principles and practices							
		Complete energy audits, carbon footprint audits, and biomass-based carbon sequestration assessments		5	25,000	250,000	H		x
		Use GIS technologies for benchmarking and tracking Environmental Management Plan parameters and climate change across program areas		1	5,000	50,000	H		x
		Integrate sustainability-based initiatives into all partnerships and other external stakeholder activities		1	1,000		H		x
		Integrate training for social justice/equity, community development, and cultural resource and partnership performance standards with all sustainability-based initiatives		1	1,000		H		x
		Refit and right-size facilities and infrastructure for energy efficiency and production		1	35,000	2,000,000	H		x

[1]**Priority Rankings:**
Very High (VH): these actions are very critical and must be completed in the first 5 years of the plan in order to move other elements of the plan forward. Funding will be directed to complete VH priority actions first and foremost.
High (H): these actions are critical and must be completed in the first 5 years of the plan in order to move other elements of the plan forward. Funding will be directed to complete H priority actions as funding levels allow.
Medium (M): these actions will be accomplished as time and funds allow.
Low (L): these actions will be accomplished as time and funds allow.
Columns:
x = project is included in the management direction or current management. -- = project is not included in the management direction or current management (thus, cost = 0).
Note: An empty space in the recurring cost column means that there will be no recurring costs. A number in this column means that the cost will recur at the amount specified at the interval identified. An empty space in the one-time cost column means that there will be no one-time costs. A number in this column means that a one-time cost at the amount specified will need to occur at some point over the lifetime of the CCP (15 years). If there is numeric information in the column for current management and only an x in the future management column, the number in the column for current management refers to the one-time cost that has already been spent. The one-time cost will be 0 for future management, but the recurring costs and recurrence interval will be the same. If there is numeric information in each column, this is the one-time cost that will vary (again, some money has already been spent). The recurring costs and intervals will be the same for current management and future management.

Table C-3. Budget Summary for Implementation and Inventory and Monitoring Activities (Visitor Services and Cultural Resources Programs)

Activity or Project	Cost/Unit	# of Units (Current Management)	# of Units (Future Management)	One-time Expense (Current Management) ($)	One-time Expense (Future Management) ($)	Recurring Expense (Current Management) ($/year)	Recurring Expense (Future Management) ($/year)
Goal 6. Welcome and Orient Visitors							
Objective 6a. Provide welcome and orientation to visitors							
Update existing panels and develop new panels at new locations	$15,000	4	8	$60,000	$120,000	$500	$500
Maintain existing and develop new vault toilets	$25,000	0	1	$0	$25,000	$3,500	$5,000
Maintain existing and develop accessible picnic tables, trash cans, and shelters	ADA – $4,500, non-ADA – $1,500	0	1 ADA, 2 non	$0	$7,500	$5,000	$5,000
Build enlarged visitor contact station and gift shop	$250,000	--	1	$0	$250,000	$0	$10,000
Rehabilitate museum facility (temperature and humidity control, accessibility) (see interpretation for interpretive panels)	$25,000-$75,000	--	1	$0	$50,000	$0	$0
Establish seasonal contact station at P Ranch	$10,000-$100,000	0	1	$0	$45,000	$0	$3,000
Develop modern media welcome and outreach materials, maintain website, etc.	$10,000			$0	$0	$1,000	$1,000
Objective 6b. Address transportation issues							
Raise and surface Center Patrol Road (CPR)	$1,200,000	1	1	0	$1,500,000		$100,000
Develop additional vehicle pull-offs	$10,000-$25,000	0	3	$0	$52,500	$0	$0

Activity or Project	Cost/Unit	# of Units (Current Management)	# of Units (Future Management)	One-time Expense (Current Management) ($)	One-time Expense (Future Management) ($)	Recurring Expense (Current Management) ($/year)	Recurring Expense (Future Management) ($/year)
Improve East Canal for vehicle access	$30,000	0	3	$0	$90,000	$0	$0
Improve public vehicle access at Boat Landing Road, including vehicle pull-offs	$30,000	0	1.5	$0	$45,000	$0	$0
Maintain Krumbo Lane							$10,000
Develop parking areas to assist with public use programs	$50,000		3	$0	$150,000	$0	$0
Overall road maintenance (public roads, vehicle pull-offs, parking areas)						$0	$20,000
Goal 7. Wildlife Observation, Photography, Interpretations							
Objective 7a. Provide wildlife observation and photography opportunities							
Docent tours on lake	$100,000	$0	1	$0	$100,000	$0	$15,000
Other land-based docent-led tours monthly plus special events (advertise, train, provide)	$50,000	0	1	$0	$50,000	$0	$5,000
Provide new non-ADA trails (also see fishing compatibility determination [CD] for fishing trails - not included here), and develop new trail signage (spur trail)	$6,000	9	12	0	$72,000	$0	$2,000
Provide new ADA trails at Sodhouse, Benson Pond, P Ranch, (also see fishing CD - not included here)	$75,000	0	3	$0	$225,000	$0	$2,000
Construct viewing overlook at Krumbo Reservoir	$40,000	0	1	$0	$40,000	$0	$1,000
Construct elevated viewing platforms	$55,000	0	4	$0	$220,000	$0	$4,000
Provide photography blinds	$10,000	0	3	$0	$30,000	$0	$1,000
Administration and management				$0	$0	$20,000	$20,000
Objective 7b. Provide birding opportunities							
Maintenance (habitats)		0	6			$1,000	$1,000

Activity or Project	Cost/Unit	# of Units (Current Management)	# of Units (Future Management)	One-time Expense (Current Management) ($)	One-time Expense (Future Management) ($)	Recurring Expense (Current Management) ($/year)	Recurring Expense (Future Management) ($/year)
Objective 7c. Provide interpretive opportunities							
Develop new interpretive panels	$10,000	0	3--6	$0	$45,000	$1,000	$1,000
Administration and management (local events, public presentations, media)				$0	$0	$35,000	$35,000
Objective 7d. Provide environmental education programs							
Build outdoor shelter at Refuge headquarters (HQ) (sun and wind protection)	$80,000		1	$0	$80,000	$1,000	$1,000
Provide outdoor learning area at Refuge HQ	$25,000		1	$0	$25,000	$1,000	$1,000
Administration and management (curriculum development, initiatives, special events, coordination)	$5,000			$0	$0	$7,000	$14,000
Equipment and materials	$10,000			$0	$0	$1,500	$2,000
Goal 8. Provide Hunting and Fishing Opportunities							
Objective 8a. Provide upland game hunting opportunities							
Administration and management (programmatic, law enforcement, information)				$0	$0	$2,000	$2,000
Maintenance (covered under waterfowl hunting CD)				$0	$0	$0	$0
Objective 8b. Provide waterfowl hunting opportunities							
Improve Saddle Butte access road (covers upland game use too)	$130,000	0	1	$0	$130,000	$0	$0
Open new ADA boat launch and parking area on Malheur Lake (end of Boat Landing Road)	$150,000	0	1	$0	$150,000	$0	$0

Activity or Project	Cost/Unit	# of Units (Current Management)	# of Units (Future Management)	One-time Expense (Current Management) ($)	One-time Expense (Future Management) ($)	Recurring Expense (Current Management) ($/year)	Recurring Expense (Future Management) ($/year)
Develop new publications and signage for hunt program	$2,000	0	1	$0	$2,000	$1,000	$1,000
Staff administration and management (programmatic, law enforcement, information)				$0	$0	$5,000	$5,000
Facility maintenance				$0	$0	$2,000	$2,000
Objective 8c. Provide stream fishing opportunities							
Develop fishing brochure	$5,000			$1,500	$1,500	$2,000	$2,000
South Fishing Loop: Build 2-3 new pedestrian crossings and complete development of loop trail	$275,000	0	1	$0	$275,000	$0	$0
Lower Blitzen: Open new seasonal bank fishing (trail with 2 bridges and parking) (portion will be ADA-accessible)	$275,000	0	1	$0	$275,000	$0	$0
Develop outdoor fishing information kiosks	$10,000	0	6	$0	$60,000	$0	$0
Replace Krumbo floating platform/other maintenance of Krumbo facilities	$35,000	1	1	0	$35,000	$2,000	$2,000
Fishing program administration and management (programmatic, law enforcement, information)						$6,000	$6,000
Goal 11. Identify and Protect Prehistoric and Historic Resources that are Eligible or Listed on the National Register of Historic Places							
Objective 11a. Increase management efforts for eligible historic sites							
Stabilization and restoration of historic structures at Sodhouse Ranch		8	8	$300,000	$300,000	$5,000	$5,000
Stabilization and restoration of the historic structures at P Ranch		3	3	$0	$150,000	$2,000	$2,000

Activity or Project	Cost/Unit	# of Units (Current Management)	# of Units (Future Management)	One-time Expense (Current Management) ($)	One-time Expense (Future Management) ($)	Recurring Expense (Current Management) ($/year)	Recurring Expense (Future Management) ($/year)
Stabilization and restoration of the sod structure at Barnes Springs		1	1	$0	$35,000	$500	$500
Stabilization and restoration of the historic structures at Double-O Ranch		3	3	$0	$100,000	$2,000	$2,000
Maintain Civilian Conservation Corps buildings at Refuge HQ and Buena Vista Station and Benson Pond		8	8	$0	$60,000	$5,000	$5,000
Goal 12. Manage the Refuge's Paleontological Resources for their Educational and Scientific Values							
Objective 12b. Provide interpretation of paleontological resources							
Develop interpretive and educational materials for paleontological resources	$15,000	2	2	$30,000	$30,000	$0	$0
				$675,000	$675,000	$14,500	$14,500

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Landscape from north of CPR
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Appendix D
Wilderness Review
Inventory Phase

D.1 Introduction

D.1.1 Refuge Overview

The 187,757 acre Malheur National Wildlife Refuge (NWR) is situated within the Harney Basin in southeastern Oregon. Located in the Northern Great Basin, this portion of the state is lightly populated, generally arid with cold winters, and characterized by wide open spaces. Although the Refuge constitutes a small percentage of the Northern Great Basin it is disproportionately important as a stop along the Pacific Flyway and as a resting, breeding, and nesting area for migratory birds and other wildlife. Many species migrating through or breeding here are highlighted as priority species in national bird conservation plans.

Malheur NWR is composed of three very distinct environments, each including a diversity of native habitats and landscapes. The core of the Refuge is dominated by a shallow lake basin and encompasses the Harney, Mud, and Malheur Lakes. This 103,799-acre area covers 56 percent of Refuge lands with the majority of acres being highly impacted by invasive common carp. The Blitzen Valley, a broad corridor (64,215 acres) to the south of the lake basin, is divided down its entire length by the Blitzen River and its associated linear riparian habitat. The Blitzen Valley covers 34 percent of the Refuge and provides most of the water flowing to the lake basins. The Double-O is a broad valley basin that covers 10 percent of Refuge lands. Intermittent water from the Silver Creek watershed flows through this management area and drains into Harney Lake. Together, these three environments result in a diversity of habitats and support more than 415 species of birds, mammals, fish, reptiles, and amphibians.

Historical bird counts show that the Refuge and the Silvies River floodplain just north of the Refuge may support anywhere between 5 to 66 percent of the Pacific Flyway migrating populations for various priority waterfowl. On the Refuge, breeding habitat is significant for waterbirds, with the Refuge currently supporting over 20 percent of the Oregon population of breeding greater sandhill cranes. Most colonial waterbird numbers have easily exceeded 10 percent of the regional population at peak, even reaching up to 77 percent of the Great Basin population for certain species. Numbers of migrating shorebirds have been documented at levels high enough to qualify the Refuge as a Regional Western Hemispheric Shorebird Reserve. The Refuge also supports high densities of certain nesting riparian passerines and meadow-dependent species such as the largest nesting population of bobolinks in the western United States.

Currently the majority of productive habitat is within the Blitzen Valley and the Double-O Units. Both of these units are comprised of highly altered habitats consisting of open water ponds, marshes, meadows, uplands, and riparian areas. Pond, marsh, and meadow habitats are intensively managed through an extensive series of roads, dikes, canals, water control structures, and other man-made features.

The lake units of the Refuge (Malheur, Mud, and Harney) have experienced a lesser degree of active management than the other units. However, during the first half of the twentieth century, invasive common carp were introduced into the Harney Basin. Introduction of carp has caused the ecological collapse of one of the largest natural freshwater marshes (Malheur Lake) in the lower 48 states.

This has resulted in a change from the 1970s when the lake’s bulrush/cattail marsh spanned tens of thousands of acres, supporting hundreds of thousands of waterfowl, shorebirds, and waterbirds.

Today the lake is a large body of muddy water absent of aquatic vegetation, with very limited bird use. The carp-induced conditions in Malheur Lake are compromising the biological integrity, diversity, and environmental health of the lake. These factors are ultimately preventing Malheur Lake from fulfilling the refuge purpose that President Theodore Roosevelt established by Executive Order No. 929, "as a preserve and breeding ground for native birds."

D.1.2 The Wilderness Review Process

U.S. Fish and Wildlife Service (USFWS) policy (602 FW 3.4 C.(1) (c)) requires that wilderness reviews be completed as part of the Comprehensive Conservation Planning process.

The National Wildlife Refuge Service's (NWRS's) Policy on Wilderness Stewardship includes guidance for conducting wilderness reviews (610 FW 4).

A wilderness review is the process of determining whether the FWS should recommend NWRS lands and waters to Congress for wilderness designation. The wilderness review process consists of three phases: wilderness inventory, wilderness study, and wilderness recommendation.

Wilderness Inventory (Phase I)

The wilderness inventory is a broad look at a refuge to identify lands and waters that meet the minimum criteria for wilderness: size, naturalness, and outstanding opportunities for solitude or primitive and unconfined type of recreation. All areas meeting the criteria are classified as preliminary Wilderness Study Areas (WSAs). If preliminary WSAs are identified, those areas then proceed to the study phase.

This Wilderness Review only includes the inventory phase (phase 1 of the whole wilderness review process). A subsequent study phase would occur following the publication of the CCP/EIS.

Wilderness Study (Phase II)

During the study phase, WSAs are further analyzed:

- for all values of ecological, recreational, cultural, economic, symbolic importance.
- for all resources, including wildlife, vegetation, water, minerals, soils.
- for existing and proposed public uses.
- for existing and proposed refuge management activities within the area.
- to assess the refuge's ability to manage and maintain the wilderness character in perpetuity, given the current and proposed management activities. Factors for evaluation may include, but are not limited to, staffing and funding capabilities, increasing development and urbanization, public uses, and safety.

Wilderness Recommendation (Phase III)

If the wilderness study demonstrates that a WSA meets the requirements for inclusion in the National Wilderness Preservation System, a wilderness study report would be written that presents the results of the wilderness review, accompanied by a Legislative Environmental Impact Statement (LEIS). The wilderness study report and LEIS that support wilderness designation are then transmitted from the Director of the USFWS through the Secretary of Interior to the President of the United States, and ultimately to the United States Congress for action. Refuge lands recommended for wilderness consideration by the wilderness study report will retain their WSA status and be managed as wilderness and in accordance with the management direction established in the refuge's CCP until Congress makes a decision on the area. According to FWS (610 FW 3.13), when a WSA is revised or eliminated, or when there is a revision in "wilderness stewardship direction, we include appropriate interagency and tribal coordination, public involvement, and documentation of compliance with NEPA."

D.1.3 Criteria for Evaluating Lands for Possible Inclusion in the National Wilderness Preservation System

The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136) provides the following description of wilderness:

> *A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act as an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions ….*

The following criteria for identifying areas as wilderness are outlined in Section 2(c) of the Act and are further expanded upon in NWRS policy (610 FW 4). The first three criteria are evaluated during the inventory phase; the fourth criterion is listed during the inventory but is then evaluated during the study phase.

- generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
- has outstanding opportunities for solitude or a primitive and unconfined type of recreation;
- has at least 5,000 acres of land or is of a sufficient size as to make practicable its preservation and use in an unimpaired condition; and
- may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

D.1.4 Relationship to Previous Wilderness Reviews

The Wilderness Act of 1964 (Public Law 88-577) provided the authority for evaluating existing NWRs, or parts thereof, for inclusion into the National Wilderness Preservation System. This Law directed the review of every roadless area of 5,000 contiguous acres or more, and every roadless island within the NWRS.

A wilderness review and subsequent WSA document was prepared in March 1967 (U.S. Department of the Interior [USDI] 1967); this document identified Malheur Lake (48,317 acres) and Harney Lake (30,000 acres) as potential wilderness areas. As a part of this procedure, the Secretary of the Interior directed the USGS to conduct mineral surveys on these sites. The USGS completed the mineral appraisal in March 1967.

A public Wilderness Hearing was conducted in Burns, Oregon, on May 2, 1967, to gather public input, and written comments continued to be accepted through August 1967. In a letter dated September 5, 1967, the USDI Bureau of Outdoor Recreation indicated that the Malheur Lake unit would be reduced to 20,600 acres; this decision was based on public comments. The Harney Lake unit remained at 30,000 acres.

The revised proposal, totaling 50,600 acres in the Malheur Lake and Harney Lake units, was first introduced in a Wilderness Omnibus Bill (S.3014) in October 1969. The Senate Committee on Interior and Insular Affairs held hearings on November 6, 1969. Due to opposition from Congress regarding the Malheur Lake unit, the Malheur proposal was deleted from the bill (S.3014) and sent back for revision.

According to a FWS Wilderness Fact Sheet, in 1973 the FWS once again reviewed the proposal as directed by Congress and revised the proposal to encompass only the 30,000-acre Harney Lake area. Memos also indicate that this revision was forwarded as a recommendation to the Secretary of the Interior. This recommendation was formally adopted, according to Refuge memos, by the Secretary on May 16, 1973. The 1979 Wilderness Fact Sheet and memos from the associate director of the Bureau of Sport Fisheries and Wildlife (BSF&W) to the Legislative Council (dated July 31, 1973, and signed August 4, 1973) and from the Secretary of the Interior to the Chairman of the House Committee on Interior and Insular Affairs outlines the issues and revised recommendation. A draft Environmental Statement (as they were known at that time) was prepared later in 1973 (USDI 1973), but was never finalized. This draft Environmental Statement included only the 30,000-acre Harney Lake unit.

In 1975, H.R. 5893 (dated April 10, 1975) and H.R. 3507 (dated February 20, 1975) were introduced during the 1st session of the 94th Congress. Both of these bills included the original 50,600 acres from the original 1967 proposal. The inclusion of Malheur Lake in these bills appears to be a mistaken carryover from the original 1969 bill, as none of the requested revisions (from the 1969 hearings) were forwarded to Congress, and there is no indication in the records that Congress discussed the Malheur proposal. No action was taken regarding the Malheur proposal during the 1976 Omnibus Wilderness Hearings.

Between 1976 and 1987, there are no Malheur NWR wilderness-related correspondences in the files. From 1988 to the present, all correspondences indicate that only the 30,000-acre Harney Lake unit was still being considered for wilderness designation. The Harney Lake unit has continued to be managed as a Wilderness Study Area since the original 1969 proposal was introduced.

D.2 Inventory Phase of Wilderness Review

The following constitutes the inventory (Phase I) of the wilderness review for Malheur NWR. Based on inventory outcomes, the next phase (wilderness study) will be conducted as a step-down process to the CCP.

D.2.1 Lands and Waters Considered Under This Wilderness Review

All FWS-owned lands and waters (in fee title) within the Malheur NWR–acquired boundary were considered during this wilderness review. This review includes the re-evaluation of Refuge lands first evaluated during the 1960s and 1970s as described above.

D.2.2 Inventory Units

The first step of a wilderness assessment is to divide the refuge or other management entity into preliminary wilderness evaluation units. The boundaries of these artificial units can follow the refuge boundary, but may not cross permanent roadways, private or other non-Federal lands, or non-Service owned waterways. These roads, non-Federal lands, or waterways can form the boundary for an individual evaluation unit. Other obvious incompatible wilderness uses or structures (such as refuge headquarters, residential areas, rights-of-way, and non-jurisdictional waters) may also be eliminated from any evaluation units at this time. Once boundaries have been established for each individual evaluation unit, the criteria in Sections D.2.3 and D.2.4 are applied to determine each unit's suitability as potential wilderness and the need for further evaluation under the Wilderness Study.

In determining units to be evaluated for wilderness character per this inventory, the Refuge was mapped using geographic information system (GIS) software. Using the major constraints set by the Wilderness Act, specifically land ownership/refuge boundary and permanent road systems, initial large evaluation units were developed by including all contiguous lands within those intractable confines. Through this process, ten units were defined for evaluation and are described below.

D.2.3 Evaluation of Unit Size

Criteria for Evaluation

Roadless areas are defined in Section 3(c) of the Wilderness Act as: 1) a roadless area of 5,000 contiguous acres or more, or 2) a roadless island. "Roadless" is defined as the absence of improved roads suitable and maintained for public travel by means of 4-wheeled, motorized vehicles that are intended for highway use.

According to Service policy (610 FW 4), roadless areas meet the size criteria if any one of the following standards applies:

- The area is over 5,000 contiguous acres solely in FWS ownership.
- It is a roadless island of any size. A roadless island is defined as "an area surrounded by permanent waters or an area that is markedly distinguished from the surrounding lands by topographical or ecological features."
- It is an area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- It is an area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management (BLM).

Results of Evaluation

The 59,664-acre **Malheur Lake Unit** meets the minimum size requirements for a wilderness area. This acreage encompasses the lake bed and associated wetland habitats. Because of the continuity of this area, it was not deemed reasonable to split the lake bed into smaller parcels.

The 31,157-acre **Harney Lake Unit** meets the minimum size requirements for a wilderness area. This is 1,157 acres more than in the 1969 Harney Lake Wilderness Proposal.

The 5,818-acre **Double-O–Stinking Lake Unit** meets the minimum size requirement for a wilderness area. This area includes the northwestern section of the Double-O Unit, including the Stinking Lake Research Natural Area (RNA).

The 5,660-acre **Double-O–Chappo Unit** meets the minimum size requirement; this unit is comprised of the northeastern section of the Double-O Unit.

The 7,973-acre **Sodhouse-West Unit** meets the minimum size requirement. It includes lands west of the Center Patrol Road.

The 6,497-acre **Sodhouse-East Unit** meets the minimum size requirement. It includes lands east of the Center Patrol Road, including the waters of the Blitzen River.

The 1,206-acre **Upper Bridge Creek–Knox Springs Unit** does not meet the minimum size requirement, but is located adjacent to a BLM Wilderness Study Area and therefore will be further evaluated.

The 426-acre **Barnes Springs Unit** does not meet the minimum size requirement, but is located adjacent to a BLM Wilderness Study Area and therefore will be further evaluated.

The 4,520-acre **Buena Vista–Unit 8 Unit** does not meet the minimum size requirement, but is sufficiently close to minimum size to continue evaluation.

The 3,336-acre **P Ranch–East Block Unit** includes lands east of the Center Patrol Road to the Refuge boundary. This unit does not meet the minimum size requirement and will not be evaluated further.

Six of the ten units identified for wilderness evaluation are of sufficient size to evaluate further in the inventory process. Two additional units do not meet the size requirement, but are adjacent to existing BLM wilderness study areas, and therefore will be considered further for inventory evaluation. One unit is only slightly less than the minimum size requirement, so it will be evaluated further. The remaining unit is sufficiently below the minimum size requirement and therefore will not be further evaluated.

D.2.4 Naturalness Evaluation

Criteria for Evaluation

Section 2(c) defines wilderness as an area that "… generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable."

According to Service Policy (610 FW 4), an area meets the naturalness criterion under the following considerations:

- We make a distinction between an area's "apparent naturalness" and "historic conditions" in the context of biological integrity, diversity, and environmental health. The term "historic conditions" refers to the condition of the landscape in a particular area before the onset of significant, human-caused change. The term "apparent naturalness" refers to whether or not an area looks natural to the average visitor who is not familiar with historic conditions versus human-affected ecosystems in a given area. We address the question of the presence or absence of apparent naturalness (i.e., are the works of humans substantially unnoticeable to the average visitor?) in the inventory phase of the wilderness review. In the study phase of the wilderness review, we make an assessment of an area's existing levels of biological integrity, diversity, and environmental health.

- We avoid an approach to assessing naturalness that limits wilderness designation only to those areas judged pristine. Land that was once logged, used for agriculture, or otherwise significantly altered by humans may be eligible for wilderness designation if it has been restored or is in the process of being restored to a substantially natural appearance.
- We use caution in assessing the effects on naturalness that relatively minor human impacts create. An area being evaluated may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Examples of manmade features that would not disqualify an area for consideration as a WSA include: trails, trail signs, bridges, fire towers, fire breaks, fire presuppression facilities, pit toilets, fisheries enhancement facilities (such as fish traps and stream barriers), fire rings, hitching posts, snow gauges, water quantity and quality measuring devices, research monitoring markers and devices, wildlife enhancement facilities, radio repeater sites, air quality monitoring devices, fencing, spring developments, and small reservoirs. Even with these features, an area may express wilderness character and values.
- We may disqualify portions of an area from consideration where significant human-caused hazards make that area unsafe for public use, such as contaminated sites or the existence of unexploded ordnance from military activity. Once these conditions are corrected, we may then consider that portion of the area.
- We do not disqualify areas from further wilderness study solely on the basis of the "sights and sounds" of civilization located outside the areas. Where human impacts are outside the area being inventoried, we do not normally consider them in assessing naturalness. However, if an outside impact of major significance exists, we should note it and evaluate it in the inventory conclusions. Human impacts outside the area should not automatically lead us to conclude that an area lacks wilderness characteristics.
- We do not disqualify areas from further wilderness study solely on the basis of established or proposed refuge management activities or refuge uses that require the use of temporary roads, motor vehicles, motorized equipment, motorboats, mechanical transport, landing of aircraft, structures, and installations generally prohibited in designated wilderness (see definition of "generally prohibited use" in 610 FW 1.5). The physical impacts of these practices should be the focus of the naturalness evaluation. We evaluate existing and proposed refuge management activities and refuge uses in the study phase of the wilderness review.

Today few areas exist that do not exhibit some impact from anthropogenic influences, be it noise, light, or air pollution; water quality or hydrological manipulations; past and current land management practices; roads; suppression of wildfires; invasions by non-native species of plants and animals; or public uses. While allowing for the near-complete pervasiveness of modern society on the landscape, the spirit of the Wilderness Act is to protect lands that still retain the wilderness qualities of being: 1) natural, 2) untrammeled, and 3) undeveloped. These three qualities are the cornerstones of wilderness character. For areas proposed or designated as wilderness, wilderness character must be monitored to determine baseline conditions and thereafter be periodically monitored to assess the condition of these wilderness qualities. Proposed and designated wilderness areas by law and policy are required to maintain wilderness character through management and/or restoration in perpetuity.

Defining the first two qualities (natural and untrammeled) requires a knowledge and understanding of the ecological systems that are being evaluated as potential wilderness. Ecological systems are comprised of three primary attributes: composition, structure, and function. Composition refers to the components that make up an ecosystem, such as the habitat types, native species of plants and animals, and abiotic (physical and chemical) features. These contribute to the diversity of the area. Structure is the spatial arrangement of the components that contribute to the complexity of the area. Composition and structure are evaluated to determine the naturalness of the area. Function refers to the processes that result from the interaction of the various components, both temporally and spatially, and the disturbance processes that shape the landscape. These processes include, but are not limited to, predator–prey relationships, insect and disease outbreaks, nutrient and water cycles, decomposition, fire, windstorms, flooding, and both general and cyclic weather patterns. Ecological functions are evaluated to determine the wildness or untrammeled quality of the area.

The third quality assessment is whether an area is undeveloped. Undeveloped refers to the absence of permanent structures such as roads, buildings, dams, fences, and other man-made alterations to the landscape. Exceptions can be made for historical structures or structures required for safety or health considerations, provided they are made of natural materials and relatively unobtrusive on the landscape.

Results of Naturalness Assessment

Malheur Lake Unit: The Malheur Lake Unit contains approximately 8 miles of levee system, 1.6 miles of access roads, and 68 miles of boundary fence. Roads access hunt areas and a boat launch. An artificial osprey nesting platform also exists within the lake bed. In the 1970s, Malheur Lake was an extensive bulrush/cattail/sago pondweed marsh that supported hundreds of thousands of migrating and nesting birds. The lake today is a body of muddy water devoid of most bird use. Although Malheur Lake has retained most hydrological inputs, the lake basin itself has lost much of its natural function due to the introduction of invasive species. Invasive species, aquatic and terrestrial, have altered this ecological system in a manner that has changed all natural attributes except hydrology. The hydrology of the lake is still driven by annual climate conditions that cause the lake to fluctuate from an average low of 24,000 acres to an average high of 47,000 acres. Lake surface acres have ranged from a low of 400 in 1992 to a high of 170,000 in 1984 (well outside of the Refuge boundary).

Due to the impacts of invasive common carp, Malheur Lake is now devoid of nearly all aquatic vegetation. Upland areas that are not submerged contain significant amounts of invasive species such as perennial pepperweed and Russian olive. Aquatic and terrestrial invasives are also present in all tributaries. This has created a situation where issues on the Refuge impact the watershed and the watershed impacts the Refuge. Although Malheur Lake is nearly devoid of aquatic vegetation, and it has lost much of its natural biological function, the works of man are substantially unnoticeable to the casual visitor. Malheur Lake would appear natural to the average visitor who is not familiar with historical conditions versus the human-affected ecosystem. Even though Malheur Lake is a highly altered ecological system that no longer functions properly, it does meet the wilderness criteria of “apparent naturalness.” Naturalness in combination with properly functioning ecosystems is a valued attribute.

Although Malheur Lake meets the “apparent naturalness” criteria, current ecological conditions do not meet the requirements of the NWR System mission, nor does the Lake possess biological integrity, diversity, or good environmental health. In addition to these criteria, Malheur Lake’s suitability for management and preservation as wilderness is evaluated based on the area’s primary purpose. The purpose for Malheur Lake is “… a refuge and breeding ground for migratory birds and other wild life …” as defined by Executive Order 7106, dated July 19, 1935.

Through the Comprehensive Conservation Planning process, the Refuge is developing strategies to restore the ecological function of Malheur Lake, thereby enabling the fulfillment of Refuge purpose and other mandates. As strategies are developed, they will be based on the best available science, including site-specific science that is being currently being compiled through extensive research, inventory, and monitoring. The Refuge’s goal is to develop and implement a comprehensive restoration strategy for Malheur Lake while striving to retain the area’s natural appearance.

Malheur Lake does meet “apparent naturalness” from a wilderness standard; however, the purpose and other required mandates for Malheur Lake are not being fulfilled under current deteriorated biological conditions. For this reason USFWS will delay further wilderness evaluation until ecological integrity is restored.

Harney Lake Unit: The Harney Lake Unit is primarily an alkali playa with a desert scrub vegetation component around the periphery. Minimal water flows reach the Harney Lake basin and originate primarily from spring systems and Silver Creek. Silver Creek inflows rarely reach the basin due to upstream diversions on the adjacent Double-O unit and private lands. Independent of these diversions and impoundments, water flows from springs and Silver Creek are insufficient to fill the basin annually, and the basin fills completely only during extreme flood events. This alkali playa creates a unique and somewhat harsh environment suited for specific flora and fauna. This unit also contains the Harney Lake RNA.

The Harney Lake Unit does not contain alterations by man-made features or biological agents. This unit retains much of its natural characteristics and will be further evaluated in Section D.2.5.

Double-O-Stinking Lake Unit: The Double-O–Stinking Lake Unit is comprised of arid shrubland habitat and natural spring systems. This area includes the Stinking Lake RNA. This unit has a well-developed wetland system, and the springs have been significantly altered for water management. The unit has three water troughs or other watering developments and eight man-made wetland units. Water flows in these wetland units are manipulated by 35 water control structures and over 7 miles of levees/roads, one borrow ditch, and 19 miles of water delivery ditches. Improved roadways for administrative use total almost 10 miles, and public access is allowed along the southern boundary of the unit. There are two historic homesteads in the unit. Other developments include an osprey nesting platform, two wells, one fish screen, and two bridges. Power lines bisect the unit to service both Refuge and private facilities.

The unit contains approximately 17 miles of fencing with 75 percent of this as interior fence. Invasive plants are problematic, especially perennial pepperweed, reed canarygrass, and Canada thistle. Non-native common carp are present and represent a serious threat to the native biodiversity; this species requires continual and intensive control measures.

Within the unit is the Stinking Lake RNA. This portion of the unit retains its natural character and function; however, this 1,555-acre area does not meet the minimum wilderness size requirements.

Thus the Double-O–Stinking Lake Unit requires considerable management and contains developed features that compromise the natural qualities of the unit and will not be considered further for evaluation.

Double-O–Chappo Unit: The Double-O–Chappo Unit lies adjacent to the Double-O–Stinking Lake Unit within the northeastern section of the Double-O Unit. The unit is comprised of arid shrubland habitat and outflows from the natural spring systems. This unit has a developed wetland system and has one water trough and seven man-made wetland units. Water flows in these wetland units are manipulated by 24 water control structures and over 6 miles of levees, 2.5 miles of water delivery ditches, and one borrow ditch. There are 4.3 miles of improved roadways for administrative use and public access is allowed along portions of these roads. Other developments include public use signage and two small bridges.

In the unit there is approximately 22 miles of fencing, half of which is interior fencing. The unit contains a mechanically leveled field used in the past for farming. Invasive plants are problematic, especially perennial pepperweed, reed canarygrass, and Canada thistle. Non-native common carp are present and represent a serious threat to the native biodiversity; this species requires continual and intensive control measures. The unit is intensively manipulated; all water flows are managed with numerous man-made structures. Past farming practices have altered the natural plant communities. Due to these factors, the unit does not contain the natural qualities to be further considered for evaluation.

Sodhouse-West Unit: The Sodhouse-West Unit consists of lands west of the Center Patrol Road, in the northern portion of the Blitzen Valley. The unit has seven man-made wetlands that are manipulated by 25 water control structures, 3 miles of dikes, and 32 miles of canals and ditches. The unit contains about 20 miles of administrative roads, with an additional 15 miles of public roads along the unit boundary, including State Highway 205. Other developments include two historic lookout towers and 13 miles of interior fencing; portions of the unit are farmed and hayed. The unit contains large acres of invasive weeds, such as perennial pepperweed, reed canarygrass, thistles, and cheatgrass; carp are also a significant issue within the waterways and negatively impact the native flora and fauna of the site. Due to the presence of non-native species, the highly managed nature of the unit, and the man-made developments, this unit does not retain sufficient naturalness to be included for further wilderness evaluation.

Sodhouse-East Unit: The Sodhouse-East Unit is comprised of a section of long linear lands east of the Center Patrol Road, including the waters of the Blitzen River. The unit contains one dam and five man-made wetlands that are manipulated by 23 water control structures, 8 miles of dikes, and 9 miles of canals and ditches. Portions of the unit are farmed for grain crops. The unit contains about 9 miles of administrative roads, with an additional 11 miles of public roads. Other developments include four bridges, a dam/fish ladder, a gravel pit, and 11 miles of interior fencing. The unit contains large acres of invasive weeds, such as perennial pepperweed, reed canarygrass, thistles, and cheatgrass; carp are also a significant issue within the waterways and negatively impact the native flora and fauna of the site. Due to the presence of non-native species and the highly managed nature of the unit with man-made developments, this unit does not retain sufficient naturalness to be included for further evaluation.

Buena Vista–Unit 8: The Buena Vista–Unit 8 Unit is a linear unit of the Refuge containing one water trough, six man-made wetlands that are manipulated by 24 water control structures, 9 miles of dikes/levees, and many miles of canals and ditches. Portions of the unit are farmed for grain crops.

The unit contains about 12 miles of administrative roads, with an additional 5.5 miles of public roads and is bordered by State Highway 205. Other developments include four bridges, a dam, a fish ladder, two fish screens, a gravel pit, and 11 miles of interior fencing. The unit also contains large acres of invasive weeds, such as perennial pepperweed, reed canarygrass, thistles, and cheatgrass; carp are also a significant issue within the waterways and negatively impact the native flora and fauna of the unit. Due to the presence of non-native species requiring active control, man-made developments, and its highly managed nature, this unit does not retain sufficient naturalness nor is of sufficient size (4,520 acres) to be included for further evaluation.

Upper Bridge Creek/Knox Springs Unit: The 1,206-acre Upper Bridge Creek/Knox Springs Unit is located adjacent to a BLM Wilderness Study Area. The unit contains one developed spring area and one culvert. A managed ditch delivers water from the spring to Refuge wetlands. The unit has 2 miles of exterior and 4 miles of interior fence. The unit also has six man-made rock weirs in Bridge Creek.

Ongoing restoration activities include the use of mechanized equipment for reconnecting creeks to floodplains, rehabilitation of waterway embankments, and tree/shrub plantings. Fencing enclosures are required for plant establishment during restoration activities. The upland vegetation of the site is dominated by non-native crested wheatgrass plantings with almost no remaining native plants. Invasive cheatgrass is also prevalent in the unit. Due to the unit's highly altered ecosystem there is a long-term need for non-native grass eradication, revegetation with native forbs and grasses, and an ongoing riparian restoration program. Under current conditions, this unit cannot fulfill the Refuge purpose, or be considered to have biological integrity, diversity, and environmental health. Because of the lack of natural qualities, the Upper Bridge Creek/Knox Springs Unit will not be considered for further wilderness evaluation at this time.

Barnes Springs Unit: The 426-acre Barnes Springs Unit is located adjacent to a BLM Wilderness Study Area. The unit contains one developed spring and an adjacent homestead site. Other developments include 3.8 miles of boundary fencing and 0.4 miles of roads/trails. This unit also contains large acres of invasive weeds, especially medusahead and cheatgrass. The former originates and re-infests the Refuge from large infestations on adjacent BLM lands. Medusahead is a particularly difficult species to eradicate/control, requiring mechanized spraying and manipulation. Juniper encroachment onto this unit requires mechanical thinning and prescribed burning regimes. Under current conditions, this unit cannot fulfill the Refuge purpose, or be considered to have biological integrity, diversity, and environmental health. Because of the lack of natural qualities, the Barnes Springs Unit will not be considered for further wilderness evaluation at this time.

D.2.5 Evaluation of Opportunities for Outstanding Solitude or Primitive/Unconfined Recreation

Criteria for Evaluation

In addition to size and naturalness, wilderness areas must provide outstanding opportunities for solitude or a primitive and unconfined type of recreation. The area does not need to have outstanding opportunities for both elements and does not need to have outstanding opportunities on every acre. An area also does not have to be open to public use and access to qualify under these criteria. Each area is assessed on its own merits and is not compared to other areas.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. Primitive recreation activities may provide opportunities to experience challenge and risk, self-reliance, and adventure.

Results of Outstanding Solitude or Primitive/Unconfined Recreation Assessment

The Harney Lake Unit is not open to public use to protect the unit's unique micro-habitats and the importance of the site to wildlife species, such as nesting western snowy plovers. Public use and interpretive facilities are planned adjacent to, but not within, the unit. If the unit were open to public use, the size of the unit would provide outstanding opportunities for solitude and/or primitive recreation.

D.2.6 Inventory Summary and Conclusion

Table D-1 summarizes the above evaluation factors for each of the units that were delineated and evaluated as described in Section D.2.2.

The majority of Malheur NWR is a highly altered wetland and upland system. The lands and waters were significantly altered both prior to and during Service ownership. The Refuge has actively managed these lands to meet the needs of wildlife species at both Refuge and Pacific Flyway levels to enable the Refuge to meet its establishing purposes. The effects of management have included changes to the soils, flora, and fauna. Man-made developments abound in the form of an extensive road system, hundreds of miles of primary dikes, ditches, and fences, altered creeks and river, and thousands of water-management structures.

In this inventory (Phase I) the Harney Lake Unit was found to meet the minimum wilderness criteria for size, naturalness, and outstanding opportunities for solitude and primitive/unconfined recreation. A total of 31,157 acres were found to have wilderness characteristics, which is 1,157 acres greater than the existing WSA proposed in 1969. Based on the findings in this inventory, Harney Lake will be further evaluated in the Wilderness Study Phase as a step-down process to the CCP.

Table D-1. Results of Wilderness Inventory (Phase I) for Malheur NWR

Refuge Unit	Size	Naturalness	Outstanding opportunities for solitude or primitive/unconfined recreation	Summary: Area will move forward for Phase II Wilderness Study
Malheur Lake	Yes	Yes	NE	No*
Harney Lake	Yes	Yes	Yes	Yes
Double-O–Stinking Lake	Yes	No	NE	No
Double-O–Chappo	Yes	No	NE	No
Sodhouse-West	Yes	No	NE	No
Sodhouse-East	Yes	No	NE	No
Upper Bridge Creek/Knox Springs	No*	No	NE	No

Refuge Unit	Size	Naturalness	Outstanding opportunities for solitude or primitive/unconfined recreation	Summary: Area will move forward for Phase II Wilderness Study
Barnes Spring	No**	No	NE	No
Buena Vista–Unit 8	No	No	NE	No
P Ranch–East	No	NE	NE	No

Notes:
NE – Not evaluated (once any wilderness criteria was not met, further evaluation was not conducted.)
* USFWS will delay further wilderness evaluation until ecological integrity is restored.
**Located adjacent to existing wilderness area or wilderness study area; size requirement does not apply.

D.3 References

U.S. Department of the Interior (USDI). 1967. Wilderness Study Areas: Malheur National Wildlife Refuge. Fish and Wildlife Service. Bureau of Sport Fisheries and Wildlife. Unpublished report on file at Refuge office.

USDI. 1973. Draft Environmental Statement. Proposed Malheur Wilderness Area, Harney County, Oregon. Bureau of Sport Fisheries and Wildlife. Unpublished report on file at Refuge office. 24 pp.

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White pelican
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Appendix E

Biological Integrity, Diversity, and Environmental Health

The Refuge System Administration Act directs managers to maintain the biological integrity, diversity, and environmental health (BIDEH) on refuges for the benefit of present and future Americans. Accordingly, the following assessment of BIDEH has been prepared for each of the major habitats at Malheur National Wildlife Refuge.

Table E-1. Biological Integrity, Diversity, and Environmental Health for Malheur National Wildlife Refuge

Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)	Natural Processes Responsible for these Conditions	Limiting Factors
Lacustrine (Lakes)		
Malheur Lake fluctuates greatly in size, from a typical minimum pool of 500 acres to approximately 90,000 acres in the mid-1980s. It has also been completely dry (1934) and has extended up to 170,000 acres (mid-1980s). Historically, a chemical and physical gradient could be observed from west (Mud Lake and directly east of Hwy 205) to east. The far west side consisted of a complex network of ponds, islands, and peninsulas. The center of the lake was dominated by emergent (e.g., hardstem bulrush) marshes and interspersed open water areas. The eastern side has been highly alkaline and contains large areas of open water. Common emergent species included hardstem bulrush, cattail, bur-reed, Baltic rush, and various sedges. Open water areas included submergent plants such as watermilfoil, sago pondweed, horned pondweed, coontail, small and leafy pondweed, white water buttercup, bladderwort, and widgeongrass. Soil surveys indicate that emergent vegetation responded to existing water levels and did not persist in specific areas with the exception of river inlets and significant spring sources.	Inflow sources include the Blitzen and Silvies rivers and Sodhouse Spring. River flows are predominantly influenced by snowpacks on Steens Mountain and Malheur Forest. Shallow water levels, annual and seasonal fluctuations in water depth, and a mosaic of permanent and cyclical water levels. The prevailing chemical gradient and variable water depths determined the composition of plant communities throughout the lake. Ice movement/scouring following flood events impact topography and reduce the presence and cover of emergent vegetation.	Common carp (introduced to the system in the early 1900s) has decimated the productivity of this marsh/lake system. They root up submergent vegetation and dramatically increase turbidity. Hydrological inputs to the lake, particularly from the Silvies River, have been altered.

Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)	Natural Processes Responsible for these Conditions	Limiting Factors
Riverine		
Waterways support riparian communities that are appropriate to stream channel type. The hydrologic floodplains are intact with balanced pool/riffle/glide ratios depending on slope and substrate. Water turbidity is typically low with an appropriate level of sediment storage, which buffers against the sediment loading of critical rearing pools and spawning gravels for native fish. Boulders, undercut banks, logs, and vegetation provide ample hiding cover for native fish and other aquatic species. Eddies and other slow current areas contain abundant populations of various aquatic invertebrates. Low turbidity also allows a variety of native aquatic vegetation to establish and propagate in suitable micro niches.	Streams such as Bridge and Mud had 1%-4% gradients and were dominated by boulders, cobbles, and gravel. The Blitzen River had a low gradient (<1%) and was dominated by gravel and silt substrates. Sediment discharge and particle size as well as streamflow and slope were in balance. Balance between sinuosity and percent slope maintained the physiological integrity of the channel by reducing velocity while intact floodplains disperse energy.	Common carp There has been a loss of riparian plant diversity due to past management and competition with invasive plant species. Channelization of the Blitzen River has compromised in-stream habitat and the system's ability to disperse energy during high flow events. Incised channel. Most floodplains are no longer functionally active as a result of altered hydrology from ditching, diversions, and dams along the river.
Woody Riparian		
The Refuge hosts a variety of riparian/riverine systems, ranging from the Blitzen River itself to various tributaries that flow into it from neighboring valleys and canyons on the northern side of Steens Mountain. Although many plant associations are found within this broader community, the principal woody species include various species of willow, redosier dogwood, Woods' rose, golden currant, common snowberry, Lewis' mock orange, water birch, and alder. Herbaceous groundcover characterized by Nebraska sedge, yellow monkey-flower, Northwest cinquefoil, American speedwell, woolly sedge, slenderbeak sedge, meadow barley,	Stream bank soils consist of gravel and cobble due to common flooding disturbance, alluvial bars, and very little soil development. Within the active floodplain, the soils are deep and consist of pluvial deposits on alluvium.	Reed canarygrass, hemlock, perennial pepperweed, and other invasives are able to out-compete native vegetation following most disturbances. River channelization Historical livestock grazing Lowered groundwater table Infrastructure (ditches, dams, roads) Water quality impairments

Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)	Natural Processes Responsible for these Conditions	Limiting Factors
tufted hairgrass, western yarrow, and Baltic rush.		Altered hydrology and minimum flows Broad-scale loss of functional connectivity between rivers and streams, and their floodplains
Palustrine Emergent (Seasonally Flooded Wet Meadows)		
Wet meadows typically occupy the transition zone between marsh and moist meadow plant communities. Native vegetation includes Baltic rush, woolly sedge, Nebraska sedge, slenderbeak sedge, arrowgrass, meadow barley, tufted hairgrass, Nevada bluegrass, western yarrow, slender cinquefoil, largeleaf avens, Oregon checker mallow, and fringed willowherb.	Surface water is generally present during the growing season (at least 2 months). Only isolated depressions or sloughs hold water into the early fall. Soils are derived from alluvium and are very deep and poorly drained (pH of 6.6-7.0).	Introduced species such as Kentucky bluegrass and common timothy have become “naturalized” within these communities, but offer habitat structure similar to that of many native species. Invasive species such as reed canarygrass (an introduced cultivar), phragmites, and perennial pepperweed displaced native species. Cattails appear to encroach on areas that are inundated for longer than two months. Altered hydrology through river channelization and ditching as well as agricultural practices including livestock grazing.
Palustrine Emergent (Seasonally Flooded Marsh associated with Wet Meadows)		
This habitat type commonly exists within mosaics of wet meadow and open water. Stand density varies greatly and has a maximum height of approximately 3 meters (9.8 feet). Common emergent plant species include bur-reeds, bulrushes, cattails, sedges, rushes, and spikerushes.	Emergent vegetation can typically tolerate fluctuations in water availability, ranging from approximately 1 meter above to 10-12 cm (4-5 inches) below the soil surface. Extended periods of standing water aid in preventing the transition to mesophytic plant communities.	The maintenance of existing emergent communities is artificial, requiring extensive infrastructure and active water diversion from the Blitzen River, its tributaries, and springs. All water delivery in the Double-O Unit, including Silver Creek flows, is highly manipulated.

Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)	Natural Processes Responsible for these Conditions	Limiting Factors
Submergent plants such as pondweeds, bladderworts, waterweeds, and duckweeds occur in nearby open water. Willow species can occur along elevated ecotones along marsh perimeters.	Emergent marshes existed throughout the lower Blitzen Valley and became less extensive north of Buena Vista. Associated with very deep, very poorly drained soils that formed in alluvium, alluvium over lacustrine deposits derived from igneous rock, or organic matter. These soils are located on low stream terraces and their depressions as well as lake basins. The natural hydroperiod for most marsh communities likely existed from spring through mid-summer.	Increased densities of emergent vegetation reduce boundary habitat for wildlife and decrease the diversity of this community type. Historical livestock grazing and haying practices favored the establishment of meadows. Altered hydrology via river channelization and the creation of irrigation ditches.
Palustrine Emergent (Semipermanent Flooded Wetland Impoundments)		
These open water habitats are semipermanently flooded at depths that preclude the development of extensive stands of emergent vegetation. Submerged and floating plants such as common and greater duckweed; Canadian waterweed; coontail; watermilfoil; common bladderwort; white water crowfoot; and sago, longleaf, and small pondweed regularly occur in open water. Emergent plants (e.g., bulrushes, cattails, sedges, rushes, spikerushes) occupy shallow areas within and alongside open water communities.	With the exception of small natural depressions next to springs (i.e., Double-O Spring), this community type has been maintained through active and intensive management. Occasional drawdowns (drought) oxidize and consolidate substrates to facilitate the germination of submergent vegetation such as sago pondweed. When pond and lake bottoms are exposed, production of smartweed and other desirable native colonizers also is often quite high, especially on mudflats in shallow benches.	Aging infrastructure and management of vegetation within water delivery systems pose challenges in ensuring ready and consistent water availability. Invasive species such as carp and reed canarygrass. Historical ditches and canals and the removal of beaver have altered hydrology.

Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)	Natural Processes Responsible for these Conditions	Limiting Factors
Dry Meadow		
Moist meadows typically occupy the transition zone between wet meadow and upland plant communities. Dominant native grass species include creeping wildrye, bluejoint, and Nevada bluegrass. Native forbs include slender cinquefoil, western yarrow, and lanceleaf goldenweed.	Soils are similar to those of wet meadow communities, but are generally located in slightly elevated areas with increased aerobic conditions during the growing season. Depth to water table typically ranges from 0 to -12 inches during the growing season.	Native forb understory has been greatly decreased through competition with invasive species and noxious weed treatment. These communities are highly susceptible to invasion by perennial pepperweed. Due to the introduction of irrigation infrastructure and the leveling of some meadows in the early twentieth century, the extent of this community has likely been reduced.
Salt Desert Scrub		
This plant community resides in barren alkali flats or alkaline valley bottomlands. It consists of widely spaced shrubs with dense patches of rhizomatous grasses with low densities of other annual and perennial grasses and succulent forbs. Plant species include black greasewood, inland saltgrass, alkali sacaton, alkali cordgrass, and alkali bluegrass. Mat muhly and Sandberg bluegrass may be present in mosaics, which exhibit more moderate conditions (lower pH).	Infrequent inundation of outer playa areas or wind erosion from these playas distributes salts to nearby low-lying areas, causing elevations in alkalinity and pH, which favor this community association.	Heavy livestock grazing may compromise plant species diversity in more moderate areas within this plant community type.
Sagebrush Lowland		
Commonly found in swales, toeslopes, the base of alluvial fans, and adjacent to moist meadow communities within the Blitzen Valley. Native plant species include native	Sites are moist or wet in the spring and dry by mid-summer. Associated species are fairly tolerant of high soil sodium	Susceptible to invasive plants such as cheatgrass and perennial pepperweed invasion. Historical livestock grazing

Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)	Natural Processes Responsible for these Conditions	Limiting Factors
shrubs (e.g., Wyoming big sagebrush, basin big sagebrush, rabbitbrush, bitterbrush, and horsebrush) interspersed with bunchgrasses such as basin wildrye, Sandberg bluegrass, crested wheatgrass, needle and thread, and Indian ricegrass. These sites are typically forb-poor.	content and alkalinity. Soils are generally deep and have moderate water-holding capacity (sandy loams).	decreased plant species diversity in many of these areas.
Sagebrush Steppe		
This community is dominated by shrubs with an understory of various bunchgrass and forb species found within interspaces. It can be found above greasewood/basin big sagebrush communities on various aspects, slopes, and soil types. Plant species include Wyoming big sagebrush, low sagebrush, bluebunch wheatgrass, Sandberg bluegrass, bottlebrush squirreltail, Idaho fescue, needle and thread, Thurber's needlegrass, western yarrow, arrowleaf balsamroot, and various locoweed and phlox species.	A gradient in soil depth determines whether Wyoming big sagebrush or low sagebrush dominates a site. Low sagebrush sites typically host higher densities of forbs due to higher concentrations of available soil moisture due to shallow, rocky conditions. These communities depend on natural fire cycles or equivalent disturbances to maintain a balance between shrub, grass, and forb components. A lack of disturbance lends itself to high shrub densities with sparse vegetation in the interspaces.	Invasive plants (especially cheatgrass) have compromised many sites from recovering naturally from wildfire. Livestock grazing Juniper encroachment from historical fire suppression greatly reduced native shrub densities and increased soil erosion. Medusahead infests clay sites and is capable of out-competing native grasses and forbs in the understory. Much of this habitat has been replaced on the Refuge with crested wheatgrass monocultures after wildfires.
Dune		
Open sand dunes hosting with widely spaced shrubs, grasses, and forbs located adjacent to playa basins. Shrubs include shortspine horsebrush, fourwing saltbush, bud sagebrush, green and gray rabbitbrush, and basin big sagebrush. Grasses include Indian	These plant communities are created by wind erosion off nearby dry playa bottoms (i.e., Stinking Lake and Harney Lake). As sites deteriorate (loss of vegetative cover and increased	Susceptible to invasion by halogeton, povertyweed, and Russian thistle Agricultural practices have altered plant community composition and succession in many dune areas.

Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)	Natural Processes Responsible for these Conditions	Limiting Factors
ricegrass, needle and thread, bottlebrush squirreltail, and alkali sacaton. Forbs include tufted evening primrose, Paiute suncup, Geyer's milkvetch, sharpleaf penstemon, and various lupines.	wind erosion), a shift toward black greasewood and inland saltgrass is possible. Soils are formed by lacustrine sands and are neutral to moderately alkaline (pH 8.2). They are moist in the winter and spring and are usually dry June through October. Low available water capacity on or near the soil surface limits the survival of seedlings. Drought-prone	
Playa		
Virtually no vascular plants reside within Harney and Stinking lakes, with the exception of spring areas where steady freshwater inflows modify water chemistry. High water events provide temporary opportunities for aquatic plants and animals (i.e., sago pondweed and tui chub) to increase. These systems are rich in invertebrates such as brine flies and brine shrimp.	Evaporation of closed basin water results in high levels of alkalinity and associated pH. Dilution during high water events stimulates temporary production of aquatic species. Soils are typically very deep and poorly drained and were formed in volcanic lacustrine deposits. Texture commonly consists of silty clay loam and is strongly alkaline (10.5), with pH dropping to 8.0 at approximately 50 inches depth.	Altered irrigation/water movement patterns may have disrupted natural water level cycles (particularly in Stinking Lake).

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Mule deer buck
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Appendix F
Statement of Compliance

The following executive orders and legislative acts have been reviewed as they apply to the implementation of the Comprehensive Conservation Plan (CCP) for Malheur National Wildlife Refuge, located in Oregon.

National Environmental Policy Act (1969) (42 U.S.C. 4321 et seq.). The planning process has been conducted in accordance with National Environmental Policy Act (NEPA) Implementing Procedures, with Department of Interior and Fish and Wildlife Service procedures, and in coordination with the affected public. The requirements of NEPA (42 U.S.C. 4321 et seq.) and its implementing regulations in 40 C.F.R. 1500-1508 have been satisfied in the procedures used to reach this decision. These procedures included the development of a range of alternatives for the Malheur Refuge CCP; analysis of the likely effects of each alternative; and public involvement throughout the planning process. The affected public was notified of the availability of documents through Federal Register notices, news releases to local newspapers, the Service's refuge planning website, and planning updates. Copies of the final CCP have been distributed to an extensive mailing list. In addition, the Service hosted a variety of public scoping events in 2009 (see Appendix J).

National Historic Preservation Act (1966) (16 U.S.C. 470 et seq.). The management of the archaeological and cultural resources of Malheur Refuge will comply with the regulations of Section 106 of the National Historic Preservation Act (NHPA). No historic properties are known to be affected by the proposed action based on the criteria of an effect or adverse effect as an undertaking defined in 36 C.F.R. 800.9 and Service Manual 614 FW 2; however, determining whether a particular action has the potential to affect cultural resources is an ongoing process that occurs as step-down and site-specific project plans are developed. Should historic properties be identified or acquired in the future, the Service will comply with the NHPA if any management actions have the potential to affect any of these properties.

Endangered Species Act (16 U.S.C. 1531-1544). This Act provides for the conservation of threatened and endangered species of fish, wildlife, and plants by Federal action and by encouraging the establishment of state programs. Documentation is required under Section 7 of the Act. Refuge policy requires the Refuge Manager to document issues that affect or may affect endangered species before initiating projects. At this time there are no species listed as endangered or threatened inhabiting the Refuge. Effects to candidate species have been considered and are described in Chapter 6 of the CCP/EIS and in the Compatibility Determinations (Appendix B). Consultation on specific projects will be conducted prior to implementation to avoid any adverse impacts to these species and their habitat.

Executive Order 12372, Intergovernmental Review. Coordination and consultation with affected tribal, local, and state governments, other Federal agencies, and local interested persons has been completed through personal contact by Refuge staff and Refuge supervisors.

Executive Order 11988, Floodplain Management. Under this order, Federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." The CCP is consistent with Executive Order 11988 because CCP implementation would maintain a number of dams and diversions on the Blitzen River system, which would minimize impacts to human safety, health, and welfare, from floods. The proposed action may restore floodplain connectivity along the Blitzen River system when and where feasible. In the interim, managed wetlands, marshes, and meadows located in the historical floodplain will continue to contribute to the natural and beneficial fish and wildlife resource values unique to the area.

Wilderness Act of 1964. The Service has evaluated the suitability of the Refuge for wilderness designation (Appendix D) through the "Inventory" phase according to the guidelines of the Wilderness Review process as described in 610 FW 4. In this inventory (Phase I), the Harney Lake Unit was found to meet the minimum wilderness criteria for size, naturalness, and outstanding opportunities for solitude and primitive/unconfined recreation. A total of 31,157 acres were found to have wilderness characteristics. Based on the findings in this inventory, Harney Lake will be further evaluated in the "Study" phase as a step-down process to the CCP.

Executive Order 11990, Protection of Wetlands. The CCP is consistent with Executive Order 11990 because CCP implementation would potentially enhance and restore wetland resources on the Refuge.

National Wildlife Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee). The National Wildlife Refuge System Improvement Act (Public Law 105-57, Improvement Act) requires the Service to develop and implement a CCP for each refuge. The CCP identifies and describes Refuge purposes; Refuge vision and goals; fish, wildlife, and plant populations and related habitats in the Refuge; archaeological and cultural values of the Refuge; issues that may affect populations and habitats of fish, wildlife, and plants; actions necessary to restore and improve biological diversity on the Refuge; and opportunities for wildlife-dependent recreation, as required by the Act. During our planning process, the Refuge Manager evaluated all the Refuge's existing and proposed uses for appropriateness. The Refuge's priority wildlife-dependent uses—wildlife observation, interpretation, photography, environmental education, waterfowl hunting, upland game hunting, and fishing—are automatically deemed appropriate under Service policy. Other uses were found to be appropriate, including commercial tours and photography, grazing and haying, gathering culturally important plants, conducting research, and farming. We completed compatibility determinations for all of the appropriate uses.

Executive Order 12898. Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. All Federal actions must address and identify, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations, low-income populations, and Indian tribes in the United States. The CCP was evaluated, and no adverse human health or environmental effects were identified for minority or low-income populations, Indian tribes, or anyone else.

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. This Order directs agencies to take certain actions to further implement the Migratory Bird Treaty Act. A provision of the Order directs Federal agencies to consider the impacts of their activities, especially in reference to birds on the Fish and Wildlife Service's list of Birds of Conservation Concern. It also directs agencies to incorporate conservation recommendations and objectives in the North American Waterbird Conservation Plan and bird conservation plans developed by Partners in Flight into agency planning as described in Chapter 1. The effects of all alternatives to Refuge habitats used by migratory birds were assessed within the CCP/EIS.

Executive Order 13175, Consultation and Coordination with Indian Tribal Governments. As required under the Secretary of the Interior's Secretarial Order 3206—American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act—the Project Leader notified and consulted interested tribes. The Service consulted with the Burns Paiute Tribe throughout the Service's planning process.

Architectural Barriers Act of 1968. This Act requires facilities designed, built, altered, or leased with Federal funds to be accessible for persons with mobility impairments. Accessibility planning was integrated into our CCP process, and specific actions are identified in Chapter 2 of the CCP.

Integrated Pest Management. This plan conforms to Department of the Interior Pesticide Use Policy as described in 517 DM 1.1 and the Service's Integrated Pest Management (569 FW 1) policy. An integrated pest management approach has been adopted to eradicate, control, or contain pest and invasive species on the Refuge. In accordance with 517 DM 1, only pesticides registered with the Environmental Protection Agency (EPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act and as provided in regulations, orders, or permits issued by EPA may be applied on lands and waters under Refuge jurisdiction.

______________________________ 1-24-2013
Chief, Division of Planning
Visitor Services and Transportation

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Appendix G

Integrated Pest Management Plan

G.1 Background

Integrated Pest Management (IPM) is an interdisciplinary approach using methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on refuge lands and waters to achieve wildlife and habitat management goals and objectives. IPM is also a scientific, adaptive management process where available scientific information and best professional judgment of the refuge staff as well as other resource experts are used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. In accordance with 43 CFR 46.145, adaptive management is particularly relevant where long-term impacts may be uncertain, and future monitoring will be needed to make adjustments in subsequent implementation decisions. After a tolerable pest population (threshold) is determined considering the achievement of refuge resource objectives and the ecology of pest species, one or more methods, or combinations thereof, will be selected that are feasible, efficacious, and most protective of non-target resources, including native species (fish, wildlife, and plants), and Service personnel, Service-authorized agents, volunteers, and the public. Staff time and available funding will be considered when determining feasibility/practicality of various treatments.

IPM techniques to address pests are presented as CCP strategies (see Chapter 2 of this CCP) in an adaptive management context to achieve refuge resource objectives. In order to satisfy requirements for IPM planning as identified in the Director's Memo (dated September 9, 2004) entitled *Integrated Pest Management Plans and Pesticide Use Proposals: Updates, Guidance, and an Online Database*, the following elements of an IPM program have been incorporated into this CCP:

- Habitat and/or wildlife objectives that identify pest species and appropriate thresholds to indicate the need for and successful implementation of IPM techniques; and
- Monitoring before and/or after treatment to assess progress toward achieving objectives including pest thresholds.

Where pesticides would be necessary to address pests, this appendix provides a structured procedure to evaluate the potential effects of proposed uses involving ground-based applications to refuge biological resources, and environmental quality in accordance with effects analyses which were presented in Chapter 6, Environmental Effects, of the Final Malheur Refuge CCP/EIS. Only pesticide uses that would likely cause minor, temporary, or localized effects to refuge biological resources and environmental quality with appropriate best management practices (BMPs), where necessary, would be allowed for use on the refuge.

This appendix does not describe the more detailed process to evaluate potential effects associated with aerial applications of pesticides. Moreover, it does not address the effects of mosquito control with pesticides (larvicides, pupacides, or adulticides) based upon identified human health threats and presence of disease-carrying mosquitoes in sufficient numbers from monitoring conducted on a refuge. However, the basic framework to assess potential effects to refuge biological resources and environmental quality from aerial application of pesticides or use of insecticides for mosquito management would be similar to the process described in this appendix for ground-based treatments of other pesticides.

G.2 Pest Management Laws and Policies

In accordance with Service policy 569 FW 1 (Integrated Pest Management), plant, invertebrate, and vertebrate pests on units of the National Wildlife Refuge System can be controlled to ensure balanced wildlife and fish populations in support of refuge-specific wildlife and habitat management objectives. Pest control on federal (refuge) lands and waters also is authorized under the following legal mandates:

- National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd-668ee);
- Plant Protection Act of 2000 (7 USC 7701 et seq);
- Noxious Weed Control and Eradication Act of 2004 (7 USC 7781-7786, Subtitle E);
- Federal Insecticide, Fungicide, and Rodenticide Act of 1996 (7 USC 136-136y);
- National Invasive Species Act of 1996 (16 USC 4701);
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC 4701);
- Food Quality Protection Act of 1996 (7 USC 136);
- Executive Order 13148, Section 601(a);
- Executive Order 13112; and
- Animal Damage Control Act of 1931 (7 USC 426-426c, 46 Stat. 1468).

Pests are defined as "…living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety" by Department policy 517 DM 1 (Integrated Pest Management Policy). Similarly, 569 FW 1 defines pests as "…invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." 517 DM 1 also defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Throughout the remainder of this CCP, the terms *pest* and *invasive species* are used interchangeably because both can prevent/impede achievement of refuge wildlife and habitat objectives and/or degrade environmental quality.

In general, control of pests (vertebrate or invertebrate) on a refuge would conserve and protect the nation's fish, wildlife, and plant resources as well as maintain environmental quality. Per 569 FW 1, animal or plant species that are considered pests may be managed if the following criteria are met:

- Threat to human health and well-being or private property, the acceptable level of damage by the pest has been exceeded, or state or local government has designated the pest as noxious;
- Detrimental to resource objectives as specified in a refuge resource management plan (e.g., comprehensive conservation plan, habitat management plan), if available; and
- Control would not conflict with attainment of resource objectives or the purposes for which the refuge was established.

The specific justifications for pest management activities on the refuge are the following:

- Protect human health and well-being;
- Prevent substantial damage to important refuge resources;
- Protect newly introduced native species or re-establish them;

- Control non-native (exotic) species in order to support existence for populations of native species;
- Prevent damage to private property; and
- Provide the public with quality, compatible wildlife-dependent recreational opportunities.

In accordance with Service policy 620 FW 1 (Habitat Management Plans), there are additional management directives regarding invasive species found on refuges:

- “We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere.”
- “Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and prevent new and expanded infestations of invasive species. Conduct refuge habitat management activities to prevent, control, or eradicate invasive species...”

Animal species damaging/destroying federal property and/or detrimental to the management program of a refuge may be controlled as described in 50 CFR 31.14 (Official Animal Control Operations). For example, the incidental removal of beavers damaging refuge infrastructure (e.g., clogging, with subsequent damage of water control structures) and/or negatively affecting habitats (e.g., removing woody species from existing or restored riparian zones) managed on refuge lands may be conducted without a pest control proposal. We recognize beavers are native species and most of their activities on refuge lands represent a natural process beneficial for maintaining wetland habitats. Though currently not found on the refuge, exotic nutria can also be controlled using the most effective techniques considering site-specific factors without a pest control proposal. Along with the loss of quality wetland habitats associated with breaching of impoundments, the safety of refuge staff and the public (e.g., auto tour routes) can be under threat when they drive on structurally compromised levees and dikes that may result in sudden and unexpected cave-ins.

Trespass and feral animals also may be controlled on refuge lands. Based upon 50 CFR 28.43 (Destruction of Dogs and Cats), dogs and cats running at large on a national wildlife refuge and observed in the act of killing, injuring, harassing, or molesting humans or wildlife may be disposed of in the interest of public safety and protection of the wildlife. Feral animals should be disposed by the most humane method(s) available and in accordance with relevant Service directives (including Executive Order 11643). Disposed wildlife specimens may be donated or loaned to public institutions. Donation or loans of resident wildlife species will only be made after securing state approval (50 CFR 30.11 [Donation and Loan of Wildlife Specimens]). Surplus wildlife specimens may be sold alive or butchered, dressed, and processed subject to federal and state laws and regulations (50 CFR 30.12 [Sale of Wildlife Specimens]).

G.3 Strategies

To fully embrace IPM as identified in 569 FW 1, the following strategies, where applicable, would be carefully considered on the refuge for each pest species:

- **Prevention.** This would be the most effective and least expensive long-term management option for pests. It encompasses methods to prevent new introductions or the spread of established pests to un-infested areas. It requires identifying potential routes of invasion to reduce the likelihood of infestation. Hazard Analysis and Critical Control Points (HACCP) planning can be used to determine if current management activities on a refuge may introduce and/or spread invasive species in order to identify appropriate BMPs for prevention. See http://www.haccp-nrm.org/ for more information about HACCP planning.

Prevention may include source reduction, using pathogen-free or weed-free seeds or fill, exclusion methods (e.g., barriers), and/or sanitation methods (e.g., wash stations) to prevent re-introductions by various mechanisms including vehicles, personnel, livestock, and horses. Because invasive species are frequently the first to establish newly disturbed sites, prevention would require a reporting mechanism for early detection of new pest occurrences with quick response to eliminate any new satellite pest populations. Prevention would also require consideration of the scale and scope of land management activities that may promote pest establishment within un-infested areas or promote reproduction and spread of existing populations. Along with preventing initial introduction, prevention would involve halting the spread of existing infestations to new sites (Mullin et al. 2000). The primary reason for prevention would be to keep pest-free lands or waters from becoming infested. Executive Order 11312 emphasizes the priority for prevention with respect to managing pests.

The following would be methods to prevent the introduction and/or spread of pests on refuge lands:

- Before beginning ground-disturbing activities (e.g., disking, scraping), inventory and prioritize pest infestations in project operating areas and along access routes. Refuge staff would identify pest species on-site or within reasonably expected potential invasion vicinity. Where possible, the refuge staff would begin project activities in un-infested areas before working in pest-infested areas.
- The refuge staff would locate and use pest-free project staging areas. They would avoid or minimize travel through pest-infested areas or restrict it to those periods when spread of seed or propagules of invasive plants would be least likely.
- The refuge staff would determine the need for and, when appropriate, identify sanitation sites where equipment can be cleaned of pests. Where possible, the refuge staff would clean equipment at on-refuge approved cleaning site(s) before entering project lands. This practice does not pertain to vehicles traveling frequently in and out of the project area that will remain on roadways. Seeds and plant parts of pest plants would need to be collected, where practical. The refuge staff would remove mud, dirt, and plant parts from project equipment before moving it into a project area.
- The refuge staff would clean all equipment before leaving the project site, if operating in areas infested with pests. The refuge staff would determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned.
- Refuge staff, their authorized agents, and refuge volunteers would, where possible, inspect, remove, and properly dispose of seed and parts of invasive plants found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and then properly discarding of them (e.g., incinerating).
- The refuge staff would evaluate options, including closure, to restrict the traffic on sites with ongoing restoration of desired vegetation. The refuge staff would revegetate disturbed soil (except travel ways on surfaced projects) to optimize plant establishment for each specific site. Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching as necessary. The refuge staff would use

native material, where appropriate and feasible. They would also use certified weed-free or weed- and seed-free hay or straw where certified materials are reasonably available.

- The refuge staff would provide information, training, and appropriate pest identification materials to permit holders and recreational visitors. The refuge staff would educate them about pest identification, biology, impacts, and effective prevention measures.
- The refuge staff would require grazing permittees to use preventative measures for their livestock while on refuge lands.
- The refuge staff would inspect borrow material for invasive plants prior to use and transport onto and/or within refuge lands.
- The refuge staff would consider invasive plants when planning for road maintenance activities.
- The refuge staff would restrict off-road travel to designated routes.

The following are methods to prevent the introduction and/or spread of pests into refuge waters:

- The refuge staff would inspect boats (including air boats), trailers, and other boating equipment. Where possible, the refuge staff would remove any visible plants, animals, or mud before leaving any waters or boat launching facilities. Where possible, the refuge staff would drain water from motor, live well, bilge, and transom wells while on land before leaving the site. If possible, the refuge staff would wash and dry boats, downriggers, anchors, nets, floors of boats, propellers, axles, trailers, and other boating equipment to kill pests not visible at the boat launch.
- Where feasible, the refuge staff would maintain a l00-foot buffer of aquatic pest-free clearance around boat launches and docks or quarantine areas when cleaning around culverts, canals, or irrigation sites. Where possible, the refuge staff would inspect and clean equipment before moving to new sites or one project area to another.

These prevention methods to minimize/eliminate the introduction and/or spread of pests were taken verbatim or slightly modified from Appendix E of the *Pacific Northwest Region Invasive Plant Program Final Environmental Impact Statement* (U.S. Forest Service 2005).

- **Mechanical/Physical Methods.** These methods would remove and destroy, disrupt the growth of, or interfere with the reproduction of pest species. For plant species, these treatments can be accomplished by hand, hand tools (manual), or power tools (mechanical) and include pulling, grubbing, digging, tilling/disking, cutting, swathing, grinding, sheering, girdling, mowing, and mulching of the pest plants.

  For animal species, Service employees or their authorized agents could use mechanical/physical methods (including trapping) to control pests as a refuge management activity. Based upon 50 CFR 31.2, trapping can be used on a refuge to reduce surplus wildlife populations for a “balanced conservation program” in accordance with federal or state laws and regulations. In some cases, non-lethally trapped animals would be relocated to off-refuge sites with prior approval from the state.

  Each of these tools would be efficacious to some degree and applicable to specific situations. In general, mechanical methods can effectively control annual and biennial pest plants. However, to control perennial plants, the root system has to be destroyed or it would re-sprout and continue to grow and develop. Mechanical controls are typically not capable of destroying a perennial plant's root system. Although some mechanical tools (e.g., disking, plowing) may damage root systems, they may stimulate regrowth, producing a denser plant population that may aid in the spread of the plant, depending upon the target species (e.g., Canada thistle). In addition, steep terrain and soil conditions would be major factors that can limit the use of many mechanical control methods.

Some mechanical control methods (e.g., mowing), which would be used in combination with herbicides, can be very effective techniques to control perennial species. For example, mowing perennial plants followed sequentially by treating the plant regrowth with a systemic herbicide would often improve the efficacy of the herbicide compared to herbicide treatment alone.

- **Horticultural Methods.** These methods involve manipulating habitat to increase pest mortality by reducing its suitability to the pest. Horticultural methods would include water-level manipulation, mulching, planting winter cover crops, changing planting dates to minimize pest impact, prescribed burning (which facilitates revegetation, increases herbicide efficacy, and removes litter to assist in emergence of desirable species), flaming with propane torches, planting trap crops, introducing crop rotations that include non-susceptible crops, moisture management, addition of beneficial insect habitat, reducing clutter, proper trash disposal, planting or seeding desirable species to shade or outcompete invasive plants, applying fertilizer to enhance desirable vegetation, prescriptive grazing, and other habitat alterations.

- **Biological Control Agents.** Classical biological control would involve the deliberate introduction and management of natural enemies (parasites, predators, or pathogens) to reduce pest populations. Many of the most ecologically or economically damaging pest species in the United States originated in foreign countries. These newly introduced pests, which are free from natural enemies found in their country or region of origin, may have a competitive advantage over cultivated and native species. This competitive advantage often allows introduced species to flourish, and they may cause widespread economic damage to crops or outcompete and displace native vegetation. Once the introduced pest species' population reaches a certain level, traditional methods of pest management may be cost prohibitive or impractical. Biological controls typically are used when these pest populations have become so widespread that eradication or effective control would be difficult or no longer practical.

  Biological control has advantages as well as disadvantages. Benefits include reducing pesticide usage, host specificity for target pests, long-term self-perpetuating control, low cost per acre, capacity for searching and locating hosts, synchronizing biological control agents to hosts' life cycles, and the unlikelihood that hosts will develop resistance to agents. Disadvantages would include the following: limited availability of agents from their native lands, the dependence of control on target species density, slow rate at which control occurs, biotype matching, the difficulty and expense of conflicts over control of the target pest, and host specificity when host populations are low.

  A reduction in target species' populations from biological controls is typically a slow process, and efficacy can be highly variable. It may not work well in a particular area even though it works in another area. Biological control agents require specific environmental conditions to survive over time. Some of these conditions are understood, whereas others are only partially understood or not at all.

Biological control agents do not eradicate a target pest. When using biological control agents, residual levels of the target pest typically are expected; the agent population level or survival would be dependent upon the density of its host. After the pest population decreases, the population of the biological control agent would decrease correspondingly. This is a natural cycle. Some pest populations (e.g., invasive plants) tend to persist for several years after a biological control agent becomes established due to seed reserves in the soil, inefficiencies in the agent's search behavior, and the natural lag in population buildup of the agent.

The full range of pest groups potentially found on refuge lands and waters include microorganisms, invertebrates (insects, mollusks), vertebrates, and invasive plants (the most common group). Often it is assumed that biological control would address many, if not most, of these pest problems. There are several well-documented success stories of biological control of invasive weed species in the Pacific Northwest including Mediterranean sage, St. John's wort (Klamath weed), and tansy ragwort. Emerging success stories include Dalmatian toadflax, diffuse knapweed, leafy spurge, purple loosestrife, and yellow star thistle. However, historically, each new introduction of a biological control agent in the United States has only about a 30 percent success rate (Coombs et al. 2004). Refer to Coombs et al. (2004) for the status of biological control agents for invasive plants in the Pacific Northwest.

Introduced species without desirable close relatives in the United States would generally be selected as biological controls. Natural enemies that are restricted to one or a few closely related plants in their country of origin are targeted as biological controls (Center et al. 1997; Hasan and Ayres 1990).

The refuge staff would ensure introduced agents are approved by the applicable authorities. Except for a small number of formulated biological control products registered by U.S. Environmental Protection Agency (USEPA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), most biological control agents are regulated by the U.S. Department of Agriculture's (USDA's) Animal Plant Health Inspection Service - Plant Protection and Quarantine (APHIS-PPQ). State departments of agriculture and, in some cases, county agricultural commissioners or weed districts have additional approval authority.

Federal permits (USDA-APHIS-PPQ Form 526) are required to import biocontrol agents from another state. Form 526 may be obtained by writing to:

USDA-APHIS-PPQ
Biological Assessment and Taxonomic Support
4700 River Road, Unit 113
Riverdale, MD 20737

or

through the Internet at:
http://www.aphis.usda.gov/ppq/permits/bioligical/weedbio.html.

The Service strongly supports the development and legal and responsible use of appropriate, safe, and effective biological control agents for nuisance and non-indigenous or pest species.

State and county agriculture departments may also be sources for biological control agents or they may have information about where biological control agents may be obtained. Commercial sources should have an Application and Permit to Move Live Plant Pests and Noxious Weeds (USDA-PPQ Form 226 USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, MD 20737) to release specific biological control agents in a state and/or county. Furthermore, certification regarding the biological control agent's identity (genus, specific epithet, subspecies, and variety) and purity (e.g., parasite free, pathogen free, and biotic and abiotic contaminants) should be specified in purchase orders.

Biological control agents are subject to 7 RM 8 (Exotic Species Introduction and Management). In addition, the refuge staff would follow the International Code of Best Practice for Classical Biological Control of Weeds as ratified by delegates to the International Symposium on Biological Control of Weeds (Balciunas 2000). This code identifies the following:

- Release only approved biological control agents,
- Use the most effective agents,
- Document releases, and
- Monitor for impact to the target pest, non-target species, and the environment.

Biological control agents formulated as pesticide products and registered by the USEPA (e.g., Bti) are also subject to pesticide use proposals (PUP) review and approval (see below).

A record of all releases would be maintained with date(s), location(s), and environmental conditions of the release site(s); the identity, quantity, and condition of the biological control agents released; and other relevant data and comments such as weather conditions. Systematic monitoring to determine the establishment and effectiveness of the release is also recommended.

National Environmental Policy Act (NEPA) documents regarding biological and other environmental effects of biological control agents prepared by another federal agency, where the scope is relevant to evaluation of releases on refuge lands, would be reviewed. Possible source agencies for such NEPA documents include the Bureau of Land Management (BLM), the U.S. Forest Service, the National Park Service, the USDA-APHIS, and the military services. It might be appropriate to incorporate, by reference, parts or all of existing document(s) from the review. Incorporating by reference (43 CFR 46.135) is a technique used to avoid redundancies in analysis. It also can reduce the bulk of a Service NEPA document, which must only identify the documents that are incorporated by reference. In addition, relevant portions must be summarized in the Service NEPA document to the extent necessary to provide the decision maker and public with an understanding of the relevance of the referenced material to the current analysis.

- **Pesticides.** The selective use of pesticides would be based upon pest ecology (including mode of reproduction), the size and distribution of pest populations, site-specific conditions (e.g., soils, topography), known efficacy under similar site conditions, and the capability to use BMPs to reduce/eliminate potential effects to non-target species and sensitive habitats, and the potential to contaminate surface and groundwater. All pesticide usage (pesticide, target species, application rate, and method of application) would comply with the applicable federal (FIFRA) and state regulations pertaining to pesticide use, safety, storage, disposal, and reporting. Before pesticides can be used to eradicate, control, or contain pests on refuge lands and waters, PUPs would be prepared and approved in accordance with 569 FW 1. PUP records would provide a detailed time-, site-, and target-specific description of the proposed use of pesticides on the refuge. All PUPs would be created, approved, or disapproved, and stored in the pesticide use proposal system (PUPS), which is a centralized database only accessible on the Service's intranet (https://systems.fws.gov/pups). Only Service employees would be authorized to access PUP records for a refuge in this database.

Application equipment would be selected to provide site-specific delivery to target pests while minimizing/eliminating direct or indirect (e.g., drift) exposure to non-target areas and degradation of surface and groundwater quality. Where possible, target-specific equipment (e.g., backpack sprayer, wiper) would be used to treat target pests. Other target-specific equipment to apply pesticides would include soaked wicks or paint brushes for wiping vegetation and lances, hatchets, or syringes for direct injection into stems. Granular pesticides may be applied using seeders or other specialized dispensers. In contrast, aerial spraying (e.g., fixed wing or helicopter) would only be used where access is difficult (remoteness) and/or the size/distribution of infestations precludes practical use of ground-based methods.

Because repeated use of one pesticide may allow resistant organisms to survive and reproduce, multiple pesticides with variable modes of action would be considered for treatments on refuge lands and waters. This is especially important if multiple applications within years and/or over a growing season would likely be necessary for habitat maintenance and restoration activities to achieve resource objectives. Integrated chemical and non-chemical controls also are highly effective, where practical, because pesticide-resistant organisms can be removed from the site.

Cost may not be the primary factor in selecting a pesticide for use on a refuge. If the least expensive pesticide would potentially harm natural resources or people, then a different product would be selected, if available. The most efficacious pesticide available with the least potential to degrade environment quality (soils, surface water, and groundwater) as well as the least potential to impact native species and communities of fish, wildlife, plants, and their habitats would be acceptable for use on refuge lands in the context of an IPM approach.

- **Habitat Restoration/Maintenance.** Restoration and/or proper maintenance of refuge habitats associated with achieving wildlife and habitat objectives would be essential for long-term prevention, eradication, or control (at or below threshold levels) of pests. Promoting desirable plant communities through the manipulation of species composition, plant density, and growth rate is an essential component of invasive plant management (Brooks et al. 2004; Masters and Sheley 2001; Masters et al. 1996). The following three components of succession could be manipulated through habitat maintenance and restoration: site availability, species availability, and species performance (Cox and Anderson 2004). Although a single method (e.g., herbicide treatment) may eliminate or suppress pest species in the short term, the resulting gaps and bare soil create niches that are conducive to further invasion by the species and/or other invasive plants. On degraded sites where desirable species are absent or in low abundance, revegetation with native/desirable grasses, forbs, and legumes may be necessary to direct and accelerate plant community recovery and achieve site-specific objectives in a reasonable time frame. The selection of appropriate species for revegetation would be dependent on a number of factors including resource objectives and site-specific abiotic factors (e.g., soil texture, precipitation/temperature regimes, and shade conditions). Seed availability and cost, ease of establishment, seed production, and competitive ability would also be important considerations.

G.4 Priorities for Treatments

For many refuges, the magnitude (number, distribution, and sizes of infestations) of pest problems is too extensive and beyond the available capital resources to effectively address during any single field season. To manage pests in the refuge, it would be essential to prioritize treatment of infestations. Highest priority treatments would be focused on early detection and rapid response to eliminate infestations of new pests, if possible. This would be especially important for aggressive pests potentially impacting species, species groups, communities, and/or habitats associated with refuge purpose(s), NWR System (NWRS) resources of concern (federally listed species, migratory birds, selected marine mammals, and interjurisdictional fish), and native species used for maintaining/restoring biological integrity, diversity, and environmental health.

The next priority would be treating established pests that appear in one or more previously un-infested areas. Moody and Mack (1988) demonstrated through modeling that small, new outbreaks of invasive plants eventually infest an area larger than the established source population. They also found that control efforts focusing on the large, main infestation rather than the new, small satellites reduced the chances of overall success. The lowest priority would be treating large infestations (sometimes monotypic stands) of well-established pests. In this case, initial efforts would focus upon containment of the perimeter followed by work to control/eradicate the established infested area. If containment and/or control of a large infestation is not effective, then efforts would focus on halting pest reproduction or managing source populations. Maxwell et al. (2009) found that treating fewer populations that are sources represents an effective long-term strategy to reduce total number of invasive populations and decreasing meta-population growth rates.

Although state-listed noxious weeds would always be of high priority for management, other pest species known to cause substantial ecological impact would also be considered. For example, cheatgrass may not be listed by a state as noxious, but it can greatly alter fire regimes in shrub steppe habitats resulting in large monotypic stands that displace native bunch grasses, forbs, and shrubs. Pest control would likely require a multi-year commitment from the refuge staff. Essential to the long-term success of pest management would be pre- and post-treatment monitoring, assessment of the successes and failures of treatments, and development of new approaches when proposed methods do not achieve desired outcomes.

G.5 Best Management Practices

BMPs can minimize or eliminate the possible effects associated with pesticide usage to non-target species and/or sensitive habitats as well as the degradation of water quality from drift, surface runoff, or leaching. Based upon the Department of Interior Pesticide Use Policy (517 DM 1) and the Service Pest Management Policy and Responsibilities (30 AM 12), the use of applicable BMPs (where feasible) also would likely ensure that pesticide uses may not adversely affect federally listed species and/or their critical habitats through determinations made using the process described in 50 CFR 402.

The following are BMPs pertaining to mixing/handling and applying pesticides for all ground-based treatments of pesticides, which would be considered and used, where feasible, based upon target- and site-specific factors and time-specific environmental conditions. Although not listed below, the most important BMP to eliminate/reduce potential impacts to non-target resources would be an IPM approach to prevent, control, eradicate, and contain pests.

G.5.1 Pesticide Handling and Mixing

- As a precaution against spilling, spray tanks would not be left unattended during filling.
- All pesticide containers would be triple rinsed and the rinsate would be used as water in the sprayer tank and applied to treatment areas.
- All pesticide spray equipment would be properly cleaned. Where possible, rinsate would be used as part of the make-up water in the sprayer tank and applied to treatment areas.
- The refuge staff would triple rinse and recycle (where feasible) pesticide containers.
- All unused pesticides would be properly discarded at a local “safe send” collection.
- Pesticides and pesticide containers would be lawfully stored, handled, and disposed of in accordance with the label and in a manner safeguarding human health, fish, and wildlife, and preventing soil and water contamination.
- The refuge staff would consider water quality parameters (e.g., pH, hardness) that are important to ensure greatest efficacy where specified on the pesticide label.
- All pesticide spills would be addressed immediately using procedures identified in the refuge spill response plan.

G.5.2 Applying Pesticides

- Pesticide treatments would only be conducted by or under the supervision of Service personnel and non-Service applicators with the appropriate state certification to safely and effectively conduct these activities on refuge lands and waters.
- The refuge staff would comply with all federal, state, and local pesticide use laws and regulations as well as departmental, Service, and NWRS pesticide-related policies. For example, the refuge staff would use application equipment and apply rates for the specific pest(s) identified on the pesticide label as required under FIFRA.
- Before each treatment season and prior to mixing or applying any product for the first time each season, all applicators would review the labels, material safety data sheets (MSDSs), and PUPs for each pesticide, determining the target pest, appropriate mix rate(s), personal protective equipment (PPE), and other requirements listed on the pesticide label.
- A 1-foot no-spray buffer from the water’s edge would be used, where applicable and where it does not detrimentally influence effective control of pest species.
- Low-impact herbicide application techniques (e.g., spot treatment, cut stump, oil basal, Thinvert system applications) would be used rather than broadcast foliar applications (e.g., boom sprayer other larger tank wand applications), where practical.
- Low-volume rather than high-volume foliar applications would be used where low-impact methods listed above are not feasible or practical, to maximize herbicide effectiveness and ensure correct and uniform application rates.
- Applicators would use and adjust spray equipment to apply the coarsest droplet size spectrum with optimal coverage of the target species while reducing drift.
- Applicators would use the largest droplet size that results in uniform coverage.

- Applicators would use drift reduction technologies such as low-drift nozzles, where possible.
- Where possible, spraying would occur during low (average <7 mph and preferably 3 to 5 mph) and consistent direction wind conditions with moderate temperatures (typically <85°F).
- Where possible, applicators would avoid spraying during inversion conditions (often associated with calm and very low wind conditions) that can cause large-scale herbicide drift to non-target areas.
- Equipment would be calibrated regularly to ensure that the proper rate of pesticide is applied to the target area or species.
- Spray applications would be made at the lowest height for uniform coverage of target pests to minimize/eliminate potential drift.
- If windy conditions frequently occur during afternoons, spraying (especially boom treatments) would typically be conducted during early morning hours.
- Spray applications would not be conducted on days with >30 percent forecast for rain within 6 hours, except for pesticides that are rapidly rain fast (e.g., glyphosate in 1 hour) to minimize/eliminate potential runoff.
- Where possible, applicators would use drift retardant adjuvants during spray applications, especially adjacent to sensitive areas.
- Where possible, applicators would use a non-toxic dye to aid in identifying target area treated as well as potential overspray or drift. A dye can also aid in detecting equipment leaks. If a leak is discovered, the application would be stopped until repairs can be made to the sprayer.
- For pesticide uses associated with cropland and facilities management, buffers, as appropriate, would be used to protect sensitive habitats, especially wetlands and other aquatic habitats.
- When drift cannot be sufficiently reduced through altering equipment set up and application techniques, buffer zones may be identified to protect sensitive areas downwind of applications. The refuge staff would only spray adjacent to sensitive areas when the wind is blowing in the opposite direction.
- Applicators would utilize scouting for early detection of pests to eliminate unnecessary pesticide applications.
- The refuge staff would consider the timing of the application such that native plants are protected (e.g., senescence) while effectively treating invasive plants.
- Rinsate from cleaning spray equipment after application would be recaptured and reused or applied to an appropriate pest plant infestation.
- Application equipment (e.g., sprayer, ATV, tractor) would be thoroughly cleaned and PPE would be removed/disposed off on-site by applicators after treatments to eliminate the potential spread of pests to un-infested areas.

G.6 Safety

G.6.1 Personal Protective Equipment

All applicators would wear the specific PPE identified on the pesticide label. The appropriate PPE will be worn at all times during handling, mixing, and applying. PPE can include the following: disposable (e.g., Tyvek) or laundered coveralls; gloves (latex, rubber, or nitrile); rubber boots; and/or a National Institute for Occupational Safety and Health (NIOSH)–approved respirator. Because exposure to concentrated product is usually greatest during mixing, extra care should be taken while preparing pesticide solutions. Persons mixing these solutions can be best protected if they wear long gloves, an apron, footwear, and a face shield.

Coveralls and other protective clothing used during an application would be laundered separately from other laundry items. Transporting, storing, handling, mixing, and disposing of pesticide containers will be consistent with label requirements, USEPA and Occupational Safety and Health Administration (OSHA) requirements, and Service policy.

If a respirator is necessary for pesticide use, then the following requirements would be met in accordance with Service safety policy: a written Respirator Program, fit testing, physical examination (including pulmonary function and blood work for contaminants), and proper storage of the respirator.

G.6.2 Notification

The restricted entry interval (REI) is the time period required after the application before someone may safely enter a treated area without PPE. Refuge staff, authorized management agents of the Service, volunteers, and members of the public who could be in or near a pesticide-treated area within the stated re-entry time period on the label would be notified about treatment areas. Posting would occur at any site where individuals might inadvertently become exposed to a pesticide during other activities on the refuge. Where required by the label and/or state-specific regulations, signs would also be posted on its perimeter and at other likely locations of entry. The refuge staff would also notify appropriate private property owners of an intended application, including any private individuals who have requested notification. Special efforts would be made to contact nearby individuals who are beekeepers or who have expressed chemical sensitivities.

G.6.3 Medical Surveillance

Medical surveillance may be required for Service personnel and approved volunteers who mix, apply, and/or monitor use of pesticides (see 242 FW 7 [Pesticide Users] and 242 FW 4 [Medical Surveillance]). In accordance with 242 FW 7.12A, Service personnel would be medically monitored if one or more of the following criteria are met: exposed or may be exposed to concentrations at or above the published permissible exposure limits or threshold limit values (see 242 FW 4); use pesticides in a manner considered "frequent pesticide use"; or use pesticides in a manner that requires a respirator (see 242 FW 14 for respirator use requirements). In 242 FW 7.7A, frequent pesticide use means "when a person applying pesticide handles, mixes, or applies pesticides, with a Health Hazard rating of 3 or higher, for 8 or more hours in any week or 16 or more hours in any 30-day period." Under some circumstances, individuals may be medically monitored even if they use pesticides infrequently, experience an acute exposure (sudden, short term), or use pesticides with a health hazard ranking of 1 or 2. This decision would consider the individual's health and fitness level, the pesticide's specific health risks, and the potential risks from other pesticide-related activities. Refuge cooperators (e.g., cooperative farmers) and other authorized agents (e.g., state and county employees) would be responsible for their own medical monitoring needs and costs.

Standard examinations (at refuge expense) of appropriate refuge staff would be provided by the nearest certified occupational health and safety physician as determined by Federal Occupational Health.

G.6.4 Certification and Supervision of Pesticide Applicators

Appropriate refuge staff or approved volunteers handling, mixing, and/or applying or directly supervising others engaged in pesticide use activities would be trained and state or federally (BLM) licensed to apply pesticides to refuge lands or waters. In accordance with 242 FW 7.18A and 569 FW 1.10B, certification is required to apply restricted use pesticides based upon USEPA regulations. For safety reasons, all individuals participating in pest management activities with general use pesticides also are encouraged to attend appropriate training or acquire pesticide applicator certification. The certification requirement would be for a commercial or private applicator depending upon the state. New staff unfamiliar with proper procedures for storing, mixing, handling, applying, and disposing of herbicides and containers would receive orientation and training before handling or using any products. Documentation of training would be kept in the files at the refuge office.

G.6.5 Record Keeping

G.6.5.1 Labels and material safety data sheets

Pesticide labels and MSDSs would be maintained at the refuge shop and laminated copies kept in the mixing area. These documents also would be carried by field applicators, where possible. A written reference (e.g., note pad, chalk board, dry erase board) for each tank to be mixed would be kept in the mixing area for quick reference while mixing is in progress. In addition, approved PUPs stored in the PUPS database typically contain website links (URLs) to pesticide labels and MSDSs.

G.6.5.2 Pesticide use proposals

A PUP would be prepared for each proposed pesticide use associated with annual pest management on refuge lands and waters. A PUP would include specific information about the proposed pesticide use including the common and chemical names of the pesticide(s), target pest species, size and location of treatment site(s), application rate(s) and method(s), and federally listed species determinations, where applicable.

In accordance with Service guidelines (Director's memo [December 12, 2007]), refuge staff may receive up to 5-year approvals for Washington Office– and field–reviewed proposed pesticide uses based upon meeting identified criteria including an approved IPM plan, where necessary (see http://www.fws.gov/contaminants/Issues/IPM.cfm). For a refuge, an IPM plan (requirements described herein) can be completed independently or in association with a CCP or a habitat management plant (HMP) if IPM strategies and potential environmental effects are adequately addressed within appropriate NEPA documentation.

PUPs would be created, approved or disapproved, and stored as records in the PUPS, a centralized database on the Service's intranet (https://systems.fws.gov/pups). Only Service employees can access PUP records in this database.

G.6.5.3 Pesticide usage

In accordance with 569 FW 1, the refuge Project Leader would be required to maintain records of all pesticides annually applied on lands or waters under refuge jurisdiction. This would encompass pesticides applied by other federal agencies, state and county governments, and nongovernment applicators including cooperators and their pest management service providers with Service permission. For clarification, "pesticide" refers to all insecticides, insect and plant growth regulators, dessicants, herbicides, fungicides, rodenticides, acaricides, nematicides, fumigants, avicides, and piscicides.

The following usage information can be reported for approved PUPs in the PUPS database:

- Pesticide trade name(s)
- Active ingredient(s)
- Total acres treated
- Total amount of pesticides used (lbs or gallons)
- Total amount of active ingredient(s) used (lbs)
- Target pest(s)
- Efficacy (percentage control)

To determine whether treatments are efficacious (eradicating, controlling, or containing the target pest) and achieving resource objectives, habitat and/or wildlife response would be monitored both pre- and post-treatment, where possible. Information regarding available annual funding and staffing, characteristics (attributes) of pest infestations (e.g., area, perimeter, degree of infestation, percentage cover, density), and habitat and/or wildlife response to treatments may be collected and stored in a relational database (e.g., Refuge Habitat Management Database), preferably a geo-referenced data management system (e.g., Refuge Lands geographic information system [GIS]) to facilitate data analyses and subsequent reporting. In accordance with adaptive management, data analysis and interpretation would allow treatments to be modified or changed over time, as necessary, to achieve resource objectives considering site-specific conditions in conjunction with habitat and/or wildlife responses. Monitoring could also identify short- and long-term impacts to natural resources and environmental quality associated with IPM treatments in accordance with adaptive management principles identified in 43 CFR 46.145.

G.7 Evaluating Pesticide Use Proposals

Pesticides would only be used on refuge lands for habitat management and croplands/facilities maintenance after approval of a PUP. In general, proposed pesticide uses on refuge lands would only be approved where there would likely be minor, temporary, or localized effects to fish and wildlife species as well as minimal potential to degrade environmental quality. Potential effects to listed and nonlisted species would be evaluated with quantitative ecological risk assessments and other screening measures. Potential effects to environmental quality would be based upon pesticide characteristics of environmental fate (water solubility, soil mobility, soil persistence, and volatilization) and other quantitative screening tools. Ecological risk assessments as well as characteristics of environmental fate and potential to degrade environmental quality for pesticides would be documented in Chemical Profiles (see Section G.7.6 of this appendix). These profiles would include threshold values for quantitative measures of ecological risk assessments and screening tools for environmental fate that represent minimal potential effects to species and environmental quality. In general, only pesticide uses with appropriate BMPs (see Section G.5 of this appendix) for habitat management and cropland/facilities maintenance on refuge lands that would potentially have minor, temporary, or localized effects on refuge biological and environmental quality (threshold values not exceeded) would be approved.

G.7.1 Overview of Ecological Risk Assessment

An ecological risk assessment process would be used to evaluate potential adverse effects to biological resources as a result of a pesticide(s) proposed for use on refuge lands. It is an established quantitative and qualitative methodology for comparing and prioritizing risks of pesticides and conveying an estimate of the potential risk for an adverse effect. This quantitative methodology provides an efficient mechanism to integrate best available scientific information regarding hazard, patterns of use (exposure), and dose-response relationships in a manner that is useful for ecological risk decision making. It provides an effective way to evaluate potential effects where there is missing or unavailable scientific information (data gaps) to address reasonable, foreseeable adverse effects in the field as required under 40 CFR 1502.22. Protocols for ecological risk assessment of pesticide uses on the refuge were developed through research and established by the U.S. Environmental Protection Agency (2004). Assumptions for these risk assessments are presented in Section G.7.2.3 of this appendix.

The toxicological data used in ecological risk assessments are typically the results of standardized laboratory studies provided by pesticide registrants to the USEPA to meet regulatory requirements under FIFRA. These studies assess the acute (lethality) and chronic (reproductive) effects associated with short- and long-term exposure to pesticides on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. Other effects data publicly available would also be used for risk assessment protocols described herein. Toxicity endpoint and environmental fate data are available from a variety of resources.

Table G-1. Ecotoxicity Tests Used to Evaluate Potential Effects to Birds, Fish, and Mammals to Establish Toxicity Endpoints for Risk Quotient Calculations

Species Group	Exposure	Measurement endpoint
Bird	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[1]
Fish	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[2]
Mammal	Acute	Oral Lethal Dose (LD_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[3]

[1]Measurement endpoints typically include a variety of reproductive parameters (e.g., number of eggs, number of offspring, eggshell thickness, and number of cracked eggs).
[2]Measurement endpoints for early life stage/life cycle typically include embryo hatch rates, time to hatch, growth, and time to swim-up.
[3]Measurement endpoints include maternal toxicity, teratogenic effects or developmental anomalies, evidence of mutagenicity or genotoxicity, and interference with cellular mechanisms such as DNA synthesis and DNA repair.

G.7.2 Determining Ecological Risk to Fish and Wildlife

The potential for pesticides used on the refuge to cause direct adverse effects to fish and wildlife would be evaluated using USEPA's Ecological Risk Assessment Process (USEPA 2004). This deterministic approach, which is based upon a two-phase process involving estimation of environmental concentrations and then characterization of risk, would be used for ecological risk assessments. This method integrates exposure estimates (estimated environmental concentration [EEC] and toxicological endpoints [e.g., LC_{50} and oral LD_{50}]) to evaluate the potential for adverse effects to species groups (birds, mammals, and fish) representative of legal mandates for managing units of the NWRS. This integration is achieved through risk quotients (RQs) calculated by dividing the EEC by acute and chronic toxicity values selected from standardized toxicological endpoints or published effect (Table G-1).

RQ = EEC/Toxicological Endpoint

The level of risk associated with direct effects of pesticide use would be characterized by comparing calculated RQs to the appropriate Level of Concern (LOC) established by USEPA (1998 [Table G-2]). The LOC represents a quantitative threshold value for screening potential adverse effects to fish and wildlife resources associated with pesticide use. The following are four exposure-species group scenarios that would be used to characterize ecological risk to fish and wildlife on the refuge: acute-listed species, acute-nonlisted species, chronic-listed species, and chronic-nonlisted species.

Acute risk would indicate the potential for mortality associated with short-term dietary exposure to pesticides immediately after an application. For characterization of acute risks, median values from LC_{50} and LD_{50} tests would be used as toxicological endpoints for RQ calculations. In contrast, chronic risks would indicate the potential for adverse effects associated with long-term dietary exposure to pesticides from a single application or multiple applications over time (within a season and over years). For characterization of chronic risks, the No Observed Concentration (NOAEC) or No Observed Effect Concentration (NOEC) for reproduction would be used as toxicological endpoints for RQ calculations. Where available, the NOAEC would be preferred over a NOEC value.

Listed species are those federally designated as threatened, endangered, or proposed in accordance with the Endangered Species Act of 1973 (16 USC 1531-1544, 87 Stat. 884, as amended-Public Law 93-205). For listed species, potential adverse effects would be assessed at the individual level because loss of individuals from a population could detrimentally impact a species. In contrast, risks to nonlisted species would consider effects at the population level. An RQ<LOC would indicate the proposed pesticide use “may affect, not likely to adversely affect” individuals (listed species) and it would not pose an unacceptable risk for adverse effects to populations (nonlisted species) for each taxonomic group (Table G-2). In contrast, an RQ>LOC would indicate a “may affect, likely to adversely affect” for listed species and it would also pose unacceptable ecological risk for adverse effects to nonlisted species.

Table G-2. Presumption of Unacceptable Risk for Birds, Fish, and Mammals

Risk Presumption		Level of Concern	
		Listed Species	Nonlisted Species
Acute	Birds	0.1	0.5
	Fish	0.05	0.5
	Mammals	0.1	0.5
Chronic	Birds	1.0	1.0
	Fish	1.0	1.0
	Mammals	1.0	1.0

Source: U.S. Environmental Protection Agency 1998.

G.7.2.1 Environmental exposure

Following release into the environment through application, pesticides experience several different routes of environmental fate. Pesticides that are sprayed can move through the air (e.g., particle or vapor drift) and may eventually end up in other parts of the environment such as non-target vegetation, soil, or water. Pesticides applied directly to the soil may be washed off the soil into nearby bodies of surface water (e.g., surface runoff) or may percolate through the soil to lower soil layers and groundwater (e.g., leaching) (Baker and Miller 1999; Butler et al. 1998; EXTOXNET 1993; Pope et al. 1999; Ramsay et al. 1995). Pesticides injected into the soil may also be subject to the latter two fates. The aforementioned possibilities are by no means exhaustive, but they do indicate the movement of pesticides in the environment is very complex, with transfers occurring continually among different environmental compartments. In some cases, these exchanges occur not only between areas that are close together, but may also involve transportation of pesticides over long distances (Barry 2004; Woods 2004).

G.7.2.1.1 Terrestrial exposure

The EEC for exposure to terrestrial wildlife would be quantified using an USEPA screening-level approach (USEPA 2004). This screening-level approach is not affected by product formulation because it evaluates pesticide active ingredient(s). This approach would vary depending upon the proposed pesticide application method: spray or granular.

G.7.2.1.1.1 Terrestrial: spray application

For spray applications, exposure would be determined using the Kanaga nomogram method (Pfleeger et al. 1996; USEPA 2004, 2005a) through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3 (USEPA 2005b). To estimate the maximum (initial) pesticide residue on short grass (<20 cm tall) as a general food item category for terrestrial vertebrate species, T-REX input variables would include the following from the pesticide label: maximum pesticide application rate (pounds of active ingredient [acid equivalent] per acre) and pesticide half-life (days) in soil. Although there are other food item categories (tall grasses; broadleaf plants and small insects; and fruits, pods, seeds and large insects), short grass was selected because it would yield maximum EECs (240 ppm per lb active ingredient [a.i.]/acre) for worst-case risk assessments. Short grass is not representative of forage for carnivorous species (e.g., raptors), but it would characterize the maximum potential exposure through the diet of avian and mammalian prey items. Consequently, this approach would provide a conservative screening tool for pesticides that do not biomagnify.

For RQ calculations in T-REX, the model would require the weight of surrogate species and Mineau scaling factors (Mineau et al. 1996). Body weights of bobwhite quail and mallard are included in T-REX by default, but body weights of other organisms (Table G-3) would be entered manually. The Mineau scaling factor accounts for small-bodied bird species that may be more sensitive to pesticide exposure than would be predicted only by body weight. Mineau scaling factors would be entered manually with values ranging from 1 to 1.55 that are unique to a particular pesticide or group of pesticides. If specific information to select a scaling factor is not available, then a value of 1.15 would be used as a default. Alternatively, zero would be entered if it is known that body weight does not influence toxicity of pesticide(s) being assessed. The upper bound estimate output from the T-REX Kanaga nomogram would be used as an EEC for calculation of RQs. This approach would yield a conservative estimate of ecological risk.

Table G-3. Average Body Weight of Selected Terrestrial Wildlife Species Frequently Used in Research to Establish Toxicological Endpoints

Species	Body Weight (kg)
Mammal (15 g)	0.015
House sparrow	0.0277
Mammal (35 g)	0.035
Starling	0.0823
Red-winged blackbird	0.0526
Common grackle	0.114
Japanese quail	0.178
Bobwhite quail	0.178
Rat	0.200
Rock dove (aka pigeon)	0.542
Mammal (1,000 g)	1.000
Mallard	1.082
Ring-necked pheasant	1.135

Source: Dunning 1984.

G.7.2.1.1.2 Terrestrial: granular application

Granular pesticide formulations and pesticide-treated seed would pose a unique route of exposure for avian and mammalian species. The pesticide is applied in discrete units, which birds or mammals might ingest accidentally with food items or intentionally as in the case of some bird species that actively seek and pick up gravel or grit to aid digestion or eat seed as a food source. Granules may also be consumed by wildlife foraging on earthworms, slugs, or other soft-bodied soil organisms to which the granules may adhere.

Terrestrial wildlife RQs for granular formulations or seed treatments would be calculated by dividing the maximum milligrams of a.i. exposed (e.g., EEC) on the surface of an area equal to 1 square foot by the appropriate LD_{50} value multiplied by the surrogate's body weight (Table G-3). An adjustment to surface area calculations would be made for broadcast, banded, and in-furrow applications. An adjustment also would be made for applications with and without incorporation of the granules. Without incorporation, it would be assumed that 100 percent of the granules remain on the soil surface available to foraging birds and mammals. Press wheels push granules flat with the soil surface, but they are not incorporated into the soil. If granules are incorporated into the soil during band or T-band applications or after broadcast applications, it would be assumed only 15 percent of the applied granules remain available to wildlife. It would be assumed that only 1 percent of the granules are available on the soil surface following in-furrow applications.

EECs for pesticides applied in granular form and as seed treatments would be determined considering potential ingestion rates of avian or mammalian species (e.g., 10%–30% body weight/day). This would provide an estimate of maximum exposure that may occur as a result of granule or seed treatment spills such as those that commonly occur at end rows during application and planting. The availability of granules and seed treatments to terrestrial vertebrates would also be considered by calculating the loading per unit area (LD_{50}/ft^2) for comparison to USEPA LOCs (USEPA). T-REX version 1.2.3 (USEPA 2005b) contains a submodel that automates Kanaga exposure calculations for granular pesticides and treated seed.

The following formulas will be used to calculate EECs depending upon the type of granular pesticide application:

- In-furrow applications assume a typical value of 1 percent granules, bait, or seed remaining unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}580\ mg/lbs)(1\%\ exposed))] / \{[(43{,}560\ ft.^2/acre)/(row\ spacing\ (ft.))] / (row\ spacing\ (ft.)\}$$

or

$$mg\ a.i./ft^2 = [(lbs\ product/1{,}000\ ft.\ row)(\%\ a.i.)(1{,}000\ ft\ row)(453{,}580\ mg/lb)(1\%\ exposed)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Incorporated banded treatments assume a typical value of 15 percent of granules, bait, and seeds remaining unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/1{,}000\ row\ ft.)(\%\ a.i.)(453{,}580\ mg/lb)(1-\%\ incorporated)] / (1{,}000\ ft.)(band\ width\ (ft.))$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Broadcast treatment without incorporation assumes 100 percent of granules, bait, seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}590\ mg/lb)] / (43{,}560\ ft.^2/acre)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

Where:

- Percentage of pesticide biologically available = 100 percent without species-specific ingestion rates
- Conversion for calculating mg a.i./ft.^{2} using ounces is 453,580 mg/lb/16 = 28,349 mg/oz.

The following equation would be used to calculate an RQ based on the EEC calculated by one of the above equations. The EEC would be divided by the surrogate LD_{50} toxicological endpoint multiplied by the body weight (Table G-3) of the surrogate.

$$RQ = EEC / [LD_{50} (mg/kg) * body\ weight\ (kg)]$$

As with other risk assessments, an RQ>LOC would be a presumption of unacceptable ecological risk. An RQ<LOC would be a presumption of acceptable risk with only minor, temporary, or localized effects to species.

G.7.2.1.2 Aquatic exposure

Exposures to aquatic habitats (e.g., wetlands, meadows, ephemeral pools, water delivery ditches) would be evaluated separately for ground-based pesticide treatments of habitats managed for fish and wildlife compared with cropland/facilities maintenance. The primary exposure pathway for aquatic organisms from any ground-based treatments likely would be particle drift during the pesticide application. However, different exposure scenarios would be necessary due to contrasting application equipment and techniques as well as pesticides used to control pests on agricultural lands (especially those cultivated by cooperative farmers for economic return from crop yields) and facilities maintenance (e.g., roadsides, parking lots, trails) compared with other managed habitats on the refuge. In addition, pesticide applications may be done at <25 feet of the high water mark of aquatic habitats for habitat management treatments, whereas, no-spray buffers (≥25 feet) would be used for croplands/facilities maintenance treatments.

G.7.2.1.2.1 Habitat treatments

For the worst-case exposure scenario to non-target aquatic habitats, EECs (Table G-4) would be derived from Urban and Cook (1986), which assumes an intentional overspray to an entire, non-target water body (1 foot depth) from a treatment <25 feet from the high water mark using the max application rate (acid basis [see above]). However, use of BMPs for applying pesticides (see Section G.5.2) would likely minimize/eliminate potential drift to non-target aquatic habitats during actual treatments. If there would be unacceptable (acute or chronic) risk to fish and wildlife with the simulated 100 percent overspray (RQ>LOC), then the proposed pesticide use may be disapproved, or the PUP would be approved at a lower application rate to minimize/eliminate unacceptable risk to aquatic organisms (RQ = LOC).

Table G-4. Estimated Environmental Concentrations (ppb) of Pesticides in Aquatic Habitats (1 foot depth) Immediately after Direct Application

Lbs/acre	EEC (ppb)
0.10	36.7
0.20	73.5
0.25	91.9

Lbs/acre	EEC (ppb)
0.30	110.2
0.40	147.0
0.50	183.7
0.75	275.6
1.00	367.5
1.25	459.7
1.50	551.6
1.75	643.5
2.00	735.7
2.25	827.6
2.50	919.4
3.00	1,103.5
4.00	1,471.4
5.00	1,839
6.00	2,207
7.00	2,575
8.00	2,943
9.00	3,311
10.00	3,678

Source: Urban and Cook 1986.

G.7.2.1.2.2 Cropland/facilities maintenance treatments

Field drift studies conducted by the Spray Drift Task Force, which is a joint project of several agricultural chemical businesses, were used to develop a generic spray drift database. From this database, the AgDRIFT computer model was created to satisfy USEPA pesticide registration spray drift data requirements and to provide a scientific basis to evaluate off-target movement of pesticides from particle drift and assess potential effects of exposure to wildlife. Several versions of the computer model have been developed (i.e., versions 2.01 through 2.10). The Spray Drift Task Force AgDRIFT model version 2.01 (Spray Drift Task Force 2003; Teske et al. 2002) would be used to derive EECs resulting from drift of pesticides to refuge aquatic resources from ground-based pesticide applications >25 feet from the high water mark. The Spray Drift Task Force AgDRIFT model is publicly available at http://www.agdrift.com. At this website, click “AgDRIFT 2.0” followed by “Download Now,” and follow the instructions to obtain the computer model.

The AgDRIFT model is composed of submodels called tiers. Tier I ground submodel would be used to assess ground-based applications of pesticides. Tier outputs (EECs) would be calculated with AgDRIFT using the following input variables: maximum application rate (acid basis [see above]), low boom (20 inches), fine to medium droplet size, EPA-defined wetland, and a ≥25-foot distance (buffer) from treated area to water.

G.7.2.2 Use of information on effects of biological control agents, pesticides, degradates, and adjuvants

In accordance with the requirements set forth in 43 CFR 46.135, the Service would specifically incorporate through reference ecological risk assessments prepared by the U.S. Forest Service and BLM. These risk assessments and associated documentation are also available with the administrative record for the Final Environmental Impact Statement entitled *Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants* (U.S. Forest Service 2005) and *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS (PEIS)* (BLM 2007). In accordance with 43 CRF 46.120(d), use of existing NEPA documents by supplementing, tiering to, incorporating by reference, or adopting previous NEPA environmental analyses would avoid redundancy and unnecessary paperwork.

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide and adjuvant uses prepared by the U.S. Forest Service would be incorporated by reference:

- 2,4-D
- Chlorsulfuron
- Clopyralid
- Dicamba
- Glyphosate
- Imazapic
- Imazapyr
- Metsulfuron methyl
- Picloram
- Sethoxydim
- Sulfometuron methyl
- Triclopyr
- Nonylphenol polyethylate (NPE)–based surfactants

As a basis for completing Chemical Profiles for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide uses as well as evaluation of risks associated with pesticide degradates and adjuvants prepared by the BLM would be incorporated by reference:

- Bromacil
- Chlorsulfuron
- Diflufenzopyr
- Diquat
- Diuron
- Fluridone
- Imazapic
- Overdrive (diflufenzopyr and dicamba)
- Sulfometuron methyl

- Tebuthiuron
- Pesticide degradates and adjuvants (*Appendix D – Evaluation of risks from degradates, polyoxyethylene-amine (POEA) and R-11, and endocrine disrupting chemicals*)

G.7.2.3 Assumptions for ecological risk assessments

There are a number of assumptions involved with the ecological risk assessment process for terrestrial and aquatic organisms associated with using the USEPA's (2004) process. These assumptions may be risk neutral or may lead to an over- or under-estimation of risk from pesticide exposure depending upon site-specific conditions. This section describes these assumptions, their application to the conditions typically encountered, and whether they may lead to recommendations that are risk neutral, or that underestimate or overestimate ecological risk from potential pesticide exposure.

- Indirect effects would not be evaluated by ecological risk assessments. These effects include the mechanisms of indirect exposure to pesticides: consuming prey items (fish, birds, or small mammals), reductions in the availability of prey items, and disturbance associated with pesticide application activities.
- Exposure to a pesticide product can be assessed based upon the active ingredient. However, exposure to a chemical mixture (pesticide formulation) may result in effects that are similar or substantially different from exposure to only the active ingredient. Non-target organisms may be exposed directly to the pesticide formulation or only various constituents of the formulation as they dissipate and partition in the environment. If toxicological information for both the active ingredient and the formulated product are available, then data representing the greatest potential toxicity would be selected for use in the risk assessment process (USEPA 2004). As a result, this conservative approach may lead to an overestimation of risk characterization from pesticide exposure.
- Because toxicity tests with listed or candidate species or closely related species are not available, data for surrogate species would be most often used for risk assessments. Specifically, bobwhite quail and mallard duck are the most frequently used surrogates for evaluating potential toxicity to federally listed avian species. Bluegill sunfish, rainbow trout, and fathead minnow are the most common surrogates for evaluating toxicity for freshwater fish. Sheep's head minnow can be an appropriate surrogate marine species for coastal environments. Rats and mice are the most common surrogates for evaluating toxicity for mammals. Interspecies sensitivity is a major source of uncertainty in pesticide assessments. As a result of this uncertainty, data is selected for the most sensitive species tested within a taxonomic group (birds, fish, and mammals), given the quality of the data is acceptable. If additional toxicity data for more species of organisms in a particular group are available, the selected data will not be limited to the species previously listed as common surrogates.
- The Kanaga nomogram outputs maximum EEC values that may be used to calculate an average daily concentration over a specified interval of time, which is referred to as a time-weighted average (TWA). The maximum EEC would be selected as the exposure input for both acute and chronic risk assessments in the screening-level evaluations. The initial or maximum EEC derived from the Kanaga nomogram represents the maximum expected instantaneous or acute exposure to a pesticide. Acute toxicity endpoints are determined using a single exposure to a known pesticide concentration typically for 48 to 96 hours. This value is assumed to represent ecological risk from acute exposure to a pesticide. On the other hand, chronic risk from pesticide exposure is a function of pesticide concentration and duration of

exposure to the pesticide. An organism's response to chronic pesticide exposure may result from the concentration of the pesticide, the length of exposure, or some combination of both factors. Standardized tests for chronic toxicity typically involve exposing an organism to several different pesticide concentrations for a specified length of time (days, weeks, months, years, or generations). For example, avian reproduction tests include a 10-week exposure phase. Because a single length of time is used in the test, time-response data is usually not available for inclusion in risk assessments. Without time-response data it is difficult to determine the concentration that elicits a toxicological response.

- Using maximum EECs for chronic risk estimates may result in an overestimate of risk, particularly for compounds that dissipate rapidly. Conversely, using TWAs for chronic risk estimates may underestimate risk if it is the concentration rather than the duration of exposure that is primarily responsible for the observed adverse effect. The maximum EEC would be used for chronic risk assessments although it may result in an overestimate of risk. TWAs may be used for chronic risk assessments, but they would be applied judiciously considering the potential for an underestimation or overestimation of risk. For example, the number of days exposure exceeds a LOC may influence the suitability of a pesticide's use. The greater the number of days the EEC exceeds the LOC, the greater the ecological risk. This is a qualitative assessment and is subject to reviewers' expertise in ecological risk assessment and tolerance for risk.
- The length of time used to calculate the TWA can have a substantial effect on the exposure estimates and there is no standard method for determining the appropriate duration for this estimate. The T-REX model assumes a 21-week exposure period, which is equivalent to avian reproductive studies designed to establish a steady-state concentration for bioaccumulative compounds. However, this does not necessarily define the true exposure duration needed to elicit a toxicological response. Pesticides that do not bioaccumulate may achieve a steady-state concentration earlier than 21 weeks. The duration of time for calculating TWAs would require justification and would not exceed the duration of exposure in the chronic toxicity test (approximately 70 days for the standard avian reproduction study). An alternative to using the duration of the chronic toxicity study is to base the TWA on the application interval. In this case, increasing the application interval would suppress both the estimated peak pesticide concentration and the TWA. Another alternative to using TWAs would be to consider the number of days that a chemical is predicted to exceed the LOC.
- Pesticide dissipation is assumed to be first-order in the absence of data suggesting alternative dissipation patterns such as bi-phasic. Field dissipation data would generally be the most pertinent for assessing exposure in terrestrial species that forage on vegetation. However, these data are often not available and can be misleading, particularly if the compound is prone to "wash-off." Soil half-life is the most common degradation data available. Dissipation or degradation data that reflect the environmental conditions typical of refuge lands would be used, if available.
- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column.
- Actual habitat requirements of any particular terrestrial species are not considered, and it is assumed that species exclusively and permanently occupy the treated area or adjacent areas receiving pesticide at rates commensurate with the treatment rate. This assumption would produce a maximum estimate of exposure for risk characterization. This assumption would likely lead to an overestimation of exposure for species that do not permanently and exclusively occupy the treated area (USEPA 2004).

- Exposure through incidental ingestion of pesticide-contaminated soil is not considered in the USEPA risk assessment protocols. Research suggests <15 percent of the diet can consist of incidentally ingested soil depending upon species and feeding strategy (Beyer et al. 1994). An assessment of pesticide concentrations in soil compared to food item categories in the Kanaga nomogram indicates incidental soil ingestion will not likely increase dietary exposure to pesticides. Inclusion of soil into the diet would effectively reduce the overall dietary concentration compared to the present assumption that the entire diet consists of a contaminated food source (Fletcher et al. 1994). An exception to this may be soil-applied pesticides in which exposure from incidental ingestion of soil may increase. Potential for pesticide exposure under this assumption may be underestimated for soil-applied pesticides and overestimated for foliar-applied pesticides. The concentration of a pesticide in soil would likely be less than predicted on food items.
- Exposure through inhalation of pesticides is not considered in the USEPA risk assessment protocols. Such exposure may occur through three potential sources: spray material in droplet form at time of application, vapor phase with the pesticide volatilizing from treated surfaces, and airborne particulates (soil, vegetative matter, and pesticide dusts). The USEPA (1990) reported that exposure from inhaling spray droplets at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size (particles reaching the lung) in birds is limited to maximum diameter of 2 to 5 microns. The spray droplet spectra covering the majority of pesticide application scenarios indicate that less than 1 percent of the applied material is within the respirable particle size. This route of exposure is further limited because the permissible spray drop size distribution for ground pesticide applications is restricted to American Society of Agricultural Engineering medium or coarser drop size distribution.
- Inhalation of a pesticide in the vapor phase may be another source of exposure for some pesticides under certain conditions. This mechanism of exposure to pesticides occurs post application, and it would pertain to those pesticides with a high vapor pressure. The USEPA is currently evaluating protocols for modeling inhalation exposure from pesticides including near-field and near-ground air concentrations based upon equilibrium and kinetics-based models. Risk characterization for exposure with this mechanism is unavailable.
- The effect from exposure to dusts contaminated with the pesticide cannot be assessed generically as partitioning issues related to application site soils and chemical properties of the applied pesticides render the exposure potential from this route highly situation specific.
- Dermal exposure may occur through three potential sources: direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, incidental contact with contaminated vegetation, or contact with contaminated water or soil. Interception of spray and incidental contact with treated substrates may pose a risk to avian wildlife (Driver et al. 1991). However, available research related to wildlife dermal contact with pesticides is extremely limited, except dermal toxicity values, which are common for some mammals used as human surrogates (rats and mice). The USEPA is currently evaluating protocols for modeling dermal exposure. Risk characterization may be underestimated for this route of exposure, particularly with high-risk pesticides such as some organophosphates or carbamate insecticides. If protocols are established by the USEPA for assessing dermal exposure to pesticides, they would be considered for incorporation into pesticide assessment protocols.
- Exposure to a pesticide may occur from consuming surface water, dew, or other water on treated surfaces. Water-soluble pesticides have the potential to dissolve in surface runoff, and puddles in a treated area may contain pesticide residues. Similarly, pesticides with lower organic carbon partitioning characteristics and higher solubility in water have a greater

potential to dissolve in dew and other water associated with plant surfaces. Estimating the extent to which such pesticide loadings to drinking water occurs is complex and would depend upon the partitioning characteristics of the active ingredient, soils types in the treatment area, and the meteorology of the treatment area. In addition, the use of various water sources by wildlife is highly species-specific. Currently, risk characterization for this exposure mechanism is not available. The USEPA is actively developing protocols to quantify drinking water exposures from puddles and dew. If and when protocols are formally established by the USEPA for assessing exposure to pesticides through drinking water, these protocols would be incorporated into pesticide risk assessment protocols.

- Risk assessments are based upon the assumption that the entire treatment area would be subject to pesticide application at the rates specified on the label. In most cases, there is potential for uneven application of pesticides through such plausible incidents as changes in calibration of application equipment, spillage, and localized releases at specific areas in or near the treated field that are associated with mixing, handling, and application equipment as well as applicator skill. Inappropriate use of pesticides and the occurrence of spills represent a potential underestimate of risk. It is likely not an important factor for risk characterization. All pesticide applicators are required to be certified by the state in which they apply pesticides. Certification training includes the safe storage, transport, handling, and mixing of pesticides; equipment calibration; and proper application, with annual continuing education.
- The USEPA relies on Fletcher (1994) for setting the assumed pesticide residues in wildlife dietary items. The USEPA (2004) "believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify." Fletcher's (1994) research suggests that the pesticide active ingredient residue assumptions used by the USEPA represent a 95th percentile estimate. However, research conducted by Pfleeger et al. (1996) indicates that USEPA residue assumptions for short grass were not exceeded. Baehr and Habig (2000) compared USEPA residue assumptions with distributions of measured pesticide residues for the USEPA's UTAB database. Overall residue selection level will tend to overestimate risk characterization. This is particularly evident when wildlife individuals are likely to have selected a variety of food items acquired from multiple locations. Some food items may be contaminated with pesticide residues, whereas others are not contaminated. However, it is important to recognize differences in species feeding behavior. Some species may consume whole aboveground plant material, but others will preferentially select different plant structures. Also, species may preferentially select a food item although multiple food items may be present. Without species-specific knowledge regarding foraging behavior, characterizing ecological risk other than in general terms is not possible.
- Acute and chronic risk assessments rely on comparisons of wildlife dietary residues with LC_{50} or NOEC values expressed as concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods are not accounting for a potentially important aspect of food requirements.
- There are several other assumptions that can affect non-target species not considered in the risk assessment process. These include possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the

environment, cumulative effects from pesticides with the same mode of action, and effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic and biotic factors) and behavioral changes induced by exposure to a pesticide. These factors may exist at some level contributing to adverse effects to non-target species, but they are usually characterized in the published literature in only a general manner, limiting their value in the risk assessment process.

- It is assumed that aquatic species exclusively and permanently occupy the water body being assessed. Actual habitat requirements of aquatic species are not considered. With the possible exception of scenarios where pesticides are directly applied to water, it is assumed that no habitat use considerations specific for any species would place the organisms in closer proximity to pesticide use sites. This assumption produces a maximum estimate of exposure or risk characterization. It would likely be realistic for many aquatic species that may be found in aquatic habitats within or in close proximity to treated terrestrial habitats. However, the spatial distribution of wildlife is usually not random because wildlife distributions are often related to habitat requirements of species. Clumped distributions of wildlife may result in an under- or over-estimation of risk depending upon where the initial pesticide concentration occurs relative to the species or species habitat.
- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column. Additional chemical exposure from materials associated with suspended solids or food items is not considered because partitioning onto sediments is likely minimal. Adsorption and bioconcentration occur at lower levels for many newer pesticides compared with older, more persistent bioaccumulative compounds. Pesticides with RQs close to the listed species LOC have the potential for additional exposure from these routes and may be a limitation of risk assessments, where potential pesticide exposure or risk may be underestimated.
- Mass transport losses of pesticide from a water body (except for losses by volatilization, degradation, and sediment partitioning) would not be considered for ecological risk assessment. The water body would be assumed to capture all pesticide active ingredients entering as runoff and drift, and adsorbed to eroded soil particles. It would also be assumed that the pesticide active ingredient is not lost from the water body by overtopping or flow-through, nor is concentration reduced by dilution. In total, these assumptions would lead to a near maximum possible water-borne concentration. However, this assumption would not account for the potential to concentrate pesticide through evaporative loss. This limitation may have the greatest impact on water bodies with high surface-to-volume ratios such as ephemeral wetlands, where evaporative losses are accentuated and applied pesticides have low rates of degradation and volatilization.
- For acute risk assessments, there would be no averaging time for exposure. An instantaneous peak concentration would be assumed, where instantaneous exposure is sufficient in duration to elicit acute effects comparable to those observed over more protracted exposure periods (typically 48 to 96 hours) tested in the laboratory. In the absence of data regarding time-to-toxic event and analyses and latent responses to instantaneous exposure, risk would likely be overestimated.
- For chronic exposure risk assessments, the averaging times considered for exposure are commensurate with the duration of invertebrate life cycle or fish early life stage tests (e.g., 21–28 days and 56–60 days, respectively). Response profiles (time to effect and latency of effect) to pesticides likely vary widely with mode of action and species and should be evaluated on a case-by-case basis as available data allow. Nevertheless, because the USEPA

relies on chronic exposure toxicity endpoints based on a finding of no observed effect, the potential for any latent toxicity effects or averaging time assumptions to alter the results of an acceptable chronic risk assessment prediction is limited. The extent to which duration of exposure from water-borne concentrations overestimate or underestimate actual exposure depends on several factors. These include the following: localized meteorological conditions, runoff characteristics of the watershed (e.g., soils, topography), the hydrological characteristics of receiving waters, the environmental fate of the pesticide active ingredient, and the method of pesticide application. It should also be understood that chronic effects studies are performed using a method that holds water concentration in a steady state. This method is not likely to reflect conditions associated with pesticide runoff. Pesticide concentrations in the field increase and decrease in surface water in a cycle influenced by rainfall, pesticide use patterns, and degradation rates. As a result of the dependency of this assumption on several undefined variables, risk associated with chronic exposure may be underestimated in some situations and overestimated in others.

- There are several other factors that can affect non-target species not considered in the risk assessment process. These would include the following: possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic [not pesticides] and biotic factors), and sub-lethal effects such as behavioral changes induced by exposure to a pesticide. These factors may exist at some level, contributing to adverse effects to non-target species, but they are not routinely assessed by regulatory agencies. Therefore, information on the factors is not extensive, limiting their value for the risk assessment process. As this type of information becomes available, it would be included, either quantitatively or qualitatively, in this risk assessment process.
- USEPA is required by the Food Quality Protection Act to assess the cumulative risks of pesticides that share common mechanisms of toxicity, or act the same within an organism. Currently, USEPA has identified four groups of pesticides that have a common mechanism of toxicity requiring cumulative risk assessments. These four groups are: the organophosphate insecticides, N-methyl carbamate insecticides, triazine herbicides, and chloroacetanilide herbicides.

G.7.3 Pesticide Mixtures and Degradates

Pesticide products are usually a formulation of several components generally categorized as active ingredients and inert, or other, ingredients. The active ingredient is defined by the FIFRA as preventing, destroying, repelling, or mitigating the effects of a pest, or as a plant regulator, defoliant, desiccant, or nitrogen stabilizer. In accordance with FIFRA, the active ingredient(s) must be identified by name(s) on the pesticide label along with its relative composition expressed in percentage(s) by weight. In contrast, inert ingredients are not intended to affect a target pest. Their role in the pesticide formulation is to act as a solvent (keep the active ingredient in a liquid phase), an emulsifying or suspending agent (keep the active ingredient from separating out of solution), or a carrier (such as clay in which the active ingredient is impregnated on the clay particle in dry formulations). For example, if isopropyl alcohol would be used as a solvent in a pesticide formulation, then it would be considered an inert ingredient. FIFRA only requires that inert ingredients identified as hazardous, their associated percentage composition, and the total percentage of all inert ingredients be declared on a product label. Inert ingredients that are not classified as hazardous are not required to be identified.

The USEPA (September 1997) issued Pesticide Regulation Notice 97-6, which encouraged manufacturers, formulators, producers, and registrants of pesticide products to voluntarily substitute the term "other ingredients" for "inert ingredients" in the ingredient statement. This change recognized that all components in a pesticide formulation potentially could elicit or contribute to an adverse effect on non-target organisms and, therefore, are not necessarily inert. Whether referred to as "inerts" or "other ingredients," these constituents within a pesticide product have the potential to affect species or environmental quality. The USEPA categorizes regulated inert ingredients into the following four lists (http://www.epa.gov/opprd001/inerts/index.html):

- List 1: Inert Ingredients of Toxicological Concern
- List 2: Potentially Toxic Inert Ingredients
- List 3: Inerts of Unknown Toxicity
- List 4: Inerts of Minimal Toxicity

Several of the List 4 compounds are naturally occurring earthen materials (e.g., clay materials, simple salts) that would not elicit toxicological response at applied concentrations. However, some of the inerts (particularly the List 3 compounds and unlisted compounds) may have moderate to high potential toxicity to aquatic species based on MSDSs or published data.

Comprehensively assessing potential effects to non-target fish, wildlife, plants, and/or their habitats from pesticide use is a complex task. It would be preferable to assess the cumulative effects from exposure to the active ingredient, its degradates, inert ingredients, and other active ingredients in the spray mixture. However, it would only be feasible to conduct deterministic risk assessments for each component in the spray mixture singly. Limited scientific information is available regarding ecological effects (additive or synergistic) from chemical mixtures that typically rely upon broadly encompassing assumptions. For example, the U.S. Forest Service (2005) found that mixtures of pesticides used in land (forest) management likely would not cause additive or synergistic effects to non-target species based upon a review of scientific literature regarding toxicological effects and interactions of agricultural chemicals (ATSDR 2004). Moreover, information on inert ingredients, adjuvants, and degradates is often limited by the availability of and access to reliable toxicological data for these constituents.

Toxicological information regarding "other ingredients" may be available from sources such as the following:

- TOMES (a proprietary toxicological database including USEPA's IRIS, the Hazardous Substance Data Bank, and the Registry of Toxic Effects of Chemical Substances [RTECS]).
- USEPA's ECOTOX database, which includes AQUIRE (a database containing scientific papers published on the toxic effects of chemicals to aquatic organisms).
- TOXLINE (a literature-searching tool).
- MSDSs from pesticide suppliers.
- Other sources such as the *Farm Chemicals Handbook*.

Because there is a lack of specific inert toxicological data, inerts in a pesticide may cause adverse ecological effects. However, inert ingredients typically represent only a small percentage of the pesticide spray mixture, and it would be assumed that negligible effects would be expected to result from inert ingredients.

Although the potential effects of degradates should be considered when selecting a pesticide, it is beyond the scope of this assessment process to consider all possible breakdown chemicals of the various product formulations containing an active ingredient. Degradates may be more or less mobile and more or less hazardous in the environment than their parent pesticides (Battaglin et al. 2003). Differences in environmental behavior (e.g., mobility) and toxicity between parent pesticides and degradates would make assessing potential degradate effects extremely difficult. For example, a less toxic and more mobile bioaccumulative or persistent degradate may have potentially greater effects on species and/or degrade environmental quality. The lack of data on the toxicity of degradates for many pesticides would represent a source of uncertainty for assessing risk.

A USEPA-approved label specifies whether a product can be mixed with one or more pesticides. Without product-specific toxicological data, it would not possible to quantify the potential effects of these mixtures. In addition, a quantitative analysis could only be conducted if reliable scientific information allowed a determination of whether the joint action of a mixture would be additive, synergistic, or antagonistic. Such information would not likely exist unless the mode of action is common among the chemicals and receptors. Moreover, the composition of and exposure to mixtures would be highly site- and/or time-specific and, therefore, it would be nearly impossible to assess potential effects to species and environmental quality.

To minimize or eliminate potential negative effects associated with applying two or more pesticides as a mixture, the use would be conducted in accordance with the labeling requirements. Labels for two or more pesticides applied as a mixture should be completely reviewed, where products with the least potential for negative effects would be selected for use on the refuge. This is especially relevant when a mixture would be applied in a manner that may already have the potential for an effect(s) associated with an individual pesticide (e.g., runoff to ponds in sandy watersheds). Use of a tank mix under these conditions would increase the level of uncertainty in terms of risk to species or potential to degrade environmental quality.

Adjuvants generally function to enhance or prolong the activity of pesticide. For terrestrial herbicides, adjuvants aid in the absorption into plant tissue. Adjuvant is a broad term that generally applies to surfactants, selected oils, anti-foaming agents, buffering compounds, drift control agents, compatibility agents, stickers, and spreaders. Adjuvants are not under the same registration requirements as pesticides, and the USEPA does not register or approve the labeling of spray adjuvants. Individual pesticide labels identify types of adjuvants approved for use with the pesticide. In general, adjuvants compose a relatively small portion of the volume of pesticides applied. Selection of adjuvants with limited toxicity and low volumes would be recommended to reduce the potential for the adjuvant to influence the toxicity of the pesticide.

G.7.4 Determining Effects to Soil and Water Quality

The approval process for pesticide uses would consider potential to degrade water quality on and off refuge lands. A pesticide can only affect water quality through movement away from the treatment site. After application, pesticide mobilization can be characterized by one or more of the following (Kerle et al. 1996):

- Attach (sorb) to soil, vegetation, or other surfaces and remain at or near the treated area;
- Attach to soil and move off-site through erosion from runoff or wind;
- Dissolve in water that can be subjected to runoff or leaching.

As an initial screening tool, selected chemical characteristics and rating criteria for a pesticide can be evaluated to assess potential to enter ground and/or surface waters. These would include the following: persistence, sorption coefficient (K_{oc}), groundwater ubiquity score (GUS), and solubility.

Persistence, which is expressed as half-life ($t_{½}$), represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially). Persistence in the soil can be categorized as the following: non-persistent is less than 30 days, moderately persistent is 30 to 100 days, and persistent is over 100 days (Kerle et al. 1996). Half-life data is usually available for aquatic and terrestrial environments.

Another measure of pesticide persistence is dissipation time (DT_{50}). This represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site, whereas half-life describes the rate for degradation only. As for half-life, units of dissipation time are usually expressed in days. Field or foliar dissipation time is the preferred data for use to estimate pesticide concentrations in the environment. However, soil half-life is the most common persistence data cited in published literature. If field or foliar dissipation data is not available, soil half-life data may be used. The average or representative half-life value of the most important degradation mechanism will be selected for quantitative analysis for both terrestrial and aquatic environments.

The mobility of a pesticide is a function of how strongly it is adsorbed to soil particles and organic matter, its solubility in water, and its persistence in the environment. Pesticides strongly adsorbed to soil particles, relatively insoluble in water, and not environmentally persistent would be less likely to move across the soil surface into surface waters or to leach through the soil profile and contaminate groundwater. Conversely, pesticides that are not strongly adsorbed to soil particles, are highly water soluble, and are persistent in the environment would have greater potential to move from the application site (off-site movement).

The degree of pesticide adsorption to soil particles and organic matter (Kerle et al. 1996) is expressed as the soil adsorption coefficient (K_{oc}). The K_{oc} is measured as micrograms of pesticide per gram of soil (μg/g) and can range from near zero to the thousands. Pesticides with higher K_{oc} values are strongly adsorbed to soil and, therefore, would be less subject to movement.

Water solubility describes the amount of pesticide that will dissolve in a known quantity of water. The water solubility of a pesticide is expressed as milligrams of pesticide dissolved in a liter of water (mg/L or parts per million [ppm]). Pesticide with solubility <0.1 ppm are virtually insoluble in water; those with solubility from 100 to 1,000 ppm are moderately soluble and those with solubility over10,000 ppm are highly soluble (U.S. Geological Survey [USGS] 2000). As pesticide solubility increases, there would be greater potential for off-site movement.

The GUS is a quantitative screening tool to estimate a pesticide's potential to move in the environment. It uses soil persistence and adsorption coefficients in the following formula.

$$GUS = \log_{10}(t_{½}) \times [4 - \log_{10}(K_{oc})]$$

The potential pesticide movement rating would be based upon its GUS value. Pesticides with a GUS less than 0.1 would be considered to have an extremely low potential to move toward groundwater. Values of 1.0 to 2.0 would be low, 2.0 to 3.0 would be moderate, 3.0 to 4.0 would be high, and over 4.0 would have a very high potential to move toward groundwater.

Water solubility describes the amount of pesticide dissolving in a specific quantity of water, where it is usually measured as mg/L or ppm. Solubility is useful as a comparative measure because pesticides with higher values are more likely to move by runoff or leaching. GUS, water solubility, $t_{½}$, and K_{oc} values are available for selected pesticides from the Oregon State University (OSU) Extension Pesticide Properties Database at http://npic.orst.edu/ppdmove.htm. Many of the values in this database were derived from the SCS/ARS/CES Pesticide Properties Database for Environmental Decision Making (Wauchope et al. 1992).

Soil properties influence the fate of pesticides in the environment. The following six properties are mostly likely to affect pesticide degradation and the potential for pesticides to move off-site by leaching (vertical movement through the soil) or runoff (lateral movement across the soil surface).

- Permeability is the rate of water movement vertically through the soil. It is affected by soil texture and structure. Coarse-textured soils (e.g., high sand content) have a larger pore size and are generally more permeable than fine textured soils (i.e., high clay content). The more permeable soils would have a greater potential for pesticides to move vertically down through the soil profile. Soil permeability rates (inches/hour) are usually available in county soil survey reports.
- Soil texture describes the relative percentage of sand, silt, and clay. In general, greater clay content with smaller pore size would lower the likelihood and rate at which water would move through the soil profile. Clay also serves to adsorb (bind) pesticides to soil particles. Soils with high clay content would adsorb more pesticide than soils with relatively low clay content. In contrast, sandy soils with coarser texture and lower water holding capacity would have a greater potential for water to leach through them.
- Soil structure describes soil aggregation. Soils with a well-developed soil structure have looser, more aggregated structure that would be less likely to be compacted. Both characteristics would allow for less restricted flow of water through the soil profile, resulting in greater infiltration.
- Organic matter would be the single most important factor affecting pesticide adsorption in soils. Many pesticides are adsorbed to organic matter, which reduces their rate of downward movement through the soil profile. Also, soils high in organic matter tend to hold more water, which may make less water available for leaching.
- Soil moisture affects how fast water moves through the soil. If soils are already wet or saturated before rainfall or irrigation, excess moisture would become runoff rather than infiltrate into the soil profile. Soil moisture also influences microbial and chemical activity in soil, which affects pesticide degradation.
- Soil pH influences chemical reactions that occur in the soil, which in turn determines whether a pesticide will degrade, the rate of degradation, and, in some instances, which degradation products are produced.

Based upon the aforementioned properties, soils most vulnerable to groundwater contamination would be sandy soils with low organic matter. In contrast, the least vulnerable soils would be well-drained clayey soils with high organic matter. Consequently, pesticides with the lowest potential for movement in conjunction with appropriate BMPs (see below) would be used in an IPM framework to treat pests while minimizing effects to non-target biota and protecting environmental quality.

Along with soil properties, the potential for a pesticide to affect water quality through runoff and leaching would be affected by site-specific environmental and abiotic conditions including rainfall, water table conditions, and topography (Huddleston 1996).

- Water is necessary to separate pesticides from soil. This can occur in two basic ways. Pesticides that are soluble move easily with runoff water. Pesticide-laden soil particles can be dislodged and transported from the application site in runoff. The concentration of pesticides in the surface runoff would be greatest for the first runoff event following treatment. The rainfall intensity and route of water infiltration into soil, to a large extent, determine pesticide concentrations and losses in surface runoff. The timing of the rainfall after application also would have an effect. Rainfall interacts with pesticides at a shallow soil depth (0.25 to 0.5 inch), which is called the mixing zone (Baker and Miller 1999). The pesticide/water mixture in the mixing zone tends to leach down into the soil or runoff depending upon how quickly the soil surface becomes saturated and how rapidly water can infiltrate into the soil. Leaching would decrease the amount of pesticide available near the soil surface (mixing zone) to runoff during the initial rainfall event following application and subsequent rainfall events.
- Terrain slope would affect the potential for surface runoff and the intensity of runoff. Steeper slopes would have greater potential for runoff following a rainfall event. In contrast, soils that are relatively flat would have little potential for runoff, except during intense rainfall events. In addition, soils in lower areas would be more susceptible to leaching as a result of receiving excessive water from surrounding higher elevations.
- Depth to groundwater would be an important factor affecting the potential for pesticides to leach into groundwater. If the distance from the soil surface to the top of the water table is shallow, pesticides would have less distance to travel to reach groundwater. Shallower water tables that persist for longer periods would be more likely to experience groundwater contamination. Soil survey reports are available for individual counties. These reports provide data in tabular format regarding the water table depths and the months during which they persist. In some situations, a hard pan exists above the water table that would prevent pesticide contamination from leaching.

G.7.5 Determining Effects to Air Quality

Pesticides may volatilize from soil and plant surfaces and move from the treated area into the atmosphere. The potential for a pesticide to volatilize is determined by the pesticide’s vapor pressure, which is affected by temperature, sorption, soil moisture, and the pesticide’s water solubility. Vapor pressure is often expressed in mm Hg. To make these numbers easier to compare, vapor pressure may be expressed in exponent form ($I \times 10^{-7}$), where *I* represents vapor pressure index. In general, pesticides with I less than 10 would have a low potential to volatilize, whereas pesticides with I greater than 1,000 would have a high potential to volatilize (Oregon State University 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database.

G.7.6 Preparing a Chemical Profile

The following instructions would be used by Service personnel to complete Chemical Profiles for pesticides. Specifically, profiles would be prepared for pesticide active ingredients (e.g., glyphosate, imazapic) that would be contained in one or more trade name products that are registered and labeled with USEPA. All information fields under each category (e.g., toxicological endpoints, environmental fate) would be completed for a Chemical Profile. If no information is available for a specific field, then "No data is available in references" would be recorded in the profile. Available scientific information would be used to complete Chemical Profiles. Each entry of scientific information would be shown with applicable references.

Completed Chemical Profiles would provide a structured decision-making process using quantitative assessment/screening tools with threshold values (where appropriate) that would be used to evaluate potential biological and other environmental effects to refuge resources. For ecological risk assessments presented in these profiles, the "worst-case scenario" would be evaluated to determine whether a pesticide could be approved for use considering the maximum single application rate specified on pesticide labels for habitat management and croplands/facilities maintenance treatments pertaining to refuges. Where the worst-case scenario likely would only result in minor, temporary, and localized effects to listed and nonlisted species with appropriate BMPs (see Section G.5 of this appendix), the proposed pesticide's use in a PUP would have a scientific basis for approval under any application rate specified on the label that is at or below rates evaluated in a Chemical Profile. In some cases, the Chemical Profile would include a lower application rate than the maximum labeled rate in order to protect refuge resources. As necessary, Chemical Profiles would be periodically updated with new scientific information or as pesticides with the same active ingredient are proposed for use on the refuge in PUPs.

Throughout this section, threshold values (to prevent or minimize potential biological and environmental effects) would be clearly identified for specific information presented in a completed Chemical Profile. Comparison with these threshold values provides an explicit scientific basis to approve or disapprove PUPs for habitat management and cropland/facilities maintenance on refuge lands. In general, PUPs would be approved for pesticides with Chemical Profiles where threshold values would not be exceeded. However, BMPs are identified for some screening tools that would minimize/eliminate potential effects (exceeding the threshold value) as a basis for approving PUPs.

Date: Service personnel would record the date when the Chemical Profile is completed or updated. Chemical Profiles (e.g., currently approved PUPs) would be periodically reviewed and updated, as necessary. The most recent review date would be recorded on a profile to document when it was last updated.

Trade Name(s): Service personnel would accurately and completely record the trade name(s) from the pesticide label, which includes a suffix that describes the formulation (e.g., WP, DG, EC, L, SP, I, II, or 64). The suffix often distinguishes a specific product among several pesticides with the same active ingredient. Service personnel would record a trade name for each pesticide product with the same active ingredient.

Common chemical name(s): Service personnel would record the common name(s) listed on the pesticide label or MSDS for an active ingredient. The common name of a pesticide is listed as the active ingredient on the title page of the product label immediately following the trade name, and in Section 2 of the MSDS (Composition/Information on Ingredients). A Chemical Profile is completed for each active ingredient.

Pesticide Type: Service personnel would record the type of pesticide for an active ingredient as one of the following: herbicide, dessicant, fungicide, fumigant, growth regulator, insecticide, piscicide, or rodenticide.

EPA Registration Number(s): This number (EPA Registration Number) appears on the title page of the label and in Section 1 of the MSDS (Chemical Product and Company Description). It is not the EPA Establishment Number, which is usually located near it. Service personnel would record the EPA Reg. No. for each trade name product with an active ingredient based upon PUPs.

Pesticide Class: Service personnel would list the general chemical class for the pesticide (active ingredient). For example, malathion is an organophosphate and carbaryl is a carbamate.

CAS (Chemical Abstract Service) Number: This number is often located in the second section (Composition/Information on Ingredients) of the MSDS. The MSDS table listing components usually contains this number immediately prior to or following the percentage composition.

Other Ingredients: Based on the most recent MSDS for the proposed pesticide product(s), Service personnel would include any chemicals in the pesticide formulation not listed as an active ingredient and described as toxic or hazardous or regulated under the Superfund Amendments and Reauthorization Act (SARA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substances Control Act (TSCA), OSHA, State Right-to-Know, or other listed authorities. These are usually found in MSDS sections titled “Hazardous Identifications”, “Exposure Control/Personal Protection,” and “Regulatory Information.” If concentrations of other ingredients are available for any compounds identified as toxic or hazardous, then Service personnel would record this information in the Chemical Profile by trade name. MSDSs may be obtained from the manufacturer, manufacturer’s website, or an online database maintained by Crop Data Management Systems, Inc. (see list below).

G.7.6.1 Toxicological Endpoints

Toxicological endpoint data would be collected for acute and chronic tests with mammals, birds, and fish. Data would be recorded for species available in the scientific literature. If no data are found for a particular taxonomic group, then “No data available in references” would be recorded as the data entry. Throughout the Chemical Profile, references (including toxicological endpoint data) would be cited using parentheses (#) following the recorded data.

Mammalian LD_{50}: For test species in the scientific literature, Service personnel would record available data for oral lethal dose (LD_{50}) in mg/kg-bw (body weight) or ppm-bw. The most common test species in scientific literature are the rat and mouse. The lowest LD_{50} value found for a rat would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk to mammals (see Table G-1 in Section G.7.1).

Mammalian LC_{50}: For test species in the scientific literature, Service personnel would record available data for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species in scientific literature are the rat and mouse. The lowest LC_{50} value found for a rat would be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Mammalian Reproduction: For test species listed in the scientific literature, Service personnel would record the test results (e.g., Lowest Observed Effect Concentration [LOEC], Lowest Observed Effect Level [LOEL], No Observed Adverse Effect Level [NOAEL], NOAEC) in mg/kg-bw or mg/kg-diet for reproductive test procedure(s) (e.g., generational studies [preferred], fertility, newborn weight). The most common test species available in scientific literature are rats and mice. The lowest

NOEC, NOAEC, NOEL, or NOAEL test results found for a rat would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

Avian LD_{50}: For test species available in the scientific literature, Service personnel would record values for oral lethal dose (LD_{50}) in mg/kg-bw or ppm-bw. Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LD_{50} value found for an avian species would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Avian LC_{50}: For test species available in the scientific literature, Service personnel would record values for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LC_{50} value found for an avian species would be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Avian Reproduction: For test species available in the scientific literature, Service personnel would record test results (e.g., LOEC, LOEL, NOAEC, NOAEL) in mg/kg-bw or mg/kg-diet consumed for reproductive test procedure(s) (e.g., early life cycle, reproductive). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for an avian species would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

Fish LC_{50}: For test freshwater or marine species listed in the scientific literature, Service personnel would record the LC_{50} in ppm or mg/L. The most common test species available in the scientific literature are the bluegill, rainbow trout, and fathead minnow (marine). Test results for many game species may also be available. The lowest LC_{50} value found for a freshwater fish species would be used as a toxicological endpoint for RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Fish Early Life Stage (ELS)/Life Cycle: For test freshwater or marine species available in the scientific literature, Service personnel would record test results (e.g., LOEC, NOAEL, NOAEC, LOAEC) in ppm for test procedure(s) (e.g., early life cycle, life cycle). The most common test species available in the scientific literature are bluegill, rainbow trout, and fathead minnow. Test results for other game species may also be available. The lowest test value found for a fish species (preferably freshwater) would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

Other: For test invertebrate as well as non-vascular and vascular plant species available in the scientific literature, Service personnel would record $LC_{50,}$ $LD_{50,}$ LOEC, LOEL, NOAEC, NOAEL, or EC_{50} (environmental concentration) values in ppm or mg/L. The most common test invertebrate species available in scientific literature are the honey bee and the water flea (*Daphnia magna*). Green algae (*Selenastrum capricornutum*) and pondweed (*Lemna minor*) are frequently available test species for aquatic non-vascular and vascular plants, respectively.

Ecological Incident Reports: After a site has been treated with pesticide(s), wildlife may be exposed to these chemical(s). When exposure is high relative to the toxicity of the pesticides, wildlife may be killed or visibly harmed (incapacitated). Such events are called ecological incidents. The USEPA maintains a database (Ecological Incident Information System) of ecological incidents. This database stores information extracted from incident reports submitted by various federal and state agencies and nongovernment organizations. Information included in an incident report is the date and location of the incident, the type and magnitude of effects observed in various species, the use(s) of pesticides known or suspected of contributing to the incident, and results of any chemical residue and cholinesterase activity analyses conducted during the investigation.

Incident reports can play an important role in evaluating the effects of pesticides by supplementing quantitative risk assessments. All incident reports for pesticide(s) with the active ingredient and associated information would be recorded.

G.7.6.2 Environmental Fate

Water Solubility: Service personnel would record values for water solubility (S_w), which describes the amount of pesticide that dissolves in a known quantity of water. S_w is expressed as mg/L (ppm). Pesticide S_w values would be categorized as one of the following: insoluble <0.1 ppm, moderately soluble = 100 to 1,000 ppm, highly soluble >10,000 ppm (USGS 2000). As pesticide S_w increases, there would be greater potential to degrade water quality through runoff and leaching.

S_w values would be used to evaluate the potential for bioaccumulation in aquatic species (see **Octanol-Water Partition Coefficient [K_{ow}]** below).

Soil Mobility: Service personnel would record available values for soil adsorption coefficient (K_{oc} [µg/g]). It provides a measure of a chemical's mobility and leaching potential in soil. K_{oc} values are directly proportional to organic content, clay content, and surface area of the soil. K_{oc} data for a pesticide may be available for a variety of soil types (e.g., clay, loam, sand).

K_{oc} values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

Soil Persistence: Service personnel would record values for soil half-life ($t_{½}$), which represents the length of time (days) required for 50 percent of the deposited pesticide to degrade (completely or partially) in the soil. Based upon the $t_{½}$ value, soil persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

Threshold for Approving PUPs:

- If soil $t_{½}$ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
- If soil $t_{½}$ >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:
    - Do not exceed one application per site per year.
    - Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
    - Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

Along with K_{oc}, soil $t_{½}$ values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

Soil Dissipation: Dissipation time (DT_{50}) represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site, whereas soil $t_{½}$ describes the rate for degradation only. As for $t_{½}$, units of DT_{50} are usually expressed in days. Field dissipation time would be the preferred data for use to estimate pesticide concentrations in the environment because it is based upon field studies unlike soil $t_{½}$, which is derived in a laboratory. However, soil $t_{½}$ is the most common persistence data available in the published literature. If field DT_{50} is not available, soil $t_{½}$ data would be used in a Chemical Profile. The average or representative $t_{½}$ value of the most important degradation mechanisms would be selected for quantitative analysis for both terrestrial and aquatic environments.

Based upon the DT_{50} value, environmental persistence in the soil also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

Threshold for Approving PUPs:

- If soil DT_{50} ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
- If soil DT_{50} >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:

  - Do not exceed one application per site per year.
  - Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
  - Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

Along with K_{oc}, soil DT_{50} values (preferred over soil $t_{½}$) would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below), if available.

Aquatic Persistence: Service personnel would record values for aquatic $t_{½}$, which represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially) in water. Based upon the $t_{½}$ value, aquatic persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

Threshold for Approving PUPs:

- If aquatic $t_{½}$ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
- If aquatic $t_{½}$ >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:

- o Do not exceed one application per site per year.
- o Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
- o Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

Aquatic Dissipation: Dissipation time (DT_{50}) represents the time required for 50 percent of the deposited pesticide to degrade or move (dissipate); whereas, aquatic $t_{½}$ describes the rate for degradation only. As for $t_{½}$, units of DT_{50} are usually expressed in days. Based upon the DT_{50} value, environmental persistence in aquatic habitats also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

Threshold for Approving PUPs:

- If aquatic $DT_{50} \leq 100$ days, then a PUP would be approved without additional BMPs to protect water quality.
- If aquatic $DT_{50} > 100$ days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the “Specific Best Management Practices” section to minimize potential surface runoff and leaching that can degrade water quality:

  - o Do not exceed one application per site per year.
  - o Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
  - o Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

Potential to Move to Groundwater: Groundwater Ubiquity Score (GUS) = $\log_{10}(\text{soil } t_{½}) \times [4 - \log_{10}(K_{oc})]$. If a DT_{50} value is available, it would be used rather than a $t_{½}$ value to calculate a GUS. Based upon the GUS, the potential to move toward groundwater would be recorded as one of the following categories: extremely low potential<1.0, low = 1.0 to 2.0, moderate = 2.0 to 3.0, high = 3.0 to 4.0, or very high >4.0.

Threshold for Approving PUPs:

- If GUS ≤ 4.0, then a PUP would be approved without additional BMPs to protect water quality.
- If GUS >4.0, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the “Specific Best Management Practices” section to minimize potential surface runoff and leaching that can degrade water quality:

  - o Do not exceed one application per site per year.
  - o Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
  - o Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

Volatilization: Pesticides may volatilize (evaporate) from soil and plant surfaces and move off-target into the atmosphere.

Threshold for Approving PUPs:

- If I $\leq$1,000, then a PUP would be approved without additional BMPs to minimize drift and protect air quality.
- If I >1,000, then a PUP would only be approved with additional BMPs specifically to minimize drift and protect air quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to reduce volatilization and potential to drift and degrade air quality:

  - Do not treat when wind velocities are <2 or >10 mph with existing or potential inversion conditions.
  - Apply the largest diameter droplets possible for spray treatments.
  - Avoid spraying when air temperatures are >85°F.
  - Use the lowest spray height possible above target canopy.
  - Where identified on the pesticide label, soil-incorporate pesticide as soon as possible during or after application.

Octanol-Water Partition Coefficient (K_{ow}): The octanol-water partition coefficient (K_{ow}) is the concentration of a pesticide in octanol and water at equilibrium at a specific temperature. Because octanol is an organic solvent, it is considered a surrogate for natural organic matter. Therefore, K_{ow} would be used to assess potential for a pesticide to bioaccumulate in tissues of aquatic species (e.g., fish). If K_{ow} >1,000 or S_w<1 mg/L and soil $t_{½}$ >30 days, then there would be high potential for a pesticide to bioaccumulate in aquatic species such as fish (USGS 2000).

Threshold for Approving PUPs:

- If potential for a pesticide to bioaccumulate in aquatic species is not high, then the PUP would be approved.
- If there is a high potential to bioaccumulate in aquatic species (K_{ow} >1,000 or S_w <1 mg/L and soil $t_{½}$ >30 days), then the PUP would not be approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Bioaccumulation/Bioconcentration: This is the physiological process where pesticide concentrations in tissue increase in biota because they are taken and stored at a faster rate than they are metabolized or excreted. The potential for bioaccumulation would be evaluated through bioaccumulation factors (BAFs) or bioconcentration factors (BCFs). Based upon BAF or BCF values, the potential to bioaccumulate would be recorded as one of the following: low: 0 to 300, moderate: 300 to 1,000, or high: >1,000 (Calabrese and Baldwin 1993).

Threshold for Approving PUPs:

- If BAF or BCF $\leq$1,000, then a PUP would be approved without additional BMPs.
- If BAF or BCF> 1,000, then a PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

G.7.6.3 Worst-Case Ecological Risk Assessment

Max Application Rates (acid equivalent): Service personnel would record the highest application rate of an active ingredient (ae basis) for habitat management and cropland/facilities maintenance treatments in this data field of a Chemical Profile. These rates can be found in Table CP.1 under the column heading “Max Product Rate – Single Application (lbs/acre – active ingredient on acid equiv basis).” This table would be prepared for a Chemical Profile from information specified in labels for trade name products identified in PUPs. If these data are not available in pesticide labels, then Service personnel would write “NS” for “not specified on label” in this table.

EECs: An ECC represents potential exposure to fish and wildlife (birds and mammals) from pesticide use. EECs would be derived by Service personnel using a USEPA screening-level approach (USEPA 2004). For each maximum application rate (see description under “Max Application Rates [acid equivalent]”), Service personnel would record two EEC values in a Chemical Profile; these would represent the worst-case terrestrial and aquatic exposures for habitat management and croplands/facilities maintenance treatments. For terrestrial and aquatic EEC calculations, see description for data entry under “Presumption of Unacceptable Risk/Risk Quotients,” which is the next field for a Chemical Profile.

Presumption of Unacceptable Risk/Risk Quotients: Service personnel would calculate and record acute and chronic RQs for birds, mammals, and fish using the provided tabular formats for habitat management and/or cropland/facilities maintenance treatments. RQs recorded in a Chemical Profile would represent the worst-case assessment for ecological risk. See Section G.7.2 of this appendix for a discussion regarding the calculations of RQs.

For aquatic assessments associated with habitat management treatments, RQ calculations would be based upon selected acute and chronic toxicological endpoints for fish, and the EEC would be derived from Urban and Cook (1986) assuming 100 percent overspray to an entire 1-foot-deep water body using the max application rate (ae basis [see above]).

For aquatic assessments associated with cropland/facilities maintenance treatments, RQ calculations would be done by Service personnel based upon selected acute and chronic toxicological endpoints for fish, and an EEC would be derived from the aquatic assessment in AgDRIFT version 2.01 under Tier I ground-based application with the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium/coarse droplet size, 20 swaths, EPA-defined wetland, and 25-foot distance (buffer) from treated area to water.

See Section G.7.2.1.2 of this appendix for more details regarding the calculation of EECs for aquatic habitats for habitat management and cropland/facilities maintenance treatments.

For terrestrial avian and mammalian assessments, RQ calculations would be done by Service personnel based upon dietary exposure, where the “short grass” food item category would represent the worst-case scenario. For terrestrial spray applications associated with habitat management and cropland/facilities maintenance treatments, exposure (EECs and RQs) would be determined using the Kanaga nomogram method through the USEPA’s T-REX version 1.2.3. T-REX input variables would include max application rate (acid basis [see above]) and pesticide half-life (days) in soil to estimate the initial, maximum pesticide residue concentration on general food items for terrestrial vertebrate species in short (<20 cm tall) grass.

For granular pesticide formulations and pesticide-treated seed with a unique route of exposure for terrestrial avian and mammalian wildlife, see discussion on terrestrial granular application in Section G.7.2.1.1 of this appendix for the procedure that would be used to calculate RQs.

All calculated RQs in both tables would be compared with LOCs established by USEPA (see Table G-2 in Section G.7.2). If a calculated RQ exceeds an established LOC value (in parentheses inside the table), then there would be potential for an acute or chronic effect (unacceptable risk) to federally listed (T&E) species and nonlisted species. See Section G.7.2 of this appendix for detailed descriptions of acute and chronic RQ calculations and comparisons to LOCs to assess risk.

Threshold for approving PUPs:

- If RQs≤LOCs, then a PUP would be approved without additional BMPs.
- If RQs>LOCs, then a PUP would only be approved with additional BMPs specifically to minimize exposure (ecological risk) to bird, mammal, and/or fish species. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to reduce potential risk to nonlisted or listed species:
    - Lower application rate and/or fewer number of applications so RQs≤LOCs.
    - For aquatic assessments (fish) associated with cropland/facilities maintenance, increase the buffer distance beyond 25 feet so RQs≤LOCs.

Justification for Use: Service personnel would describe the reasons for using pesticide-based control of specific pests or groups of pests. In most cases, the pesticide label will provide the appropriate information regarding control of pests to describe in the section.

Specific Best Management Practices (BMPs): Service personnel would record specific BMPs necessary to minimize or eliminate potential effects to non-target species and/or degradation of environmental quality from drift, surface runoff, or leaching. These BMPs would be based upon scientific information documented in previous data fields of a Chemical Profile. Where necessary and feasible, these specific practices would be included in PUPs as a basis for approval.

If there are no specific BMPs that are appropriate, then Service personnel would describe why the potential effects to refuge resources and/or degradation of environmental quality is outweighed by the overall resource benefit(s) from the proposed pesticide use in the BMP section of the PUP. See Section G.5 of this appendix for a complete list of BMPs associated with mixing and applying pesticides appropriate for all PUPs with ground-based treatments that would be additive to any necessary, chemical-specific BMPs.

References: Service personnel would record scientific resources used to provide data/information for a Chemical Profile. Use the number sequence to uniquely reference data in a chemical profile.

The following online data resources are readily available for toxicological endpoint and environmental fate data for pesticides:

1. California Product/Label Database. Department of Pesticide Regulation, California Environmental Protection Agency. (http://www.cdpr.ca.gov/docs/label/labelque.htm#regprods)

2. ECOTOX database. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. (http://cfpub.epa.gov/ecotox/)

3. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. Cooperative effort of University of California-Davis, Oregon State University, Michigan State University, Cornell University, and University of Idaho through Oregon State University, Corvallis, Oregon. (http://extoxnet.orst.edu/pips/ghindex.html)

4. FAO specifications and evaluations for plant protection products. Pesticide Management Unit, Plant Protection Services, Food and Agriculture Organization, United Nations. (http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPP/Pesticid/)

5. Human health and ecological risk assessments. Pesticide Management and Coordination, Forest Health Protection, U.S. Department of Agriculture, U.S. Forest Service. (http://www.fs.fed.us/foresthealth/pesticide/risk.htm)

6. Pesticide Chemical Fact Sheets. Clemson University Pesticide Information Center. (http://entweb.clemson.edu/pesticid/Document/Labels/factshee.htm)

7. Pesticide Fact Sheets. Published by Information Ventures, Inc. for Bureau of Land Management, Department of Interior; Bonneville Power Administration, U.S. Department of Energy; and U.S. Forest Service, U.S. Department of Agriculture. (http://infoventures.com/e-hlth/pesticide/pest-fac.html)

8. Pesticide Fact Sheets. National Pesticide Information Center. (http://npic.orst.edu/npicfact.htm)

9. Pesticide Fate Database. U.S. Environmental Protection Agency, Washington, D.C. (http://cfpub.epa.gov/pfate/home.cfm).

10. Pesticide product labels and material safety data sheets. Crop Data Management Systems, Inc. (CDMS) (http://www.cdms.net/pfa/LUpdateMsg.asp) or multiple websites maintained by agrichemical companies.

11. Registered Pesticide Products (Oregon database). Oregon Department of Agriculture. (http://www.oda.state.or.us/dbs/pest_products/search.lasso)

12. Regulatory notes. Pest Management Regulatory Agency, Health Canada, Ontario, Canada. (http://www.hc-sc.gc.ca/pmra-arla/)

13. Reptile and Amphibian Toxicology Literature. Canadian Wildlife Service, Environment Canada, Ontario, Canada. (http://www.cws-scf.ec.gc.ca/nwrc-cnrf/ratl/index_e.cfm)

14. Specific Chemical Fact Sheet – New Active Ingredients, Biopesticide Fact Sheet and Registration Fact Sheet. U.S. Environmental Protection Agency, Washington, D.C. (http://www.epa.gov/pestidides/factsheets/chemical_fs.htm)

15. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Invasive Species Initiative. The Nature Conservancy. (http://tnsweeds.ucdavis.edu/handbook.html)

16. Wildlife Contaminants Online. U.S. Geological Survey, Department of Interior, Washington, D.C. (http://www.pwrc.usgs.gov/contaminants-online/)

17. One-liner database. 2000. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, D.C.

Chemical Profile

Date:			
Trade Name(s):		**Common Chemical Name(s):**	
Pesticide Type:		**EPA Registration Number:**	
Pesticide Class:		**CAS Number:**	
Other Ingredients:			

Toxicological Endpoints

Mammalian LD_{50}:	
Mammalian LC_{50}:	
Mammalian Reproduction:	
Avian LD_{50}:	
Avian LC_{50}:	
Avian Reproduction:	
Fish LC_{50}:	
Fish ELS/Life Cycle:	
Other:	

Ecological Incident Reports

Environmental Fate

Water solubility (S_w):	
Soil Mobility (K_{oc}):	
Soil Persistence ($t_{½}$):	
Soil Dissipation (DT_{50}):	
Aquatic Persistence ($t_{½}$):	
Aquatic Dissipation (DT_{50}):	
Potential to Move to Groundwater (GUS score):	
Volatilization (mm Hg):	
Octanol-Water Partition Coefficient (K_{ow}):	
Bioaccumulation/Bioconcentration:	**BAF:`** **BCF:**

Worst-Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** **Croplands/Facilities Maintenance:**
EECs	**Terrestrial (Habitat Management):** **Terrestrial (Croplands/Facilities Maintenance):** **Aquatic (Habitat Management):** **Aquatic (Croplands/Facilities Maintenance):**

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Justification for Use:	
Specific Best Management Practices (BMPs):	
References:	

Table CP.1 Pesticide Name

Trade Name[a]	Treatment Type[b]	Max Product Rate - Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - active ingredient on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)

[a]From each label for a pesticide identified in PUPs, Service personnel would record application information associated with possible/known uses on Service lands.
[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

G.8 References

AgDrift. 2001. A user's guide for AgDrift 2.04: a tiered approach for the assessment of spray drift of pesticides. Spray Drift Task Force. Macon, MO.

ATSDR (Agency for Toxic Substances and Disease Registry). 2004. Guidance manual for the assessment of joint toxic action of chemical mixtures. U.S. Department of Health and Human Services, Public Health Service, ATSDR, Division of Toxicology. 62 pp. + appendices.

Baehr, C. and C. Habig. 2000. Statistical evaluation of the UTAB database for use in terrestrial nontarget organism risk assessment. 10th Symposium on Environmental Toxicology and Risk Assessment. American Society of Testing and Materials. West Conshohocken, PA. 358 pp.

Baker, J. and G. Miller. 1999. Understanding and reducing pesticide losses. Extension Publication PM 1495, Iowa State University Extension. Ames, IA. 6 pp.

Balciunas, J.K. 2000. Proceedings of the X International Symposium on Biological Control of Weeds. Montana State University, Bozeman, MT. 435 pp.

Barry, T. 2004. Characterization of propanil prune foliage residues as related to propanil use patterns in the Sacramento Valley, CA. Proceedings of the International Conference on Pesticide Application for Drift Management. Waikoloa, HI. 15 pp.

Battaglin, W.A., E.M. Thurman, S.J. Kalkhoff, and S.D. Porter. 2003. Herbicides and transformation products in surface waters of the midwestern United States. Journal of the American Water Resources Association (JAWRA) 39(4):743-756.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. Journal of Wildlife Management 58:375-382.

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. BioScience 54:677-688.

BLM (Bureau of Land Management). 2007. Vegetation treatments using herbicides on Bureau of Land Management lands in 17 western states programmatic EIS (PEIS). Washington office, Bureau of Land Management.

Butler, T., W. Martinkovic, and O.N. Nesheim. 1998. Factors influencing pesticide movement to ground water. Extension Publication PI-2, University of Florida Cooperative Extension Service. Gainesville, FL. 4 pp.

Calabrese, E.J. and L.A. Baldwin. 1993. Performing ecological risk assessments. Chelsea, MI: Lewis Publishers.

Center, T.D., J.H. Frank, and F.A., Dray Jr. 1997. Biological control. Pages 245-263 in: Strangers in paradise: impact and management of nonindigenous species in Florida. Washington D.C.: Island Press.

Cox, R.D. and V.J. Anderson. 2004. Increasing native diversity of cheatgrass-dominated rangeland through assisted succession. Journal of Range Management 57:203-210.

Coombs, E.M., J.K Clark, G.L. Piper, and A.F. Cofrancesco Jr. 2004. Biological control of invasive plants in the United States. Corvallis, OR: Oregon State University Press.

Driver, C.J., M.W. Ligotke, P. Van Voris, B.D. McVeety, B.J. Greenspan, and D.B. Brown. 1991. Routes of uptake and their relative contribution to the toxicologic response of northern bobwhite (*Colinus virginianus*) to an organophosphate pesticide. Environmental Toxicology and Chemistry 10:21-33.

Dunning, J.B. 1984. Body weights of 686 species of North American birds. Western Bird Banding Association. Monograph No. 1. West Lafayette, ID.

EPA (U.S. Environmental Protection Agency). 1990. Laboratory test methods of exposure to microbial pest control agents by the respiratory route to nontarget avian species. EPA/600/3-90/070. Environmental Research Laboratory, Corvallis, OR.

EPA. 1998. A comparative analysis of ecological risks from pesticides and their uses: background, methodology and case study. U.S. EPA. Environmental Fate & Effects Division, Office of Pesticide Programs, Washington, D.C. 105 pp.

EPA. 2004. Overview of the ecological risk assessment process in the Office of Pesticide Programs, U.S. EPA. Endangered and threatened species effects determinations. Office of Pesticide Programs, Washington, D.C. 101 pp.

EPA. 2005a. Technical overview of ecological risk assessment. Analysis phase: exposure characterization. U.S. EPA, Office of Pesticide Programs, Washington, D.C. Available at: http://www.epa.gov/oppefed1/ecorisk_ders/toera_analysis_exp.htm. Accessed July 28,2011.

EPA. 2005b. User's guide TREX v1.2.3. U.S. EPA, Office of Pesticide Programs, Washington, D.C. 22 pp. Available at: http://www.epa.gov/oppefed1/models/terrestrial/trex_usersguide.htm. Accessed July 28, 2011.

EXTOXNET (The Extension Toxicology Network). 1993. Movement of pesticides in the environment. Pesticide Information Project of Cooperative Extension Offices of Cornell University, Oregon State University, University of Idaho, University of California – Davis, and the Institute for Environmental Toxicology, Michigan State University. 4 pp.

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kenaga) nomogram, an instrument for estimating pesticide residue on plants. Environmental Toxicology and Chemistry 13:1381-1391.

Hasan, S. and P.G. Ayres. 1990. The control of weeds through fungi: principles and prospects. Tansley Review 23:201-222.

Huddleston, J.H. 1996. How soil properties affect groundwater vulnerability to pesticide contamination. EM 8559. Oregon State University Extension Service. 4 pp.

International Symposium on Biological Control of Weeds. International Code of Best Practice for Classical Biological Control of Weeds. 1999. Available at: http://sric.ucdavis.edu/exotic/exotic.htm.

Kerle, E.A., J.J. Jenkins, P.A. Vogue. 1996. Understanding pesticide persistence and mobility for groundwater and surface water protection. EM 8561. Oregon State University Extension Service. 8 pp.

Masters, R.A and R.L. Sheley. 2001. Invited synthesis paper: principles and practices for managing rangeland invasive plants. Journal of Range Management 54:502-517.

Masters, R.A., S.J. Nissen, R.E. Gaussoin, D.D. Beran, and R.N. Stougaard. 1996. Imidazolinone herbicides improve restoration of Great Plains grasslands. Weed Technology 10:392-403.

Maxwell, B.D., E. Lehnhoff, and L.J. Rew. 2009. The rationale for monitoring invasive plant populations as a crucial step for management. Invasive Plant Science and Management 2:1-9.

Mineau, P., B.T. Collins, and A. Baril. 1996. On the use of scaling factors to improve interspecies extrapolation of acute toxicity in birds. Regulatory Toxicology and Pharmacology 24:24-29.

Moody, M.E. and R.N. Mack. 1988. Controlling the spread of plant invasions: the importance of nascent foci. Journal of Applied Ecology 25:1009-1021.

Mullin, B.H., L.W. Anderson, J.M. DiTomaso, R.E. Eplee, and K.D. Getsinger. 2000. Invasive plant species. Issue Paper (13):1-18.

Oregon State University. 1996. EXTOXNET (Extension Toxicology Network) Pesticide Information Profiles. Oregon State University, Corvallis, OR.

Pfleeger, T.G., A. Fong, R. Hayes, H. Ratsch, C. Wickliff. 1996. Field evaluation of the EPA (Kanaga) nomogram, a method for estimating wildlife exposure to pesticide residues on plants. Environmental Toxicology and Chemistry 15:535-543.

Pope, R., J. DeWitt, and J. Ellerhoff. 1999. Pesticide movement: what farmers need to know. Extension Publication PAT 36, Iowa State University Extension, Ames, Iowa and Iowa Department of Agriculture and Land Stewardship, Des Moines, IA. 6 pp.

Ramsay, C.A., G.C. Craig, and C.B. McConnell. 1995. Clean water for Washington—protecting groundwater from pesticide contamination. Extension Publication EB1644, Washington State University Extension, Pullman, WA. 12 pp.

Spray Drift Task Force. 2003. A summary of chemigation application studies. Spray Drift Task Force, Macon, MO.

Teske, M.E., S.L. Bird, D.M. Esterly, T.B. Curbishley, S.L. Ray, and S.G. Perry. 2002. AgDRIFT: a model for estimating near-field spray drift from aerial applications. Environmental Toxicology and Chemistry 21:659-671.

Urban, D.J and N.J. Cook. 1986. Ecological risk assessment. EPA 540/9-85-001. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington D.C. 94 pp.

USGS (U.S. Geological Survey). 2000. Pesticides in stream sediment and aquatic biota: current understanding of distribution and major influences. USGS Fact Sheet 092-00, U.S. Geological Survey, Sacramento, CA. 4 pp.

U.S. Forest Service. 2005. Pacific Northwest Region invasive plant program: preventing and managing invasive plants. Final environmental impact statement. 359 pp.

Wauchope, R.D., T.M. Buttler, A.G. Hornsby, P.M. Augustijn-Beckers, and J.P. Burt. 1992. The SCS/ARS/CES pesticide properties database for environmental decision making. Reviews of Environmental Contamination and Toxicology 123:1-155.

Woods, N. 2004. Australian developments in spray drift management. Proceedings of the International Conference on Pesticide Application for Drift Management. Waikoloa, HI. 8 pp.

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Turkey vultures
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Appendix H
Glossary of Terms and Acronyms

H.1 Glossary

303(d) – A section of the Clean Water Act that required states, territories, and authorized tribes to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes.

4th level HUC – The fourth level of classification is the cataloging unit, the smallest element in the hierarchy of hydrologic units.

Adaptive Management – The rigorous application of management, research, and monitoring to gain the information and experience necessary to assess and modify management activities. It refers to a process that uses feedback from refuge research and monitoring, and evaluation of management actions to support or modify objectives and strategies at all planning levels (602 FW 1.4).

Adjudicated water right – An adjudication is an administrative or judicial determination of all rights to use water in a particular stream system or watershed, to establish the priority, point of diversion, place and nature of use and the quantity of water used among the various claimants. These stream or watershed adjudications can be initiated by a water user (including the United States) or by the State. The United States may be joined in an adjudication if the requirements of the McCarran Amendment are met.

Aerenchyma – Modified parenchymatous tissue having large intracellular air spaces that is found especially in aquatic plants where it facilitates gaseous exchange and maintains buoyancy.

Alternative – Different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues (602 FW 1.6). The “no action” alternative is current refuge management, while the “action” alternatives are all other alternatives.

Alluvial – Made up of or found in the materials that are left by the waters of rivers, floods, etc.

Appropriate Use – A proposed or existing use on a refuge that meets at least one of the following four conditions:

(1) The use is a wildlife-dependent recreational use as identified in the Improvement Act.
(2) The use contributes to fulfilling the refuge purpose(s), the Refuge System mission or goals, or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
(3) The use involves the take of fish and wildlife under State regulations.
(4) The use has been found to be appropriate as specified in Section 1.11 of the U.S. Fish and Wildlife Service (USFWS) Appropriate Use Policy (603 FW 1).

Approved Acquisition Boundary – National Wildlife Refuge boundary approved by the National or Regional Fish and Wildlife Service Director for potential acquisition of lands by the Service.

Approved Refuge Boundary – A National Wildlife Refuge boundary approved by the National or Regional Fish and Wildlife Service Director. Within this boundary, the Service may negotiate with landowners to acquire lands not already owned by the Service.

Benthic – The collection of organisms living on or in sea or lake bottoms.

Big Six – Wildlife-dependent recreational uses under Refuge System Improvement Act. This includes hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

Biological Diversity (also Biodiversity) – The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur (601 FW 3). The Refuge System's focus is on indigenous species, biotic communities, and ecological processes.

Biological Integrity – Biotic composition, structure, and functioning at the genetic, organism, and community levels comparable with historical conditions, including the natural biological processes that shape genomes, organisms, and communities (601 FW 3).

Colluvium – Soil and debris that accumulate at the base of a slope by mass wasting or sheet erosion. It generally includes angular fragments, not sorted according to size, and may contain slabs of bedrock that dip back toward the slope, indicating both their place of origin and that slumping was the process of transportation. At the edges of valleys, colluvium may be interfingered with and almost indistinguishable from alluvium.

Compatibility Determination – A written determination signed and dated by the refuge manager and regional chief signifying that a proposed or existing use of a National Wildlife Refuge is or is not a compatible use. The director makes this delegation through the Regional Direction (603 FW 2).

Compatible Use – A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the director, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge (603 FW 3.6). A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

Conservation Targets (also see Resources of Concern; Priority Species; Species Groups; and Communities) – This is the term used by land management agencies and conservation organizations to describe the resources (ecological systems, ecological communities, species, species groups, or other natural resources) selected as the focus of conservation actions.

Consumptive Use – Recreational activities, such as hunting and fishing that involve harvest or removal of wildlife or fish, generally to be used as food by humans.

Consumptive Use Rate – Consumptive use rate represents the difference between the amount of water diverted and the amount of the return flow to the system (e.g., surface stream or underground basin). It is that amount by which the total resource is depleted.

Cover – The estimated percent of an area, projected onto a horizontal surface, that is occupied by a particular plant species.

Decadent – Undergoing a process of decline or decay.

Dissolved Oxygen – The concentration of oxygen dissolved in water, expressed in mg/L or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature.

Duripan – A horizon in mineral soil characterized by cementation by silica.

Ecotourism – Tourism that is designed to contribute to the protection of the environment or at least minimize damage to it, often involving travel to areas of natural interest in developing countries or participation in environmental projects.

Effect (impact) – A direct result of an action that occurs at the same time and place; or an indirect result of an action that occurs earlier in time or in a different place and is reasonably foreseeable; or the cumulative results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 Code of Federal Regulations (CFR) 1508.8).

Emergent – Erect plants rooted underwater that grow above (emerge from) the surface of the water (e.g., cattails).

Emissions Scenarios – Climate change term that is group into four categories of cumulative CO_2 emissions (all sources) between 1990 and 2100: low, medium low, medium high, and high emissions. Each category contains situations with a range of different driving forces yet similar cumulative emissions.

Eolian – Borne, deposited, produced, or eroded by the wind.

Exotic – From another part of the world; foreign.

Fecundity – The quality or power of producing abundantly; fruitfulness or fertility.

Flood Irrigation – A method of irrigation using water released into a field and allowed to flood over its entire surface.

Fluvial – Of or pertaining to a river.

Focal Species (also Priority Resources of Concern or Focal Conservation Target) – A suite of conservation targets that, for the purposes of planning, are sorted and condensed to represent threats to biological integrity, diversity, and environmental health at the refuge level.

Goal – Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (620 FW 1.6).

Greenhouse effect – The greenhouse effect refers to circumstances where the short wavelengths of visible light from the sun pass through a transparent medium and are absorbed, but the longer wavelengths of the infrared re-radiation from the heated objects are unable to pass through that medium. The trapping of the long wavelength radiation leads to more heating and a higher resultant temperature.

Habitat Management Plan – A plan that provides refuge managers a decision-making process; guidance for the management of refuge habitat; and long-term vision, continuity, and consistency for habitat management on refuge lands (620 FW 1.4).

Habitat Restoration – Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

Historical Conditions – Composition, structure, and functioning of ecosystems resulting from natural processes that are believed, based on sound professional judgment, to have been present prior to substantial human-related changes to the landscape (601 FW 3).

Idle – Not working or active; in the context of the Malheur Refuge comprehensive conservation plan (CCP), fields that are not receiving grazing or haying treatment in the current year.

Important Bird Areas – A site, designated by the National Audubon Society, that provides essential habitat for one or more species of birds and that is recognized as being important on a global, continental, or state level.

Integrated Pest Management (IPM) – The use of pest and environmental information in conjunction with available pest control technologies to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to persons, property, and the environment.

Interpretation – A teaching technique that combines factual information with stimulating explanation. Frequently used to help people understand natural and cultural resources.

Inundation – To cover with water, especially floodwaters.

Invasive – Marked by the tendency to spread. As applied to plant or animal species, *invasive* connotes a species (often but not always non-native) that rapidly takes over a habitat or area, often crowding out other species and reducing diversity and ecosystem health.

Inviolate Sanctuary – The original intent of the term *inviolate sanctuary* is found in the Migratory Bird Conservation Act (first passed in 1918 as the Migratory Bird Treaty Act and amended in 1934 and 1938). This Act originally required that all refuges be inviolate sanctuaries and deemed that refuges' primary purposes were as breeding grounds and habitat for migratory birds. Migratory bird hunting was prohibited in migratory waterfowl areas by the Act, but most other human uses were not addressed. The 1938 amendment to the Act gave refuge managers authority to decide if, when, and how bird hunting would be allowed. After World War II, public demand for opening refuges to recreation increased. The 1949 Duck Stamp Act allowed waterfowl hunting on refuges, but restricted the percentage of each refuge open to hunting. Current policy states that portions of a refuge are considered "inviolate sanctuaries" if they were (a) acquired with the approval of the Migratory Bird Conservation Commission (MBCC) for the purpose of an inviolate sanctuary; (b) acquired with MBCC approval or Land and Water Conservation Funds to protect a threatened or endangered species; or (c) established by an instrument or document that states the intent to manage the area as an "inviolate sanctuary for migratory birds" or to fulfill the purpose of the Migratory Bird Conservation Act. Policy further allows migratory game bird hunting on no more than 40 percent of the area considered inviolate sanctuary if it is compatible with a refuge's purposes and mission. Inviolate sanctuary classification imposes no limits on hunting non-migratory birds, fur bearers, or other game species.

Lacustrine – Of or relating to a lake.

Lithology – The study of the general physical characteristics of rocks.

Lunette dune – Accumulations of semiconsolidated fine sand, silt, and clay-pellet aggregates that form rounded, low (meters high) dunes on the downwind sides of playas.

Macrophyte – A plant that is large enough to be visible to the naked eye. A macrophyte may be an emergent, submergent, or floating type of aquatic plant. Its ecological significance is providing cover for fish and acting as substrate for aquatic invertebrates, as well as producing oxygen and serving as food for some fish and other wildlife.

Meristematic tissue – Embryonic tissue located at the tips of stems and roots and occasionally along their entire length; can divide to produce new cells; one of the four main tissue systems in plants.

Mesic – Characterized by, relating to, or requiring a moderate amount of moisture.

Migratory birds – Those species of birds listed under 50 CFR 10.13 (as defined by various treaties) (720 FW 1).

Monotypic – The sole member of a group, such as a single species that constitutes a genus.

National Register of Historic Places – The nation's master inventory of known historic properties administered by the National Park Service. Includes buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archeological, or cultural significance at the national, state, and local levels.

National Wildlife Refuge – A designated area of land, water, or an interest in land or water within the Refuge System, excluding coordination areas (601 FW 1.3).

National Wildlife Refuge System – Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management areas; or waterfowl production areas.

National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) – A federal law that amended and updated the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668).

Native – With respect to a particular ecosystem, a species that historically occurred or currently occurs (other than as a result of an introduction) in that ecosystem (601 FW 3).

Non-consumptive Recreation – Recreational activities that do not involve harvest, removal, or consumption of fish, wildlife, or other natural resources.

Non-native species – A species that is present in the planning area but was not known to exist prior to Euro-American settlement of the Americas.

Novel community – Made up of either native and non-native species or native species outside historical spatial distributions.

Noxious Weed – A plant species designated by Federal or state law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insect or disease; or non-native, new, or not common to the United States. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has adverse effects on man or his environment and is therefore detrimental to the agriculture and commerce of the United States and to the public health.

Objective – A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Objectives should be attainable, time-specific, and measurable (620 FW 1.6).

Outcropping – A portion of bedrock or other stratum protruding through the soil level.

Pacific Decadal Oscillation (PDO) – Described as a long-lived El Niño-like pattern of Pacific climate variability. As seen with the better-known El Niño/Southern Oscillation (ENSO), extremes in the PDO pattern are marked by widespread variations in the Pacific Basin and the North American climate.

Pacific Flyway – One of several major north-south travel corridors for migratory birds. The Pacific Flyway is west of the Rocky Mountains.

Paleontological – The study of the forms of life existing in prehistoric or geologic times, as represented by the fossils of plants, animals, and other organisms.

Palustrine – Relating to a system of inland, nontidal wetlands characterized by the presence of trees, shrubs, and emergent vegetation (vegetation that is rooted below water but grows above the surface).

Pedogenic – The formation and development of soil.

Phreatophyte – A deep-rooted plant that obtains water from a permanent ground supply or from the water table.

Physiographic Province – A region in which the landforms are similar in geologic structure and differ significantly from the landform patterns in adjacent regions.

Phytoplankton – Photosynthetic or plant constituent of plankton; mainly unicellular algae.

Piezometric – Of or relating to pressure.

Plant Community – An assemblage of plant species unique in its composition, occurring in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community (e.g., Oregon white oak woodland).

Playa – Enclosed shallow depressions in desert basins, tectonic lows, interdune flats, wadis, and abandoned channels that contain deposits and evaporate from the impoundment of episodic stream flow or near-surface groundwater.

Priority Public Uses – Hunting, fishing, wildlife observation and photography, and environmental education and interpretation, where compatible, are identified under the National Wildlife Refuge System Improvement Act of 1997 as the six priority public uses of the National Wildlife Refuge System.

Priority Resources of Concern – See *Resources of Concern* and *Focal Species* definitions.

Proving up (on water rights) – The state process of meeting all the conditions placed on water right permits.

Rake-bunch grazing – A form of treatment where meadow hay is mowed and raked into windrows, but left in place to be consumed by livestock during the late fall and winter.

Refuge Purpose(s) – The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit. For refuges that encompass congressionally designated wilderness, the purposes of the Wilderness Act are additional purposes of the refuge (620 FW 1.6).

Residuum – Something remaining after removal of a part; a residue.

Resource of Concern (ROC) – This refers to all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), the Refuge System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are ROCs on a refuge whose purpose is to protect "migrating waterfowl and shorebirds." Federal or state threatened and endangered species on that same refuge are also an ROC under terms of the respective endangered species acts (620 FW 1.4).

Rested – Allowed to be inactive in order to regain strength, health, or energy.

Riverine – Relating to or resembling a river. Located on or inhabiting the banks of a river; riparian.

Scoping – Early in the planning process, this is the phase of notifying the public of the opportunity to participate in the planning process to help identify issues, concerns, and opportunities related to the project.

Seasonal Moisture Deficit – The difference between the amount of water that is in a soil and the amount needed for crops to grow successfully.

Seasonal Wetlands – Areas that are periodically inundated or have soils saturated to the surface at some time during the growing season (but not year-round).

Senescent – Growing old; aging. As applied to plants, when they are in a dormant phase (often during winter).

Sen-Theil-Kendall Line – A type of statistical analysis for water resources.

Significant Effect – Use of this term in the National Environmental Policy Act (NEPA) requires consideration of both context and intensity (40 CFR 1508.27). The significance of an action must be analyzed in its current and proposed short- and long-term effects on the whole of a given resource (e.g., affected region) (context). Intensity is the severity of the effect.

SLR Line – A simple linear regression line.

Snow Water Equivalents – A common snowpack measurement. It is the amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if the entire snowpack were melted instantaneously.

Species of Concern (Federal) – Taxa whose conservation status is of concern to the USFWS (many previously known as Category 2 candidates), but for which further information is still needed. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing.

Steppe – Arid land with xerophilous vegetation, found usually in regions of extreme temperature range and loess soil.

Strategy – A specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives (620 FW 1.6).

Subirrigated – To irrigate (land) by means of an underground system of pipelines or by natural moisture in the subsoil.

Submergent – A plant that is completely beneath the surface of water.

Successional – The gradual and orderly process of ecosystem development brought about by changes in community composition and the production of a climax characteristic of a particular geographic region.

Telemetry – The science and technology of automatic measurement and transmission of data by wire, radio, or other means from remote sources, such as from space vehicles, to receiving stations for recording and analysis.

THEIL – A nonparametric statistical test that can be used instead of regression-based methods for discerning a monotonic trend.

TMDL (total maximum daily load) – A calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

Tolerance thresholds – The maximum amount of disturbance a suite of plant species can tolerate before an irreparable shift in plant community composition takes place.

Transpiration – The passage of water through a plant from the roots through the vascular system to the atmosphere.

Tuff – A rock composed of the finer kinds of volcanic detritus usually fused together by heat.

Wetlands – Wetlands are lands transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface or the land is covered by shallow water at some time during the growing season of each year (660 FW 2).

Wildlife-dependent Recreational Use – A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation. These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. The Service will also consider these other uses in the preparation of refuge CCPs; however, the six priority public uses always will take precedence (620 FW 1.6).

H.2 Acronyms

Act	National Wildlife Refuge System Improvement Act of 1997 (also Improvement Act or NWRSIA)
ADA	Americans with Disabilities Act
AM	Adaptive Management
ARPA	Archaeological Resources Protection Act
AUD	Appropriate Use Determination
BCR	Bird Conservation Region
BIDEH	Biological Integrity, Diversity, and Environmental Health
BLM	Bureau of Land Management
BMP	Best Management Practice
CCC	Civilian Conservation Corps
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
C.F.R.	Code of Federal Regulations
cfs	Cubic Feet per Second
CIG	Climate Information Group at the University of Washington
COA	Conservation Opportunity Area
CPR	Center Patrol Road
DDT	Dichlorodiphenyltrichloroethane
DPS	Distinct Population Segment
EE	Environmental Education
EIS	Environmental Impact Statement
EMS	Environmental Management System
ENSO	El Niño/Southern Oscillation
EOLC	Eastern Oregon Livestock Company
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
HACCP	Hazard Analysis and Critical Control Points Planning
HCHS	Harney County Historical Society Museum
HCWC	Harney County Watershed Council
HUC	Hydrologic Unit Code
I&M	Inventory and Monitoring
IBA	Important Bird Area
Improvement Act	National Wildlife Refuge System Improvement Act (P.L. 105-57)
IPM	Integrated Pest Management
IPCC	Intergovernmental Panel on Climate Change
LCC	Landscape Conservation Cooperative
LEIS	Legislative Environmental Impact Statement
MBCC	Migratory Bird Conservation Commission
MPH	Miles Per Hour
msl	Mean Sea Level
NAGPRA	Native American Graves Protection and Repatriation Act
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service

NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System or the Refuge System
NWS	National Weather Service
OCS	Oregon Conservation Strategy
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
O-M pcp	October-March Precipitation
OPDR	Oregon Parks and Recreation Department
OWRD	Oregon Water Resources Department
PCB	Polychlorinated Biphenyl
PDO	Pacific Decadal Oscillation
PIF	Partners in Flight
P.L.	Public Law
PLO	Public Land Order
PPM	Parts Per Million
PRISM	Parameter-elevation Regressions on Independent Slopes Model
PRPA	Paleontological Resources Preservation Act
PUP	Pesticide Use Proposal
RAPP	Refuge Annual Performance Plan
Refuge Administration Act	National Wildlife Refuge System Administration Act of 1966 as amended (16 U.S.C. 668dd-668ee)
Refuge System	National Wildlife Refuge System or NWRS
RNA	Research Natural Areas
ROC	Resource of Concern
SCORP	Oregon Statewide Comprehensive Outdoor Recreation Plan
Service	United States Fish and Wildlife Service or USFWS
SLR	Sea Level Rise
SNOTEL	Snowpack Telemetry (designed to collect snowpack and related climatic data in the Western United States and Alaska)
STM	State and Transition Model
SWE	Snow Water Equivalent
TLDEIS	Transmission Line Project Draft Environmental Impact Statement
TMDL	Total Maximum Daily Load
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	United States Fish and Wildlife Service or the Service
USGS	United States Geological Survey
USHCN	United States Historical Climatology Network
WSA	Wilderness Study Areas
YCC	Youth Conservation Corp

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Ross' geese landing
at Malhuer NWR
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Appendix I
Contributors

Table I-1. Core Planning Team

Name	Title	Organization
Linda Beck	Fish Biologist, Malheur Refuge	U.S. Fish and Wildlife Service (USFWS)
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Carey Goss	Visitor Services Manager, Malheur Refuge	USFWS
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John Megan	Law Enforcement Officer, Malheur Refuge	USFWS
Sharon Selvaggio	Planner, Division of Planning and Visitor Services, Region 1	USFWS
Jess Wenick	Ecologist, Malheur Refuge	USFWS

Table I-2. Collaborative Participants and Reviewers

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Jenny Barnett	Zone I&M Biologist	USFWS
Christine Bates	Burns District Office, Fish & Wildlife Biologist	Bureau of Land Management (BLM)
Jessica Boone	Former Director	Harney County Chamber of Commerce
Brad Bortner	Chief, Division of Migratory Birds and Habitat Programs, Region 1	USFWS

Name	Title	Organization
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Name	Title	Organization
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Keegan Heron	Volunteer	USFWS
Orritt Hoffman	P Ranch Substation Manager, Malheur Refuge	USFWS
Jen Hoke	Director	Harney County Chamber of Commerce
Jeff Holm	Refuge Program Specialist	USFWS
Charles Houghton	Division Chief of Planning and Visitor Services, Region 1	USFWS
Matt Howe	Visual Information Specialist	USFWS
Mark Howell	NRCS Wildlife Biologist	USGS
Shannon Hurn	District Fish Biologist	ODFW
Gary Ivey	President MWA, Subject Matter Expert	MWA
Dick Jenkins	Neighboring Land Owner	Jenkins Ranch, Round Barn VC
Dustin Johnson	Extension, Harney County	OSU
Jay Kerby	Southeast Oregon Project Manager	The Nature Conservancy
Kevin Kilbride	Regional Refuge Biologist	USFWS
Rodney Klus	District Wildlife Biologist	ODFW
Esther Lev	Director	Wetlands Conservancy
Matt Little	Conservation Director	Oregon Natural Desert Association (ONDA)
Sam Lohr	Fish Biologist	USFWS
Don Lyons	Postdoctoral Research Associate	Oregon Cooperative Fish & Wildlife Research Unit
Erica Maltz	Fisheries Program Manager	Burns Paiute Tribe
Gary Marshall	Private Land Manager	Broken Circle Ranch
Tara Martinak	Public Affairs Specialist	BLM
Mike Marxen	Branch Chief, Division of Planning and Visitor Services, Region 1	USFWS

Name	Title	Organization
Alan Mauer	Fish & Wildlife Biologist	USFWS
Tim Mayer	Water Resource Division, Region 1	USFWS
Scott McCarthy	Branch Chief of Refuge Planning, Region 1	USFWS
Lila Messnick	Director	MFS
Bill Modey	Double-O Substation Manager, Malheur Refuge	USFWS
Karen Moon	Director	Harney County Watershed Council
Danny Morris	Maintenance Supervisor	USFWS
Maren Murphy	Recreation Planning Assistant	Americorps/USFWS
Dan Nichols	Private Land Owner	Harney County Court
Matt Obradovich	Biologist	BLM
Julia Olsen	Former Director	Harney County Chamber of Commerce
Dan Otley	Private Land Owner	Rancher
Virginia Parks	Regional Refuge Archaeologist	USFWS
Clay Pierce	Assistant Unit Leader, Fisheries	Iowa Cooperative Fish and Wildlife Research Unit
Anan Raymond	Regional Cultural Resources Manager	USFWS
Andy Renc	Buena Vista Substation Manager, Malheur Refuge	USFWS
Robert Renchler	Realty Specialist	BLM
William Renwick	MWA Board Member	High Desert Partnership/MWA
Shannon Richardson	Fish Biologist	USFWS
Steve Robertson	Education Director	Audubon Society of Portland
Dan Roby	Associate Professor Fisheries & Wildlife	OSU
Chris Rombough	Herpetologist	Private Contractor
Pete Runnels	County Commissioner	Harney County Court/Business Owner
Zola Ryan	District Conservationist	Natural Resources Conservation Service
Bob Sallinger	Conservation Director	Audubon Society of Portland
Rudy Schuster	Branch Chief of Policy Analysis and Science Assistant	USGS

Name	Title	Organization
Mike Shannon	Regional Biologist	Ducks Unlimited
Steve Shunk	Naturalist	Paradise Birding
Angela Sitz	Ecological Services Office Assistant	USFWS
Peter Sorensen	Professor	University of Minnesota
Al Smith	Mussel Biologist	Retired - ODFW
Erin Stockenberg	Geographic Information Specialist	USFWS
Martin St. Louis	Summer Lake Wildlife Area Manager	ODFW
Marty Suter	District Manager	Harney County Soil and Water Conservation District
Tony Svejcar	Research Leader	ARS
Bruce Taylor	Oregon Biodiversity Program Director, Executive Director	Oregon Defenders of Wildlife, Oregon Habitat Joint Venture
Rick Thein	Subject Matter Expert	Private Citizen
Rick Vetter	Fish Biologist	US Forest Service
Lacey Wall	Planning Assistant	USFWS
Tim Walters	Former District Fish Biologist	ODFW
Julie Weikel	Board Member	ONDA
Robin West	Refuge Supervisor	USFWS

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Northern pintail
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Appendix J
Public Involvement

Public involvement was sought throughout the development of the comprehensive conservation plan (CCP). A collaborative process was defined as a goal early in the planning process and was an integral aspect of the planning process. Public involvement strategies included face-to-face meetings with community organizations, local, State, and Federal agencies, elected officials (or their aides), tribal governments, and Refuge users. The planning team also held open houses, conducted listening posts, provided newsletters, and gave presentations to inform the public, invite discussion, and solicit feedback. The Refuge maintained a website where CCP information could be found and where the public could print out comment forms or submit emails during the scoping phase. Below is a brief summary of the events, meetings, and outreach tools that were used in our scoping public involvement efforts.

Meetings with Congressional Representatives and/or their Aides

- July 2009. Met with U.S. Representative Greg Walden's aide Colby Marshall, Burns, OR
- October 2010. Met with U.S. Representative Greg Walden's aide Nick Strader, Bend, OR
- October 2010. Met with U.S. Senator Ron Wyden's aide Wayne Kennedy, Bend, OR
- October 2010. Met with U.S. Senator Jeff Merkley's aide, Bend, OR
- February 2011. Met with U.S. Senator Jeff Merkley's aide Elizabeth Scheeler, Pendleton, OR
- September 2011. Met with U.S. Representative Greg Walden's aide Nick Strader, Bend, OR

Meetings with Tribes

- April 2009. Met with Burns Paiute staff, Burns, OR
- November 2009. Open house at Burns Paiute Tribe Gathering Center, Burns, OR
- June 2010. Meet with Burns Paiute Tribe at council meeting, Burns, OR
- April 2012. Met with Burns Paiute Tribe at council meeting, Burns, OR

Meetings with Elected Officials

- February 2009. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- April 2009. Met with Harney County Court (County Commissioners), Burns, OR
- July 2009. Met with Steve Grasty, Harney County Court (County Commissioners), Burns, OR
- January 2010. Met with Harney County Court (County Commissioners), Burns, OR
- August 2010. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- September 2010. Met with Harney County Court (County Commissioners), Burns, OR
- January 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- February 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- March 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- May 2011. Met with Steve Grasty, Harney County Court (County Commissioners), Burns, OR

- May 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR

Meetings with Community/Business Organizations

- April 2009. Met with the board of the High Desert Partnership, Burns, OR
- August 2009. Met with Lions Club, Burns OR
- October 2009. Met with Burns/Hines Kiwanis Club, Burns, OR
- October 2009. Met with various merchants, Burns, OR
- October 2009. Met with the board of Portland Audubon Society, Portland, OR
- October 2009. Met with Harney County Chamber of Commerce.
- October 2009. Met with Harney County Historical Society, Burns OR
- November 2009. Met with Harney County Stockgrowers, Burns, OR
- December 2009. Met with Harney County Farm Bureau, Burns, OR
- January 2010. Met with Lions Club, Burns, OR
- January 2010. Met with Ducks Unlimited, Burns, OR
- April 2010. Met with the Oregon Natural Desert Association, Burns, OR
- May 2010. Met with Malheur Wildlife Associates, Frenchglen, OR
- June 2010. Met with Central Oregon Flyfishers, Princeton, OR
- June 2010. Met with Oregon Natural Desert Association, Bend, OR
- August 2010. Met with Oregon Natural Desert Association, Bend, OR
- August 2010. Met with Bureau of Land Management (BLM) Steens Mountain Advisory Council, Burns, OR
- September 2010. Met with East Cascades Audubon Chapter, Bend, OR
- September 2010. Met with Ducks Unlimited and Defenders of Wildlife, Burns, OR
- September 2010. Met with Oregon Natural Desert Association, Burns, OR
- October 2010. Met with Oregon Natural Desert Association, Burns, OR
- October 2010. Met with Portland Audubon Society, Burns, OR
- January 2011. Met with Ducks Unlimited, Burns, OR
- January 2011. Met with Oregon Natural Desert Association, Burns, OR
- January 2011. Met with Defenders of Wildlife, Burns, OR
- February 2011. Met with Lions Club, Ontario, OR
- February 2011. Met with High Desert Partnership, Burns, OR
- March 2011. Met with Harney County Soil and Water Conservation District (HCSWCD), Burns Oregon
- May 2011. Met with Ducks Unlimited, Vancouver, WA
- May 2011. Met with Ducks Unlimited, Princeton, OR
- May 2011. Met with Oregon Natural Desert Association, Burns, OR
- June 2011. Met with Ducks Unlimited, Burns, OR

Meetings with Collaborators

- May 2009. Met with collaborators, Prineville, OR
- October 2009. Met with collaborators, Prineville, OR
- May 2010. Met with collaborators, Harney County Chamber of Commerce, Burns, OR
- June 2010. Met with collaborators, Harney County Chamber of Commerce, Burns, OR

- September 2010. Met with collaborators, Harney County Chamber of Commerce, Burns, OR
- January 2011. Met with collaborators, Agriculture Research Station, Burns, OR
- March 2011. Met with collaborators, Senior Citizen Center, Burns, OR
- April 2011. Met with collaborators, High Desert Partnership, Burns, OR
- May 2011. Met with collaborators, U.S. Forest Service (USFS) Office, Prineville, OR
- September 2011. Met with collaborators and High Desert Partnership about Harney Basin Wetlands Initiative, Harney County Chamber of Commerce, Burns, OR
- October 2011. Met with collaborators, Harney County Chamber of Commerce, Burns, OR

Meetings with Agencies and Academia

- January 2009. Met with Oregon Department of Fish and Wildlife (ODFW) staff, Burns, OR
- February 2009. Met with Harney County Soil and Water Conservation District, Burns, OR
- March 2009. Met with Oregon Natural Desert Association, Bend, OR
- April 2009. Met with Agricultural Research Service staff, Burns OR.
- October 2009. Met with various Oregon State University (OSU) professors and students from wildlife department (34), Corvallis, OR
- October 2009. Met with Harney County school educators in Burns and Crane OR
- October 2009. Met with U.S. Geological Survey (USGS) staff, Forest and Range Resources Center, Corvallis, OR
- January 2010. Met with University of Minnesota Staff, St. Paul, MN
- January 2010. Met with Iowa State University Staff, Ames, IA
- February 2010. Conference call with USGS staff, Forest and Range Resources Center, and OSU Co-Op, Corvallis, OR
- March 2010. Met with USFS Staff, Burns, OR
- March 2010. Met with Harney County Soil and Water Conservation District, Burns, OR
- April 2010. Conference call with USGS staff and Forest and Range Resources Center, Corvallis, OR
- April 2010. Conference call with Aquatic Health Funding and Partnership Work Group
- April 2010. Conference call with Aquatic Health Carp Control Work Group
- April 2010. Presented at NWR-CRFPO 2010 Workshop, Vancouver, WA
- April 2010. Met with Harney County Soil and Water Conservation District, Burns, OR
- May 2010. Conference call with Fish Carcass Users Group
- May 2010. Met with U.S. Army Corp of Engineers, Princeton, OR
- June 2010. Conference call with Aquatic Health Assessment Work Group
- June 2010. Met with Genie Monteblanc, Science Delivery Project Coordinator, Princeton, OR
- July 2010. Met with David Dobkin and Lewis & Clark College students, Princeton, OR
- September 2010. Met with ODFW, BLM, and Aquatic Health Group Chair, Burns, OR
- September 2010. Conference call with Aquatic Health Funding and Partnership Work Group
- October 2010. Met with University of Minnesota staff, Princeton, OR
- October 2010. Met with Central Utah Water Conservancy District, Orem, UT
- October 2010. Met with ODFW, Burns, OR
- November 2010. Met with ODFW, Burns, OR
- December 2010. Met with ODFW, Burns, OR

- January 2011. Met with ODFW Directorate, Tualatin National Wildlife Refuge (NWR), Tualatin, OR
- January 2011. Met with DU, Burns, OR
- January 2011. Met with ODFW, BLM, HCSWCD, HCWSC, FS, Oregon Natural Desert Association, DU, The Nature Conservancy, BPT, USGS, OSU, HDP, Defenders of Wildlife for NAWCA Funding, BLM District Office, Burns, OR
- February 2011. Met with OSU and USGS scientists, Corvallis, OR
- February 2011. Met with American Fisheries Society, Bend, OR
- March 2011. Met with ODFW, BLM, HCSWCD, HCWSC, FS, Oregon Natural Desert Association, DU, The Nature Conservancy, BPT, USGS, HDP, Defenders of Wildlife for NAWCA Funding, BLM District Office, Burns, OR
- April 2011. Met with ODFW, Burns Office.
- May 2011. Met U.S. Fish and Wildlife Service Regional Office for Brown Bag carp presentation, Portland, OR
- May 2011. Met with fisheries professionals, Vancouver, WA
- June 2011. Met with HCSWD, Natural Resource Conservation Society (NRCS), and ODFW, Burns, OR
- June 2011. Met with Bill Renwick, Burns, OR

Ecology Work Group

- January 2010. Teleconference with Tony Svejcar (Agricultural Research Service), Esther Lev (Wetlands Conservancy), John Christy (Oregon Natural Heritage Program), and Mike Shannon (Ducks Unlimited), Burns, OR
- July 2010. Teleconference with Tony Svejcar, Esther Lev, John Christy, and Gary Ivey (independent wildlife biologist), Burns, OR
- May 2011. Telephone discussions with core group (see January 2010 attendees) regarding May 2011 update
- September 2011. Telephone discussions with core group (see January 2010 attendees) regarding September 2011 update
- October 2011. Refuge field trip and inventory and monitoring planning by core group. Princeton, OR

Public Open Houses/Scoping Sessions

- February 2008. Presentation and public open houses for CCP scoping afternoon and evening sessions. Salem, OR
- February 2008. Presentation and public open houses for CCP scoping afternoon and evening sessions. Corvallis, OR
- September 2009. Presentation and public open house, Harney County Chamber of Commerce, Burns, OR
- October 2009. Presentation and public open house, Central Oregon Environmental Center, Bend, OR
- October 2009. Presentation and public open house, Doubletree Hotel-Lloyd Center, Portland, OR
- October 2009. Presentation and public open house, Golden Eagle Audubon Society, Boise, ID

Listening Posts/Displays

- September 2009. Held at Harney County Fair, Burns, OR
- September 2009. Held at Harney County Library, Burns, OR
- September 2009. Held at Harney County Senior Citizens Center, Burns, OR
- September 2009. Held at Harney County Chapter of the Oregon Hunters Association, Burns, OR
- September 2009. Held at The Narrows Restaurant, Princeton, OR
- September 2009. Held at Round Barn Visitor Center, Diamond, OR
- September 2009. Held at Lane County Audubon Society, Eugene, OR
- September 2009. Held at Harney County Chamber of Commerce, Burns, OR
- September 2009. Held at Frenchglen Hotel, Frenchglen, OR
- September 2009. Held at Harney County Courthouse, Burns, OR
- October 2009. Held at Thriftway Grocery Store, Hines, OR
- October 2009. Held at Central Oregon Environmental Center, Bend, OR
- October 2009. Held at Crane High School, Crane, OR
- October 2009. Held at Portland Audubon Society, Portland, OR
- October 2009. Held at Corvallis Audubon Society, Corvallis, OR
- March 2010. Redmond Sports Show, Redmond, OR
- August 2010. Harney County Library Foundation, Burns, OR
- August 2010. Invasive Carp Awareness Day, Princeton, OR

Meetings with Individuals

- February 2009. Met with Gary Marshall, Refuge permit holder, Princeton, OR
- March 2009. Met with Dick Jenkins, local rancher, Diamond, OR
- July 2009. Met with John and Laurie O'Connor, former Refuge employees, Burns, OR
- July 2009. Met with Dick Jenkins, owner of Round Barn Interpretive Center, longtime resident, current Refuge haying/grazing permit holder, Diamond, OR
- July 2009. Met with John and Cindy Witzel, lifelong residents of Frenchglen, descendents of former Refuge haying/grazing permit holder, Frenchglen, OR
- July 2009. Met with Malena Koenik, Frenchglen General Store owner, Frenchglen, OR
- July 2009. Met with Steve, Dwight, and Susie Hammond, neighboring landowners and former permit holders, Frenchglen, OR
- July 2009. Met with Guy Sheeter, retired school teacher and hunter, Burns, OR
- July 2009. Met with Joe Hendry, retired BLM biologist, Burns, OR
- September 2009. Met with Stacy Davies, local rancher, Catlow Valley, OR
- September 2009. Met with Tom Downs, former Refuge employee, Fields, OR
- October-November 2009. Met with several Refuge permit holders (G. Marshall, G. Miller, Tyler family, R. Dunbar, Buck Taylor, and Don Opie), rural Harney County, OR
- November 2009. Met with Mark and Susan Doverspike, ranchers, rural Harney County, OR
- March 2010. Met with Bill Renwick, community activist, Burns, OR
- March 2010. Met with Gary Marshall, Refuge permit holder, Princeton, OR
- August 2010. Met with Gary Marshall, Refuge permit holder, Princeton, OR
- October 2010. Met with past Refuge managers, Princeton, OR
- January 2011. Met with Tom Downs, former Refuge employee, Fields, OR

- February 2011. Met with past Refuge biologists, Princeton, OR
- March 2011. Met with Bill Renwick, Burns, OR
- March 2011. Met with Dan Otley, Diamond, OR
- March 2011. Met with Dick Jenkins, Diamond, OR
- May 2011. Met with Nancy Fine, *Ruralite* writer, Burns, OR
- May 2011. Met with Gary Marshall, Refuge permit holder, Burns, OR
- June 2011. Met with Wayne Baron, entrepreneur, Burns, OR

Workshops/Field Reviews

- June 2009. Conducted a Wildlife and Habitat Program Review with approximately 40 participants, Princeton, OR
- July 2009. Conducted a Visitor Services Program Review with approximately 40 participants, Princeton, OR
- October 20, 2009. Conducted a Priority Resources of Concern workshop with approximately 40 participants, Prineville, OR
- March 2010. Conducted an Invasive Carp workshop with 64 participants, Burns, OR
- January 2011. Presented Aquatic Health and Habitat CCP goals, objectives, and progress made to Science in the Service meeting, Stevenson, WA

Press Coverage

- Fall 2009. Various notices of CCP open houses and listening posts printed in the local *Burns-Times Herald*, *The Oregonian*, and online (Oregon Birders' online network, National Rifle Association online notice, online notice of CCP public open house in Salem's *Statesman Journal*).
- March 2012. Press releases printed in the *Burns-Times Herald* and the *Bend Bulletin* about the availability of the draft CCP for review and comments.

Planning Updates

- September 2009. Planning Update 1 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.
- November 2009. Creation of Carp Coalition Listserve. Updates sent at least monthly to approximately 150 members from creation to present.
- May 2010. Planning Update 2 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various

locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.

- February 2012. Planning Update 3 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.
- December 2012. Planning Update 4 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.

Other Tools

- June 2009. Updated Refuge website to include CCP information.
- March 2011. Central Oregon Sportsman Show, Redmond, OR

Federal Register Notices

- June, 2009. Federal Register published Notice of Intent to prepare a CCP and environmental impact statement (EIS); request for comments.
- March, 2012. Federal Register published Notice of Release of draft CCP and EIS; request for comments.
- December, 2012. Federal Register published Notice of Availably of the final CCP and EIS.

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Hay at P Ranch
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Appendix K

Wet Meadow Treatment Ratios

K.1 Refuge Management Treatments

K.1.1 Management Treatment Acres

The following table (Table K-1) will be used to track acres treated by various management strategies throughout the life of the CCP. It will enable Refuge staff, collaborators, and interested public to understand if and how management may change over time in striving toward or maintaining met objectives in various habitat types.

Table K-1. Management Treatment Acres per Treatment Year

Treatment	Acres per Treatment Year					
	2013-2014	2014-2015	2015-2016	2016-2017	2018-2019	2019-2020
Rakebunch (DS)						
True Graze (DS)						
True Graze (WS)						
Haying (DS)						
Seeding						
Grain Farming						
Shrub Planting						
Disking						
Chemical-Habitat						
Chemical-Fisheries						
Rx Fire						
Commercial Fishing						
Juniper Control						
Carp Objectives Met						

DS: Dormant Season; WS: Warm Season as described in Appendix B Haying and Grazing CD

K.2 Dormant Season Haying and Grazing in Wet Meadows

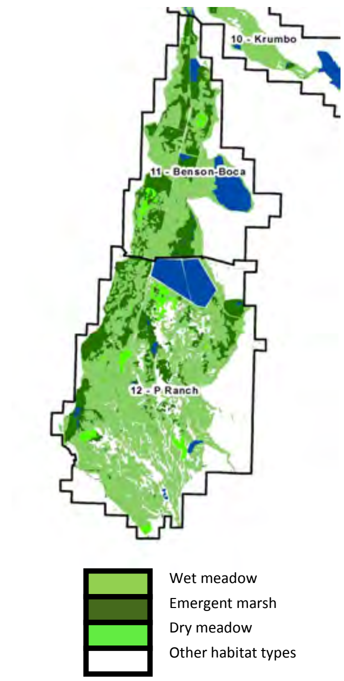
The initial ratio of wet meadows receiving haying and rake-bunch grazing treatments on an annual basis to those left idle will be 60:40 (±10 percent). This translates to 12,000 to 15,000 of 20,000 to 25,000 acres being treated in a given year[1]. This figure is based on the sound professional judgment of seven past and present Refuge wildlife biologists with 50 collective years of experience managing

[1] Acreage ranges exist to provide needed flexibility to account for (1) acreage refinement as the Refuge's GIS layers become more precise, (2) the possible need of reclassifying some acreages as inventory and monitoring data continues to be collected (e.g., existing emergent marsh that has resulted from cattail encroachment into wet meadow), and (3) climatic conditions or other unforeseen restraints that may hinder the Refuge's ability to treat all targeted acres.

Refuge meadows. This ratio is relevant only when considering all wet meadows within the Refuge and differs across fields and area-specific management units. The needs of focal species, the suite of wildlife they represent, and the nature of habitats they depend on determines the use and extent of these tools in realizing or maintaining attributes identified under Objective 4a. The ratio itself is not prescriptive. It serves as an indicator of treatment changes over time.

The purpose of this appendix is to provide an overarching rationale behind the initial 60:40 ratio by highlighting four major areas (southern, central, and northern Blitzen Valley and Double-O Unit) and identifying associated needs for treated and/or untreated acres for wet meadow focal species (i.e., bobolink, greater sandhill crane, and cinnamon teal). It is not intended to replace established Refuge management units, but is designed specifically to facilitate greater understanding of how management needs change as one moves across the Refuge landscape.

K.2.1 South Blitzen Valley



Total wet meadow area: Out of 20,300 total acres in this management area, 8,000 will be occupied by wet meadow habitat.

Focal species as identified in the CCP for wet meadow habitats[2]:

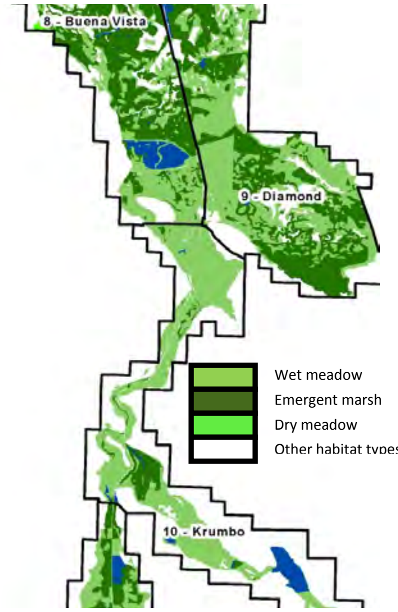
- **Bobolink:** Concentrated populations are found in mesic wet meadows, totaling approximately 3,500 acres. Nesting/feeding habitat is dependent on short vegetation heights achieved via treatments (populations decrease substantially under non-treated status). The Blitzen Valley hosts the largest bobolink population west of the Great Plains and has over 90 percent of the bobolinks that breed in Oregon. They only occur at approximately six other sites supporting numbers of less than 20 individuals (Marshall et al. 2006). Approximately 85 percent of the Refuge bobolinks are found in this area (2,471 out of 2,902, Refuge unpublished data).
- **Greater sandhill crane:** A 1999 Refuge summary report found 99 out of 235 pairs (42 percent) using this area. Nesting occurs in adjacent emergent marsh vegetation. Crane pairing and young-rearing takes place on approximately 6,000 acres of meadows with an overall treated vegetation height of <6 inches. Acreage overlaps bobolink use areas.
- **Cinnamon teal**: Primarily dry meadow habitats and secondarily, upland habitats provide a majority of this species' nesting habitat in this area. Mallards, which are represented by this focal species, do commonly nest in emergent marsh habitat. Mesic wet meadows less prone to flooding provide suitable nesting habitat (approximately 800 acres) for some waterfowl species. Areas susceptible to nest loss via water management are treated to provide waterfowl pairing/pre-nesting habitat (overlap above treated acreages).

Treated:Untreated ratio for this area: 90:10 for wet meadow, 35:65 for total area

[2] Basic habitat principles discussed in regard to the southern Blitzen Valley generally apply to all units.

K.2.2 Mid-Blitzen Valley

Total wet meadow area: Out of 19,600 total acres, 6,400 will be occupied by wet meadow habitat.



Focal species as identified in the CCP for wet meadow habitats:

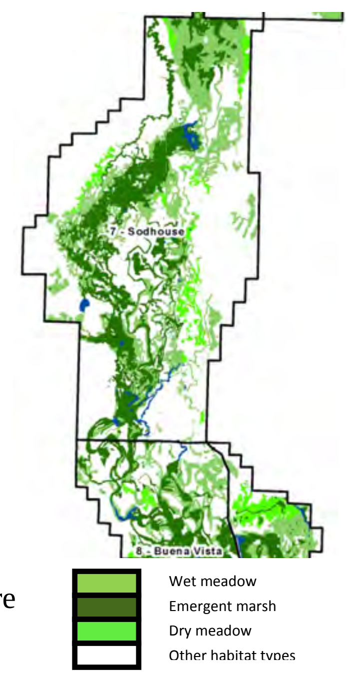
- **Bobolink**: Approximately 50 to 100 acres of suitable, used mesic wet meadow habitat are known to exist in this area. Less than 1 percent of Refuge bobolinks are found in this area (14 out of 2,902, Refuge unpublished data).
- **Greater sandhill crane:** Concentrations of greater sandhill crane territories remain high, but are a little lower in this area compared to the south Blitzen Valley (62 out of 235 pairs, or 26 percent). Approximately 4,000 acres of wet meadow are treated to provide crane pairing/pre-nesting habitat.
- **Cinnamon teal:** Approximately 2,300 acres of mesic wet meadow is left untreated to provide nesting habitat.

An increase in reed canarygrass dominance in many meadows greatly minimizes their value in regard to waterfowl nesting habitat and overall wildlife use if left untreated. Currently approximately 4,000 acres (out of approximately 6,000 total acres) of reed canarygrass is located in this area.

Treated:Untreated ratio for this area: 64:36 for wet meadow, 21:79 for total area.

K.2.3 North Blitzen Valley

Total wet meadow area: Out of 24,000 total acres, 4,600 will be occupied by wet meadow habitat.

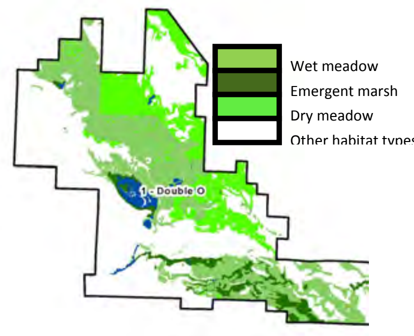


Focal species as identified in the CCP for wet meadow habitats:

- **Bobolink**: The use of this species is focused on expansive wet meadows on the north end of this area (approximately 600 acres). Approximately 14 percent of the Refuge bobolinks are found in this area (417 out of 2,902, Refuge unpublished data).
- **Greater sandhill crane:** Crane territories are less concentrated in this area (28 out of 235 pairs, or 12 percent) so approximately 1,200 acres of treatment are targeted for pairing/pre-nesting habitat.
- **Cinnamon teal:** Many wet meadow communities in this area are very small and less prone to extensive nest flooding because of the prevailing dichotomy of elevations found throughout its fields and the greater edge of surrounding dry meadow nesting habitats. Approximately 3,200 acres of the area's wet meadows are left untreated to provide nesting habitat.

Treated:Untreated ratio for this area: 30:70 for wet meadow, 6:94 for total area.

K.2.4 Double-O



Total wet meadow area: Out of 20,000 total acres, 4,600 will be occupied by wet meadow habitat.

Focal species as identified in the CCP for wet meadow habitats:

- **Bobolink**: 0 acres.
- **Greater sandhill crane:** Crane territories concentrate in the southern fields where water is provided by Double-O Spring as well as the northwestern meadows maintained by Silver Creek. Approximately 2,000 acres are treated for pairing and young-rearing. Twenty percent, or 46 out of 235 crane pairs use this area
- **Cinnamon teal:** 300 acres of wet meadow areas north and east of the central ponded area (Martha, Warbler, and Derrick ponds) are managed primarily for waterfowl nesting.

Treated:Untreated ratio for this area: 40:60 for wet meadow, 10:90 for total area.

Total Treated:Untreated ratio across all habitat types within the Refuge: **8:92**

K.3 References

Marshall, D.B., M.G. Hunter, and A. Contreras. 2006. Birds of Oregon: a general reference. Corvallis, O: Oregon State University Press 752 pp.

Northern shoveler
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Appendix L

The Ecology Work Group and the State and Transition Model

L.1 Adaptive Management and the State and Transition Model

Habitat management within the Malheur Refuge comprehensive conservation plan (CCP) will rest on an inductive ecological framework that uses a broad spectrum of relevant research from similar systems. This will enable the Refuge to form premises that assist in developing reasonable management strategies to meet various identified habitat objectives. The foundation from which habitat management approaches will arise within this CCP is "adaptive management."

The U.S. Department of the Interior recognizes that this concept "is much more than simply tracking and changing management direction," and that it "focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable resource systems" (Williams et al. 2007).

The Malheur State and Transition Model (STM) will play a vital role in achieving this. The STM is a framework that is being developed by the Service with the assistance of ecologists from various State and Federal agencies and non-government organizations. As illustrated conceptually in Figure L-1, STM will:

(1) describe various habitat types and associated plant communities;
(2) discuss the conditions that likely cause transitions[1] to other plant assemblages;
(3) identify existing information gaps in the scientific knowledge base that need to be addressed in further understanding the functionality of these habitat types and possible strategies for obtaining this critical information;
(4) develop management strategies by combining individual tools/treatments to meet the objectives specified in this plan;
(5) analyze the success of initiated management strategies; and
(6) modify management over time to meet CCP objectives.

The benefits of the STM concept for Malheur Refuge expand beyond greater ecological understanding of Refuge habitat. It also provides transparency, heightened and continued interaction with partnering agencies/organizations (i.e., Oregon State University, U.S. Department of Agriculture's Agricultural Research Service, Oregon Heritage Program, Ducks Unlimited, Wetlands Conservancy, etc.), and accountability for continued monitoring of management actions. The STM is a living model that is continually transformed as new information is gleaned over time, and because of this, it introduces an amplified dependence on actualized adaptive management. It also provides us with a framework for organizing our results and reporting them to the interested public.

L.2 The Ecology Work Group

As mentioned above, the STM is developed by ecologists and fish/wildlife biologists from the Service and partnering entities. It is a product of the Service, created in cooperation with the Ecology Work Group, which was created during the development of the 2012 Malheur CCP. This group is designed to assist Refuge staff in carrying out adaptive management by providing experience, vital

[1] These transitions are called thresholds when severe climatic or management stresses cause the composition of species within a particular assemblage to change radically, and they are often difficult to reverse without a lot of external input (labor and funding).

connections to best available science, and increased opportunities for acquiring the resources needed in pursuing dynamic management of Refuge habitats. The Ecology Group will meet prior to each field season to discuss data gathered in previous seasons and assess the effectiveness of current strategies. It will assist the Service in determining if objectives are being met or, in instances where long-term tenacity is required, if existing management is moving target habitats toward desired conditions over time. The Ecology Group will also analyze data and discuss management successes and challenges at the conclusion of each field season and consider if alterations to the STM need to be made as more information becomes available.

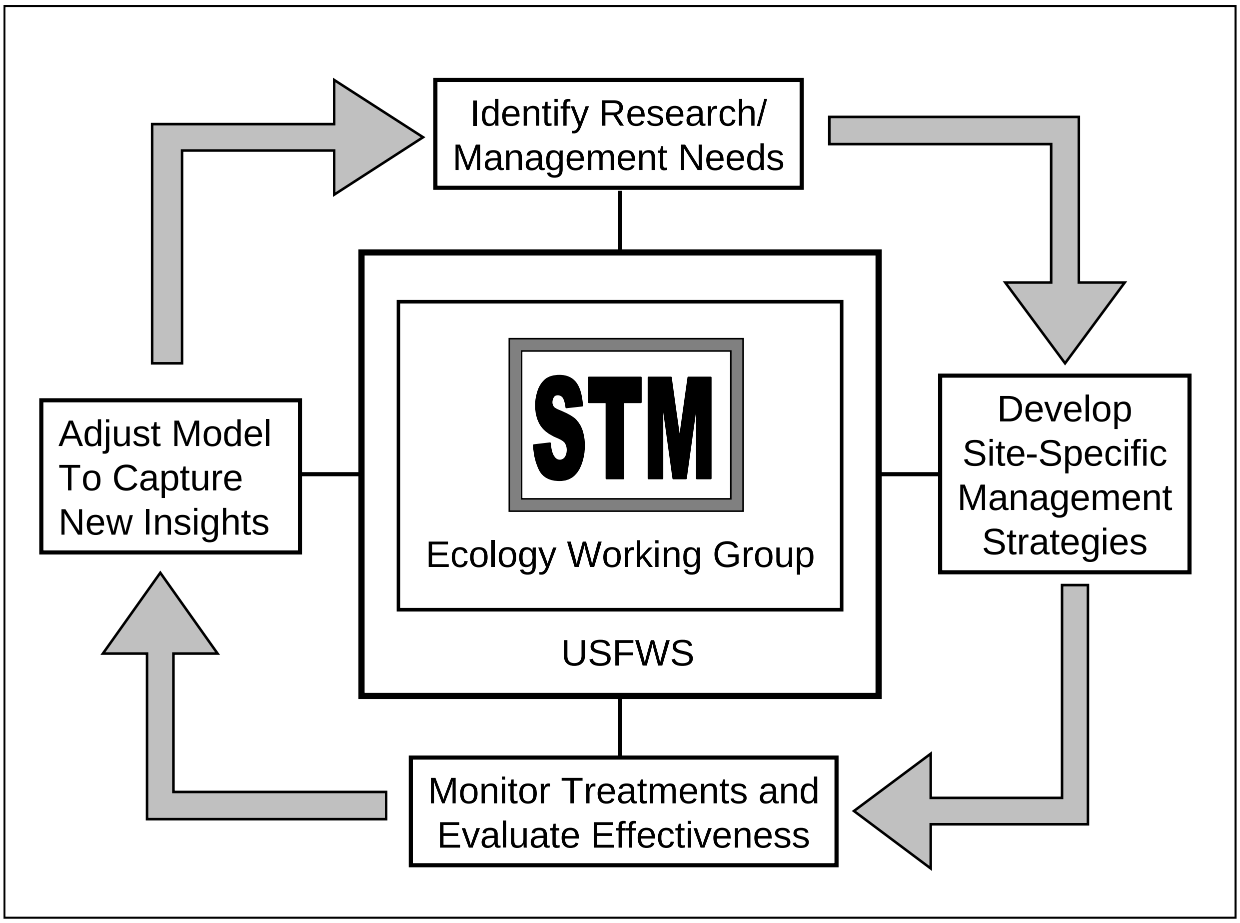

Figure L-1. A conceptual diagram of the State and Transition Model as an adaptive management tool.

L.3 References

Williams B.K., R.C. Szaro, and C.D. Shapiro. 2007. Adaptive management: the U.S. Department of Interior technical guide. Adaptive Management Working Group, U.S. Department of the Interior. Washington D.C.

Western frittilary
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Appendix M
Climate Change

M.1 Introduction

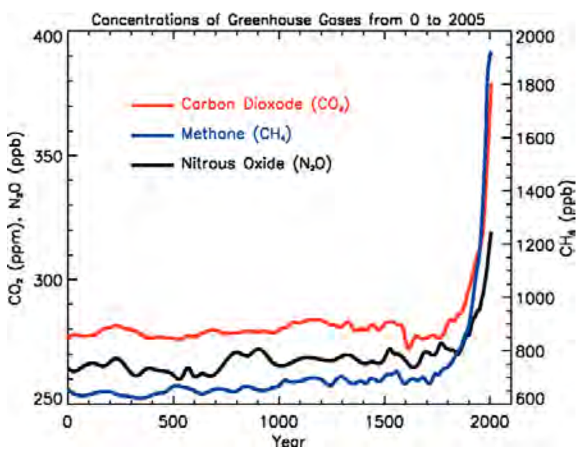
As required by DOI Secretarial Order 3226, issued in 2001, the Service requires consideration and analysis of climate change in long-range planning.

M.1.1 Global Greenhouse Gases

The greenhouse effect is a natural phenomenon that assists in regulating and warming the temperature of our planet. Just as a glass ceiling traps heat inside a greenhouse, certain gases in the atmosphere, called greenhouse gases (GHGs), absorb heat from sunlight, trapping heat in the atmosphere and warming the planet. The primary GHGs occurring in the atmosphere include carbon dioxide (CO_2), water vapor, methane, and nitrous oxide. CO_2 is produced in the largest quantities, accounting for more than half of the current impact on the Earth's climate.

A growing body of scientific evidence from basic theory, climate model simulations, and observations has emerged to support the idea that humans are changing the Earth's climate (U.S. Global Change Research Program [USGCRP] 2009; Intergovernmental Panel on Climate Change [IPCC] 2007; National Academy of Sciences [NAS] 2008). The concentrations of heat-trapping GHGs have increased significantly over the last several hundred years due to human activities such as deforestation and the burning of fossil fuels (Figure M-1).

Although climate alterations are well documented in the Earth's history, even in relatively recent geologic time (e.g., the Ice Age of 10,000 years ago), the current warming trend differs from earlier shifts in two ways. First, this recent change in climate appears to be driven primarily by human activity, particularly the burning of fossil fuels, which results in a higher concentration of atmospheric GHGs). Second, atmospheric CO_2 and other GHGs, levels of which are strongly correlated with the Earth's temperature, are now higher than at any time in at least the last 420,000 years (Figure M-2) (USGCRP 2009).



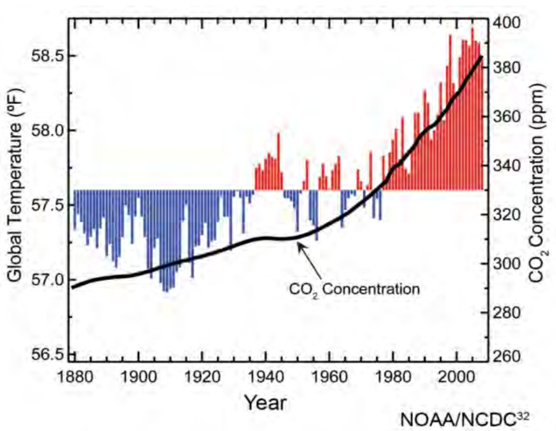
Source: IPCC 2007.

Figure M-1. Concentrations of important heat-trapping greenhouse gases over the last 2,000 years.

Prior to the start of the Industrial Revolution in 1750, the amount of CO_2 in the atmosphere was about 280 parts per million (ppm). Current levels are about 390 ppm and are increasing at a rate of about 2 ppm/year. Data from ice cores, which record prehistoric atmospheric conditions, show that for the last 800,000 years, CO_2 concentrations have ranged from 180 ppm during cold, glacial periods to 300 ppm during warm, interglacial periods. The current concentrations of CO_2 and other GHGs, as well as the rapid rate of increase in recent decades, are unprecedented in the prehistoric record.

M.1.2 Temperature and Precipitation

There is a direct correlation between GHG concentrations and the temperature of the Earth's surface. Global surface temperatures have increased about 1.3°F since the late nineteenth century (USGCRP 2009), and the rate of temperature increase has risen in more recent years (Figure M-2). The IPCC, a large group of scientists in a panel created by the United Nations to evaluate the risk of climate change caused by human activities, reported in 2007 that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level." (IPCC 2007).



Global annual average temperature (as measured over both land and oceans). Red bars indicate temperatures above and blue bars indicate temperatures below the average temperature for the period 1901-2000. The black line shows atmospheric carbon dioxide (CO_2) concentration in parts per million (ppm). While there is a clear long-term global warming trend, each individual year does not show a temperature increase relative to the previous year, and some years show greater changes than others.[33] These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niños, La Niñas, and the eruption of large volcanoes.

Source: USGCRP 2009.

Figure M-2. Global average temperature and CO_2 concentrations from 1880 to 2008.

In the northern hemisphere, recent decades appear to be the warmest since about A.D. 1000, and the warming since the late nineteenth century is unprecedented over the last 1,000 years. Globally, 2010 and 2005 tie as the warmest years in the instrumental record (1880 to the present), while 2009 was only a fraction of a degree cooler, matching 1998, 2002, 2003, 2006, and 2007 for the second-warmest year on record, according to independent analyses by the National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) (Table M-1). The new 2010 record is particularly noteworthy because it occurred in the presence of a La Niña and a period of low solar activity, two factors that have a cooling influence on the planet. However, in general, decadal trends are far more important than any particular year's ranking.

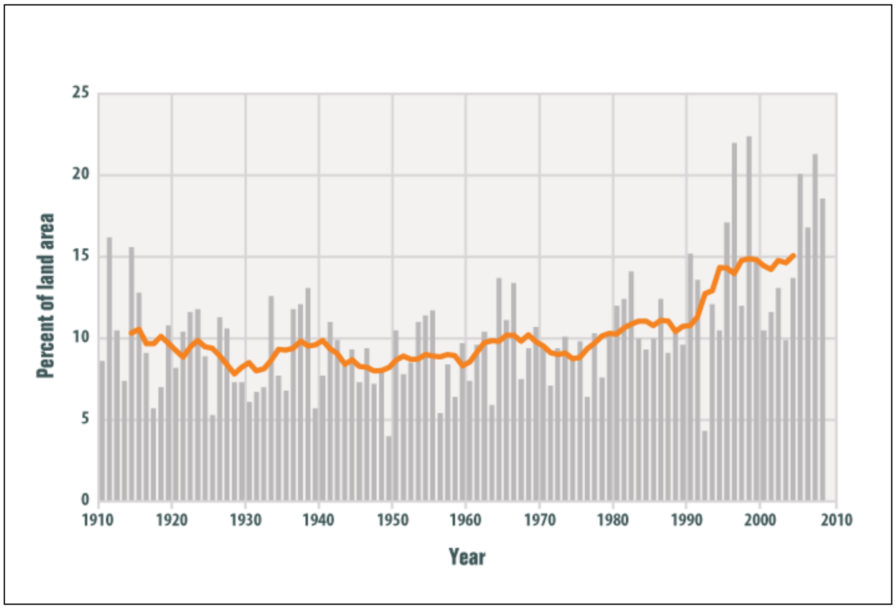
Table M-1. Top 10 Warmest Years in the Instrumental Record from 1880 to 2010[a]

Global Top 10 Warmest Years (Jan-Dec)	Anomaly (°C)	Anomaly (°F)
2010	0.62	1.12
2005	0.62	1.12
1998	0.60	1.08
2003	0.58	1.04
2002	0.58	1.04
2009	0.56	1.01
2006	0.56	1.01
2007	0.55	0.99
2004	0.54	0.97
2001	0.52	0.94

Source: National Climatic Data Center 2010.
[a] The instrumental record refers to the period with recorded temperatures.

Trends in precipitation are more difficult to detect than changes in temperature because precipitation is generally more variable. Over the last century, there have been increases in annual precipitation in the higher latitudes of both hemispheres and decreases in the tropical regions of Africa and southern Asia (USGCRP 2009). Most of the increases have occurred in the first half of the twentieth century, and it is not clear if this trend is due to increasing GHG concentrations.

Just as important as precipitation totals are changes in the intensity, frequency, and type of precipitation. Warmer climates, owing to increased water vapor, lead to more intense precipitation events, including more snowstorms and possibly more flooding, even with no change in total precipitation (Figure M-3). On the other hand, more droughts and heat waves can be expected as hotter, longer-lasting high-pressure systems dry out the land.



Source: EPA 2010.

Figure M-3. Percent of land area in the lower 48 states that has experienced greater than normal precipitation for the period 1910 to 2008.

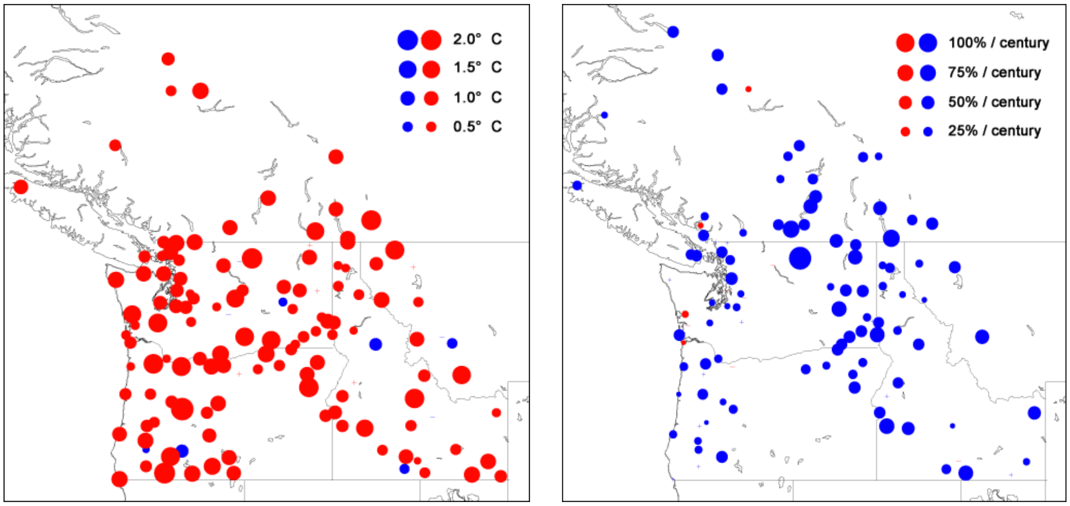
M.1.3 Emissions Scenarios

When climate modelers project future climate, they make assumptions about future GHG emissions. These assumptions are called emission scenarios. A common set of emissions scenarios was developed in 2000 by the IPCC. Three scenarios from this set are frequently used by the modeling community: the A2 (high emissions scenario), A1B (medium emissions scenario), and B1 (low emissions scenario). Because of a lag between GHG emissions and climate response, the assumptions about future emissions will not influence the next 30 years or so. GHG concentrations and climate in the short term will be determined by emissions that have already occurred. Longer-term climate projections are more uncertain and vary because of uncertainty in future GHG emissions (and therefore future concentrations of GHGs). This is why, typically, there are differences in climate model projections beyond 2050.

M.2 Pacific Northwest Climate Indicators and Observed Trends

M.2.1 Observed Temperature and Precipitation Changes

From a climate change perspective the Refuge is more closely aligned with changes that have occurred in the Pacific Northwest, rather than the desert regions of the Southwest. In the Pacific Northwest, the regionally averaged temperature rose 1.5°F between 1920 and 2000 (Figure M-4), slightly more than the global average. Warming was greatest for the winter months of January to March. Minimum daily temperatures have increased faster than maximum daily temperatures. Longer-term precipitation trends in the Pacific Northwest are more variable and vary with the period of record analyzed (Mote et al. 2005). Looking at the period 1920 to 2000, precipitation has increased almost everywhere in the region. Most of that increase occurred during the first part of the record.



Source: Climate Impacts Group 2011.
Note: Red (blue) circles indicate warming (cooling) air temperatures or decreasing (increasing) precipitation.

Figure M-4. Trends in annual temperature or precipitation from 1920 to 2000.

In the Pacific Northwest, increased GHGs and warmer temperatures have resulted in a number of physical and chemical impacts to the region. These include changes in snowpack, streamflow timing and volume, flooding and landslides, sea levels, ocean temperatures and acidity, and disturbance regimes like wildfires and insect and disease outbreaks (USGCRP 2009).

M.2.2 Observed Snowpack, Streamflow, and Glacial Changes

Snowpack Changes: One of the most important responses to warmer winter temperatures in the Pacific Northwest has been the loss of spring snowpack (Mote et al. 2005). As temperatures rise, the likelihood of winter precipitation falling as rain rather than snow increases. This is especially true in the Pacific Northwest where mountainous areas of snow accumulation are at relatively low elevations and winter temperatures are near freezing. Small increases in average winter temperatures can lead to increased rains, reduced snowpack, and earlier snowmelt. The loss of spring snowpack in the Pacific Northwest has been significant, with most stations showing, on average, a decrease (Figure M-5). Data recorded each April 1st show that snowpacks have declined 25 percent over the past 40 to 70 years (Mote et al. 2005). The fact that the declines are greatest at low elevation sites and the trend has occurred in the absence of significant decreases in winter precipitation implicates temperature rather than precipitation as the cause of the trend.

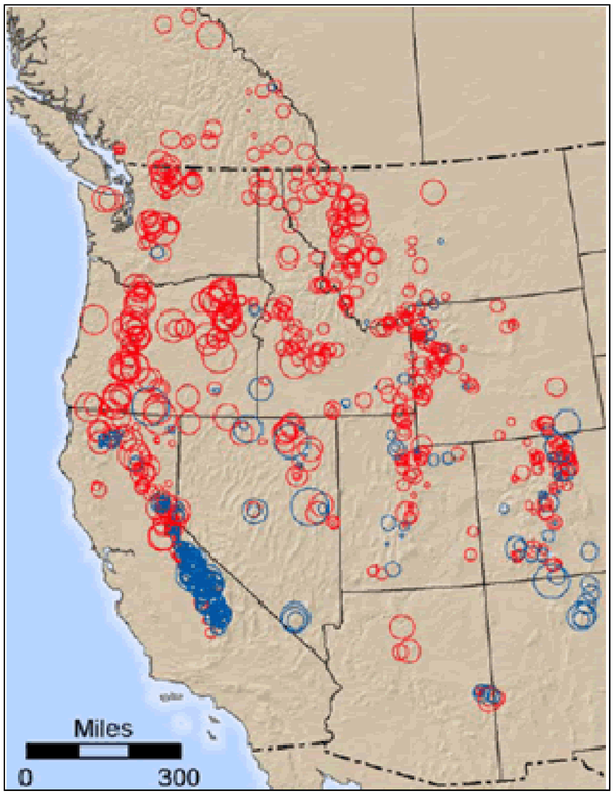
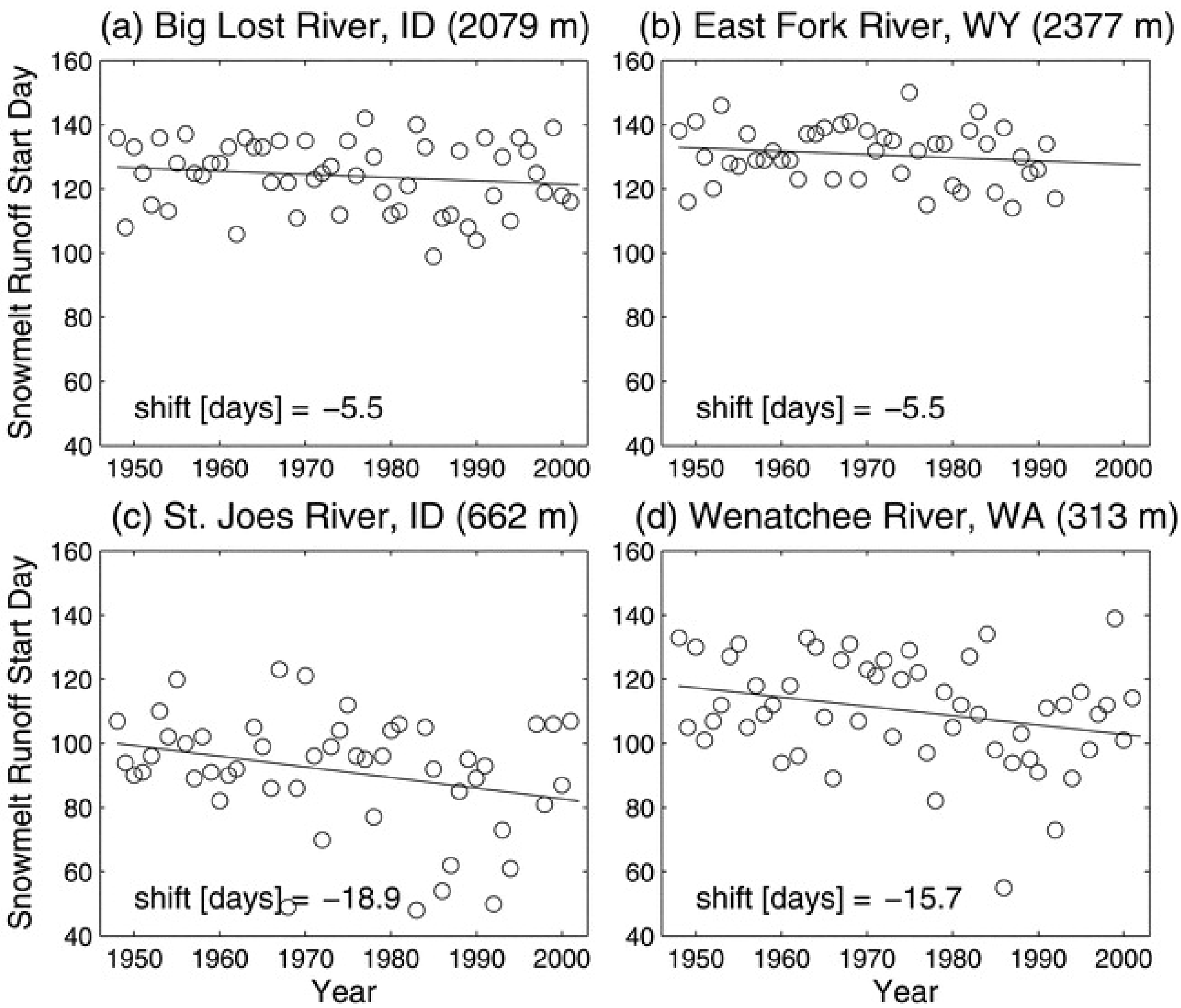


Figure M-5. Trends in April 1st snow water equivalent (SWE) in the western United States from 1950 to 1997. Red (blue) circles indicate decreasing (increasing) SWE, with the size of the symbol indicating the magnitude of the trend

Source: Mote et al. 2005.

Streamflow Changes: The decrease in spring snowpack and earlier snowmelt have led to a change in streamflow in many systems, including earlier spring runoff peaks, increased winter streamflow, and reduced summer and fall streamflows. Stewart et al. (2005) examined 302 streamflow gages in the western United States and reported that the timing of winter runoff and annual streamflow had advanced by 1 to 4 weeks from 1948 to 2002. The degree of change depends on the location and elevation of the specific river basin. Basins located significantly above freezing levels have been much less affected by warmer temperatures than those located at lower elevations (Figure M-6). River basins whose average daily winter temperatures are close to freezing are the most sensitive to climate change, as is apparent from the dramatic shifts in streamflow timing that have resulted from relatively small increases in winter temperatures.



Source: Stewart et al. 2005.

Figure M-6. Observed spring pulse of snowmelt-generated streamflow for (a) and (b) two high and (c) and (d) two mid-elevation Pacific Northwest streams, illustrating the much greater advance in timing in the mid-elevation streams.

The advance in streamflow timing also results in decreased summer and fall base flows, at precisely the time when streamflow is needed most. In addition, warmer temperatures have lengthened the growing season (defined as the time between the last frost of spring and the first frost of fall) in the western United States by an average of about 10 to 15 days. Warmer temperatures and longer growing seasons increase water requirements for evapotranspiration, hydropower, and irrigation, resulting in potential water supply shortages and conflicts.

Figure M-7. Grinnell Glacier, Glacier National Park, photographs from 1940 and 2006.

Source: U.S. Geological Survey (USGS) Northern Rocky Mountain Science Center 2011.

Glacier Changes: Another indication of climate change in the Pacific Northwest is the decline and retreat of many of the region's iconic glaciers, including those in Glacier National Park. Models predict that all of the Park's glaciers will melt by 2030 (Hall and Fagre 2003). Scientists have begun the task of documenting glacial decline through repeat photographic images such as the pair shown in Figure M-7.

M.3 Climate Change Indicators and Trends at Malheur Refuge

M.3.1 Sources and References for Refuge Climate Data

PRISM: There are several sources of historical climate data for the Refuge. The main data source used here is the Parameter-elevation Regressions on Independent Slopes Model (PRISM) (Daly 2002; Daly et al. 2008). PRISM provides a complete record (i.e., no missing data) of temperature and precipitation data at 4-km resolution for the entire conterminous United States. We used monthly minimum and maximum temperature and monthly precipitation PRISM data from 1950 to 2009. Geographic information system (GIS) was used to delineate two areas—the area encompassed by the Refuge boundary and the Blitzen watershed upstream of the Refuge and Page Springs. We then intersected the 4-km gridded PRISM data and queried temperature and precipitation for all grid points within the boundaries of these two areas at each monthly time step, to calculate an average monthly temperature and total monthly precipitation for both the Refuge and the Blitzen watershed for every month from 1950 to 2009.

PRISM is a method developed by Oregon State University researchers for generating gridded estimates of historical precipitation and temperature at monthly and daily time steps. The method interpolates between point data from thousands of weather stations using a digital elevation model (DEM) and many other geographic data sets. The gridded estimates account for spatial variations in climate caused by elevation, terrain orientation, effectiveness of terrain as a barrier to flow, coastal proximity, moisture availability, atmospheric inversions, and topographic position (valley, mid-slope, ridge). PRISM provides a complete record (no missing data) of monthly minimum and maximum temperature and monthly precipitation data from 1895 to the present at a 4-km resolution for the conterminous United States. In addition to the time series data at a 4-km resolution, 30-year average monthly temperature and precipitation, based on the period 1971-2000, are available at an 800-m resolution for any point in the conterminous United States and the Pacific Islands. Because of the complete geographic coverage, PRISM can provide estimates of climate data for remote areas where there is often little or no data available.

USHCN: A second source of daily and monthly climate data is the individual weather stations in the area. This includes Burns Municipal Airport, four National Weather Service/National Oceanic and Atmospheric Administration (NWS/NOAA) government weather stations on the Refuge (Buena Vista Station, P Ranch Substation, Double-O Station, and Refuge Headquarters), and the United States Historical Climatology Network (USHCN) Malheur Refuge Headquarters station (Station No. 355162). We mainly relied on the USHCN station data because this station provides a complete record of high-quality climate data (Menne et al. 2009). The PRISM method described above likely used data from all these local stations, as well as snowpack telemetry (SNOTEL) station data described below, to develop the interpolated data set for the area.

The USHCN is a high-quality data set of daily and monthly records of basic meteorological variables from 1,218 observing stations across the conterminous United States (Menne et al. 2011). The USHCN data have been corrected to remove biases or heterogeneities from non-climatic effects such as urbanization or other landscape changes, station moves, and instrument and time of observation changes. The network has been developed over the years at the NOAA National Climatic Data Center (NCDC) to assist in the detection of regional climate change. It is used by NOAA to monitor temperature and precipitation over the United States. This includes the calculation of trends over roughly the last century and regular updates to yearly and monthly state/regional rankings of temperature and precipitation. The USHCN network includes a complete record (no missing data) of monthly maximum, mean, and minimum temperature and monthly precipitation for the period 1895 to the present. The only USHCN station close to Malheur is the Malheur Refuge Headquarters (USHCN Station No. 355162).

Both the PRISM and USHCN have the advantage of being complete data sets with no missing records. In each of these data sets, missing data have been estimated in a sophisticated procedure using a weighted average of values from highly correlated neighboring stations. This is often a problem when using data from local stations. The estimation of missing data involves considerable effort and too often the problem is ignored, with no attempt to estimate missing values. This can skew estimates of averages and trends.

SNOTEL: A third source of climate data is the two Natural Resources Conservation Service (NRCS) SNOTEL sites, Silvies SNOTEL (Site No. 759) and the Fish Creek SNOTEL (Site No. 477), located on Steens Mountain within the Blitzen watershed (NRCS 2011). The Silvies site is slightly lower (6,990 feet) than the Fish Creek site (7,660 feet) but both sites are at relatively high elevations for SNOTEL sites in Oregon. These sites have April 1 snow water equivalent measurements (SWE) from 1939 to the present, with daily SWE, precipitation, and air temperature measurements beginning in 1984. The statistically significant trend in the monthly temperature and precipitation PRISM data for the area of the Malheur Refuge from 1950 to 2009 is a 3.5°F increase (0.6°F per decade) in March monthly temperatures (Figure M-8).

M.3.2 Observed Trends in Refuge Climate Data

The PRISM data for the Blitzen watershed area show a statistically significant increase in March monthly temperatures (Figure M-8), as do the USHCN data from the Malheur Refuge Headquarters station (data not shown). The USHCN station data also show statistically significant increases in several other months. Precipitation data from PRISM and USHCN show opposite trends (one increasing and one decreasing) from 1950 to 2009, but neither trend is statistically significant. As discussed above, winter temperatures, particularly in January and March, have been shown by other studies to be increasing in the West (Hamlet and Lettenmaier 2007; Knowles et al. 2006). The increases can cause more precipitation to fall as rain instead of snow, resulting in reduced April 1st snow water equivalent (SWE), earlier snowmelt, and changes in streamflow.

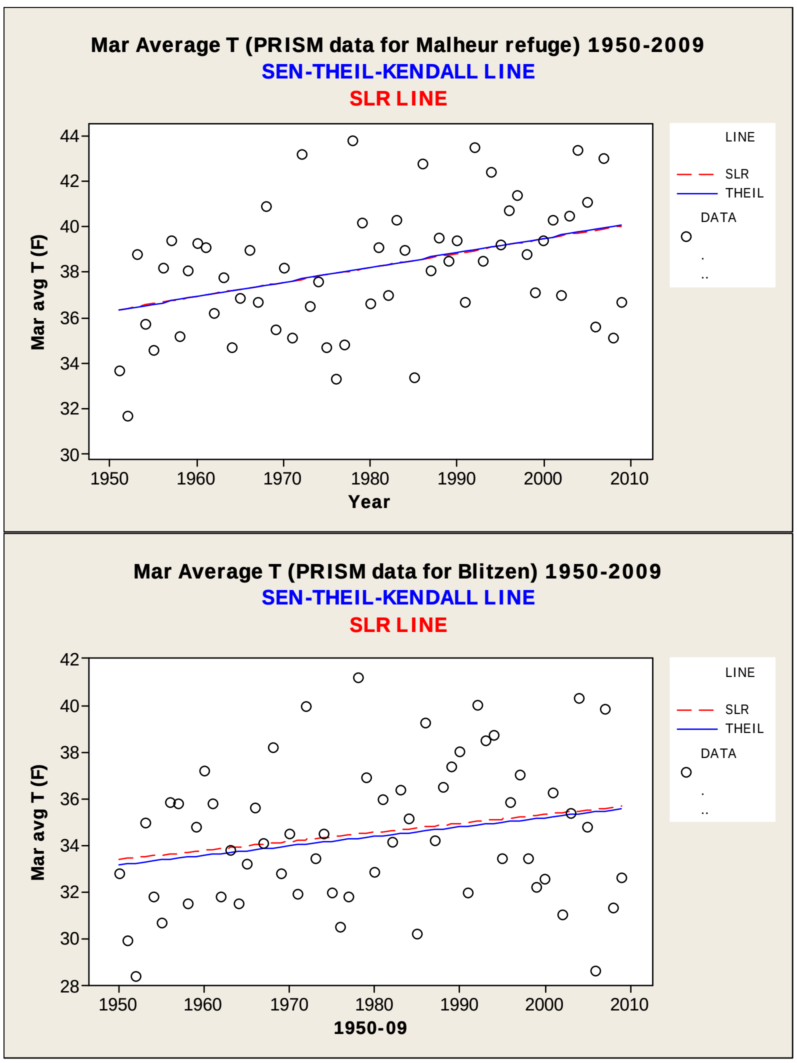
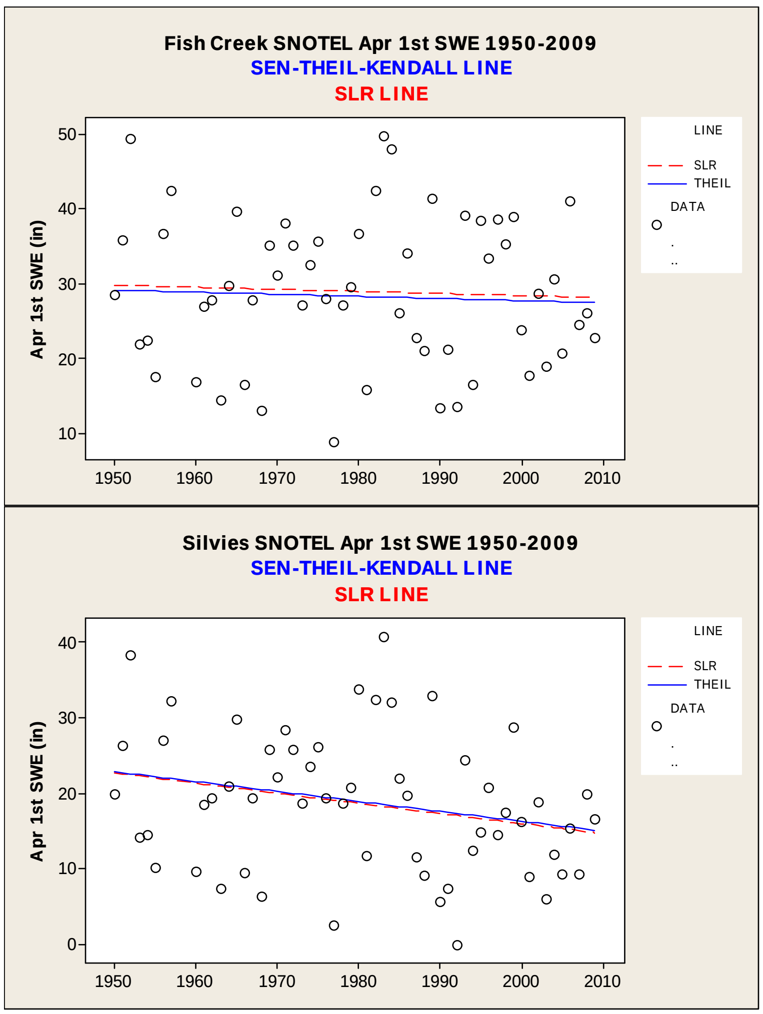


Figure M-8. Trend in March monthly temperature for the Refuge and the Blitzen watershed (PRISM data) from 1950 to 2009.

The SNOTEL data on Steens Mountain suggest that warmer March temperatures may have impacted snowpack at least at lower elevations in the Blitzen watershed (NRCS 2011). There is a statistically significant decreasing trend (−5 percent per decade, or −34 percent) from 1950 to 2009 in the April 1st SWE at the Silvies SNOTEL, the lower elevation site (Figure M-9). April 1st SWE at Fish Creek, the higher elevation site, shows a very slight decrease from 1950 to 2009, but the trend is not statistically significant. Note that the Blitzen PRISM data set shows an increase in precipitation over the same period. The fact that precipitation in the Blitzen watershed has increased or at least not changed while the SWE at the lower elevation site has decreased significantly indicates that the decreasing trend at the Silvies SNOTEL site is most likely related to warmer temperatures. Because of the relatively high elevation and cold climate of the Blitzen watershed and the Steens Mountain area, snowpack has not been affected by warming temperatures to the degree it has in other, lower elevation areas around the Pacific Northwest. However, as temperatures continue to warm, snowpack will likely continue to decline.



Source: NRCS 2011.

Figure M-9. April 1st SWE at Fish Creek SNOTEL (elevation 7,660 ft.) and Silvies SNOTEL (elevation 6,990 ft.) for the period 1950 to 2009.

One of the expected impacts of declining snowpacks and earlier snowmelt is a change in streamflow timing and volume, specifically higher winter flows, an earlier snowmelt runoff peak, and reduced late season base flows. Because the USGS Blitzen River stream gage has a long period of record (continuous measurements from 1939 onward) and is upstream of any significant diversions or regulation, it provides an excellent record of the response of the river to climate. To date, few climate change impacts can be observed in the Blitzen River streamflow record, in contrast to other stream systems in the Pacific Northwest. There is no trend in the annual streamflow centroid (the date on which approximately half of the annual volume of streamflow occurs for the water year) or the annual minimum 7-day average flow (Figure M-10). There has been no change in the percentage of monthly flows to total annual flow for March to September over the same period (data not shown). There has been a slight decrease in the ratio of June/May flows, as might be expected with earlier runoff, and an increase in the annual maximum daily flow, as might be expected with more winter/spring rains (Figure M-11), but the statistical significance of both of these trends is weak (p = 0.14).

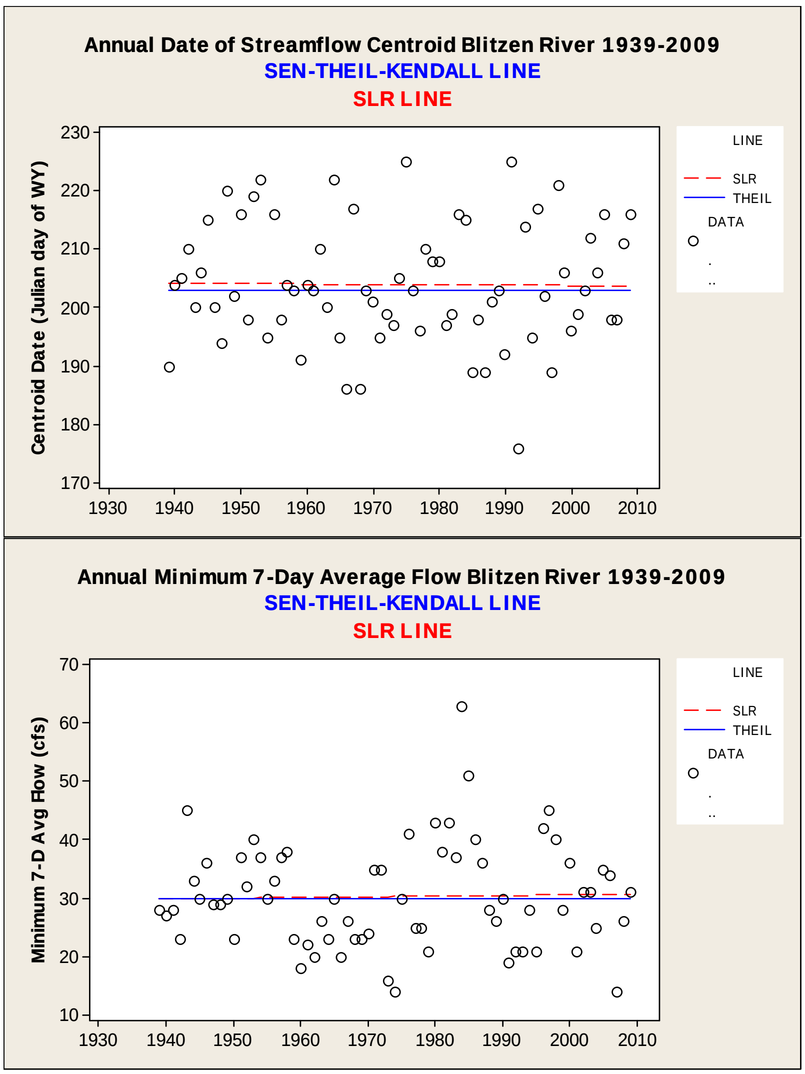


Figure M-10. Trends in the annual streamflow centroid (the date on which approximately half of the annual streamflow occurs) and the annual minimum 7-day average flow for the Blitzen River near Frenchglen, 1939 to 2009. Both data sets show no statistically significant changes for the period.

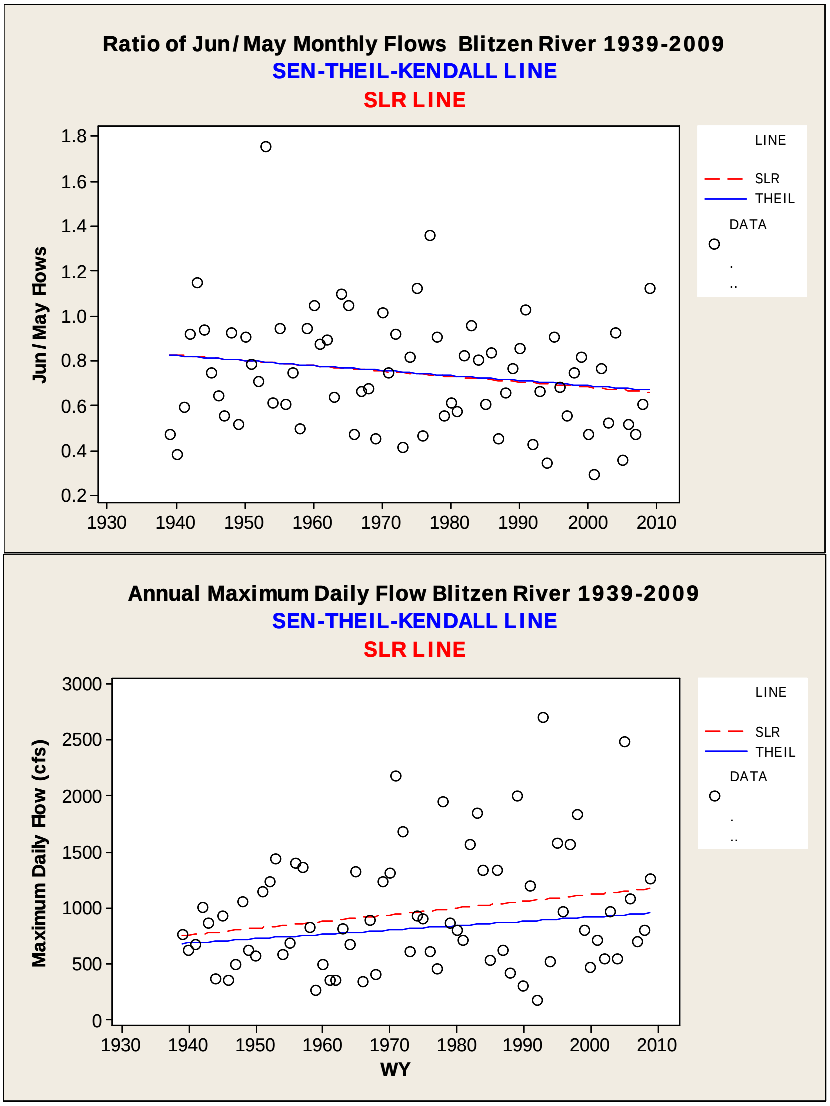
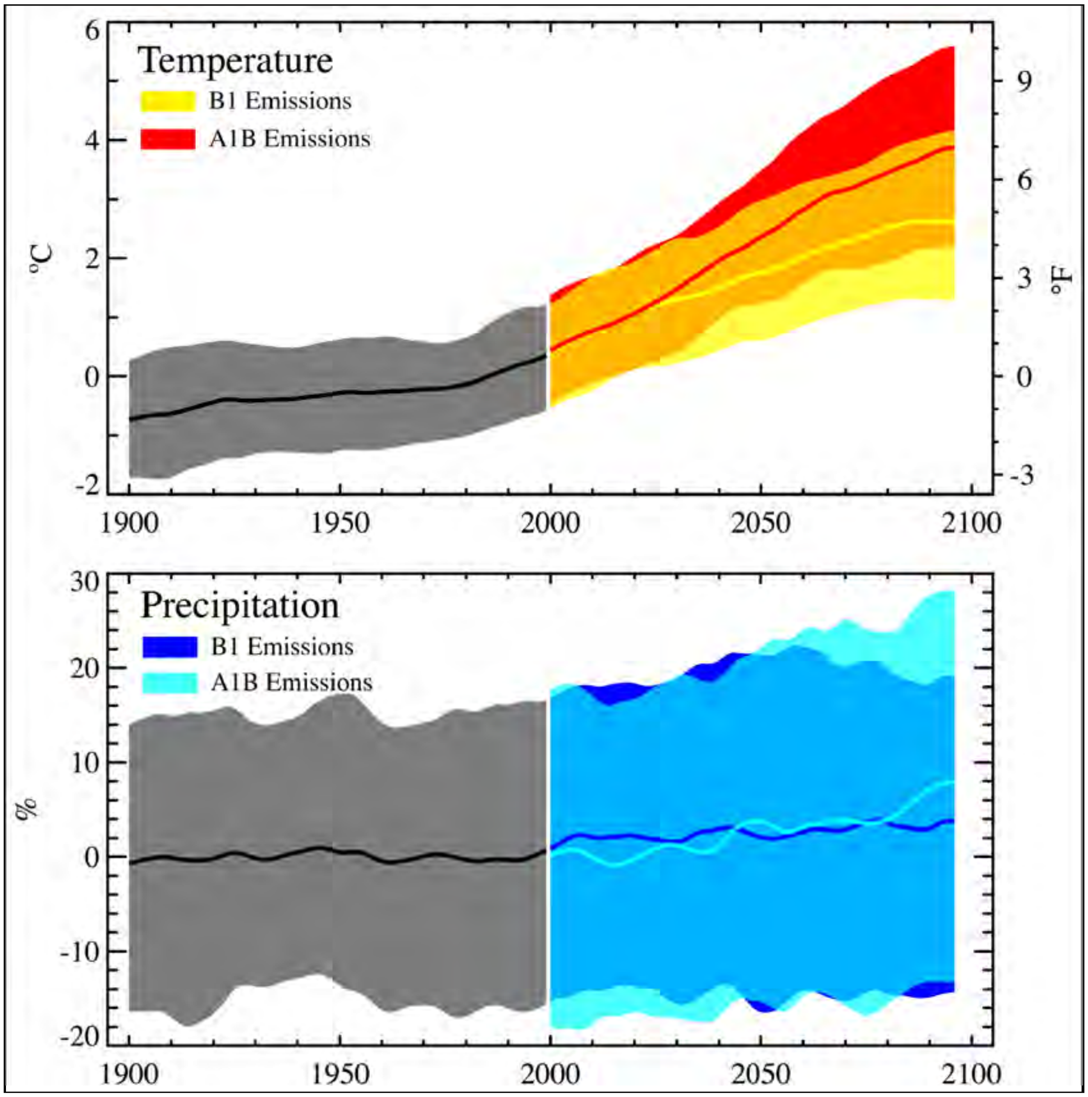


Figure M-11. Trends in the annual ratio of June/May monthly flows and the annual maximum daily flow for the Blitzen River near Frenchglen, 1939 to 2009. Both trends are only weakly significant.

M.4 Projected Climate Changes for the Pacific Northwest and Malheur Refuge

The Climate Impacts Group (CIG) has projected changes in mean annual temperature for the Pacific Northwest, based on several climate models and two emissions scenarios as described in Mote and Salathe (2010). By the 2080s, the temperature increase is about 6°F under the A1B medium emissions scenario and 4.5°F under the B1 low emissions scenario. Considering both scenarios, average annual temperature is projected to increase 2.0°F by the 2020s, 3.2°F by the 2040s, and 5.3°F by the 2080s, relative to the 1970 to 1999 average temperature. The projected changes in average annual temperature are substantially greater than the 1.5°F (0.8°C) increase in average annual temperature observed in the Pacific Northwest during the twentieth century. The mean rate of warming is 0.5°F per decade through mid twenty-first century. Seasonally, summer temperatures are projected to increase the most. It is important to note that actual global emissions of GHGs in the past decade have exceeded even the highest emissions scenario (the A2 scenario), resulting in a scenario that wasn't modeled by CIG. If this trend continues, the temperature increases could actually turn out to be much greater than those projected in Figure M-12.

Projected changes in mean annual precipitation are less clear (Figure M-12). Precipitation trends are very small relative to the interannual variability in precipitation. Seasonally, precipitation is projected to decrease in the summer and increase in the winter by most climate models, although the average shifts are small. However, even small changes in seasonal precipitation could have impacts on streamflow flooding, summer water demand, drought stress, and wildland fire frequency.

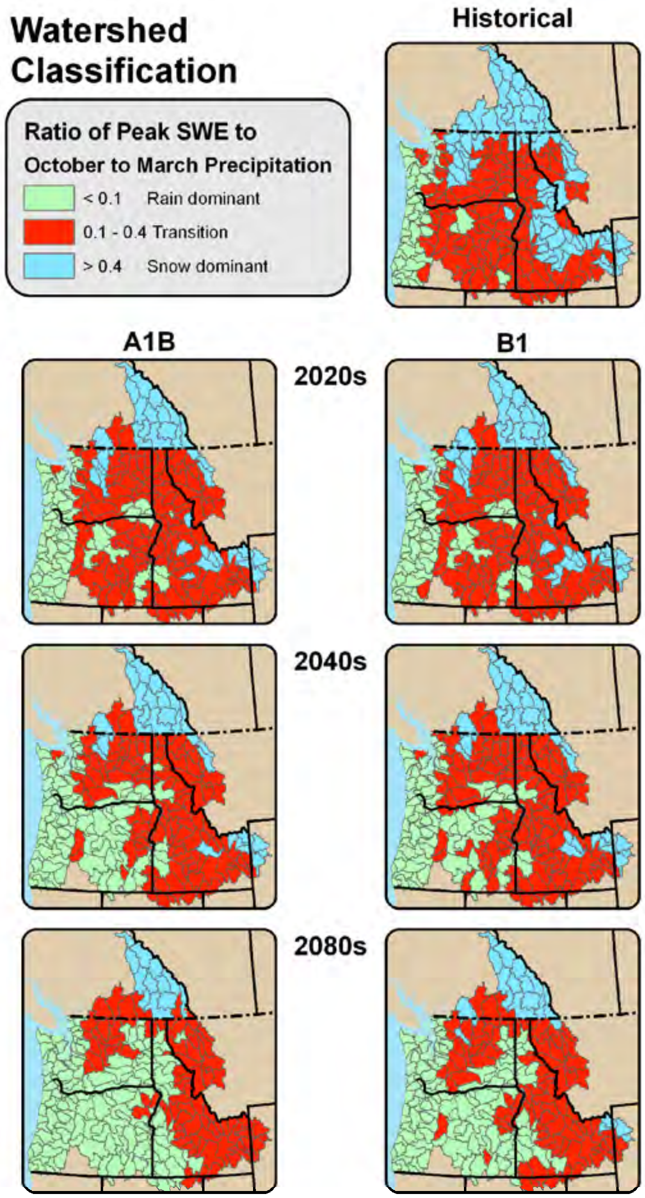


Source: Mote and Salathe 2010.
Note: The black curve for each panel is the weighted average of all models during the twentieth century. The colored curves are the weighted average of all models in that emissions scenario ("low" or B1, and "medium" or A1B) for the twenty-first century. The colored areas indicate the range (5th to 95th percentile) for each year in the twenty-first century. All changes are relative to 1970 to 1999 averages.

Figure M-12. Simulated temperature change (top panel) and percent precipitation change (bottom panel) in the Pacific Northwest using twentieth and twenty-first century global climate model simulations.

In addition to changes in the amount of precipitation, a major concern in the Pacific Northwest is the change in the form of winter precipitation expected due to warmer temperatures. CIG has modeled changes in the current and future peak SWE versus October to March precipitation for fourth-level HUC watersheds in the Columbia Basin Area, including the Blitzen watershed (Figure M-13). They have classified watersheds into three categories to reflect projections of the dominant precipitation regime: snow (peak SWE/O-M pcp >0.4), transition (peak SWE/O-M pcp = 0.1 to 0.4), and rain (peak SWE/O-M pcp <0.1). Generally, there is a large shift in the Pacific Northwest from snow and transition basins to rain basins. In basins where these changes occur, there will likely be a tendency for higher winter flows and possible increased risk of flooding, earlier snowmelt and runoff peaks, and lower summer streamflows.

The Blitzen watershed is currently classified as a transition basin and is projected to remain that way until the 2080s under the A1B scenario and through the 2080s under the B1 scenario, when it will become a rain basin. This shift to a rain basin occurs more slowly than in many of the surrounding basins in the Pacific Northwest, and the Blitzen watershed appears to be more resilient to climate change, probably because of the higher elevation and cooler climate in the Steens Mountain area.



Note: The Blitzen watershed is not identified in this figure; however, it is the small, isolated basin in southeastern Oregon shown in red in the lowest right figure.

Figure M-13. Ratio of April 1st SWE to total March to October precipitation for the historical period (1916–2006) for the A1B scenario (left panel), and for the B1 scenario (right panel) at three future time periods (2020s, 2040s, 2080s).

M.5 Observed and Predicted Ecological Response to Climate Change in the Region

An emerging body of literature indicates that over the past three decades, the changes in the climate system described above—including the anthropogenic component of warming— have caused physical and biological changes in a variety of ecosystems (IPCC 2007; Parmesan 2006; Root et al.

2003) that are discernable at the global scale. These changes include shifts in genetics (Bradshaw and Holzapfel 2006), species' ranges, phenological patterns, and life cycles (reviewed in Parmesan 2006). Most (85 percent) of these observed ecological responses have been in the expected direction (e.g., poleward shifts in species distributions) and are very likely due to climate change. Climate change has and will continue to combine with other non-climate stressors to impact ecosystems and threaten biodiversity. In the Great Basin, climate change, invasive species, habitat fragmentation, and rangeland and riparian degradation have placed numerous species at risk, including sage grouse and redband trout (Chambers and Pellant 2008).

Disturbances, both natural and human-induced, shape ecosystems by influencing their composition, structure, and function. One observed response to climate change in the Pacific Northwest is the change in disturbance regimes like fire and insect/disease outbreaks. Increased spring and summer temperatures, earlier snowmelt, and prolonged drought, have contributed to longer fire seasons and an increase in wildfire activity in the Pacific Northwest. Westerling et al. (2006) evaluated the effects of both land use histories and climate on wildfire and concluded that the increase in fire frequency in the past two to three decades has been driven primarily by recent changes in climate. Areas in southern Oregon, northern California, and the northern Rockies have been especially vulnerable to these changes.

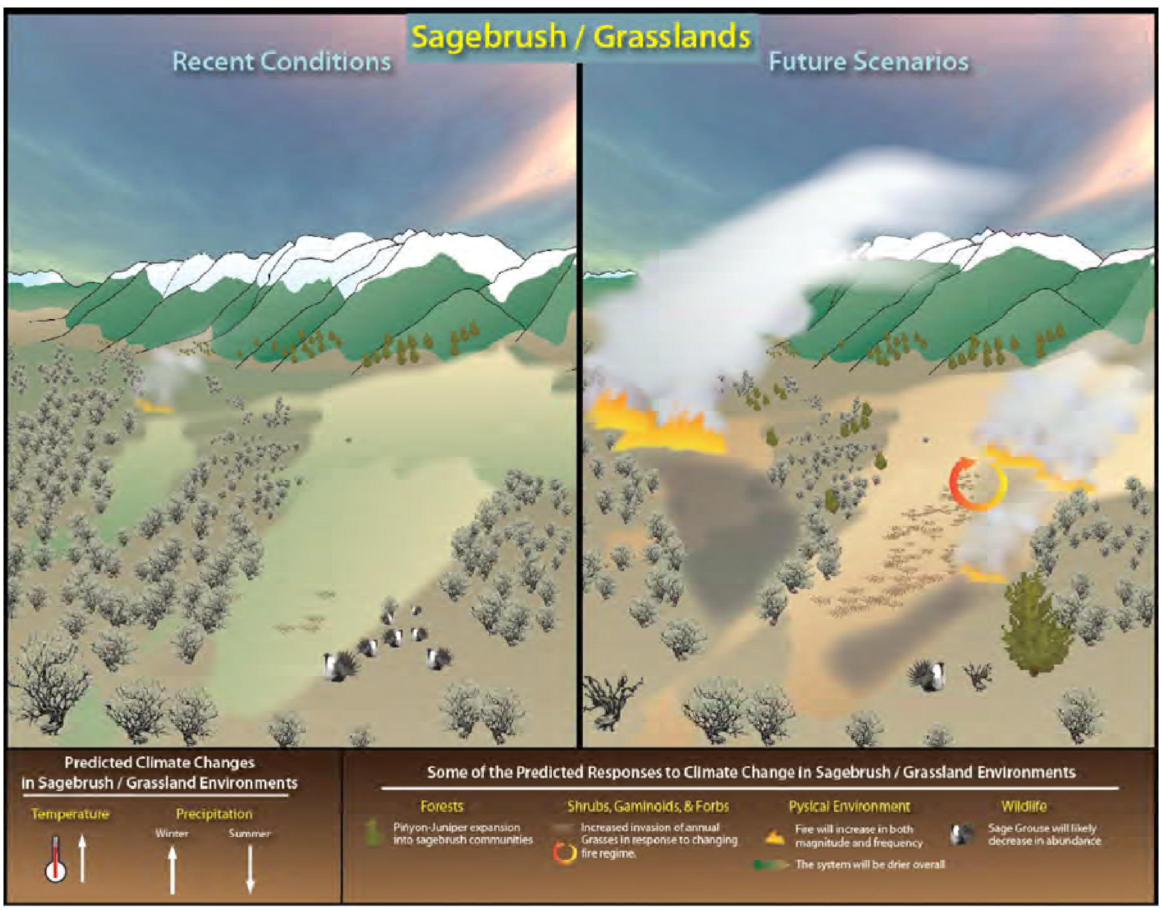
Since the mid-1990s, an outbreak of mountain pine beetles has reached unprecedented levels in terms of acreage, northern expansion and distribution, and number of trees killed (Bentz 2008) (Figure M-14). In addition to lodgepole pine, the beetle is starting to cause mortality in whitebark and limber pine at high elevations. Climate change is partly responsible for these trends. Warmer temperatures have facilitated bark beetle outbreaks in three ways: 1) drought stress makes trees more vulnerable to attack; 2) warmer winters mean less mortality for overwintering insects; and 3) insect populations respond to increased temperatures by speeding up their reproductive cycles (e.g., to one-year life cycles).

Source: British Columbia Ministry of Forests, Lands, and Natural Resource Operations 2011.

Figure M-14. Mountain pine beetle damage in British Columbia.

The effects of climate change and non-native invasive species may combine to increase invasion risk to ecosystems. Bradley (2009) showed that the potential area for cheatgrass (*Bromus tectorum*) invasion, which is sensitive to precipitation and temperature, increased up to 45 percent in the western United States with decreasing summer precipitation and warmer winter temperatures. Cheatgrass invasion also works in conjunction with climate change to alter fire regimes. Frequent fires promote invasive grasses like cheatgrass, and large grassland fires are more likely in a warmer, drier climate with exotic grasses present. The cheatgrass fire cycle has been a major factor in the decline of sagebrush steppe ecosystems, and climate change is likely to exacerbate this decline (Chambers and Pellant 2008).

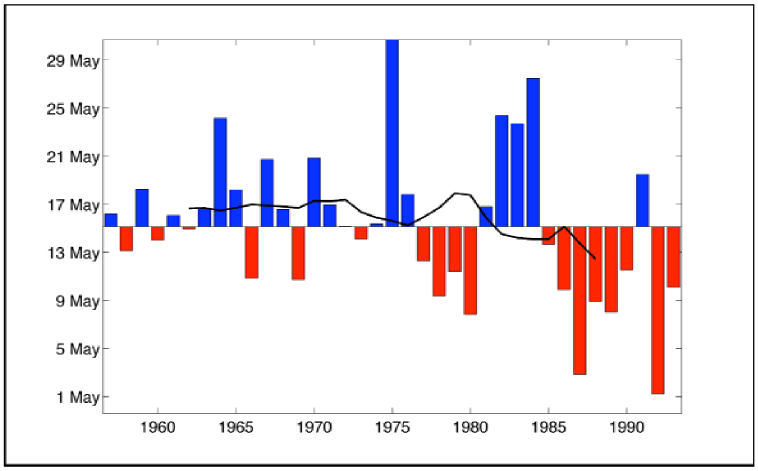
Climate change is also expected to cause major changes in grassland and sagebrush distribution across the landscape (Bachelet et al. 2001). Range expansions of woody species are predicted to continue, particularly the expansion of pinyon-juniper into sagebrush steppe and grasslands (Rowland et al. 2008), resulting in a decrease in sagebrush and an increase in woodlands across the West (Figure M-15). More frequent wildfires may favor non-native invasives and exacerbate the loss of big sagebrush, a keystone species that is not very fire-tolerant. In the Great Basin, current sagebrush habitat is predicted to decrease 12 percent for each 1°C increase in temperature, partly because of these factors (Chambers and Pellant 2008). However, more frequent fires might also limit juniper expansion.



Source: Ashton 2010.

Figure M-15. Illustration of climate change impacts to sagebrush/grassland communities.

Another ecological response to climate change is the change in timing of phenological events like leaf-out, flowering, senescence, migration, hibernation, and insect emergence. These events are often sensitive to variations in temperature and precipitation. There are indications that some of these events are responding to climate change. From 1957 to 1994, flowering of lilacs (*Syringa vulgaris*) and honeysuckle (*Lonicera tatarica* and *L. korolkowii*) have shown an advance of 7.5 and 10 days, respectively, in the West. This is most likely due to the 2°F-5°F increase in spring temperatures during that period (Cayan et al. 2001). In Idaho, the average bloom date for lilacs advanced one week from 1957 to 1993 (Figure M-16). Warmer temperatures will continue to affect the timing of reproduction, emergence, and migration of numerous species, which may affect community structure and function. On the other hand, phenological events that are tied to day length rather than climate, such as the emergence of many plants, are not expected to change. These asynchronous responses of different species to climate change may alter species' interactions (e.g., predator–prey relationships and competition) and have unforeseen consequences.

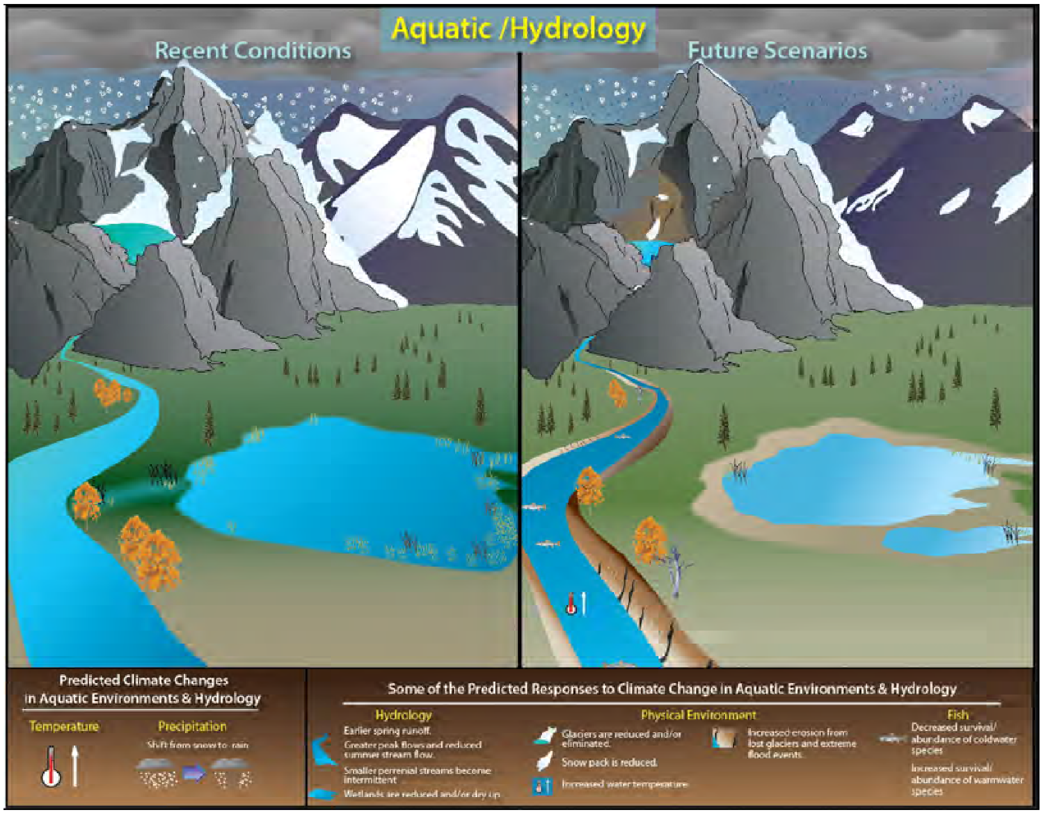


Source: Gillis et al. 2011.

Figure M-16. Average statewide bloom date of lilacs in Idaho, 1957 to 1993.

Climate change has a large potential to impact aquatic ecosystems in the Pacific Northwest (Figure M-17). Although there have been few climate change impacts on Blitzen streamflow to date, aquatic habitats at Malheur NWR, including rivers, streams, springs, wetlands, and wet meadows, face future threats from climate change. River and stream temperatures may increase with warmer air temperatures and longer growing seasons, threatening redband trout. Water temperatures in the Blitzen River are already quite warm; 7-day average maximum temperatures are frequently near 25°C in the summer (Mayer et al. 2007). Even at the upstream end, where the river enters the Refuge from the canyon, water temperatures exceeded the state standard of 20°C for an average of 64 days during the summers of 2003 and 2005 (Mayer et al. 2007).

Evaporative and seepage losses in wetlands and wet meadows may increase due to warmer temperatures, longer growing seasons, drier soils, and lower water tables, potentially limiting the available habitat that can be sustained for migratory waterfowl. Changes in transpiration are uncertain. There may be less transpiration because of greater photosynthetic efficiency from higher CO_2 concentrations in the atmosphere, but higher CO_2 concentrations could also mean more plant growth, plant leaf area, and increased transpiration. Earlier runoff and higher evaporation losses could cause a decrease in wetland acreage that can be maintained on the Refuge given the Refuge's water supply.



Source: Ashton 2010.

Figure M-17. Illustration of climate change impacts to aquatic communities.

M.6 Climate Change Adaptation Strategies

The slower response and apparent resilience of the Blitzen watershed to climate change may provide the Refuge with an opportunity to develop and implement climate change adaptation strategies (or adjustments in management). The goal of adaptation is to reduce the risk of adverse environmental outcomes through activities that increase the resilience of ecosystems to climate change and other stressors (United States Climate Change Science Program [USCCSP] 2008). Resilience is defined as the amount of change or disturbance a system can absorb without undergoing a fundamental shift to a different set of processes and/or structures. One of the most effective means of increasing resilience is to reduce or eliminate non-climate stressors.

Climate change will combine with other non-climate stressors to exacerbate existing problems with water supply, aquatic resources, invasive weeds, and ecosystem function on the Refuge. Even now, there are difficulties balancing the needs of water management for wetlands with the needs of in-stream flows for fish. Wetland irrigation and water management on the Refuge decrease river flows, exacerbate high water temperatures, and reduce dissolved oxygen concentrations in the river (Mayer et al. 2007). River temperatures are already at or near the limit of tolerance for redband trout on most of the Refuge. The river has been channelized to facilitate drainage and water delivery. Riparian vegetation is limited and the river habitat is degraded, with little complexity. Wetland and wet meadow habitats on the Refuge are threatened by several non-native invasive plant species including perennial pepperweed, Russian olive, and reed canarygrass. Aquatic and riverine habitats are threatened by non-native carp.

Reducing non-climate stressors means controlling invasive species and could include restoring the river, rehabilitating riparian vegetation, reestablishing, where possible, the natural sinuosity of the channel, and reconnecting, where viable, valley wetlands and floodplains with the river channel. Reducing the impacts of current stressors is a “no regrets” adaptation strategy that could be taken now to enhance ecosystem resilience to climate change. These activities will require time. Fortunately, the fact that climate change impacts are slower to manifest themselves here compared with other areas would allow more time to implement these restoration activities.

Key to the successful implementation of these adaptation and restoration strategies will be the monitoring of results. The National Weather Service (NWS) weather stations, the USGS Blitzen River gage, and the two Natural Resources Conservation Services (NRCS) SNOTEL sites on Steens Mountain will continue to provide very valuable climate and streamflow information on the local impacts of climate change. It is in the Refuge’s best interest to see that these sites are maintained and monitored in the future. The Water Resources Branch monitors streamflows and diversions at several sites on the Refuge—this should be continued as well. The Branch also monitored water temperatures in the river during the summers of 2002, 2003, and 2005. This seasonal water temperature monitoring should be continued in the future. Finally, ongoing efforts to monitor and contain invasive species will be important for providing information on the status of non-climate stressors.

Monitoring may provide information that will require modification of adaptation strategies or point to new restoration needs. One method for integrating new information into resource management decisions, given uncertainty, is adaptive management. Adaptive management is a process that promotes flexible decision making so that adjustments are made to decisions as outcomes from management actions and other events are better understood. This method supports managers in taking action today using the best available information while also providing the possibility of ongoing future refinements through an iterative learning process.

M.7 References

Ashton, I.W. 2010. Observed and projected ecological response to climate change in the Rocky Mountains and the Upper Columbia Basin. Natural Resource Report NPS/ROMN/NRR—2010/220. National Park Service. Fort Collins, CO.

Bachelet, D., R.P. Neilson, J.M. Lenihan, and R.J. Drapek. 2001. Climate change effects on vegetation distribution and carbon budget in the United States. Ecosystems 4:164-185.

Bentz, B. 2008. Western U.S. bark beetles and climate change. USDA Forest Service, Climate Change Resource Center. Available at: http://www.fs.fed.us/ccrc/topics/bark-beetles.shtml. Accessed

Bowers, W., R. Smith, R. Messmer, C. Edwards, and R. Perkins. 1999. Conservation status of Oregon basin redband trout. Oregon Department of Fish and Wildlife. Hines, OR.

Bradley, B.A. 2009. Regional analysis of the impacts of climate change on cheatgrass invasion shows potential risk and opportunity. Global Change Biology 15:196-208.

Bradshaw, W.E. and C.M. Holzapfel. 2006. Evolutionary response to rapid climate change. Science 312:1477-1478.

British Columbia Ministry of Forests, Lands, and Natural Resource Operations. 2011. Photos: aerial view of extensive attack by mountain pine beetle. Available at: http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/images/Jul1-8_roll1_Williams_Lake_MPB1.jpg. Accessed August 19, 2011.

Cayan, D.R., S.A. Kammerdiener, M.D. Dettinger, J. Caprio, and D.H. Peterson. 2001. Changes in the onset of spring in the western United States. Bulletin of the American Meteorological Society 82:399-415.

Chambers, J.C., B.A. Roundy, R.R. Blank, S.E. Meyer, and A. Whittaker. 2007. What makes Great Basin sagebrush ecosystems invasible by *Bromus tectorum*? Ecological Monographs 77:117-145.

Chambers J.C., and M. Pellant. 2008. Climate change impacts on northwestern and intermountain United States rangelands. Society of Range Management. Available at: http://www.treesearch.fs.fed.us/pubs/30834.

CIG (Climate Impacts Group, University of Washington). 2010. Analysis of extreme events. Available at: http://www.hydro.washington.edu/2860/report/. Accessed August 19, 2011.

CIG. 2011. Past and future trends in PNW climate. Available at: http://cses.washington.edu/cig/pnwc/pnwc.shtml#pastfuture. Accessed August 19, 2011.

Daly, C. 2002. Climate division normal derived from topographically-sensitive grids. Proceedings of the 13th AMS Conference on Applied Climatology, American Meteorological Society, May 13-16, 2002, Portland, OR, 177-180.

Daly et al. 2008. Physiographically sensitive mapping of climatological temperature and precipitation across the conterminous United States. International Journal of Climatology. doi 10.1002/joc.1688.

EPA (Environmental Protection Agency). 2010. Climate change indicators in the United States. U.S. Environmental Protection Agency. Washington D.C.

Gillis, S., B. Knapp, J. Wolf, J. Izo, K. McElligott, J. Reader, A.Peterson, D. VanSant, and N. Weller. 2011. Indicators of climate change in Idaho. Report Summary, University of Idaho, Moscow, ID. Available at: http://webpages.uidaho.edu/jabatzoglou/PDF/IndicatorsofClimateChangeIdaho.pdf.

Hall, M.H.P. and D.B. Fagre. 2003. Modeled climate-induced glacier change in Glacier National Park, 1850-2100. Bioscience 53(2):131-140.

Hamlet, A.F. and D.P. Lettenmaier. 2007. Effects of 20th century warming and climate variability on flood risk in the western U.S. Water Resources Research 43, W06427, doi:10.1029/2006WR005099.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate change 2007: the physical science basis. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor, and H.L. Miller, eds. Cambridge, United Kingdom and New York: Cambridge University Press.

Knowles, N., M.D. Dettinger, and D.R. Cayan. 2006. Trends in snowfall versus rainfall in the western United States. Journal of Climate 19(18):4545-4559.

Mayer, T., K. Janssen, T. Hallock, and R. Roy. 2007. Blitzen River temperature monitoring. Pages 1-24, Chapter 5 in: OR–Assessment of degraded water quality effects associated with habitat and water management of wetlands and meadows at Malheur National Wildlife Refuge. Regional One, Regional Office, U.S. Fish and Wildlife Service. Portland, OR.

Menne, M.J., C.N. Williams, Jr., and R.S. Vose. 2009. United States Historical Climatology Network (USHCN) Version 2 Serial Monthly Dataset. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory. Oak Ridge, TN.

Menne, M.J., C.N. Williams, Jr., and R.S. Vose. United States Historical Climatology Network (USHCN) Version 2 Serial Monthly Dataset. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory. Oak Ridge, TN. Available at: http://cdiac.ornl.gov/epubs/ndp/ushcn/monthly_doc.html.

Mote, P.W., A.F. Hamlet, M.P. Clark, and D.P. Lettenmaier. 2005. Declining mountain snowpack in western North America. Bulletin of the American Meteorological Society 86(1):39-49.

Mote, P.W. and E.P. Salathe. 2010. Future climate in the Pacific Northwest. Climate Change 109:29-50.

NAS (National Academy of Sciences). 2008. Understanding and responding to climate change: highlights of national academies reports. 2008 edition. Board on Atmospheric Sciences and Climate, National Academy of Sciences. Washington D.C.

NCDC (National Climatic Data Center). 2010. State of the climate, annual 2010. Available at: http://www.ncdc.noaa.gov/sotc/2010/13.

NRCS (Natural Resources Conservation Service). 2011. SNOTEL data and products. Available at: http://www.wcc.nrcs.usda.gov/snow/. Accessed August 19, 2011.

Parmesan, C. 2006. Ecological and evolutionary responses to recent climate change. Annual Review of Ecology, Evolution, and Systematics 37: 637-669.

Root, T.L., J.T. Price, K.R. Hall, S.H. Schneider, C. Rosenzweig, and J.A. Pounds. 2003. Fingerprints of global warming on wild animals and plants. Nature 421:57-60.

Rowland, M.M., L.H. Suring, R.J. Tausch, S. Geer, and M.J. Wisdom. 2008. Characteristics of western juniper encroachment into sagebrush communities in central Oregon. USDA Forest Service Forestry and Range Sciences Laboratory. La Grande, OR.

Stewart, I.T., D.R. Cayan, and M.D. Dettinger. 2005. Changes toward earlier streamflow timing across western North America. Journal of Climate 18(8):1136-1155.

USCCSP (United States Climate Change Science Program). 2008. Preliminary review of adaptation options for climate-sensitive ecosystems and resources. United States Climate Change Science Program. Final Report, Synthesis and Assessment Product 4.4. Washington, D.C.

USGCRP (U.S. Global Change Research Program). 2009. Global climate change impacts in the United States. Karl, Thomas R., Jerry M. Melillo, and Thomas C. Peterson, eds. New York: Cambridge University Press.

USGS (U.S. Geological Survey) Northern Rocky Mountain Science Center. 2011. Grinnell Glacier from Overlook 1940-2006-old. Available at: http://www.nrmsc.usgs.gov/repeatphoto/gg_overlook_old.htm. Accessed August 19, 2011.

Westerling, A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. Science 313:940-943.

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White-faced ibis
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Appendix N

List of Common and Scientific Names Used in the Malheur National Wildlife Refuge CCP

Table N-1. Birds

Common Name	**Scientific Name**
American bittern	*Botaurus lentiginosus*
American coot	*Fulica americana*
American white pelican	*Pelecanus erythrorhynchos*
American wigeon	*Anas americana*
Bobolink	*Dolichonyx oryzivorus*
Burrowing owl	*Athene cunicularia*
California quail	*Callipepla californica*
Canada goose	*Branta canadensis*
Canvasback	*Aythya valisineria*
Cinnamon teal	*Anas cyanoptera*
Common raven	*Corvus corax*
Common snipe	*Gallinago gallinago*
Eastern kingbird	*Tyrannus tyrannus*
Gadwall	*Anas strepera*
Great horned owl	*Bubo virginianus*
Greater sandhill crane	*Grus canadensis tabida*
Lark sparrow	*Chondestes grammacus*
Long-billed curlew	*Numenius americanus*
Long-eared owl	*Asio otus*
Mallard	*Anas platyrynchos*
Northern harrier	*Circus cyaneus*
Northern pintail	*Anas acuta*
Northern shoveler	*Anas clypeata*
Pied-billed grebe	*Podilymbus podiceps*
Redhead	*Aythya americana*
Red-winged blackbird	*Agelaius phoeniceus*
Ring-necked pheasant	*Phasianus colchicus*
Ruddy duck	*Oxyura jamaicensis*
Sharp-tailed grouse	*Tympanuchus phasianellus*
Trumpeter swan	*Cygnus buccinator*
Western grebe	*Aechmophorus occidentalis*

Common Name	Scientific Name
White-faced ibis	*Plegadis chihi*
Willow flycatcher	*Empidonax traillii*
Wilson's phalarope	*Phalaropus tricolor*
Yellow warbler	*Dendroica petechia*

Table N-2. Mammals

Common Name	Scientific Name
American badger	*Taxidea taxus*
American mink	*Neovison vison*
Beaver	*Castor canadensis*
Bighorn sheep	*Ovis canadensis*
Black-tailed jackrabbit	*Lepus californicus*
Bobcat	*Lynx rufus*
Bushy-tailed woodrat	*Neotoma cinerea*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Desert woodrat	*Neotoma lepida*
Dusky-footed woodrat	*Neotoma fuscipes*
Elk	*Cervus canadensis*
Golden-mantled ground squirrel	*Callospermophilus lateralis*
Great Basin pocket mouse	*Perognathus parvus*
Kangaroo rat	*Dipodomys* spp.
Least chipmunk	*Neotamias minimus*
Malheur shrew	*Sorex preblei*
Merriam’s shrew	*Sorex merriami*
Montane vole	*Microtus montanus*
Mountain lion (Cougar)	*Puma concolor*
Mule deer	*Odocoileus hemionus*
Muskrat	*Ondatra zibethica*
Northern grasshopper mouse	*Onychomys leucogaster*
Northern pocket gopher	*Thomomys talpoides*
Nuttal’s cottontail	*Sylvilagus nuttallii*

Common Name	Scientific Name
Preble's shrew	*Sorex preblei*
Pronghorn antelope	*Antilocapra americana*
Pygmy rabbit	*Brachylagus idahoensis*
Raccoon	*Procyon lotor*
Red fox	*Vulpes vulpes*
River otter	*Lontra canadensis*
Sagebrush vole	*Lemmiscus curtatus*
Townsend's ground squirrel	*Urocitellus townsendii*
Townsend's pocket gopher	*Thomomys townsendii*
Weasel	*Mustela* spp.
Yellow-bellied marmots	*Marmota flaviventris*

Table N-3. Bats

Common Name	Scientific Name
Fringed myotis	*Myotis thysanodes*
Long-legged myotis	*Myotis volans*
Spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Corynorhinus townsendii*
Western small-footed myotis	*Myotis ciliolabrum*
Yuma myotis	*Myotis yumanensis*

Table N-4. Fish

Common Name	Scientific Name
Bluegill	*Lepomis macrochirus*
Bridge lip sucker	*Catostomus columbianus*
Brown bullhead	*Ictalurus nebulosus*
Chisel mouth sucker	*Acrocheilus alutaceus*
Coarse scale sucker	*Castostomus macrocheilus*
Common Carp	*Cyprinus carpio*
Green sunfish	*Lepomis cyanellus*
Large-mouthed bass	*Micropterus salmoides*
Longnose dace	*Rhinichthys cataractae*

Common Name	Scientific Name
Malheur mottled sculpin	*Cottus bendirei*
Mosquito fish	*Gambusia affinis*
Mountain whitefish	*Prosopium williamsoni*
Northern pike minnow	*Ptychocheilus oregonensis*
Pumpkinseed	*Lepomis gibbosus*
Rainbow trout	*Oncorhynchus mykiss*
Red-band trout	*Oncorhynchus mykiss gairdnerii*
Red-sided shiner	*Leuciscus elongatus*
Speckled dace	*Rhinichthys osculus*
Tui Chub	*Gila bicolor*
White crappie	*Pomoxis annularis*
Yellow bullhead	*Ictalurus natalis*
Yellow perch	*Perca flavescens*

Table N-5. Mollusks

Common Name	Scientific Name
Bivalve mollusk	*Musculium* spp.

Table N-6. Reptiles and Amphibians

Common Name	Scientific Name
American bullfrog	*Rana catesbeiana*
Collared lizard	*Crotaphytus collaris*
Columbian spotted frog	*Rana luteiventris*
Common garter snake	*Thamnophis sirtalis*
Desert horned lizard	*Phrynosoma platyrhinos*
Gopher snake	*Pituophis catenifer catenifer*
Great basin spadefoot	*Spea intermontana*
Leopard lizard	*Gambelia wislizenii*
Long-toed salamander	*Ambystoma macrodactylum*
Night snake	*Hypsiglena torquata*
Pacific tree frog	*Pseudacris regilla*
Racer	*Drymobius* spp.

Common Name	Scientific Name
Rubber boa	*Charina bottae*
Sagebrush lizard	*Sceloporus graciosus*
Short-horned lizard	*Phrynosoma hernandesi*
Side-blotched lizard	*Uta stansburiana*
Spade-foot toads	*Spea hammondii*
Striped whipsnake	*Masticophis taeniatus*
Western fence lizard	*Sceloporus occidentalis*
Western ground snake	*Sonora semiannulata*
Western rattlesnake	*Crotalus oreganus*
Western skink	*Plestiodon skiltonianus*
Western terrestrial garter snake	*Thamnophis elegans*
Western toad	*Anaxyrus boreas*
Western whiptail	*Aspidoscelis tigris*

Table N-7. Invertebrates

Common Name	Scientific Name
Brine fly	*Ephydra* spp.
Brine shrimp	*Artemia* spp.
Thistle beetle	*Ceutorhynchus litura*
Thistle stem gall fly	*Urophora cardui*
Thistle weevil	*Rhinocyllus conicus*

Table N-8. Plants

Common Name	Scientific Name
Alder	*Alnus*
Alkali bluegrass	*Poa juncifolia*
Alkali cordgrass	*Spartina gracilis*
Alkali sacaton	*Sporobolus airoides*
Alkali saltgrass	*Distichlis spicata*
American sloughgrass	*Beckmannia syzigachne*
American speedwell	*Veronica americana*
Antelope bitterbrush	*Purshia tridentata*

Common Name	**Scientific Name**
Arrow-grass	*Triglochin palustris*
Arrowleaf balsam root	*Balsamorhiza sagittata*
Baltic rush	*Juncus balticus*
Basin big sagebrush	*Artemisia tridentata*
Basin wildrye	*Leymus cinereus*
Bladderwort	*Utricularia* spp.
Bluebunch wheatgrass	*Pseudoroegneria spicata*
Bluejoint	*Calamagrostis canadensis*
Bottlebrush squirreltail	*Elymus elymoides*
Bud sagebrush	*Picrothamnus desertorum*
Bull thistle	*Cirsium vulgare*
Bur-reed	*Sparganium eurycarpum*
Canada thistle	*Cirsium arvense*
Canadian waterweed	*Elodea canadensis*
Cattail	*Typha* spp.
Cheatgrass	*Bromus tectorum*
Chokecherry	*Prunus virginiana L.* var. *demissa*
Cinquefoil	*Potentilla L.*
Common duckweed	*Lemna minor*
Common reed	*Phragmites australis*
Common snowberry	*Symphoricarpos albus*
Coontail (Hornwart)	*Ceratophyllum demersum*
Coyote willow	*Salix exigua Nutt.*
Creeping wildrye	*Leymus triticoides*
Crested wheatgrass	*Agropyron cristatum*
Diffuse knapweed	*Centaurea diffusa*
False lupine (bush pea)	*Thermopsis villosa*
Fourwing saltbush	*Atriplex canescens*
Fringed willow-herb	*Epilobium ciliatum*
Geyer’s milkvetch	*Astragalus Geyeri*
Golden currant	*Ribes aureum Pursh*
Goose berry	*Ribes hirtellum*

Common Name	**Scientific Name**
Greasewood	*Sarcobatus* spp.
Greater duckweed	*Spirodela polyrhiza*
Hardstem bulrush	*Scirpus acuta*
Hawthorn	*Crataegus L.*
Horned pondweed	*Zannichellia palustris*
Hornwort fruits	*Ceratophyllum*
Indian ricegrass	*Achnatherum hymenoides*
Inland saltgrass	*Distichlis spicata*
Italian thistle	*Carduus pynocephalus*
Kentucky bluegrass	*Poa pratensis*
Lanceleaf goldenweed	*Pyrrocoma lanceolata*
Large-leafed avens	*Geum macrophyllum*
Leafy pondweed	*Potamogeton foliosus*
Lewis' mock orange	*Philadelphus lewisii Pursh*
Locoweed	*Astragalus* spp.
Lupine	*Lupinus* spp.
Malheur wire-lettuce	*Stephanomeria malheurensis*
Mat muhly	*Muhlenbergia richardsonis*
Meadow barley	*Hordeum brachyantherum*
Meadow foxtail	*Alopecurus pratensis*
Medusahead rye	*Taeniatherum* spp.
Milkweed	*Asclepias* spp.
Oregon checkermallow	*Sidalcea oregana*
Mountain big sagebrush	*Artemisia tridentata* ssp. *vaseyana*
Nebraska sedge	*Carex nebraskensis*
Needle-and-thread grass	*Stipa comata*
Nevada bluegrass	*Poa nevadensis*
Northwest cinquefoil	*Potentilla gracilis*
Orchardgrass	*Dactylis glomerata*
Paiute suncup	*Camissonia scapoidea*
Perennial pepperweed	*Lepidium latifolium*
Phlox	*Phlox* spp.

Common Name	**Scientific Name**
Pinyon	*Pinus* spp.
Poison hemlock	*Conium maculatum*
Pondweed	*Potamogenton*
Povertyweed	*Iva axillaris*
Puncture vine	*Tribulus terrestris*
Quackgrass	*Agropyron repens*
Rabbitbrush	*Chrysothamnus* spp.
Red top	*Agrostis gigantea*
Redosier dogwood	*Cornus sericea L.*
Reed canarygrass	*Phalaris arundinacea L.*
Russian knapweed	*Acroptilon repens*
Russian olive	*Elaeagnus angustifolia L.*
Russian thistle	*Salsola kali L.*
Sago pondweed	*Stuckenia pectinata*
Salt cedar	*Tamarix ramosissima*
Saltlover	*Halogeton glomeratus*
Sandberg's bluegrass	*Poa secunda*
Saskatoon serviceberry	*Amelanchier alnifolia*
Scotch thistle	*Onopordum acanthium*
Scouler's willow	*Salix scouleriana*
Sedge	*Scirpus*
Seepweed (wada)	*Sueda depressa*
Sharpleaf penstemon	*Penstemon acuminatus*
Shortspine horsebrush	*Tetradymia spinosa*
Shrubby cinquefoil	*Dasiphora fruticosa*
Silver buffaloberry	*Shepherdia argentea*
Silver sagebrush	*Artemisia cana*
Slender cinquefoil	*Potentilla gracilis*
Slender-beaked sedge	*Carex athrostachya*
Small pondweed	*Potamogeton pusillus*
Smooth brome	*Bromus inermis*
Spike bentgrass	*Agrostis exarata*

Common Name	**Scientific Name**
Three-tip sagebrush	*Artemisia tripartita*
Thurber’s needlegrass	*Achnatherum thurberianum*
Timothy grass	*Phleum pratense*
Tufted evening primrose	*Oenothera caespitosa*
Tufted hairgrass	*Deschampsia caespitosa*
Water birch	*Betula occidentalis*
Water milfoil	*Myriophyllum* spp.
Water sedge	*Carex aquatilis*
Waterweed	*Elodea canadensis*
Western horsetail	*Equisetum arvense*
Western juniper	*Juniperus occidentalis*
Western needlegrass	*Achnatherum occidentale* ssp.
Western yarrow	*Achillea millefolium*
Wheat sedge	*Carex atherodes*
White water buttercup	*Ranunculus aquatilis*
White water crowfoot	*Ranunculus aquatilis*
Whitetop	*Cardaria* spp.
Widgeongrass	*Ruppia*
Willow	*Salix* spp.
Wood’s rose	*Rosa woodsii*
Wooly sedge	*Carex pellita*
Wyoming big sagebrush	*Artemisia tridentata Nutt.* ssp. *wyomingensis*
Yellow monkey-flower	*Mimulus guttatus*

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Cinnamon teal
©Peter Baer

Appendix O

Advancing Sustainability-Based Approaches and Practices

O.1 Sustainability Philosophy

From local to global and back again, our National Wildlife Refuges are a sanctuary of the past, a bridge to the future, and a natural laboratory with real consequences in which we test our ability to navigate successfully between the past and the future for the sake of our own and all other species.

Refuge policy and practice are directly and indirectly responsible for being part of the solution and/or part of the problem. For example, what makes us think that the majesty of the Refuge is sustainable in the face of uncontrolled carp populations, or that polar bears are sustainable in the face of an ice-free Arctic Ocean?

The word "sustainability" has come into common use only in the past 25 years, most formally in 1987 when the Brundtland Commission defined sustainable development as "… meeting the needs of the present without compromising the ability of future generations to meet their own needs."

This widely published definition says much about the ethics and responsibility of one generation to the next. Sustainability is how we commonly think in terms of leaving the nation and world a better place for our children and grandchildren, whether in regard to family, land, and finances, or in terms of public lands and resources.

As such, it is a reinforcement of traditional American values of protection of our natural and cultural resources, self-sufficiency, self-determination, ingenuity, and responsibility in balance with life, liberty, and the pursuit of happiness.

At the core of our deliberations must be how sustainability-based planning, design, and management practices are absolutely essential to biodiversity and to native species, the viability of their populations, and the habitats that must be conserved, protected, restored, and expanded if we are to live up to the traditional American values that preserved them in the first place.

Sustainability-based planning, design, and management are also essential for, if not synonymous with, the local communities and native tribes and cultures that were indigenous to these lands for thousands of years before European settlement. All of these are major partners in Refuge sustainability initiatives.

The planning, design, and management practices of the past have served us well. However, the best available science now indicates that there are fundamentally different questions that we need to address in regards to emerging issues, many of which have profound implications.

Besides water, the most clear and present danger to the future of America's natural heritage, if not our entire national security, is fossil fuel energy dependence (especially oil and coal) and climate change. If ever there was a role for America's public lands to play in meeting both the natural and cultural heritage priorities of the past and present, it is now.

There are numerous policy statements and initiatives that call for integrating sustainability-based principles and practices within the CCP.

- Malheur Refuge is one of seventeen U.S. Fish and Wildlife Service (USFWS) facilities chosen to implement the U.S. Department of the Interior's (DOI's) Environmental Management System;
- Executive Order directing Federal Leadership in Environment, Energy, and Economic Performance (October 5, 2009);
- Secretary of Interior Salazar's speech at the United Nations Conference on Climate Change in Copenhagen (December 10, 2009), entitled "New Energy Future: The Role of Public Lands in Clean Energy Production and Carbon Capture";
- USFWS Directorate Working Group, and Strategic Plan for Climate Change; and
- USFWS development of Landscape Conservation Cooperatives.

The Refuge is taking a holistic systems approach to carbon neutrality (targeting carbon negative) and energy and material efficiency in all facets of Refuge planning, design, operation, and management for meeting our mission in collaboration with our local, regional, and national stakeholders. The latest scientific data and analysis regarding the rapid scale and impact of foreign energy dependence, climate change, and associated challenges leave us little room for compromise.

As such, in the interest of contributing to national security and economic competitiveness through our mission, the Refuge must do its part in producing more energy than it consumes, storing more carbon than it produces, rapidly adapting to the range of projected climate change models, and maximizing the delivery of all other ecologic services, especially biodiversity and clean water.

The Refuge is taking the approach of the old adage that if we are not part of the solution, then we are part of the problem. If we are part of the problem, then we risk being irrelevant, if not disposable, in the eyes of the general public. Our intent is to lead.

O.2 Sustainability Actions

By integrating our conservation-based mission with the best available science, the Refuge will become a leader in advancing best design and management practices for an innovative, sustainable Refuge and community development opportunities.

- Achieve carbon neutrality (striving for carbon negative), meeting and exceeding energy and material efficiency and effectiveness as defined by U.S. DOI policies for all facets of refuge management.
- Establish performance benchmarks within our Environmental Management Plan as part of the Environmental Management System's critical first step, and then create metrics and benchmarks for all other sustainability-based practices (environmental, social, economic, and community).
- Complete energy and material use, carbon footprint, and biomass-based carbon sequestration audits.
- Integrate sustainable-based approaches and practices into partnerships, contracts, and other external stakeholder efforts.
- Provide staff and external stakeholder training for sustainability-based principles and practices, ecosystem services, social justice/equity, community development, and partnership performance standards.
- Develop projects to refit and right-size facilities, infrastructure, and vehicle fleet to maximize energy efficiency and production. Seek funding through Refuge Operations Needs and

Deferred Maintenance databases, Federal Business Management System, and other opportunistic/entrepreneurial funding sources.

O.3 Sustainability Assessments

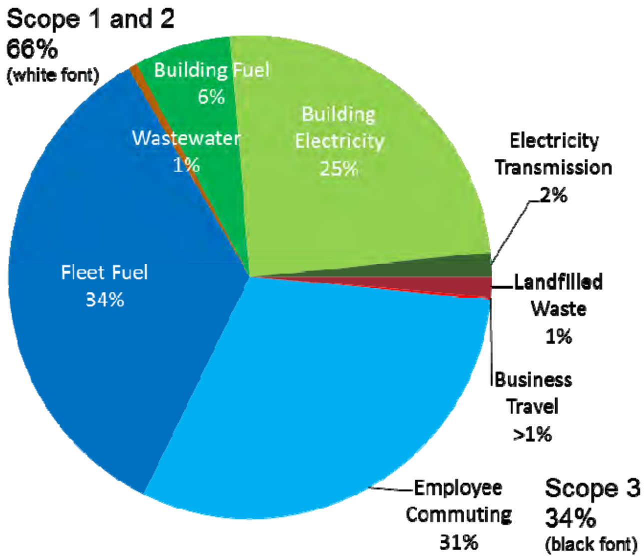
The Refuge has already initiated steps toward improving sustainability. These steps are primarily focused on sustainability assessments and planning. Sustainability assessments include conducting a comprehensive energy and water evaluation as well as preparing a greenhouse gas (GHG) emission inventory.

The findings of a Tier 1 energy and water evaluation indicate that there are many low-cost opportunities to improve energy and water performance within the Refuge's building portfolio. Many opportunities have payback periods of less than five years while other opportunities require larger capital investment and have 5- to 20-year payback periods.[1] Malheur NWR has initiated efforts to implement the energy and water conservation measures recommended by the Tier 1 energy and water evaluation.

The findings of a fiscal year (FY) 2008 baseline GHG emission inventory indicate that the Refuge's scope 1 and scope 2 GHG emissions stem primarily from building energy consumption and fleet fuel consumption.[2] Scope 1 and scope 2 GHG emissions totaled 310 metric tons of carbon dioxide equivalent (MTCO2E).

In accordance with Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, the Refuge also estimated GHG emissions for six scope 3 emission sources, including employee commuting, contracted solid waste (*landfilled waste*), business air travel, business ground travel, transmission and distribution losses (*electricity transmission*), and contracted wastewater treatment (*not applicable*). GHG emissions from scope 3 emission sources totaled 158 MTCO2E. Scope 1, scope 2, and scope 3 emission sources totaled 468 MTCO2E (Figure O-1).

[1] U.S. Fish and Wildlife Service, 2010.
[2] Scope 1 and 2 GHG emissions are primarily associated with on-site fossil fuel combustion and electricity consumption from the grid, respectively.



	MTCO2E
Scope 1	194
Building Fuel Combustion	30
Fleet Fuel Combustion	161
Wastewater	3
Scope 2	115
Building Electricity	115
Scope 3	158
Employee Commuting	144
Business Travel	1
Electricity Transmission	8
Landfilled Waste	6
Total	**468**

Figure O-1. Malheur NWR FY 2008 Greenhouse Gas Emission Inventory Results by Source

Fleet fuel combustion was the single largest emission source. Malheur NWR is a large refuge that requires considerable staff travel to conduct routine management activities such as trail maintenance, patrols, and resource management. An analysis of 25 gasoline fleet vehicles driven from April 2011 to September 2011 (6 months) indicated that on average each vehicle drives about 4,350 miles and consumes about 275 gallons of fuel—for an average fleet fuel economy of 15.8 miles per gallon (MPG), which is lower than the national average fuel economy for light-duty trucks (24.8 MPG) and passenger cars (32.9 MPG).[3] Fifteen of the gasoline vehicles had a fuel economy that fell below the refuge average while ten had a fuel economy that was above the refuge average. The most fuel-efficient vehicle was a 2008 Ford Escape Hybrid, which was also one of the top three most driven vehicles. The vehicle that was driven the most during this period was a 2010 Ford F250 (11,416 miles) (Figure O-2).

[3] Bureau of Transportation Statistics, 2012

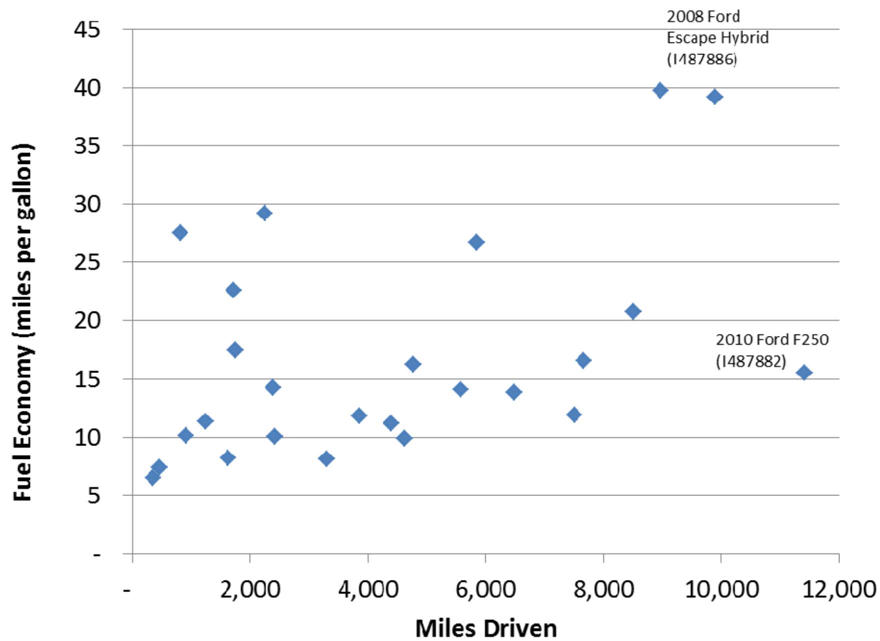


Figure O-2. Gasoline Fleet Vehicle Fuel Economy and Miles Driven by Vehicle (Apr 2011 through Sept 2011)

The GHG emission inventory also assessed the GHG emission footprint of visitor vehicle travel to and within the Refuge. These estimates were prepared using data provided by the *National Wildlife Refuge Visitor Survey (2010/2011): Individual Refuge Results for Malheur National Wildlife Refuge* (Appendix Q). GHG emissions from visitor travel to the Refuge were approximated to be 9,500 MTCO2E, annually, while emissions from visitor travel within the Refuge were approximated to be 630 MTCO2E, annually.

All GHG emission estimates were prepared using the draft *Climate Leadership in Refuges* (CLIR) Tool, which is a GHG management tool developed by the Fish and Wildlife Service in partnership with the Federal Lands Highway Program as part of the *Climate Friendly Refuges* (CFR) pilot initiative.

O.4 Sustainability Planning

The Refuge recognizes that to move toward a more sustainable future, sustainability-based practices must be integrated into the Refuge culture. Sustainability-based practices will address, and seek to improve performance within, the four aspects of sustainability identified by the Refuge—environmental, social, economic, and community. Our approach to improving environmental, social, economic, and community performance will rest on five management areas—*Purpose, Performance, Resources*, *People*, and *Leadership* (Figure O-3). These management areas are introduced below:

- *Purpose* refers to the drivers of the Refuge's sustainability commitment. These drivers will establish a vision for instituting a culture of sustainability.
- *Performance* refers to the Refuge's efforts to demonstrate, implement, and measure the Refuge's sustainability progress.

- *Resources* refers to the materials and information that will be needed to support the Refuge's sustainability commitment.
- *People* refers to the organizational capacity that is needed to support the Refuge's sustainability commitment.
- *Leadership* refers to the Refuge's efforts to demonstrate leadership through the sustainability commitment.

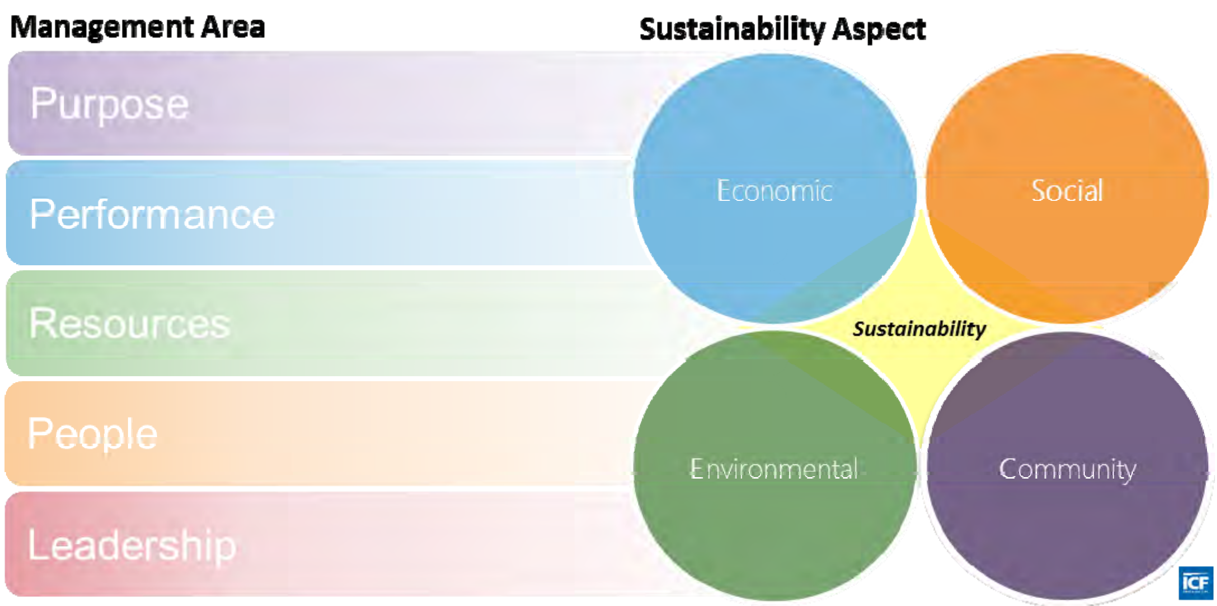


Figure O-3. Sustainability Management Areas and Aspects

We have begun to identify sustainability practices within each of the management areas to further integrate sustainability into the Refuge culture, as described below:

Purpose: The Refuge will clearly define the drivers of the Refuge's sustainability commitment. Drivers include the USFWS mission, to "work with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people", federal mandates, a commitment to improving refuge operational efficiency, and Malheur NWR's enabling legislation.

Performance: The Refuge will implement processes that allow the Refuge to implement, measure, and demonstrate sustainability performance. The primary implementation mechanism will be the Refuge's Environmental Management System—Malheur NWR is one of seventeen refuges that are required to use an Environmental Management System to improve environmental performance. The Refuge will use sustainability indicators to measure performance. Sustainability indicators identified include building energy intensity (energy consumption per gross square foot of building space); scope 1, scope 2, and scope 3 GHG emissions; fleet fuel consumption; and solid waste diversion.[4] The Refuge will demonstrate performance by tracking progress with respect to the sustainability indicators over time.

[4] Solid waste diversion is the percent of total solid waste generated that is diverted from a landfill through recycling, composting, and other means.

Resources: The Refuge will stay informed of resources (e.g., materials and information) that will assist the Refuge in improving sustainability performance. The Refuge will work with Region 1 staff to identify resource needs, such as information on best available technologies; expert consultations for fleet optimization, partnership development, renewable energy assessments, visitor engagement, and building commissioning; grant exposure and writing support; and case studies and lessons learned from other FWS sustainability activities.

People: Malheur NWR's staff consists of approximately 16 full-time employees as well as seasonal employees and volunteers. Refuge staff recognize the importance of integrating sustainability into the Refuge's operations and have committed to identifying and implementing personal sustainability projects (PSPs). Examples of Malheur NWR staff PSPs include:

- Prepare monthly energy consumption reports by building to help staff evaluate and monitor monthly energy consumption.
- Coordinate travel across program areas to combine trips and combine tasks across program areas to reduce trips.
- Monitor buildings for efficient use of lighting.
- Review manufacturer specifications for vehicles and equipment to make sure they are being maintained and operated efficiently. Post instructions for proper use on dashboard and ensure a proper maintenance schedule.
- Conduct or obtain a site evaluation of headquarters to look for opportunities to replace inefficient boiler system and use renewable energy.
- Review fleet fuel consumption to look for optimization opportunities.

Leadership: The Refuge will look for opportunities to engage with partners, the public, private landowners, sister agencies, and other individuals and organizations to collaborate on sustainability programs and practices. The Refuge will share best management practices, success stories, and lessons learned from implementing sustainability practices with interested parties using existing outreach mechanisms and media such as the Refuge website, local newspaper, school visits, and Friends Newsletter to highlight sustainability practices at Malheur NWR.

We will use this management approach as a framework for further incorporating sustainability into Refuge culture while emphasizing continual improvement and striving to meet Objective 14a, Achieve Carbon Neutrality (striving for carbon negative), meeting and exceeding all energy and material efficiency and effectiveness as defined by 565 FW 1 and Executive Order 13514 for all facets of refuge management and operations.

O.5 References

Brundtland Commission. 1987. Our common future: Brundtland report. Available at: http://www.worldinbalance.net/intagreements/1987-brundtland.php.

Bureau of Transportation Statistics. 2012. *Average Fuel Efficiency of U.S. Light Duty Vehicles*. Available online at: http://www.bts.gov/publications/national_transportation_statistics/html/table_04_23.html.

U.S. Fish and Wildlife Service. 2010. *Comprehensive Energy and Water Evaluation for the Malheur National Wildlife Refuge*. Conducted by Tetra Tech Engineering and Architecture Services. On file, Malheur Refuge.

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Ring-necked pheasant
©Dan Dzurisin

Appendix P
Hunting Plan

Hunting Plan

for

Malheur National Wildlife Refuge

UNITED STATES FISH AND WILDLIFE SERVICE

2012

Recommended by ______________________ Date: 1/24/13

(Acting) Project Leader

Reviewed by ______________________ Date: 1/24/13

Refuge Supervisor

Approved by ______________________ Date: 1-24-13

Regional Chief, National Wildlife Refuge System

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P.1 Overview

Malheur National Wildlife Refuge was created in 1908 primarily as a preserve and breeding ground for native birds at Malheur, Mud, and Harney lakes. In 1935, the Blitzen Valley was established as a refuge and breeding ground for migratory birds and other wildlife, and the Double-O Unit was established as a reservation for migratory birds in 1941. Map 1 in the Comprehensive Conservation Plan (CCP), shows the location of Malheur Refuge.

The hunt programs addressed in this plan incorporate the hunt features (spatial layout, timing, types of hunts, etc.) as designed in the management direction of the CCP. Under the CCP, hunting will occur only in the Malheur Lake and Buena Vista hunt units.

This hunt plan has been prepared as a step-down plan to the CCP. Further descriptions of Refuge history, programs, and habitats can be found in Chapters 1, 4, and 5 of the CCP. A detailed analysis of the effects of the hunt program is found in the compatibility determinations for upland game and waterfowl hunting. Pertinent conclusions of these analyses are presented below in Section P.6 (Assessment).

P.1.1 Species Covered by this Plan

The species listed below have populations sufficient to allow for recreational harvest. No commercial harvesting of wildlife or use of hunting guides will be allowed, to ensure continued healthy populations and general public opportunity.

Species That Can be Hunted on Buena Vista Hunt Unit

- Dove, geese, duck, coot, snipe, pigeon, pheasant (rooster), California quail, and partridge (chukar and Hungarian partridge).

Species That Can be Hunted on Malheur Lake Hunt Unit

- Dove, geese, duck, coot, snipe, pigeon, pheasant (rooster), California quail, and partridge (chukar and Hungarian partridge).

Species That Can be Hunted on Boundary Hunt Unit

- Dove, geese, duck, coot, snipe, pigeon, pheasant, California quail, partridge, deer, pronghorn, coyote, black-tailed jackrabbit, and Nuttall’s cottontail.

P.1.2 Game Species not Hunted

Due to conflicts with Refuge purposes and other forms of wildlife-dependent recreation, hunting of any other species is not allowed on the Refuge.

P.2 Conformance with Statutory Authority

P.2.1 Conformance with Statutory Objectives

Any use of a national wildlife refuge must be compatible with resource protection and conform to applicable laws, regulations, and Fish and Wildlife Service (FWS) policies. Recreational use, in this case hunting, is allowed under the Refuge Recreation Act of 1962 (16 U.S.C. 460K, amended), which authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use. The Refuge Recreation Act requires: 1) that any recreational use permitted will not interfere with the primary purpose for which the refuge was established; and 2) that funds are available for the development, operation, and maintenance of the permitted forms of recreation.

Likewise, statutory authority for FWS management and associated habitat/wildlife management planning on units of the National Wildlife Refuge System is derived from the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee). The National Wildlife Refuge System Improvement Act provided a mission for the Refuge System and clear standards for its management, use, planning, and growth. The National Wildlife Refuge System Improvement Act recognizes that wildlife-dependent recreational uses—including hunting, fishing, wildlife observation and photography, environmental education, and interpretation—when determined to be compatible with the mission of the Refuge System and the purposes of the refuge are legitimate and appropriate public uses of national wildlife refuges. Sections 5(c) and (d) of the National Wildlife Refuge System Improvement Act state "compatible wildlife-dependent recreational uses are the priority general public uses of the National Wildlife Refuge System and shall receive priority consideration in planning and management; and when the Secretary [of the Interior] determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated, subject to such restrictions or regulations as may be necessary, reasonable, and appropriate."

P.2.2 Conformance with Refuge Purposes

Conformance of refuge uses with refuge purposes is determined through a formal compatibility determination process. Compatibility means that the use would not materially interfere with or detract from the fulfillment of the purposes of the refuge(s) or mission of the National Wildlife Refuge System (603 FW 2).

Both the upland game and waterfowl hunts, as described below in Section P.4, were determined to be compatible with Malheur Refuge purposes, with stipulations. See the compatibility determinations in Appendix B for more detail.

P.3 Statement of Goals and Objectives

P.3.1 Refuge Goals

Thirteen goals were developed for Malheur Refuge during the CCP process. They are:

1. Enhance aquatic health and habitat conditions essential to the conservation of the flora and fauna that depend on Malheur Lake and associated water bodies.
2. Protect, maintain, and rehabilitate riverine and riparian habitats to conditions essential for the conservation of native fish and wildlife species.
3. Protect, maintain, and rehabilitate riparian habitats to conditions essential for the conservation of wildlife species.
4. Enhance, protect, and/or maintain primary habitats essential to the conservation of a diversity of aquatic and terrestrial wildlife species.
5. Enhance and maintain rare and unique habitats.
6. Welcome visitors and help them safely experience the Refuge's outstanding features—diversity of wildlife, signs of earlier inhabitants, scenic landscapes, and solitude. As a result, visitors will leave the Refuge with a memorable experience that fosters a connection between themselves and nature, and an appreciation of Malheur Refuge's unique resources.
7. Connect the hearts and minds of visitors with places and resources the Refuge protects, and enlighten visitors' experiences with an understanding, appreciation, and knowledge of historical and natural resources, and the importance of conservation and stewardship.
8. Provide reasonable challenges and opportunities, and provide uncrowded conditions for the hunting and fishing public.
9. Initiate and nurture relationships to build support of the Refuge, and fortify Refuge programs and activities to achieve the Refuge's mission and goals.
10. Manage prehistoric and historic cultural resources for their educational, scientific, and cultural values for the benefit of present and future generations of Refuge users and for the communities that are connected to these resources.
11. Identify and protect prehistoric and historic resources on the Refuge that are eligible for or listed in the National Register of Historic Places.
12. Manage the Refuge's paleontological resources for their educational and scientific values for the benefit of present and future generations of Refuge users.
13. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

P.3.2 Refuge Objectives for Hunting

Goal 8 pertains directly to the provision of wildlife-dependent recreational opportunities on the Refuge. Two Refuge hunt program objectives were developed as part of the CCP development process and are repeated below. The objective numeric identifier (e.g., 8a, 8b) is consistent with the objective numbering system in the CCP. A more complete program description is found in Section P.4 of this hunt plan.

Objective 8a. Provide Hunting Opportunities for Upland Game
Provide high-quality hunting opportunities for upland game hunting in the Malheur Lake, Buena Vista, and Boundary hunt units, for the species, seasons, and other details described in the Hunt Plan. The program shall be managed such that: • Youth are provided added emphasis; • Conditions are uncrowed, with abundant opportunities for solitude on over 58,000 allowable hunting acres; • The hunt is safe and managed to minimize conflicts with wildlife and other priority wildlife-

Objective 8a. Provide Hunting Opportunities for Upland Game
dependent recreational uses; • Access is provided on suitable all-weather access roads; • Game are wild or naturalized (not stocked); • Most hunters reach their quota each day; • Refuge staff engages in close cooperation and coordination with State fish and wildlife management agencies for management of hunting opportunities on the Refuge and in setting population management goals and objectives; and • The hunt is consistent with State fish and wildlife laws, regulations, and management plans.

Objective 8b: Provide Hunting Opportunities for Waterfowl
Provide high-quality opportunities for waterfowl hunting in the Malheur Lake, Buena Vista, and Boundary hunt units for the species, seasons, and other details described in the Hunt Plan. The program shall be managed such that: • Youth are provided added emphasis; • Conditions are uncrowded, with abundant opportunities for solitude on over 63,000 allowable hunting acres; • The hunt is safe and managed to minimize conflicts with wildlife and other priority wildlife-dependent recreational uses; • Access is provided on suitable all-weather roads; • Hunters can enjoy a range of waterfowl hunting experiences, from traditional setup with decoys and dogs to jump-shooting; • Parking areas are adequate, with parking at three existing locations and one new parking area and boat launch at the airboat launch site to access a new hunt opportunity on the southern side of Malheur Lake; • Most hunters reach their quota each day; • Refuge staff engages in close cooperation and coordination with State fish and wildlife management agencies for management of hunting opportunities on the Refuge and in setting population management goals and objectives; • Hunt is consistent with State fish and wildlife laws, regulations, and management plans.

P.4 Description of Hunting Program

The areas open to upland game and waterfowl hunting on the Refuge are shown in Map 3a.

P.4.1 Upland Game Hunting: Proposed Program

Tables P-1, P-2, and P-3 describe the proposed upland game hunt in the Malheur Lake, Buena Vista, and Boundary hunt units.

Table P-1. Northern Portion of Malheur Lake Hunt Unit

Aspect	Description
Location	A total of 22,500 acres (14% of the Refuge) would be open to upland game hunting on the northern portion of Malheur Lake (See Map 3b)
Allowable species	Pheasant, quail, chukar and partridge
Season	State pheasant season
Bag Limits	State upland game limits
Fees	None
Permits	None
Other hunt regulations	Per State regulations

Table P-2. Buena Vista Hunt

Aspect	Description
Location	A total of 36,000 acres (19% of the Refuge) would be open to upland game hunting (See Map 3b)
Allowable species	Pheasant, quail, chukar and partridge
Season	Fourth Saturday of October to the end of the State pheasant season
Limits	State upland game limits
Fees	None
Permits	None
Other hunt regulations	Per State regulations

Table P-3. Boundary Hunt Unit

Aspect	Description
Location	A total of 2,626 acres (1.4% of the Refuge) would be open to upland game hunting (See Map 3b)
Allowable species	Pheasant, quail, chukar, partridge, deer, pronghorn, coyote, black-tailed jackrabbit, and Nuttall’s cottontail
Season	State seasons
Limits	State upland game limits
Fees	None
Permits	None
Other hunt regulations	Per State regulations

Stipulations Necessary to Ensure Compatibility

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles would be allowed only on maintained public roadways. Parking is allowed only within one vehicle length of the roadway. Hunters would be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires would not be permitted on the Refuge.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Hunting closures would be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. Shooting from or across public roads or road rights-of-way would be prohibited.
- Law enforcement patrols would ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information would be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

P.4.2 Waterfowl Hunting: Proposed Program

Tables P-4, P-5, and P-6 describe the proposed waterfowl hunting program on the Malheur Lake and Buena Vista hunt units, and Table P-7 describes the proposed youth hunt on the Malheur Lake Hunt Unit.

Table P-4. Northern Portion of Malheur Lake Hunt Unit

Aspect	Description
Location	A total of 26,200 acres (14% of the Refuge) would be open to waterfowl hunting on the northern portion of Malheur Lake (See Map 4a)
Allowable species	Doves, geese, ducks, coots, snipe, and pigeons
Season	State waterfowl season
Limits	State waterfowl limits
Boats	Nonmotorized or electric boats will be permitted
Blinds	Temporary blinds may be erected on a day-to-day basis
Fees	None
Permits	None
Other hunt regulations	Per State regulations; at low water (<10,000 acres), Malheur Lake Hunt Unit will be closed to waterfowl hunting

Table P-5. Southern Portion of Malheur Lake Hunt Unit

Aspect	Description
Location	A total of 4,600 acres (2% of the Refuge) would be open to waterfowl hunting on the southern portion of Malheur Lake (see Map 3b)
Allowable species	Doves, geese, ducks, coots, snipe, and pigeons
Season	Fourth Saturday of October to the end of the State waterfowl season
Limits	State waterfowl limits
Boats	Nonmotorized or electric boats will be permitted
Blinds	Temporary blinds may be erected on a day-to-day basis
Fees	None
Permits	None
Other hunt regulations	Per State regulations; at low water (<10,000 acres), Malheur Lake Hunt Unit will be closed to waterfowl hunting

Table P-6. Buena Vista Hunt Unit

Aspect	Description
Location	A total of 36,000 acres (19% of the Refuge) would be open to waterfowl hunting (see Map 3b)
Allowable species	Doves, geese, ducks, coots, snipe, and pigeons
Season	Fourth Saturday of October to the end of the State waterfowl season
Bag Limits	State waterfowl limits
Boats	Not permitted
Blinds	Not permitted
Fees	None
Permits	None
Other hunt regulations	Per State regulations

Table P-7. Malheur Lake Youth Hunt

Aspect	Description
Location	A total of 26,200 acres (14% of the Refuge) would be open to waterfowl hunting on the northern portion of Malheur Lake (see Map 4a)
Allowable species	Doves, geese, ducks, coots, snipe, and pigeons
Season	State-designated weekend
Bag Limits	State waterfowl limits

Aspect	Description
Boats	Nonmotorized or electric boats will be permitted
Blinds	Temporary blinds may be erected on a day-to-day basis
Fees	None
Permits	None
Other hunt regulations	Per State regulations; at low water (<10,000 acres), Malheur Lake Hunt Unit will be closed to waterfowl hunting

Stipulations Necessary to Ensure Compatibility

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles would be allowed only on maintained public roadways. Parking would be allowed only within one vehicle length of the roadway. Hunters would be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires would not be permitted on the Refuge.
- Access would be by walk-in only. Electric motorized boating or nonmotorized boating would be permitted on Malheur Lake during the waterfowl hunt season.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Seasonal hunting closures may occur to protect waterfowl populations when the Malheur Lake water level drops below 10,000 acres.
- Hunting closures would be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. The new Caspian tern island in the South Malheur Lake Unit will be permanently closed to hunting. Shooting from or across public roads or road rights-of-way is prohibited.
- Law enforcement patrols would ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information would be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

P.4.3 Procedures for Consultation and Coordination with Oregon Department of Fish and Wildlife

FWS staff will coordinate with Oregon Department of Fish and Wildlife (ODFW) staff regarding annual hunt season dates, areas open to hunting, etc. ODFW will publish information on the Refuge upland game and waterfowl hunts annually in State hunting regulations.

P.5 Measures Taken to Avoid Conflicts with Other Management Objectives

P.5.1 Measures to Avoid Biological Conflicts

The hunts have been designed to minimize biological conflicts through a variety of measures. A large portion of the Refuge, including the southern part of the Blitzen Valley, Harney Lake, and the Double-O Unit, will remain closed to hunting and will provide undisturbed habitat for migrating birds. In addition, at low water (<10,000 acres), Malheur Lake will be closed. The new Caspian tern island in the South Malheur Lake Unit will be permanently closed to hunting. Vehicles will be limited to roads. Boats will be restricted to Malheur Lake, and only electric or nonmotorized boats will be permitted. The opening date for both the waterfowl and upland game hunts for the Buena Vista Hunt Unit and the southern portion of Malheur Lake Hunt Unit is set as the last Saturday in October, which will prevent disturbance to staging sandhill cranes, who use these areas in early fall. Only federally approved nontoxic shot will be permitted to be in hunters' possession while on the Refuge.

Outreach with hunting brochures and timely information on the website would help educate hunters on hunting opportunities, regulations, and ethical hunter behavior. Youth hunters will also be required to complete a hunter education course.

P.5.2 Measures to Avoid Public Use Conflicts

Various aspects of the proposed hunt programs, including temporal restriction and spatial restrictions, combined with the seasonal nature of other wildlife-dependent recreation activities on the Refuge, will reduce the potential for conflict. Generally, late fall and winter use on the Refuge is only a fraction of the use during the spring and fall seasons.

Hunting regulations would be established to provide a no-hunt buffer zone around the airboat launch site and observation tower. Persons not engaged in hunting would not be permitted to access the Malheur Lake Hunt Unit or the Buena Vista Hunt Unit, except where public roads border or traverse these units. State regulations also prohibit shooting from on and across roads, which would limit conflicts. Fishing along the Blitzen River from Sodhouse Lane to the Boat Landing Road would conclude prior to the hunting season opener.

Other measures taken to avoid or reduce potential conflicts with other Refuge visitors include law enforcement patrols, posting hunt signs to maintain public awareness during the hunting seasons, and providing descriptive brochures explaining hunting opportunities. Regulations will be printed and dispensed at Refuge Headquarters and brochure boxes at Refuge parking lots, entrances to the hunt units, or online at the Refuge website.

Conflicts between hunters themselves will be minimized by providing the staggered season openers described above. In addition, the relatively large hunt area compared to the expected number of hunters will minimize crowding and safety conflicts.

P.5.3 Measures to Avoid Administrative Conflicts

Hunt closures will be in effect around Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. The hunt program has the potential to conflict with some of the normal management, maintenance and biological monitoring activities that might be occurring in the same vicinity as the hunt program. Safety briefings for Refuge staff working in hunt areas will occur. Hunters will be warned of Refuge activities that might be occurring in the hunt units. These measures will ensure the safety of Refuge staff and Service-authorized agents and will allow for the completion of Refuge management activities as well as other Refuge uses. The project leader will retain the discretion to close areas to hunting when necessary for the protection of Refuge staff and authorized agents who are conducting Refuge management activities or for the safety of hunters who could be at risk from Refuge management activities (e.g., prescribed fire). Overall, there will be minimal administrative conflicts expected.

P.6 Assessment

P.6.1 Compatibility with Refuge Objectives

Hunting is one of the six wildlife-dependent recreational uses included in the National Wildlife Refuge System Improvement Act of 1997. Conducting well-managed hunts on the Refuge will assist the Refuge in meeting one of the Refuge System's primary goals (namely, providing the public opportunities to participate in compatible wildlife-dependent recreational programs). The State-designated youth waterfowl hunt also provides a unique opportunity for the Refuge to introduce young hunters to the Refuge System and educate them on the importance of wildlife conservation.

Compatibility with other Refuge programs is addressed below.

P.6.2 Biological and Other Considerations

Upland Game

Potential effects of upland game hunting to target populations, non-target species, listed species, Refuge habitats, and other public use programs are summarized below. Section P.5 examines measures to avoid conflicts with these resources. Also see the compatibility determination for upland game hunting (Appendix B in the CCP) for a detailed effects analysis.

Effects Analysis	Summary Conclusion
Effects to target populations	The estimated harvest for upland game birds would not likely increase from the current levels because the program would not markedly expand. The earlier season opening would provide additional hunting opportunities during the season and may increase hunters' success rate, but the harvest is small overall; the estimated Refuge harvest of <600 gamebirds would only be likely to be <5% of the entire harvest in Harney and Malheur counties. Given the wide range of upland gamebirds and an average of 49,000 acres available to hunt, it is expected that the overall upland game hunting pressure under would be low. Given the small amount of the estimated take and the distribution of the hunt units, the hunt program as designed is not expected to

Effects Analysis	Summary Conclusion
	adversely affect the Refuge's ability to sustain optimum population levels for maintaining populations of upland gamebirds. Although Refuge-specific population and past harvest data are unavailable for coyote and rabbits, neither of these hunts on the Boundary Unit is expected to negatively affect populations of the target species. Refuge-specific harvest data are also unavailable for deer and pronghorn. Pronghorn have showed a gradual increase in populations statewide, while mule deer are on a prolonged decline. However, given the low level of harvest that is expected to occur on these species on the available Refuge hunt area, hunting is not expected to significantly impact target populations.
Effects to non-target species	Potential minor disturbance to other foraging or resting birds would occur from dogs, human activity, and noise associated with hunting. Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. A late season opener for the southern portion of Malheur Lake and the Buena Vista Unit would allow sufficient protection of the sandhill cranes until they migrate farther south. Since most birds have migrated during the fall season, disturbance level would be minor overall. Disturbance to other taxa would be unlikely or negligible.
Effects to Refuge habitats, vegetation, soil, and water	No facilities would be added to support this use; therefore, there is no additional amount of habitat that will be lost due to facilities. Foot travel associated with upland game hunting could result in temporary and minor vegetation trampling. No impact is expected to soil or water resources as a result of this use.
Effects to listed species	Due to the slight increase in upland game hunting opportunities, access, and visitation projected, disturbance impacts to greater sage-grouse would be expected to increase, although sage-grouse is not a huntable species on the Refuge and does not readily occur within Refuge boundaries. If off-trail use results in unacceptable adverse effects to candidate species or habitats, the Refuges would limit use to the trails. ODFW continues to closely track sage-grouse populations to ensure the numbers stay and increase to a sustainable level.
Effects to other priority public uses	Use of the Refuge by non-hunting visitors is very light during hunting season, and this is expected to mitigate any conflict between hunting and other uses in the Buena Vista Unit. Hunt closures will be in effect around high-use areas such as the Headquarters and airboat launch/viewing tower.

Waterfowl/Migratory Birds

Potential effects of waterfowl hunting to target populations, non-target species, listed species, Refuge habitats, and other public use programs are summarized below. Section P.5 examines measures to avoid conflicts with these resources. Also see the compatibility determination for waterfowl hunting (Appendix B in the CCP) for more detail.

Effects	Summary Conclusion
Effects to target populations	Near-term, the number of birds harvested would be expected to increase slightly but would still likely be <250 ducks and <200 geese annually. These estimated harvests represent <1% of the total midwinter population of wintering ducks and geese in the Regional Survey Unit (Klamath, Lake, and Harney counties) and an even smaller fraction of the State of Oregon and Pacific Flyway population. The overall impacts from the harvest estimates would be minor to negligible. Longer-term, as management activities work to control carp in Malheur Lake over the next 15 years, it would be expected that the number of nesting birds in this area would increase and consequently harvests would also increase. There are many unknowns in carp control, and an accurate estimate of waterfowl to be harvested under this scenario cannot be predicted at this time. In addition to direct mortality, hunting could result in redistribution of waterfowl and waterbirds at the Refuge.
Effects to non-target species	Potential minor disturbance to other foraging or resting birds would occur from dogs, human activity, and noise associated with hunting. Hunting seasons do not coincide with the nesting season; thus, reproduction will not be reduced by hunting. Disturbance to the foraging or resting activities of migrating or resident birds will increase with the new access for boats at the south end of Malheur Lake and the new opening of the Buena Vista Hunt Unit to waterfowl hunters. However, even with these changes, hunting is still expected to involve a small numbers of participants. On the north side of Malheur Lake, many of the hunters hunt the shoreline rather than using boats on Malheur Lake, thus limiting the area disturbed on that side. The Buena Vista Unit will remain a walk-in hunt, and hunters do not generally walk distances of more than a mile from roads to access hunting areas. Prohibiting overnight camping would also decrease the likelihood of hunters roaming long distances on the Refuge, particularly in the Buena Vista Unit. Disturbance to other taxa would be unlikely or negligible. Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. A late season opener for the southern portion of Malheur Lake and the Buena Vista Unit would allow sufficient protection of the sandhill cranes until they migrate. Other birds using the area may be disturbed from noise and human presence; however, since most birds have migrated during the fall, disturbance effects would be minor overall.
Effects to Refuge habitats	No facilities would be added to support this use; therefore, there is no additional amount of habitat that will be lost due to facilities. Foot travel associated with accessing Malheur Lake for waterfowl hunting could potentially result in temporary and minor vegetation trampling. Limiting boat type to electric or nonmotorized boats will prevent exhaust and emissions from entering Refuge waters.
Effects to listed species	Due to the increase in waterfowl hunting opportunities, access, and visitation projected, disturbance impacts to the candidate species greater sage-grouse and Columbia spotted frog would be expected to increase, but the total impacts related to waterfowl hunting are expected to be minor. Impacts can be reduced by locating public facilities away from habitats that host candidate species. Increasing specific public education can also assist in raising awareness and preventing undue impacts to the species.

Effects	Summary Conclusion
Effects to other priority public uses	Hunting has the potential to disturb Refuge visitors engaged in other priority public uses; however, given the season during which hunting occurs, the likelihood of conflicts is low. Hunt closures will be in effect around high-use areas such as the Headquarters and airboat launch/viewing tower.

P.6.3 Funding and Staffing Requirements for the Hunt

The proposed upland game hunt program at the Refuge would require administrative staff time from a biologist, visitor services manager, maintenance staff, and a law enforcement officer. The total annual cost to administer the hunt with the changes proposed is projected to be approximately $2,000 per year. There are currently enough funds in Refuge operations to implement this program.

The proposed waterfowl hunt at the Refuge would require administrative staff time from a biologist, visitor services manager, maintenance staff, and a law enforcement officer. With facility improvements, approximately $282,000 in one-time costs are projected, and the total annual cost to operate this program is estimated at $8,000. There are not currently enough funds in Refuge operations to implement this program; additional sources will be sought.

Outreach about the new hunting programs will require minimal reprogramming of existing resources.

P.7 Conduct of the Hunt

Like any use of public lands, location-specific regulations allow for the safety of visitors and the accommodation of many uses. Hunting on the Refuge is no exception.

P.7.1 Anticipated Public Reaction to the Hunt

The existing hunting program is generally accepted locally and does not generate anti-hunting controversy. Nationally, there is a component of the population that is opposed to hunting, and some organizations are opposed to hunting, or at least expansion of hunting, on national wildlife refuges and other public lands. Thus, it is expected that some objections may be voiced to some or all of the hunts within this plan.

P.7.2 Hunter Application Process

No permits or fees are required to participate in the hunt. Areas available are open each day on a first-come, first-served basis.

P.7.3 Media Selection for Publicizing the Hunt

Newspapers and TV/radio stations throughout Oregon will be provided copies of an annual news release covering the hunts. Descriptive brochures explaining hunting opportunities and regulations will be printed and dispensed at Refuge Headquarters and brochure boxes at Refuge parking lots, entrances to the hunt units, or online at the Refuge website.

P.7.4 Hunter Requirements and regulations

1. Age: Youths must be accompanied by an adult, 21 years of age or older.

2. All hunters must obtain a hunting or combination license and participate in the Harvest Information Program (HIP). Because of season dates and hunting regulations change annually, hunters must review all information and regulations in the Oregon’s statewide hunting booklets before the hunts.

Wildlife observers
©Barbara Wheeler

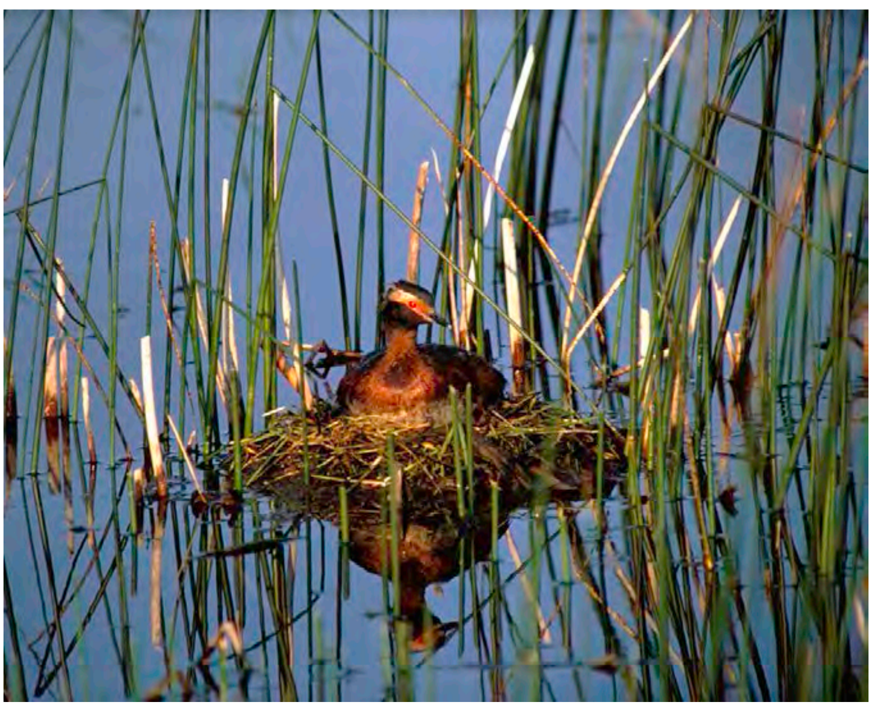
Appendix Q

National Wildlife Refuge Visitor Survey

National Wildlife Refuge Visitor Survey 2010/2011: Individual Refuge Results for Malheur National Wildlife Refuge

By Natalie R. Sexton, Alia M. Dietsch, Andrew W. Don Carlos, Lynne Koontz, Adam N. Solomon and Holly M. Miller

> *I love this refuge. The experience is life affirming. Not only do we love the experience of being in the unique landscape and viewing the birds, we have loved getting to know some of the local people we connect with again each year, and meeting other travelers.. Some years we have gone twice. Each trip I learn something new (often from another visitor) or recognize a bird that I could not identify before. It is an opportunity to be with our friends in an environment we love and appreciate. It is so interesting to see the differences through the years... Are the owls nesting in the same place? Will the area be dry or wet? Will the number of birds returning be similar in number or will events (natural or not) over the last year affect their population? My life experience would be greatly diminished if I could not come here.*—Survey comment from visitor to Malheur National Wildlife Refuge.



Horned Grebe at Malheur National Wildlife Refuge. Photo credit: U.S. Fish and Wildlife Service.

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Introduction

The National Wildlife Refuge System (NWRS), established in 1903 and managed by the U.S. Fish and Wildlife Service (FWS), is the largest system of lands in the world dedicated to the conservation of wildlife. There are over 550 National Wildlife Refuges (NWRs) nationwide, encompassing more than 150 million acres. The mission of the NWRS is to “administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.” Part of achieving this mission is the goal “to foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use” (Clark, 2001). About 98% of the system is open to the public, attracting nearly 40 million visitors annually. More than 25 million people per year visit refuges to observe and photograph wildlife, 8 million to hunt and fish, and more than half a million to participate in educational and interpretation programs (Uniack, 1999; U.S. Fish and Wildlife Service, 2007). Understanding visitors and characterizing their experiences on National Wildlife Refuges are critical elements of managing these lands and meeting the goals of the NWRS.

To address such information needs, the FWS Division of Visitor Services and Communications partnered with the Policy Analysis and Science Assistance Branch (PASA) of the U.S. Geological Survey’s Fort Collins Science Center to collect data on visitor experiences across the NWRS. PASA scientists have conducted biological, social, economic, and institutional analyses of conservation policies and management practices on numerous refuges across the nation in support of refuge planning and management. PASA’s mission is to integrate biological, social, and economic research so that natural resource professionals can use the resulting information to make informed decisions and resolve related conflicts.

The goal of the 2010/2011 National Visitor Survey is to provide refuge managers, planners, and visitor services specialists with reliable baseline data about refuge visitors and their experiences. The survey was conducted to provide information both at a national level *and* at a field station level to more effectively manage visitor services and facilities across the System and to inform site-specific management and planning decisions such as Comprehensive Conservation Plans (CCPs), Visitor Services step-down plans, and transportation plans.

Organization of Results

These results are for Malheur NWR (this refuge) and are part of USGS Data Series 643 (Sexton and others, 2011). All refuges participating in the 2010/2011 surveying effort will receive individual refuge results specific to the visitors to that refuge. Each set of results is organized by the following categories:

- **Introduction:** An overview of the NWRS and the goals of the national surveying effort.
- **Methods:** The procedures for the national surveying effort, including selecting refuges, developing the survey instrument, contacting visitors, and guidance for interpreting the results.
- **Refuge Description:** A brief description of the refuge location, acreage, purpose, recreational activities, and visitation statistics, including a map (where available) and refuge website link.
- **Sampling at This Refuge:** The sampling periods, locations, and response rate for this refuge.
- **Selected Survey Results:** Key findings for this refuge, including:
    - Visitor and Trip Characteristics
    - Visitor Spending in the Local Communities
    - Visitors Opinions about This Refuge
    - Visitor Opinions about National Wildlife Refuge System Topics

- **Conclusion**
- **Acknowledgements**
- **References**
- **Survey Frequencies (Appendix A):** A copy of the survey instrument with the frequency results for this refuge.
- **Visitor Comments (Appendix B):** The verbatim responses to the open-ended survey questions for this refuge.

Methods

Selecting Participating Refuges

The National Visitor Survey was conducted from July 2010 – August 2011 on 53 refuges across the NWRS (table 1). Based on the Division of Refuge's 2008 Refuge Annual Performance Plan (RAPP; U.S. Fish and Wildlife Service, 2011, personal communication), 192 refuges with a minimum visitation of 25,000 visitors were considered. This criterion was the median visitation across the NWRS and the minimum visitation necessary to ensure that the surveying would be logistically feasible onsite. Thirty-five of the participating refuges were randomly selected for national-level analyses. Fifteen additional refuges were selected for participation by regional office Visitor Services Chiefs based on the need to inform individual refuge planning processes. An additional three refuges were added to the effort by an interagency agreement with USGS.

Developing the Survey Instrument

PASA researchers developed the survey in consultation with FWS managers, planners, and visitor services professionals. The survey was peer-reviewed by academic and government researchers and was further pre-tested with NWRS Friends Group representatives from each region to ensure readability and overall clarity. The survey and associated methodology were approved by the Office of Management and Budget (OMB control #: 1018-0145; expiration date: 6/30/2013).

Contacting Visitors

Refuge staff identified two separate 15-day sampling periods and one or more locations that best reflected the unique visitation patterns of each participating refuge. Sampling periods and locations were identified by refuge staff and submitted to PASA via an internal website that included a customized mapping tool. A standardized sampling schedule was created for all refuges that included eight systematically selected sampling shifts during each of the two sampling periods. Sampling shifts were three- to five-hour time bands that were stratified across AM and PM, as well as weekend and weekdays. Any necessary customizations were made, in coordination with refuge staff, to the standardized schedule to accommodate the identified sampling locations and to address unique spatial and temporal patterns of visitation.

Twenty visitors per sampling shift were targeted, for a total of 320 willing participants per refuge—160 per sampling period—to ensure an adequate sample of completed surveys. When necessary, shifts were moved, added, or extended to alleviate logistical limitations (for example, weather or low visitation at a particular site) in an effort to reach target numbers.

Table 1. Participating refuges in the 2010/2011 National Wildlife Refuge Visitor Survey.

Pacific Region (R1)	
Kilauea Point National Wildlife Refuge (HI)	William L. Finley National Wildlife Refuge (OR)
Deer Flat National Wildlife Refuge (ID)	McNary National Wildlife Refuge (WA)
Cape Meares National Wildlife Refuge (OR)	Turnbull National Wildlife Refuge (WA)
Malheur National Wildlife Refuge (OR)	
Southwest Region (R2)	
Bitter Lake National Wildlife Refuge (NM)	Aransas National Wildlife Refuge (TX)
Bosque del Apache National Wildlife Refuge (NM)	San Bernard/ Brazoria National Wildlife Refuge (TX)
Wichita Mountains Wildlife Refuge (OK)	
Great Lakes-Big Rivers Region (R3)	
Desoto National Wildlife Refuge (IA)	Upper Mississippi River National Fish and Wildlife Refuge - McGregor District (MN)
Neal Smith National Wildlife Refuge (IA)	
Muscatatuck National Wildlife Refuge (IN)	Big Muddy National Wildlife Fish and Wildlife Refuge (MO)
Rice Lake National Wildlife Refuge (MN)	Horicon National Wildlife Refuge (WI)
Tamarac National Wildlife Refuge (MN)	Necedah National Wildlife Refuge (WI)
Southeast Region (R4)	
Wheeler National Wildlife Refuge (AL)	Banks Lake National Wildlife Refuge (GA)
Big Lake National Wildlife Refuge (AR)	Noxubee National Wildlife Refuge (MS)
Pond Creek National Wildlife Refuge (AR)	Cabo Rojo National Wildlife Refuge (Puerto Rico)
Merritt Island National Wildlife Refuge (FL)	Pea Island National Wildlife Refuge (NC)
St. Marks National Wildlife Refuge (FL)	Cape Romain National Wildlife Refuge (SC)
Ten Thousand Islands National Wildlife Refuge (FL)	Reelfoot National Wildlife Refuge (TN)
Northeast Region (R5)	
Stewart B. McKinney National Wildlife Refuge (CT)	Moosehorn National Wildlife Refuge (ME)
Bombay Hook National Wildlife Refuge (DE)	Great Swamp National Wildlife Refuge (NJ)
Monomoy National Wildlife Refuge (MA)	Montezuma National Wildlife Refuge (NY)
Parker River National Wildlife Refuge (MA)	Wertheim National Wildlife Refuge (NY)
Patuxent Research Refuge (MD)	Occoquan Bay/ Elizabeth Hartwell Mason Neck National Wildlife Refuge (VA)
Mountain-Prairie Region (R6)	
Monte Vista National Wildlife Refuge (CO)	Sand Lake National Wildlife Refuge (SD)
Quivira National Wildlife Refuge (KS)	National Elk Refuge (WY)
Charles M. Russell National Wildlife Refuge (MT)	
Alaska Region (R7)	
Alaska Maritime National Wildlife Refuge (AK)	Kenai National Wildlife Refuge (AK)
California and Nevada Region (R8)	
Lower Klamath/Tule Lake National Wildlife Refuge (CA)	Ruby Lake National Wildlife Refuge (NV)
Sonny Bono Salton Sea National Wildlife Refuge (CA)	

Refuge staff and/or volunteers (survey recruiters) contacted visitors on-site following a protocol provided by PASA to ensure a diverse sample. Instructions included contacting visitors across the entire sampling shift (for example, every n^{th} visitor for dense visitation, as often as possible for sparse visitation), and only one person per group. Visitors were informed of the survey effort, given a token incentive (for example, a small magnet, temporary tattoo), and asked to participate. Willing participants provided their name, mailing address, and preference for language (English or Spanish) and survey mode (mail or online). Survey recruiters also were instructed to record any refusals.

Visitors were mailed a postcard within 10 days of the initial on-site contact thanking them for agreeing to participate in the survey and inviting them to complete the survey online. Those visitors choosing not to complete the survey online were sent a paper copy a week later. Two additional contacts were made by mail during the next seven weeks following a modified Tailored Design Method (Dillman, 2007): 1) a reminder postcard one week after the first survey, and 2) a second paper survey two weeks after the reminder postcard. Each mailing included instructions for completing the survey online and a postage paid envelope for returning the paper version of the survey. Those visitors indicating a preference for Spanish were sent Spanish versions of all correspondence (including the survey). Finally, a short survey of six questions was sent to nonrespondents four weeks after the second survey mailing to determine any differences between respondents and nonrespondents at the national level. Online survey data were exported and paper survey data were entered using a standardized survey codebook and data entry procedure. All survey data were analyzed by using SPSS v.18 statistical analysis software.

Interpreting the Results

The extent to which these results accurately represent the total population of visitors to this refuge is dependent on 1) an adequate sample size of those visitors and 2) the representativeness of that sample. The adequacy of the sample size for this refuge is quantified as the margin of error. The composition of the sample is dependent on the ability of the standardized sampling protocol for this study to account for the spatial and temporal patterns of visitor use unique to each refuge. Spatially, the geographical layout and public use infrastructure varies widely across refuges. Some refuges only can be accessed through a single entrance, while others have multiple unmonitored access points across large expanses of land and water. As a result, the degree to which sampling locations effectively captured spatial patterns of visitor use will likely vary from refuge to refuge. Temporally, the two 15-day sampling periods may not have effectively captured all of the predominant visitor uses/activities on some refuges during the course of a year. Therefore, certain survey measures such as visitors' self-reported "primary activity during their visit" may reflect a seasonality bias.

Herein, the sample of visitors who responded to the survey are referred to simply as "visitors." However, when interpreting the results for Malheur NWR, any potential spatial and temporal sampling limitations specific to this refuge need to be considered when generalizing the results to the total population of visitors. For example, a refuge that sampled during a special event (for example, birding festival) held during the spring may have contacted a higher percentage of visitors who traveled greater than 50 miles to get to the refuge than the actual number of these people who would have visited throughout the calendar year (that is, oversampling of nonlocals). In contrast, another refuge may not have enough nonlocal visitors in the sample to adequately represent the beliefs and opinions of that group type. If the sample for a specific group type (for example, nonlocals, hunters, those visitors who paid a fee) is too low ($n < 30$), a warning is included. Additionally, the term "*this* visit" is used to reference the visit on which people were contacted to participate in the survey, which may or may not have been their most recent refuge visit.

Refuge Description for Malheur National Wildlife Refuge

Malheur National Wildlife Refuge is located in the sagebrush country of eastern Oregon. The Refuge was established by Theodore Roosevelt in 1908 as a preserve and breeding ground for native birds. The Refuge has since grown through a 65,000-acre purchase in 1935 and a 14,000-acre purchase in 1942, covering a total of 187,000 acres. Malheur NWR attracts a variety of visitors, from bird watchers, hikers and bicyclists, to anglers and hunters. Over 320 species of birds and 58 mammal species call the refuge home, providing hunters and birders with ample recreation opportunities. Flocks of waterfowl and sandhill cranes use Malheur NWR as a resting point and feeding ground during their migration along the Pacific Flyway in the spring and fall, providing a range of visitors with unique recreation experiences. Malheur NWR attracts 65,000 annual visitors (based on 2008 RAPP database; U.S. Fish and Wildlife Service, 2011, written comm.). Figure 1 depicts a map of Malheur NWR. For more information, go to *http://www.fws.gov/malheur/*.

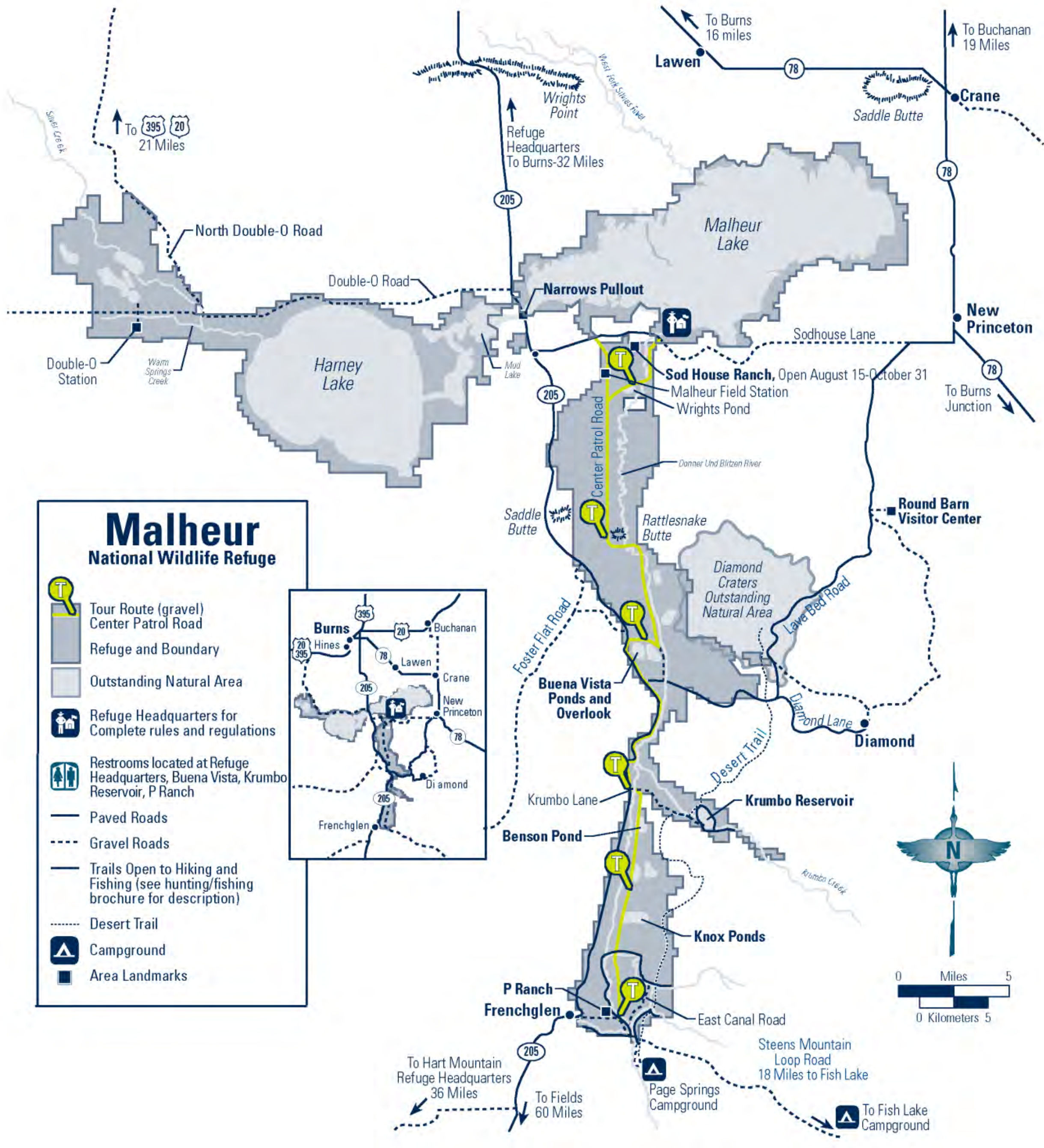


Figure 1. Map of Malheur NWR, courtesy of U.S. Fish and Wildlife Service.

Sampling at Malheur National Wildlife Refuge

A total of 315 visitors agreed to participate in the survey during the two sampling periods at the identified locations at Malheur NWR (table 2). In all, 276 visitors completed the survey for an 89% response rate and ±5% margin of error at the 95% confidence interval.[1] The majority of the contacts were made at the Visitor Center (68%), whereas 20% were made at Krumbo Reservoir, 7% at Historic P Ranch, 3% along the Auto Tour Route, and 2% at the Historic Sod House Ranch. The refuge experienced flooding during sampling period 2 which may have affected participation in some activities on the refuge, such as use of the autor tour route.

Table 2. Sampling and response rate summary for Malheur NWR.

Sampling period	Dates	Locations	Total contacts	Undeliverable addresses	Completed surveys	Response rate
1	8/28/10 to 09/11/10	Auto Tour Route, Center Patrol Road Historic Sod House Ranch Krumbo Reservoir Visitor Center/Refuge HQ	144	2	126	89%
2	05/21/11 to 06/04/11	Historic P Ranch Krumbo Reservoir Visitor Center/Refuge HQ	171	3	150	89%
Total			**315**	**5**	**276**	**89%**

Selected Survey Results

Visitor and Trip Characteristics

A solid understanding of refuge visitors and details about their trips to refuges can inform communication outreach efforts, inform visitor services and transportation planning, forecast use, and gauge demand for services and facilities.

Familiarity with the NWRS

Visitors to Malheur NWR reported that before participating in the survey, they were aware of the role of the U.S. Fish and Wildlife Service in managing National Wildlife Refuges (92%) and that the Refuge System has the mission of conserving, managing, and restoring fish, wildlife, plants and their habitat (95%). Positive responses to these questions concerning the management and mission of the NWRS do not necessarily indicate that these visitors fully understand the day-to-day management practices of individual

[1] The margin of error (or confidence interval) is the error associated with the results related to the sample and population size. A margin of error of ± 5%, for example, means if 55% of the sample answered a survey question in a certain way, then 50–60% of the entire population would have answered that way. The margin of error is calculated with an 80/20 response distribution, assuming that for any given dichotomous choice question, approximately 80% of respondents selected one choice and 20% selected the other (Salant and Dillman, 1994).

refuges, only that visitors feel they have a basic knowledge of who manages refuges and why. Compared to other public lands, many visitors feel that refuges provide a unique recreation experience (96%; see Appendix B for visitor comments on "What Makes National Wildlife Refuges Unique?"); however, reasons for why visitors find refuges unique are varied and may not directly correspond to their understanding of the mission of the Refuge System. Most visitors to Malheur NWR had been to at least one other National Wildlife Refuge in the past year (78%), with an average of 6 visits to other refuges during the past 12 months.

Visiting This Refuge

Most visitors (72%) had only been to Malheur NWR once in the past 12 months, while others had been multiple times (28%). These repeat visitors went to the refuge an average of 3 times during that same 12-month period. Visitors used the refuge during only one season (79%) and during multiple seasons (21%).

Most visitors first learned about the refuge from friends/relatives (59%), refuge printed information (15%), or a recreation club/organization (13%; fig. 2). Key information sources used by visitors to find their way to this refuge include a road atlas/highway map (56%), previous knowledge (55%), or signs on highways (52%; fig. 3).

Few visitors (4%) live in the local area (within 50 miles of the refuge), whereas 96% are nonlocal visitors. For most local visitors, Malheur NWR was the primary purpose or sole destination of trip (80%; table 3). For most nonlocal visitors, the refuge also was the primary purpose or sole destination of trip (50%). Local visitors (n = 10) reported that they traveled an average of 41 miles to get to the refuge, while nonlocal visitors (n = 266) traveled an average of 437 miles. ***It is important to note that summary statistics based on a small sample size (n < 30) may not provide a reliable representation of the population.*** **F**igure 4 shows the residence of visitors travelling to the refuge. About 60% of visitors travelling to Malheur NWR were from Oregon.

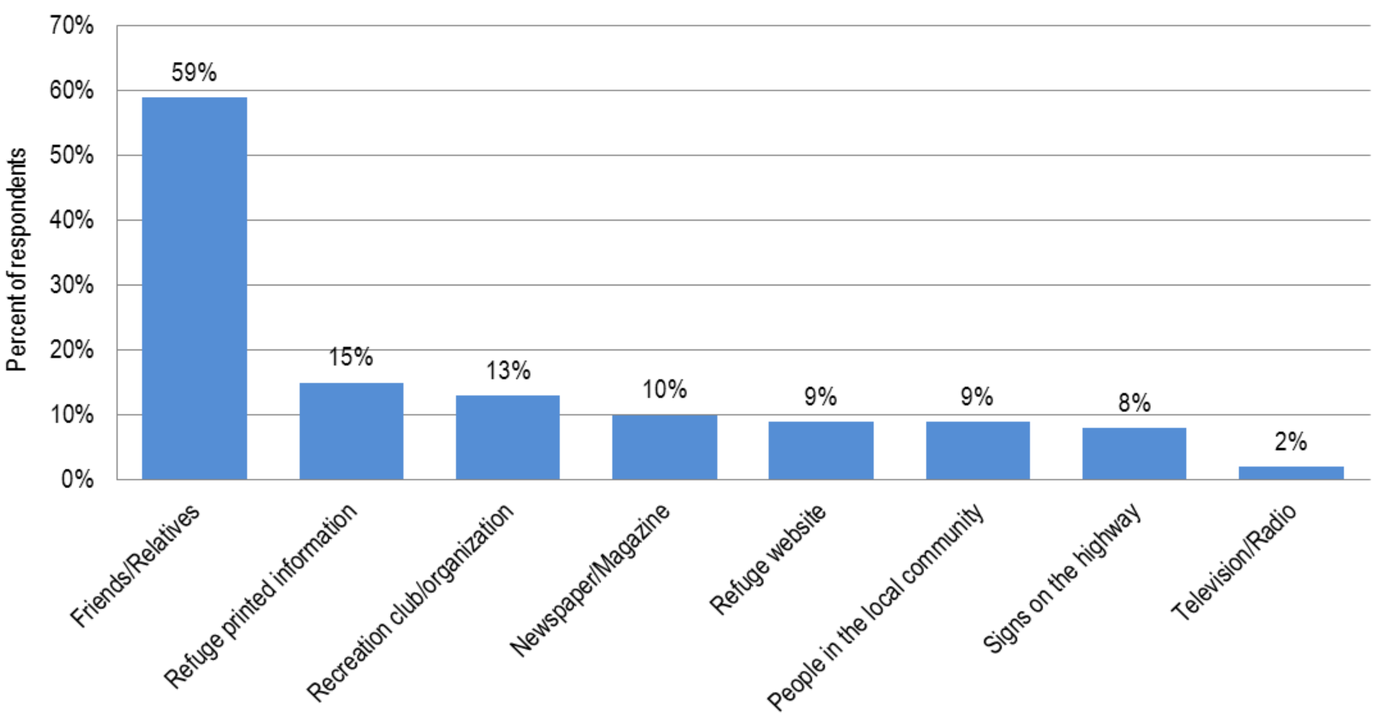


Figure 2. How visitors first learned or heard about Malheur NWR (n = 271).

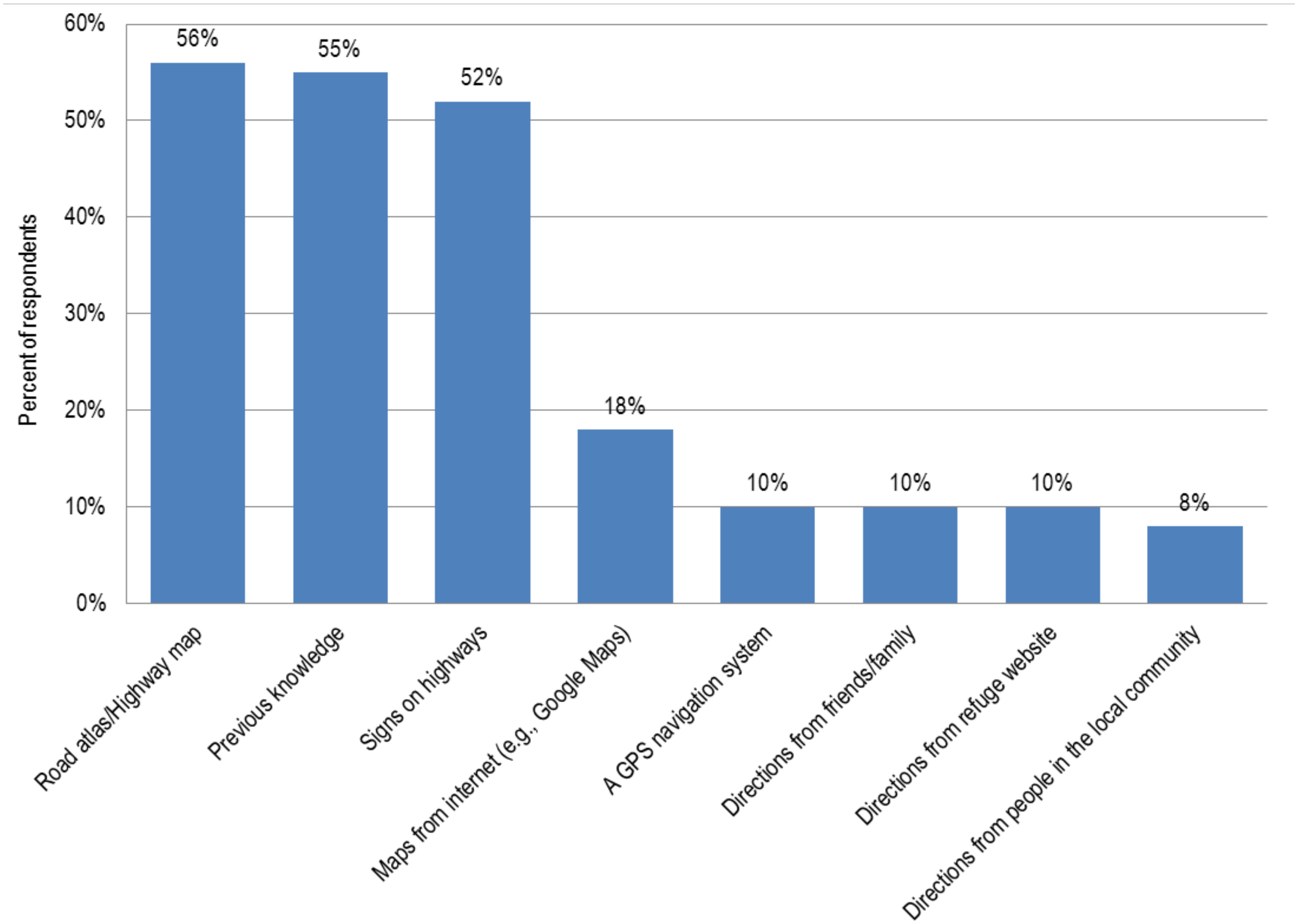
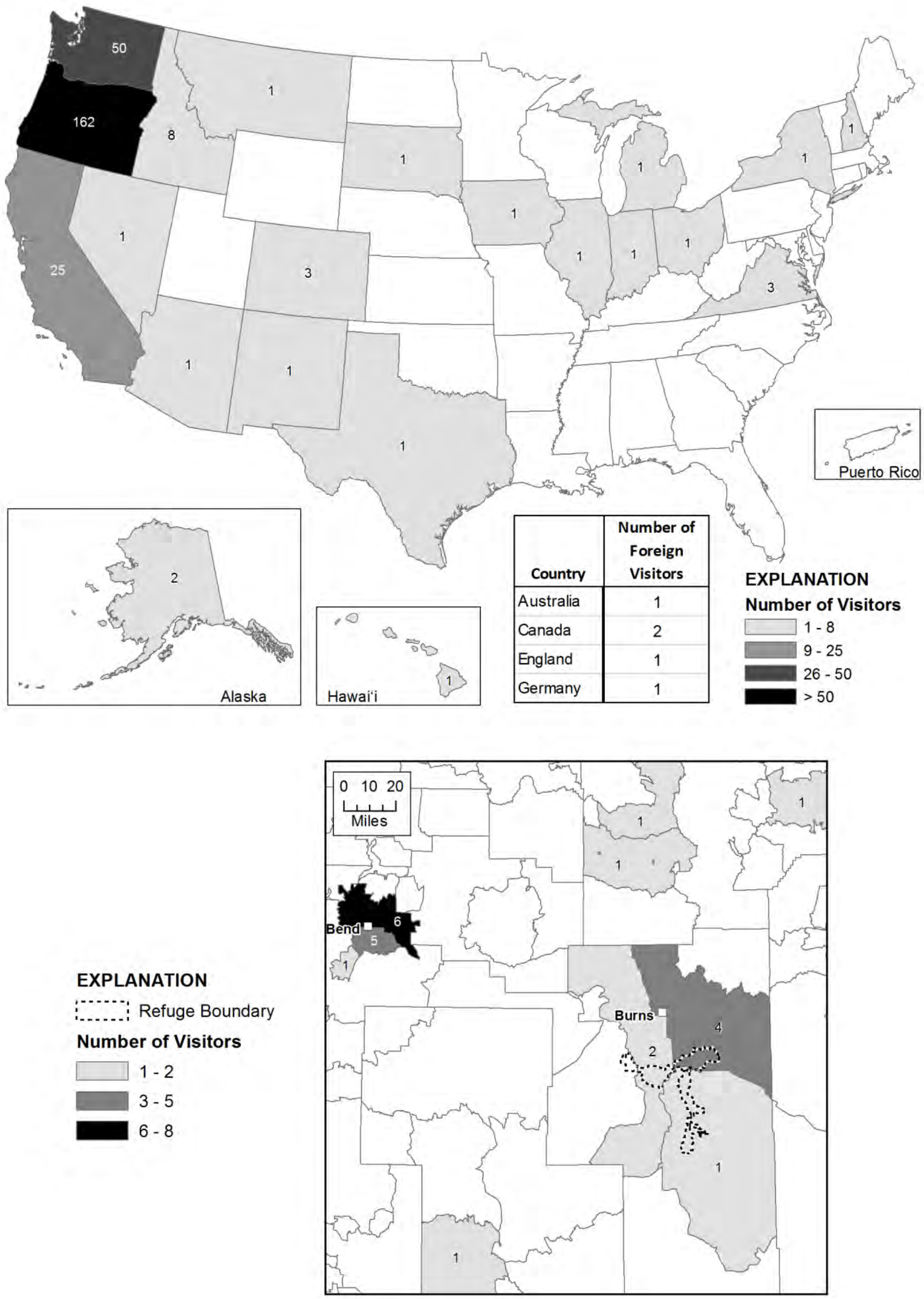


Figure 3. Resources used by visitors to find their way to Malheur NWR during *this* visit (n = 272).

Table 3. Influence of Malheur NWR on visitors' decision to take *this* trip.

Visitors	Visiting this refuge was...		
	the primary reason for trip	one of many equally important reasons for trip	an incidental stop
Nonlocal	50%	44%	7%
Local	80%	20%	0%
Total	51%	43%	6%



Country	Number of Foreign Visitors
Australia	1
Canada	2
England	1
Germany	1

Figure 4. Number of visitors travelling to Malheur NWR by residence. Top map shows residence by state and bottom map shows residence by zip codes near the refuge (n = 276).

Visitors reported that they spent an average of 7 hours at Malheur NWR during one day there (a day visit is assumed to be 8 hours). However, the most frequently reported length of visit during one day was actually 8 hours (76%). The key modes of transportation used by visitors to travel around the refuge were private vehicle (83%) and walking/hiking (42%; fig. 5). Most visitors indicated they were part of a group on their visit to this refuge (74%), travelling primarily with family and friends (table 4).

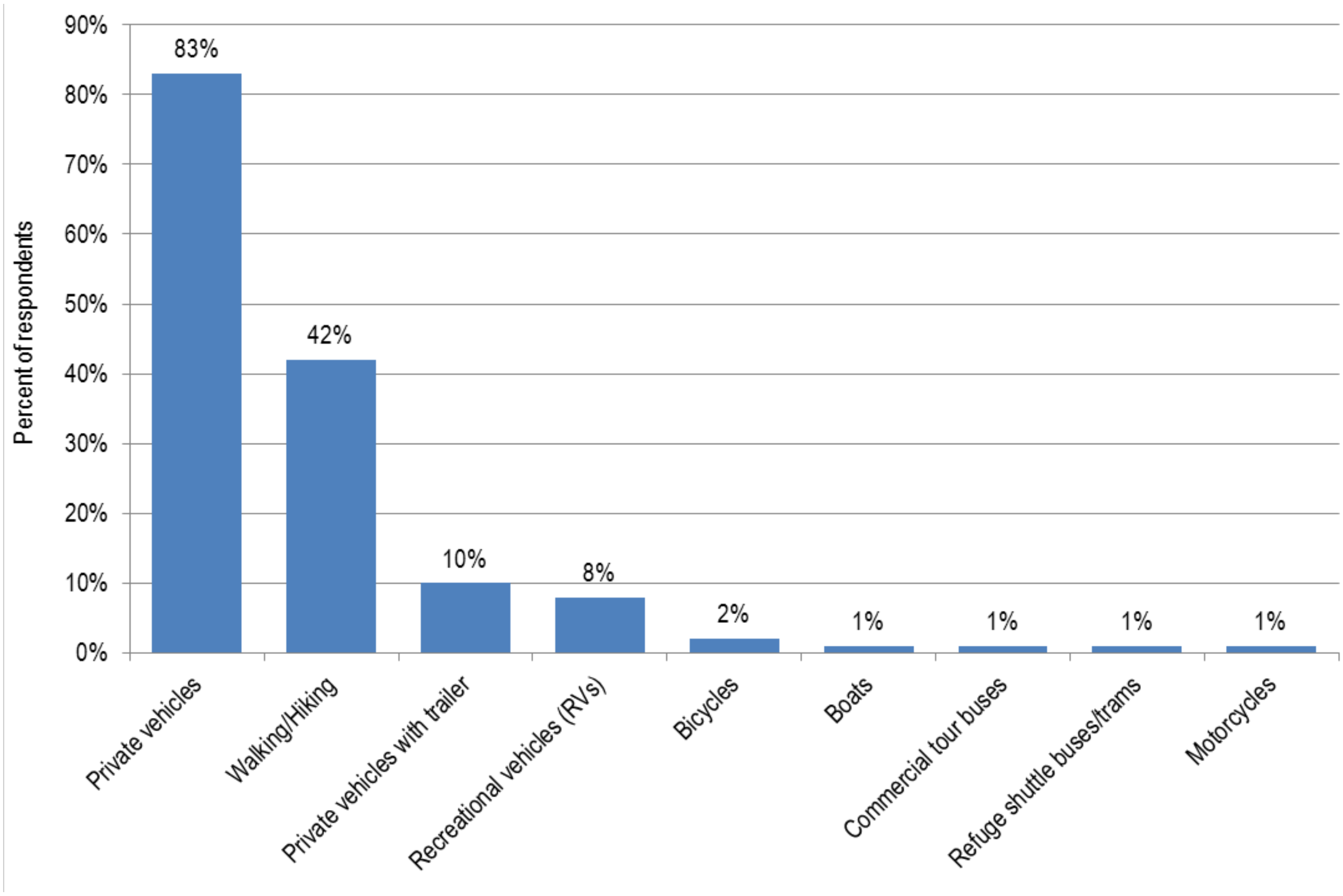


Figure 5. Modes of transportation used by visitors to Malheur NWR during *this* visit (n = 273).

Table 4. Type and size of groups visiting Malheur NWR (for those who indicated they were part of a group, n = 202).

Group type	Percent (of those traveling in a group)	Average group size		
		Number of adults	Number of children	Total group size
Family/Friends	85%	4	0	4
Commercial tour group	1%	10	0	10
Organized club/School group	11%	12	1	13
Other group type	2%	11	0	11

Visitors participated in a variety of refuge activities during the past 12 months (fig. 6); the top three activities reported were bird watching (93%), wildlife observation (87%), auto tour route/driving (61%) and photography (60%). The primary reasons for their most recent visit included bird watching (68%), wildlife observation (11%), and fishing (5%; fig. 7). The visitor center was used by 93% of visitors, mostly to visit the gift shop/bookstore (87%), stop to use the facilities (84%), and ask information of staff/volunteers (81%; fig. 8).

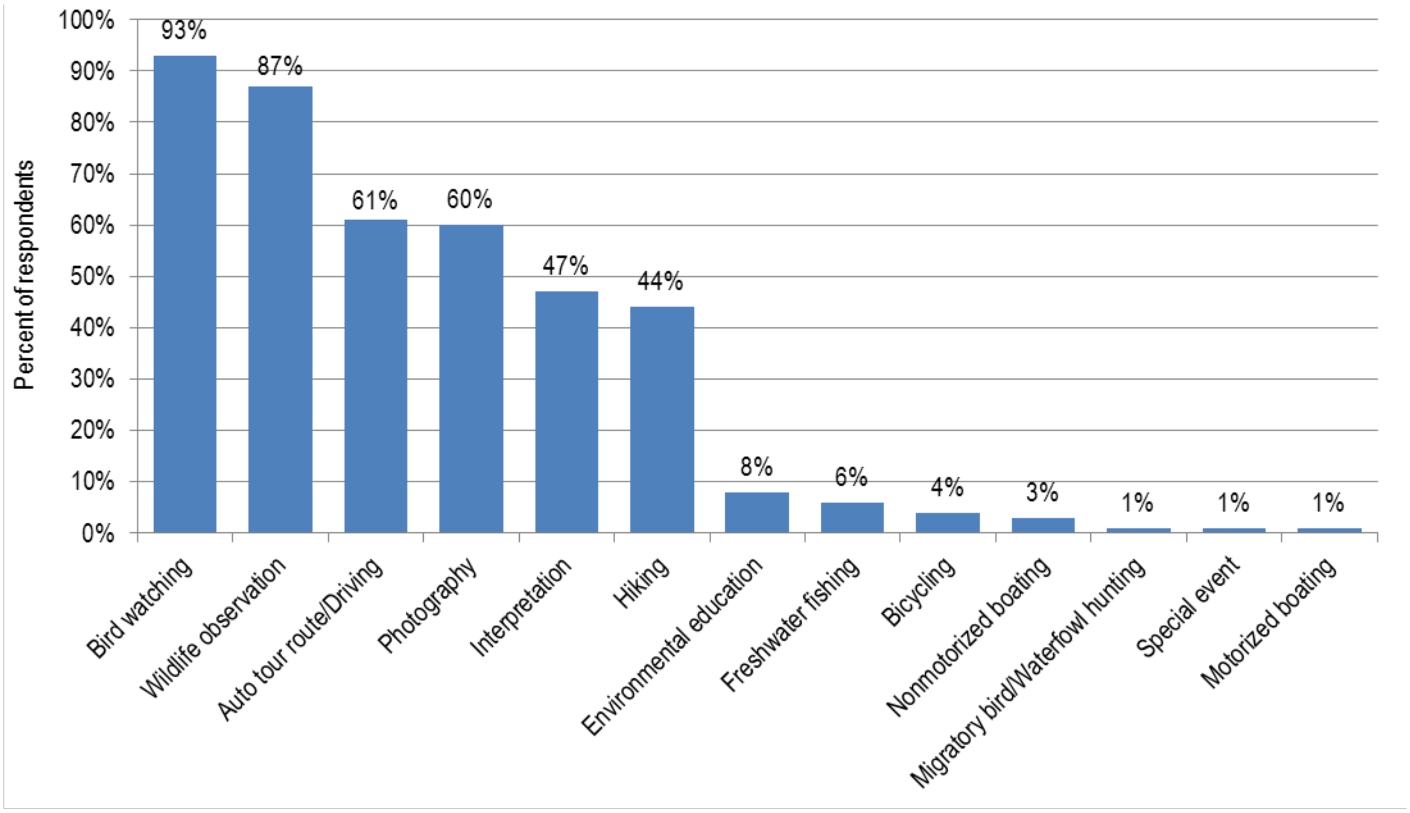


Figure 6. Activities in which visitors participated during the past 12 months at Malheur NWR (n = 271). See Appendix B for a listing of “other” activities.

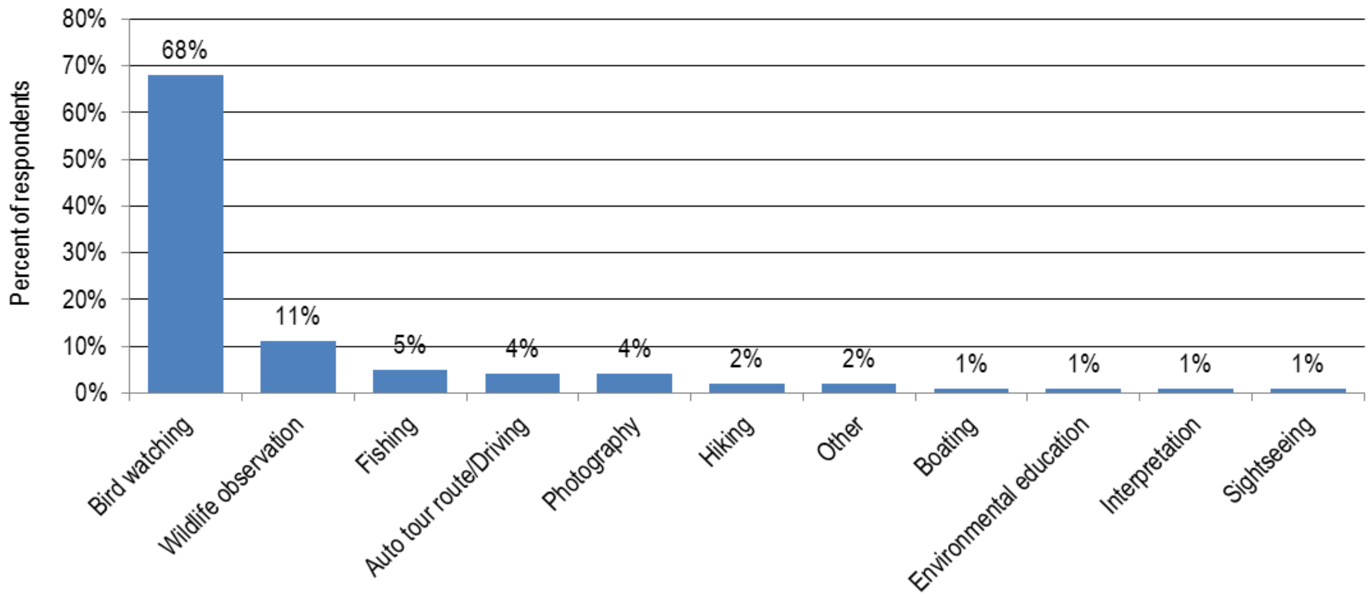


Figure 7. The primary activity in which visitors participated during *this* visit to Malheur NWR (n = 260). See Appendix B for a listing of "other" activities.

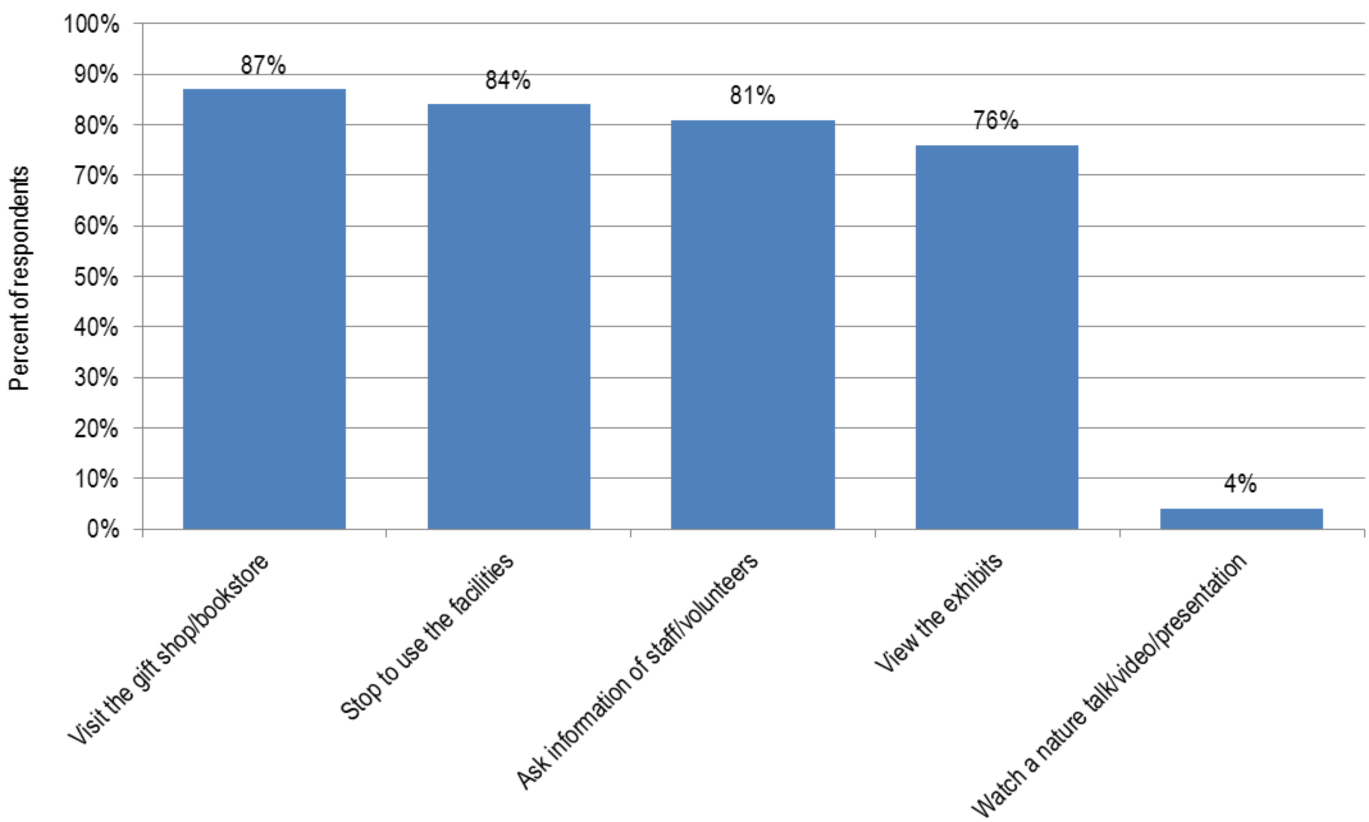


Figure 8. Use of the visitor center at Malheur NWR (for those visitors who indicated they used the visitor center, n = 253).

Visitor Characteristics

Nearly all (98%) visitors to Malheur NWR indicated that they were citizens or permanent residents of the United States. Visitors were a mix of 53% male with an average age of 58 years and 47% female with an average age of 59 years. Visitors, on average, reported they had 17 years of formal education (graduate or professional school). The median level of income was $75,000–$99,000. See Appendix A for more demographic information. In comparison, the 2006 National Survey of Fishing, Hunting and Wildlife-Associated Recreation found that participants in wildlife watching and hunting on public land were 55% male and 45% female with an average age of 46 years, an average level of education of 14 years (associate degree or two years of college), and a median income of $50,000–$74,999 (Harris, 2011, personal communication). Compared to the U.S. population, these 2006 survey participants are more likely to be male, older, and have higher education and income levels (U.S. Department of Interior and U.S. Department of Commerce, 2007).

Visitor Spending in Local Communities

Tourists usually buy a wide range of goods and services while visiting an area. Major expenditure categories include lodging, food, supplies, and gasoline. Spending associated with refuge visitation can generate considerable economic benefits for the local communities near a refuge. For example, more than 34.8 million visits were made to National Wildlife Refuges in fiscal year 2006; these visits generated $1.7 billion in sales, almost 27,000 jobs, and $542.8 million in employment income in regional economies (Carver and Caudill, 2007). Information on the amount and types of visitor expenditures can illustrate the economic importance of refuge visitor activities to local communities. Visitor expenditure information also can be used to analyze the economic impact of proposed refuge management alternatives.

A region (and its economy) is typically defined as all counties within 50 miles of a travel destination (Stynes, 2008). Visitors that live within the local 50-mile area of a refuge typically have different spending patterns than those that travel from longer distances. Approximately 4% of visitors to Malheur NWR indicated that they live within the local area. Nonlocal visitors (96%) stayed in the local area, on average, for 3 days. Table 5 shows summary statistics for local and nonlocal visitor expenditures, with expenditures reported on a per person per day basis. ***It is important to note that summary statistics based on a small sample size (n < 30) may not provide a reliable representation of that population.*** Nonlocal visitors spent an average of $65 per person per day and local visitors spent an average of $60 per person per day.

Table 5. Total visitor expenditures for Malheur NWR expressed in dollars per person per day.

Visitors	n[1]	Median	Mean	Standard deviation	Minimum	Maximum
Nonlocal	240	$52	$65	$51	$0	$375
Local	9	$44	$60	$53	$8	$155

[1]n = number of visitors who answered both locality *and* expenditure questions.

Visitor Opinions about This Refuge

National Wildlife Refuges provide visitors with a variety of services, facilities, and wildlife-dependent recreational opportunities. Understanding visitors' perceptions of their refuge experience is a key component of the NWRS mission as it pertains to providing high-quality wildlife-dependent recreational opportunities. Having a baseline understanding of visitor experience can inform management decisions to better balance visitors' expectations with the NWRS mission. Recent studies in outdoor recreation have included an emphasis on declining participation in traditional activities such as hunting and an increasing need to connect the next generation to nature and wildlife. These factors highlight the importance of current refuge visitors as a key constituency in wildlife conservation. A better understanding is increasingly needed to better manage the visitor experience and to address the challenges of the future.

Visitors' overall satisfaction with the services, facilities, and recreational opportunities provided at Malheur NWR were as follows (fig. 9):

- 97% were satisfied with the recreational activities and opportunities,
- 94% were satisfied with the information and education about the refuge and its resources,
- 94% were satisfied with the services provided by employees or volunteers, and
- 92% were satisfied with the refuge's job of conserving fish, wildlife and their habitats.

Though 14% of visitors indicated that they paid a fee to enter the refuge, Malheur NWR does not charge an entrance fee.

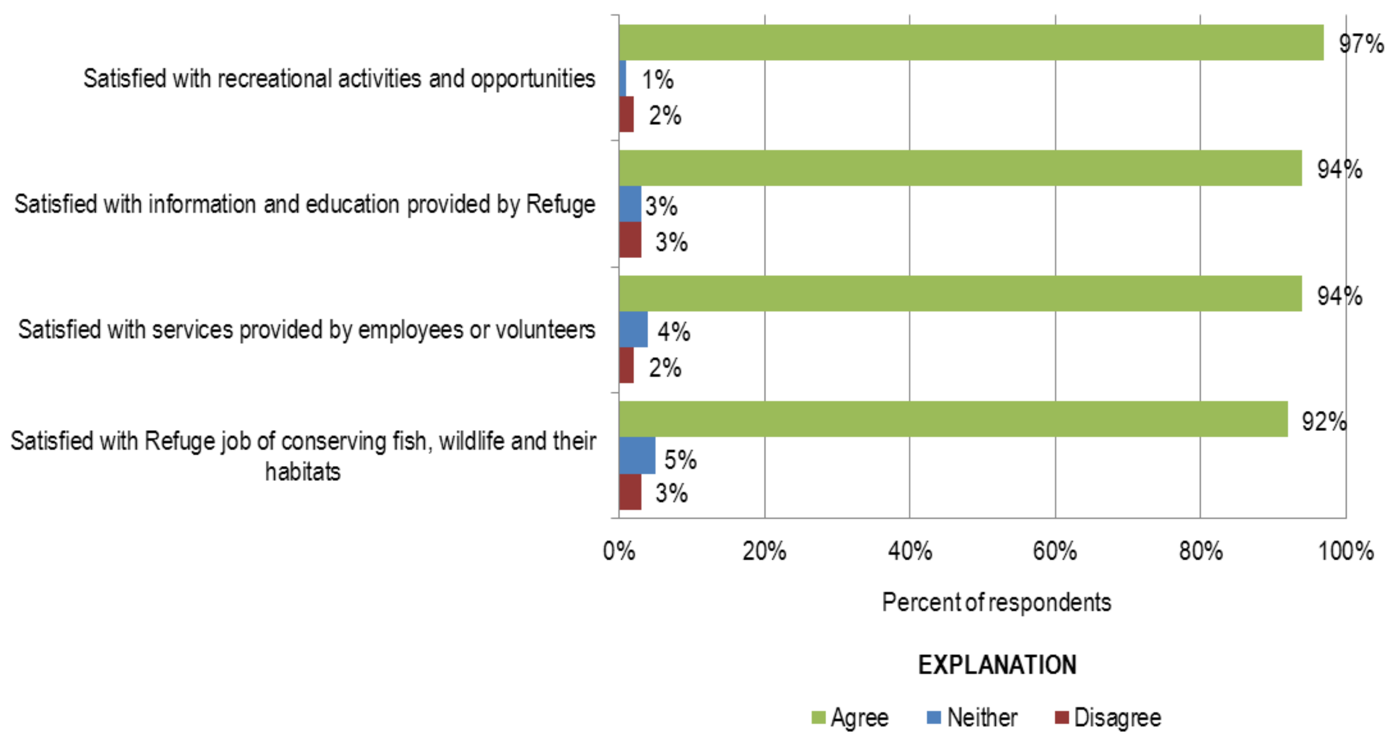


Figure 9. Overall satisfaction with Malheur NWR during *this* visit (n ≥ 269).

Importance/Satisfaction Ratings

Comparing the importance and satisfaction ratings for visitor services provided by refuges can help to identify how well the services are meeting visitor expectations. The importance-performance framework presented in this section is a tool that includes the importance of an attribute to visitors in relation to their satisfaction with that attribute. Drawn from marketing research, this tool has been applied to outdoor recreation and visitation settings (Martilla and James, 1977; Tarrant and Smith, 2002). Results for the attributes of interest are segmented into one of four quadrants (modified for this national study):

- Keep Up the Good Work = high importance/high satisfaction;
- Concentrate Here = high importance/low satisfaction;
- Low Priority = low importance/low satisfaction; and
- Look Closer = low importance/high satisfaction.

Graphically plotting visitors' importance and satisfaction ratings for different services, facilities, and recreational opportunities provides a simple and intuitive visualization of these survey measures. However, this tool is not without its drawbacks. One is the potential for variation among visitors regarding their expectations and levels of importance (Vaske et al., 1996; Bruyere et al., 2002; Wade and Eagles, 2003), and certain services or recreational opportunities may be more or less important for different segments of the visitor population. For example, hunters may place more importance on hunting opportunities and amenities such as blinds, while school group leaders may place more importance on educational/informational displays than would other visitors. This potential for highly varied importance ratings needs to be considered when viewing the average results of this analysis of visitors to Malheur NWR. This consideration is especially important when reviewing the attributes that fall into the "Look Closer" quadrant. In some cases, these attributes may represent specialized recreational activities in which a small subset of visitors participate (for example, hunting, kayaking) or facilities and services that only some visitors experience (for example, exhibits about the refuge). For these visitors, the average importance of (and potentially the satisfaction with) the attribute may be much higher than it would be for the overall population of visitors.

Figures 10-12 depict importance-satisfaction results for refuge services and facilities, recreational opportunities, and transportation-related features at Malheur NWR, respectively. All refuge services and facilities fell in the "Keep Up the Good Work" quadrant (fig. 10). Many refuge recreational opportunities fell in the "Keep Up the Good Work" quadrant except hunting, fishing, bicycling, and volunteering opportunities, which fell into the "Look Closer" quadrant (fig. 11). The average importance of X activities in the "Look Closer" quadrant may be higher among visitors who have participated in these activities during the past 12 months; however, there were not enough individuals in the sample to evaluate the responses of such participants. Nearly all transportation-related features fell in the "Keep Up the Good Work" quadrant except condition of parking areas, which fell into the "Look Closer" quadrant (fig. 12).

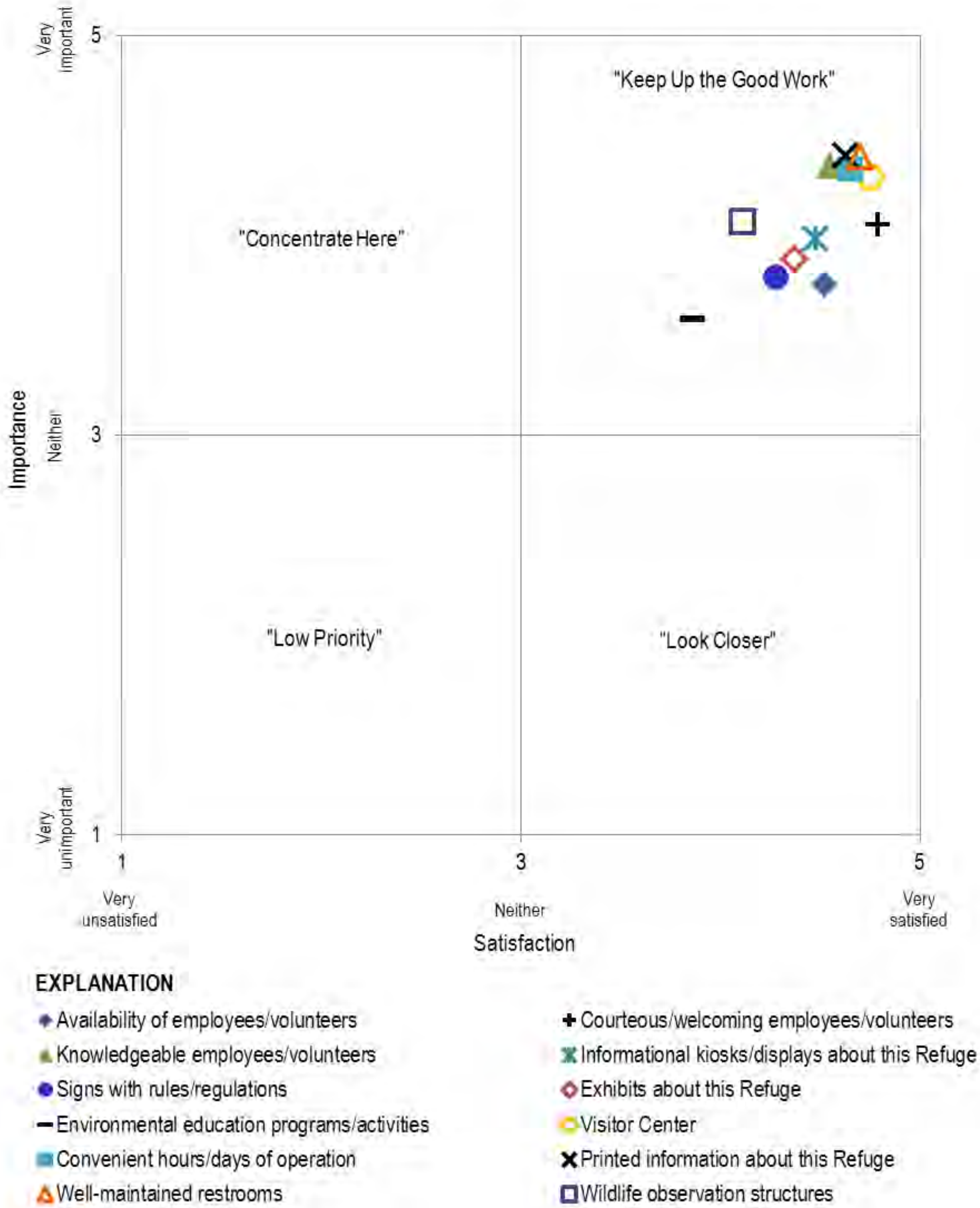


Figure 10. Importance-satisfaction ratings of services and facilities provided at Malheur NWR.

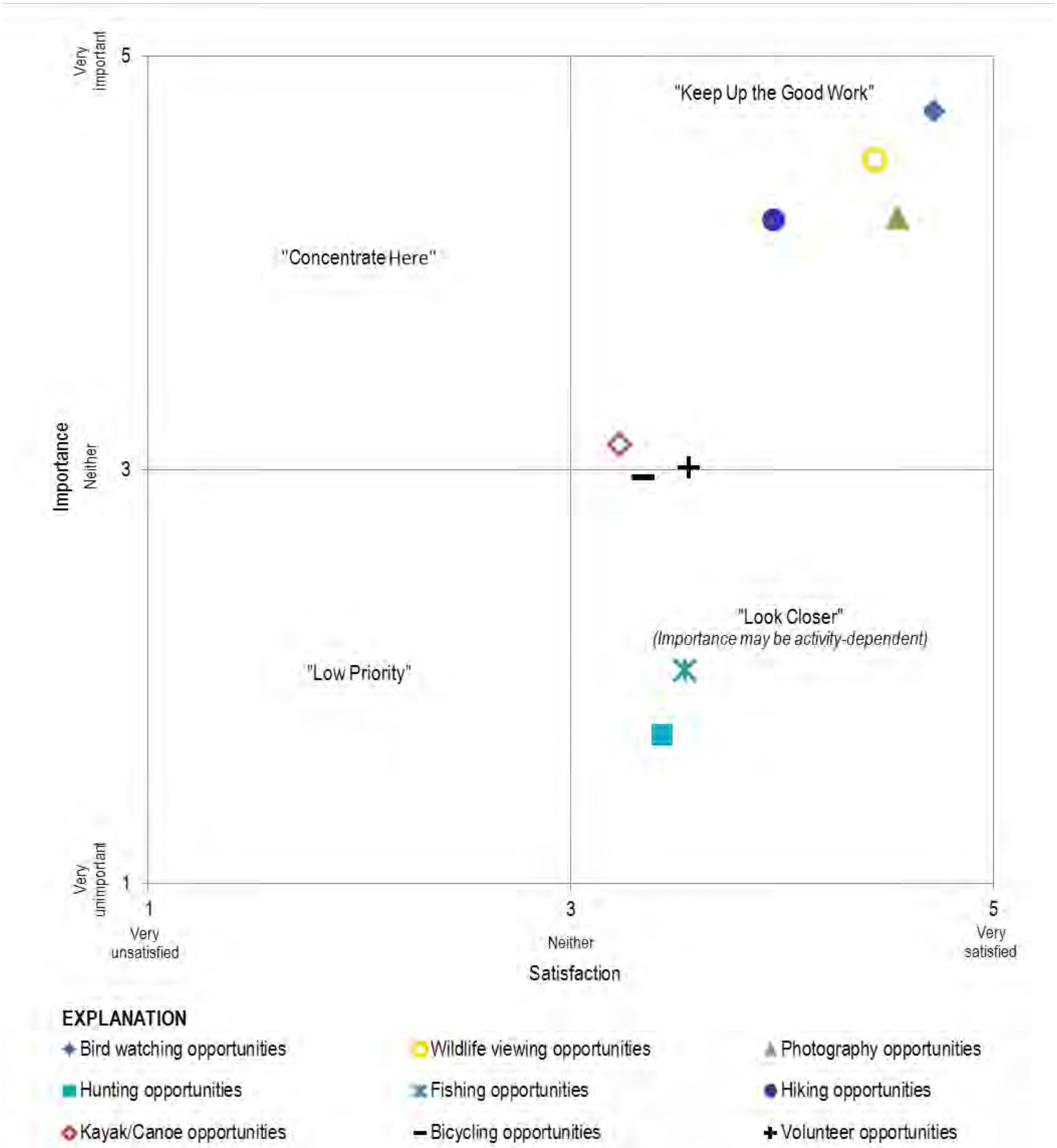


Figure 11. Importance-satisfaction ratings of recreational opportunities provided at Malheur NWR.

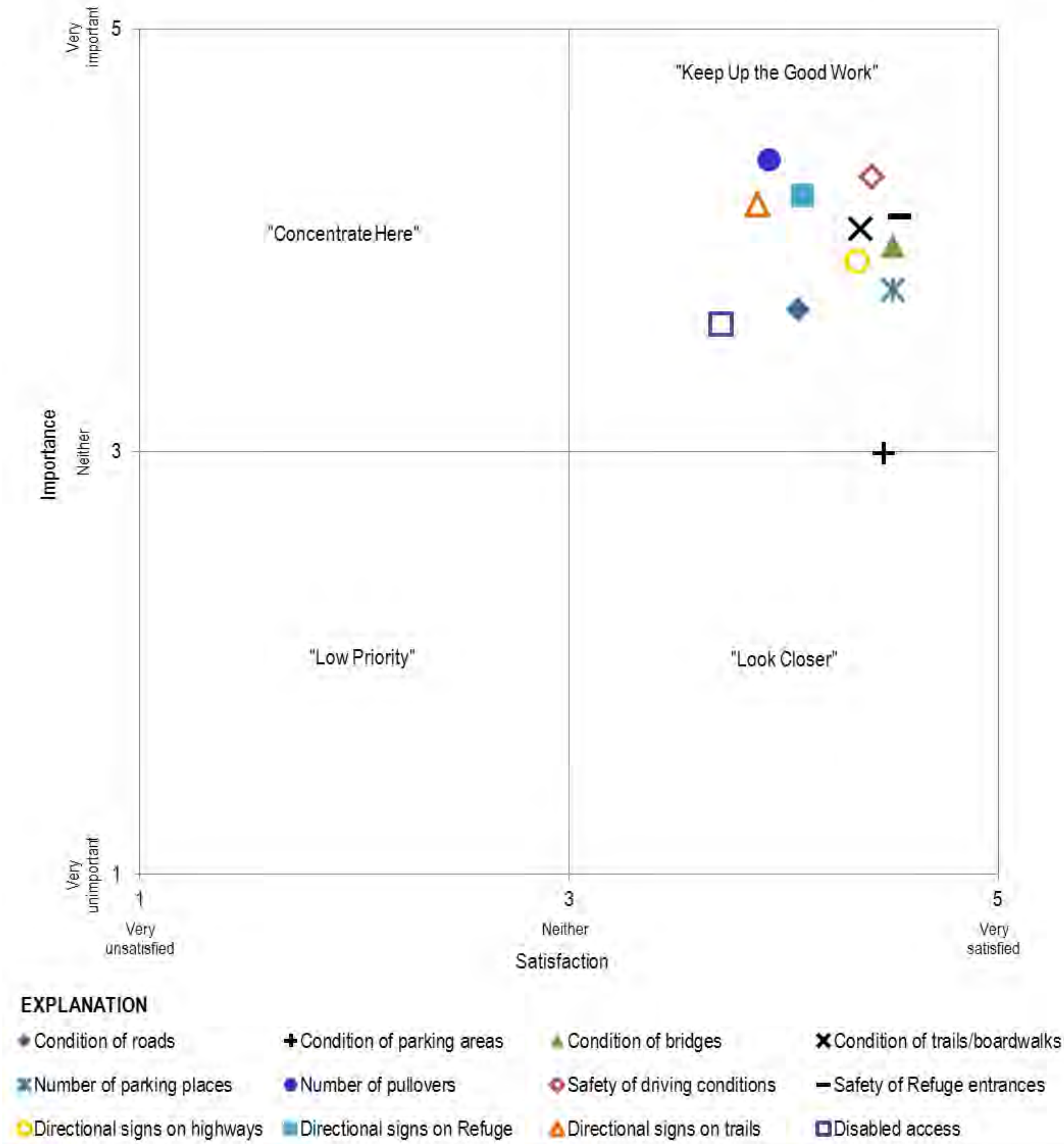


Figure 12. Importance-satisfaction ratings of transportation-related features at Malheur NWR.

Visitor Opinions about National Wildlife Refuge System Topics

One goal of this National Visitor Survey was to identify visitor trends across the NWRS to more effectively manage refuges and provide visitor services. Two important issues to the NWRS are transportation on refuges and communicating with visitors about climate change. The results to these questions will be most meaningful when they are evaluated in aggregate (data from all participating refuges together). However, basic results for Malheur NWR are reported here.

Alternative Transportation and the National Wildlife Refuge System

Visitors use a variety of transportation means to access and enjoy National Wildlife Refuges. While many visitors arrive at the refuge in a private vehicle, alternatives such as buses, trams, watercraft, and bicycles are increasingly becoming a part of the visitor experience. Previous research has identified a growing need for transportation alternatives within the refuge system (Krechmer et al., 2001); however, less is known about how visitors perceive and use these new transportation options. An understanding of visitors' likelihood of using certain alternative transportation options can help in future planning efforts. Visitors were asked their likelihood of using alternative transportation options at National Wildlife Refuges in the future.

Of the seven NWRS-wide alternative transportation options listed on the survey, the majority of Malheur NWR visitors were likely to use the following options at National Wildlife Refuges in the future (fig. 13):

- an offsite parking lot that provides trail access;
- a boat that goes to different points on Refuge waterways; and
- a bike share program.

The majority of visitors were *not* likely to use a bus/tram that takes passengers to different points on National Wildlife Refuges in the future (fig. 13).

When asked about using alternative transportation at Malheur NWR specifically, 38% of visitors indicated they were unsure whether it would enhance their experience; however, some visitors thought alternative transportation would enhance their experience (25%) and others thought it would not (37%).

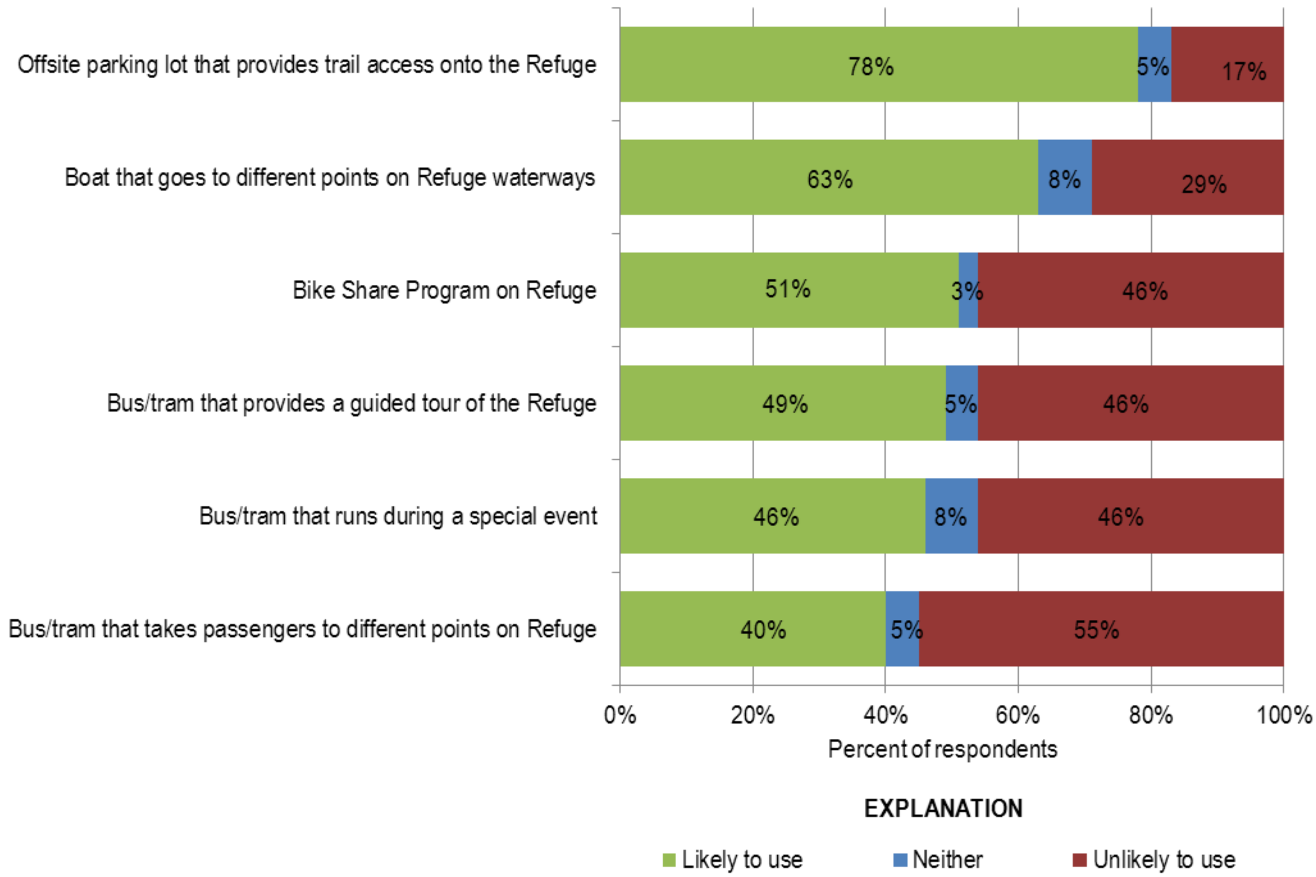


Figure 13. Visitors' likelihood of using alternative transportation options at National Wildlife Refuges in the future ($n \geq 261$).

Climate Change and the National Wildlife Refuge System

Climate change represents a growing concern for the management of National Wildlife Refuges. FWS' climate change strategy, titled "Rising to the Urgent Challenge," establishes a basic framework for the agency to work within a larger conservation community to help ensure wildlife, plant, and habitat sustainability (U.S. Fish and Wildlife Service, 2010). To support the guiding principles of the strategy, refuges will be exploring options for more effective engagement with visitors on this topic. The National Visitor Survey collected information about visitors' level of personal involvement in climate change related to fish, wildlife and their habitats and visitors' beliefs regarding this topic. Items draw from the "Six Americas" framework for understanding public sentiment toward climate change (Leiserowitz, Maibach, and Roser-Renouf, 2008) and from literature on climate change message frames (e.g., Nisbet, 2009). Such information provides a baseline for understanding visitor perceptions of climate change in the context of fish and wildlife conservation that can further inform related communication and outreach strategies.

Factors that influence how individuals think about climate change include their basic beliefs, levels of involvement, policy preferences, and behaviors related to this topic. Results presented below provide baseline information on visitors' levels of involvement with the topic of climate change related to fish, wildlife and their habitats. The majority of visitors to Malheur NWR agree with the following statements (fig. 14):

- "I am personally concerned about the effects of climate change on fish, wildlife and habitats;"
- "I stay well-informed about the effects of climate change;"
- "I take actions to alleviate the effects of climate change;" and
- "My experience would be enhanced if the Refuge provides information about how I can help address climate change effects."

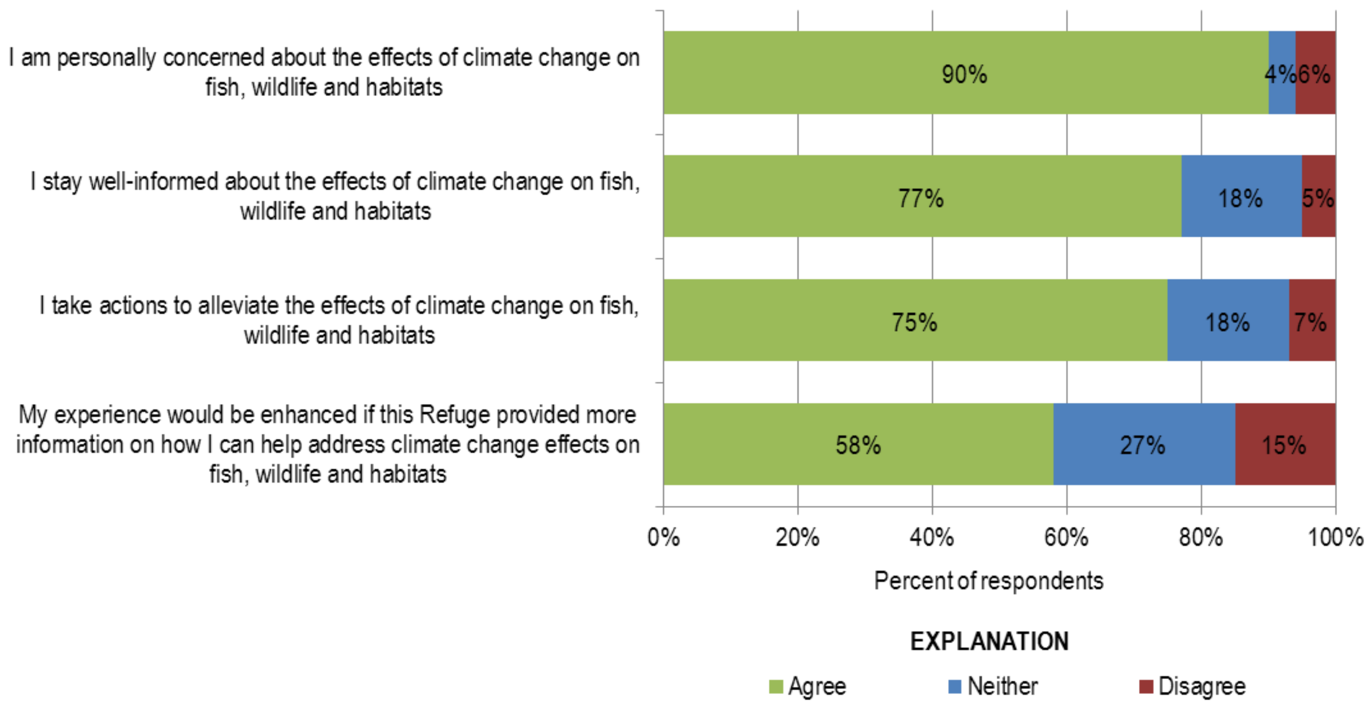


Figure 14. Visitors' personal involvement with climate change related to fish, wildlife and their habitats (n ≥ 264).

These results are most useful when coupled with responses to belief statements about the effects of climate change on fish, wildlife and their habitats, because such beliefs may be used to develop message frames (or ways to communicate) about climate change with a broad coalition of visitors. Framing science-based findings will not alter the overall message, but rather place the issue in a context in which different audience groupings can relate. The need to mitigate impacts of climate change on Refuges could be framed as a quality-of-life issue (for example, preserving the ability to enjoy fish, wildlife, plants, and their habitat) or an economic issue (for example, maintaining tourist revenues, supporting economic growth through new jobs/technology).

For Malheur NWR, the majority of visitors believe the following regarding climate change related to fish, wildlife and their habitats (fig. 15):

- "Future generations will benefit if we address climate change effects;"
- "We can improve our quality of life if we address the effects of climate change;" and
- "It is important to consider the economic benefits to local communities when addressing climate change effects."

The majority of visitors do *not* believe:

- "There has been too much emphasis on the catastrophic effects of climate change;" or
- "There is too much scientific uncertainty to adequately understand climate change effects."

Such information suggests that certain beliefs resonate with a greater number of visitors than other beliefs do. This information is important to note because the majority of visitors (58%) indicated that their experience would be enhanced if Malheur NWR provided information about how they could help address the effects of climate change on fish, wildlife, and their habitats (fig. 14), and framing the information in a way that resonates most with visitors may result in a more engaged public who support strategies aimed at alleviating climate change pressures. Data will be analyzed further at the aggregate, or national level, to inform the development of a comprehensive communication strategy about climate change.

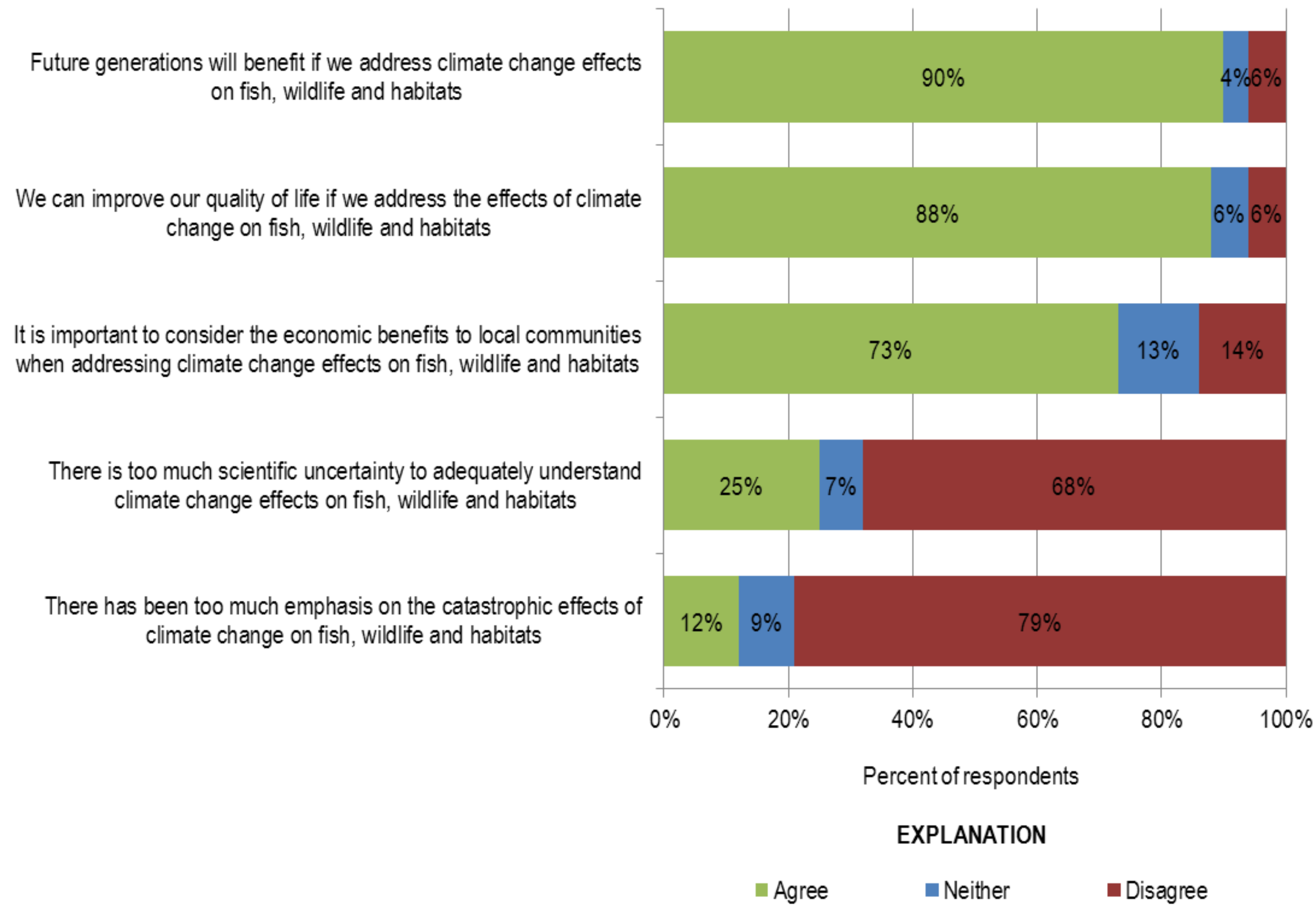


Figure 15. Visitors' beliefs about the effects of climate change on fish, wildlife and their habitats (n ≥ 264).

Conclusion

These individual refuge results provide a summary of trip characteristics and experiences of a sample of visitors to Malheur NWR during 2010–2011. These data can be used to inform decision-making efforts related to the refuge, such as Comprehensive Conservation Plan implementation, visitor services management, and transportation planning and management. For example, when modifying (either minimizing or enhancing) visitor facilities, services, or recreational opportunities, a solid understanding of visitors' trip and activity characteristics, their satisfaction with existing offerings, and opinions regarding refuge fees is helpful. This information can help to gauge demand for refuge opportunities and inform both implementation and communication strategies. Similarly, an awareness of visitors' satisfaction ratings with refuge offerings can help determine if any potential areas of concern need to be investigated further. As another example of the utility of these results, community relations may be improved or bolstered through an understanding of the value of the refuge to visitors, whether that value is attributed to an appreciation of the refuge's uniqueness, enjoyment of its recreational opportunities, or spending contributions of nonlocal visitors to the local economy. Such data about visitors and their experiences, in conjunction with an understanding of biophysical data on the refuge, can ensure that management decisions are consistent with the NWRS mission while fostering a continued public interest in these special places.

Individual refuge results will be available for downloading as they are completed during fall/winter 2011 at *http://pubs.usgs.gov/ds/643/*. Aggregated data from all participating refuges will be used to inform national-level NWRS goals, such as Goal 4: Welcome and Orient Visitors; Goal 5: Provide Quality Wildlife Dependent Recreation and Education Programs; and Goal 8: Provide Infrastructure and Equipment Adequate to Support Mission. The national-level report will be available spring 2012. PASA researchers are available at any time at *national_visitor_survey@usgs.gov* or 970.226.9205 to discuss the site-specific surveying effort at this refuge or the national-level results.

Acknowledgments

This study was commissioned by the FWS Division of Visitor Services and Communications. The study design and survey instrument were developed collaboratively with representatives from FWS and researchers from the PASA Branch, U.S. Geological Survey. We would like to thank the staff and any volunteers at Malheur NWR who assisted with the implementation of this surveying effort. The success of this effort is largely a result of their dedication to the refuge and its resources as well as to the people who come to explore these unique lands. We also would like to thank the following PASA team members for their hard work throughout the surveying effort, which has included (among *many* things) the arduous tasks of stuffing more than 20,000 envelopes, managing multiple databases, and preparing numerous reports: Shannon Conk, Halle Musfeldt, Phadrea Ponds, Gale Rastall, Margaret Swann, Emily Walenza, and Katie Walters.

References

Bruyere, B.L., Rodriguez, D.A., and Vaske, J.J., 2002, Enhancing importance-performance analysis through segmentation: Journal of Travel and Tourism Marketing, v. 12, no. 1, p. 81-95.

Carver, E., and Caudill, J., 2007, Banking on nature 2006: The economic benefits to local communities of National Wildlife Refuge visitation: U.S. Fish and Wildlife Service, Division of Economics, Washington, D.C., 372 p., accessed September 30, 2011, at *http://www.fws.gov/refuges/about/msWord/BankingonNature_2006_11-23.doc.*

Clark, J.R., 2001, Mission and Goals (National Fish and Wildlife Service Director's Order #132–601 FW1), accessed November 18, 2011 at *http://www.fws.gov/refuges/policiesandbudget/HR1420_missionGoals.html*.

Dillman, D.A., 2007, Mail and Internet surveys: The tailored design method. (2nd ed.): Hoboken, N.J., John Wiley and Sons, Inc., 523 p.

Krechmer, D., Grimm, L., Hodge, D., Mendes, D., and Goetzke, F., 2001, Federal lands alternative transportation systems study – Volume 3 – Summary of national ATS needs: prepared for Federal Highway Administration, and Federal Transit Administration in association with National Park Service, Bureau of Land Management, and U.S. Fish and Wildlife Service, 80 p. (Also available at *http://www.fta.dot.gov/documents/3039_study.pdf.)*

Leiserowitz, A, Maibach, E., and Roser-Renouf, C., 2008, Global warming's six Americas: An audience segmentation: New Haven, Conn., Yale University.

Martilla, J.A., and James, J.C., 1977, Importance-performance analysis: Journal of Marketing, v. 41, p. 77–79.

Nisbet, M.C., 2009, Communicating climate change: Why frames matter for public engagement: Environment, v. 51, p. 12-23.

Salant, P., and Dillman, D.A., 1994, How to conduct your own study: New York, N.Y., John Wiley and Sons, Inc.

Sexton, N.R., Dietsch, A.M., Don Carlos, A.W., Koontz, L., Solomon, A. and Miller, H., 2011, National Wildlife Refuge visitor survey 2010/2011: Individual refuge results: U.S. Geological Survey Data Series 643.

Stynes, D.J., 2008, National Park visitor spending and payroll impacts, 2007: East Lansing, Mich., Michigan State University, Department of Community, Agriculture, Recreation and Resource Studies.

Tarrant, M.A., and Smith, E.K., 2002, The use of a modified importance-performance framework to examine visitor satisfaction with attributes of outdoor recreation settings: Managing Leisure, v. 7, no. 2, p. 69–82.

Uniack, T., 1999, The citizen's wildlife refuge planning handbook: Charting the future of conservation on the National Wildlife Refuge near you: Defenders of Wildlife, Washington, D.C., accessed April 2010 at http://www.defenders.org/resources/publications/programs_and_policy/habitat_conservation/federal_lands/citizen's_wildlife_refuge_planning_handbook.pdf.

U.S. Department of Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau, 2007, 2006 National survey of fishing, hunting, and wildlife-associated recreation: U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C., 168 p.

U.S. Fish and Wildlife Service, 2007, America's National Wildlife Refuges, Fact Sheet, last updated July 31, 2007.

U.S. Fish and Wildlife Service, 2010, Rising to the urgent challenge: Strategic plan for responding to accelerating climate change: U.S. Fish and Wildlife Service, Division of Refuges, Washington, D.C., 32 p., accessed April 2011 at http://www.fws.gov/home/climatechange/pdf/CCStrategicPlan.pdf.

Vaske, J.J., Beaman, J., Stanley R., and Grenier, M., 1996, Importance-performance and segmentation: Where do we go from here?: *in* Fesenmaier, D.R., O'Leary, J.T., and Uysal, M., eds., Recent advances in tourism marketing research: New York, The Haworth Press, Inc., p. 225-240.

Wade, D.J. and Eagles, P.F.J., 2003, The use of importance-performance analysis and market segmentation for tourism management in parks and protected areas: An application to Tanzania's National Parks: Journal of Ecotourism, v. 2, no. 3, p. 196-212.

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National Wildlife Refuge Visitor Survey

PLEASE READ THIS FIRST:

Thank you for visiting a National Wildlife Refuge and for agreeing to participate in this study! We hope that you had an enjoyable experience. The U.S. Fish and Wildlife Service and the U.S. Geological Survey would like to learn more about National Wildlife Refuge visitors in order to improve the management of the area and enhance visitor opportunities.

If you have recently visited more than one National Wildlife Refuge or made more than one visit to the same Refuge, *please respond regarding only the Refuge and the visit when you were asked to participate in this survey*. Any question that uses the phrase "this Refuge" refers to the Refuge and visit when you were contacted.

SECTION 1. Your visit to this Refuge

1. Including your most recent visit, which activities have you participated in during the past 12 months at this Refuge? (*Please mark **all that apply**.*)

0% Big game hunting	44% Hiking	8% Environmental education (for example, classrooms or labs, tours)
0% Upland/Small-game hunting	4% Bicycling	1% Special event (*please specify*) See Appendix B
1% Migratory bird/Waterfowl hunting	61% Auto tour route/Driving	4% Other (*please specify*) See Appendix B
87% Wildlife observation	0% Motorized boating	1% Other (*please specify*) See Appendix B
93% Bird watching	3% Nonmotorized boating (including canoes/kayaks)	
6% Freshwater fishing	47% Interpretation (for example, exhibits, kiosks, videos)	
0% Saltwater fishing		
60% Photography		

2. Which of the activities above was the ***primary*** purpose of your visit to this Refuge?
(*Please write **only one activity** on the line.*) See report for categorized results; see Appendix B for miscellaneous responses

3. Did you go to a Visitor Center at this Refuge?
   - 7% No
   - 93% Yes → If yes, what did you do there? (*Please mark **all that apply**.*)

87% Visit the gift shop or bookstore	4% Watch a nature talk/video/presentation
76% View the exhibits	84% Stopped to use the facilities (for example, get water, use restroom)
81% Ask information of staff/volunteers	26% Other (*please specify*) See Appendix B

4. Which of the following best describes your visit to this Refuge? (*Please mark **only one**.*)

Nonlocal	Local	Total	
50%	80%	51%	It was the primary purpose or sole destination of my trip.
44%	20%	43%	It was one of many equally important reasons or destinations for my trip.
7%	0%	6%	It was just an incidental or spur-of-the-moment stop on a trip taken for other purposes or to other destinations.

5. Approximately how many **miles** did you travel to get to this Refuge?

Nonlocal 437 number of miles

Local 41 number of miles

6. How much time did you spend at this Refuge on your visit?

See Report for Results

7. Were you part of a group on your visit to this Refuge?

26% No (*skip to question #9*)

74% Yes → What **type of group** were you with on your visit? (*Please mark **only one**.*)

- 85% Family and/or friends
- 11% Organized club or school group
- 1% Commercial tour group
- 2% Other (*please specify*) See Appendix B

8. How many people were in your group, including yourself? (*Please answer each category.*)

5 number 18 years and over   0 number 17 years and under

9. How did you **first learn or hear about** this Refuge? (*Please mark **all that apply**.*)

- 59% Friends or relatives
- 8% Signs on highway
- 13% Recreation club or organization
- 9% People in the local community
- 15% Refuge printed information (brochure, map)
- 9% Refuge website
- 3% Other website (*please specify*) See Appendix B
- 2% Television or radio
- 10% Newspaper or magazine
- 20% Other (*please specify*) See Appendix B

10. During which seasons have you visited this Refuge in the last 12 months? (*Please mark **all that apply**.*)

- 58% Spring (March-May)
- 25% Summer (June-August)
- 43% Fall (September-November)
- 0% Winter (December-February)

11. How many times have you visited…

…this Refuge (including this visit) in the last 12 months? 2 number of visits

…other National Wildlife Refuges in the last 12 months? 5 number of visits

SECTION 2. Transportation and access at this Refuge

1. What **forms of transportation** did you use on your visit to this Refuge? (*Please mark* ***all that apply.***)

- 83% Private vehicle without a trailer
- 10% Private vehicle with a trailer (for boat, camper or other)
- 1% Commercial tour bus
- 8% Recreational vehicle (RV)
- 1% Refuge shuttle bus or tram
- 0% Motorcycle
- 0% ATV or off-road vehicle
- 1% Boat
- 0% Wheelchair or other mobility aid
- 2% Bicycle
- 42% Walk/Hike
- 3% Other (*please specify below*) See Appendix B

2. Which of the following did you use to find your way to this Refuge? (*Please mark* ***all that apply.***)

- 52% Signs on highways
- 10% A GPS navigation system
- 56% A road atlas or highway map
- 18% Maps from the Internet (for example, MapQuest or Google Maps)
- 10% Directions from Refuge website
- 8% Directions from people in community near this Refuge
- 10% Directions from friends or family
- 55% Previous knowledge/I have been to this Refuge before
- 5% Other (*please specify*) See Appendix B

3. Below are different alternative transportation options that could be offered at some National Wildlife Refuges in the future. Considering the different Refuges you may have visited, please tell us **how likely you would be to use each transportation option**. (*Please circle one number for each statement.*)

How likely would you be to use…	Very Unlikely	Somewhat Unlikely	Neither	Somewhat Likely	Very Likely
…a bus or tram that takes passengers to different points on the Refuge (such as the Visitor Center)?	34%	21%	5%	28%	12%
…a bike that was offered through a Bike Share Program for use while on the Refuge?	33%	12%	3%	31%	20%
…a bus or tram that provides a guided tour of the Refuge with information about the Refuge and its resources?	30%	15%	5%	35%	15%
…a boat that goes to different points on Refuge waterways?	19%	9%	8%	41%	22%
…a bus or tram that runs during a special event (such as an evening tour of wildlife or weekend festival)?	28%	18%	8%	31%	15%
…an offsite parking lot that provides trail access for walking/hiking onto the Refuge?	10%	6%	5%	35%	44%
…some other alternative transportation option? (*please specify*) See Appendix B	17%	9%	0%	30%	43%

4. If alternative transportation were offered at *this* Refuge, would it enhance your experience?

25% Yes   37% No   38% Not Sure

5. For each of the following transportation-related features, first, **rate how important** each feature is to you when visiting this Refuge; then **rate how satisfied** you are with the way this Refuge is managing each feature.
If this Refuge does not offer a specific transportation-related feature, please rate how important it is to you and then circle NA "Not Applicable" under the Satisfaction column.

Importance *Circle one for each item.*						**Satisfaction** *Circle one for each item.*					
Very Unimportant	Somewhat Unimportant	Neither	Somewhat Important	Very Important		Very Unsatisfied	Somewhat Unsatisfied	Neither	Somewhat Satisfied	Very Satisfied	Not Applicable
3%	16%	12%	50%	19%	Surface conditions of roads	3%	14%	5%	30%	48%	NA
15%	22%	17%	40%	6%	Surface conditions of parking areas	3%	0%	8%	24%	65%	NA
3%	11%	11%	36%	39%	Condition of bridges	1%	1%	10%	20%	67%	NA
2%	7%	8%	50%	33%	Condition of trails and boardwalks	0%	3%	9%	35%	52%	NA
5%	11%	9%	54%	21%	Number of places for parking	1%	2%	7%	24%	66%	NA
3%	2%	3%	39%	53%	Number of places to pull over along Refuge roads	2%	15%	8%	39%	36%	NA
2%	4%	6%	39%	49%	Safety of driving conditions on Refuge roads	0%	4%	8%	31%	57%	NA
1%	9%	8%	41%	41%	Safety of Refuge road entrances/exits	0%	1%	8%	25%	66%	NA
6%	9%	11%	39%	36%	Signs on highways directing you to the Refuge	1%	6%	8%	29%	56%	NA
4%	4%	4%	42%	45%	Signs directing you around the Refuge roads	2%	12%	6%	37%	44%	NA
2%	4%	12%	39%	43%	Signs directing you on trails	1%	12%	18%	35%	34%	NA
6%	9%	29%	33%	23%	Access for people with physical disabilities or who have difficulty walking	0%	7%	42%	24%	27%	NA

6. If you have any comments about transportation-related items at this Refuge, please write them on the lines below.

See Appendix B

SECTION 3. Your expenses related to your Refuge visit

1. Do you live in the local area (within approximately 50 miles of this Refuge)?

   4% Yes

   96% No → How much time did you spend **in local communities** on this trip?

   4 number of hours OR 3 number of days

2. Please record the amount that **you and other members of your group** with whom you shared expenses (for example, other family members, traveling companions) spent in the local 50-mile area during **your most recent visit** to this Refuge. (*Please enter the amount spent to the nearest dollar in each category below. Enter 0 (zero) if you did not spend any money in a particular category.*)

Categories	**Amount Spent in <u>Local Communities & at this Refuge</u>** ***(within 50 miles of this Refuge)***
Motel, bed & breakfast, cabin, etc.	See Report for Results
Camping	
Restaurants & bars	
Groceries	
Gasoline and oil	
Local transportation (bus, shuttle, rental car, etc.)	
Refuge entrance fee	
Recreation guide fees (hunting, fishing, wildlife viewing, etc.)	
Equipment rental (canoe, bicycle, kayak, etc.)	
Sporting good purchases	
Souvenirs/clothing and other retail	
Other (*please specify*)________________	

3. Including yourself, how many people in your group shared these trip expenses?

   3 number of people sharing expenses

4. As you know, some of the costs of travel such as gasoline, hotels, and airline tickets often increase. If your total trip costs were to increase, what is the maximum extra amount you would pay and still visit this Refuge? (*Please circle the highest dollar amount.*)

$0	$10	$20	$35	$50	$75	$100	$125	$150	$200	$250
1%	1%	5%	2%	16%	5%	34%	2%	7%	8%	19%

5. If you or a member of your group paid a fee or used a pass to enter this Refuge, how appropriate was the fee? (*Please mark **only one**.*)

5% Far too low | 18% Too low | 77% About right | 0% Too high | 0% Far too high | 86% Did not pay a fee (*skip to Section 4*)

6. Please indicate whether you disagree or agree with the following statement. (*Please mark **only one**.*)

The value of the recreation opportunities and services I experienced at this Refuge was at least equal to the fee I paid.

0% Strongly disagree | 0% Disagree | 5% Neither agree or disagree | 36% Agree | 59% Strongly agree

SECTION 4. Your experience at this Refuge

1. Considering your visit to this Refuge, please indicate the extent to which you disagree or agree with each statement. (*Please circle one number for each statement.*)

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Not Applicable
Overall, I am satisfied with the recreational activities and opportunities provided by this Refuge.	1%	1%	1%	26%	71%	NA
Overall, I am satisfied with the information and education provided by this Refuge about its resources.	0%	3%	3%	29%	65%	NA
Overall, I am satisfied with the services provided by employees or volunteers at this Refuge.	0%	2%	4%	25%	69%	NA
This Refuge does a good job of conserving fish, wildlife and their habitats.	1%	2%	6%	23%	68%	NA

2. For each of the following services, facilities, and activities, first, **rate how important** each item is to you when visiting this Refuge; then, **rate how satisfied** you are with the way this Refuge is managing each item.
If this Refuge does not offer a specific service, facility, or activity, please rate how important it is to you and then circle NA "Not Applicable" under the Satisfaction column.

Importance *Circle one for each item.*						**Satisfaction** *Circle one for each item.*					
Very Unimportant	Somewhat Unimportant	Neither	Somewhat Important	Very Important	**Refuge Services, Facilities, and Activities**	Very Unsatisfied	Somewhat Unsatisfied	Neither	Somewhat Satisfied	Very Satisfied	Not Applicable
5%	11%	11%	47%	25%	Availability of employees or volunteers	1%	4%	6%	19%	70%	NA
5%	6%	5%	44%	39%	Courteous and welcoming employees or volunteers	1%	0%	4%	8%	87%	NA
3%	4%	3%	33%	56%	Knowledgeable employees or volunteers	1%	3%	4%	24%	68%	NA
2%	4%	2%	35%	56%	Printed information about this Refuge and its resources (for example, maps and brochures)	1%	2%	3%	23%	72%	NA
3%	8%	7%	52%	30%	Informational kiosks/displays about this Refuge and its resources	0%	2%	7%	31%	59%	NA
4%	11%	13%	44%	28%	Signs with rules/regulations for this Refuge	0%	2%	18%	31%	50%	NA
3%	9%	10%	53%	24%	Exhibits about this Refuge and its resources	0%	4%	10%	29%	56%	NA
6%	11%	24%	36%	22%	Environmental education programs or activities	2%	2%	37%	26%	33%	NA
3%	3%	4%	43%	48%	Visitor Center	0%	1%	2%	18%	79%	NA
3%	1%	5%	44%	48%	Convenient hours and days of operation	0%	1%	5%	22%	72%	NA
3%	2%	3%	37%	55%	Well-maintained restrooms	0%	1%	4%	16%	78%	NA
3%	7%	8%	44%	38%	Wildlife observation structures (decks, blinds)	1%	7%	14%	34%	43%	NA
2%	1%	2%	11%	84%	Bird-watching opportunities	0%	0%	2%	21%	76%	NA
1%	2%	2%	35%	60%	Opportunities to observe wildlife other than birds	0%	2%	8%	34%	56%	NA
4%	4%	6%	38%	48%	Opportunities to photograph wildlife and scenery	1%	1%	7%	26%	66%	NA
70%	3%	15%	7%	4%	Hunting opportunities	4%	1%	62%	14%	19%	NA
56%	10%	17%	10%	8%	Fishing opportunities	2%	3%	59%	13%	24%	NA
2%	3%	7%	47%	41%	Trail hiking opportunities	3%	8%	13%	43%	33%	NA
18%	15%	19%	36%	13%	Water trail opportunities for canoeing or kayaking	5%	11%	52%	20%	12%	NA
23%	13%	21%	30%	13%	Bicycling opportunities	3%	10%	53%	20%	15%	NA
20%	10%	35%	22%	14%	Volunteer opportunities	1%	3%	57%	17%	22%	NA

3. If you have any comments about the services, facilities, and activities at this Refuge, please write them on the lines below.

See Appendix B

SECTION 5. Your opinions regarding National Wildlife Refuges and the resources they conserve

1. Before you were contacted to participate in this survey, were you aware that National Wildlife Refuges…

…are managed by the U. S. Fish and Wildlife Service?	92% Yes	8% No
…have the primary mission of conserving, managing, and restoring fish, wildlife, plants and their habitat?	95% Yes	5% No

2. Compared to other public lands you have visited, do you think Refuges provide a unique recreation experience?

96% Yes   4% No

3. If you answered "Yes" to Question 2, please briefly describe what makes Refuges unique. ______________________

See Appendix B

4. There has been a lot of talk about climate change recently. We would like to know what you think about climate change as it relates to fish, wildlife and their habitats. To what extent do you disagree or agree with each statement below? (*Please circle one number for each statement.*)

Statements about climate change	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
I am personally concerned about the effects of climate change on fish, wildlife and their habitats.	2%	4%	4%	25%	66%
We can improve our quality of life if we address the effects of climate change on fish, wildlife and their habitats.	3%	3%	6%	27%	61%
There is too much scientific uncertainty to adequately understand how climate change will impact fish, wildlife and their habitats.	36%	32%	7%	17%	9%
I stay well-informed about the effects of climate change on fish, wildlife and their habitats.	0%	5%	18%	50%	26%
It is important to consider the economic costs and benefits to local communities when addressing the effects of climate change on fish, wildlife and their habitats.	2%	12%	13%	49%	23%
I take actions to alleviate the effects of climate change on fish, wildlife and their habitats.	1%	6%	17%	51%	24%
There has been too much emphasis on the catastrophic effects of climate change on fish, wildlife and their habitats.	50%	29%	9%	7%	5%
Future generations will benefit if we address the effects of climate change on fish, wildlife and their habitats.	2%	4%	4%	25%	65%
My experience at this Refuge would be enhanced if this Refuge provided more information about how I can help address the effects of climate change on fish, wildlife and their habitats.	6%	9%	27%	43%	14%

SECTION 6. A Little about You

***** Please tell us a little bit about yourself. Your answers to these questions will help further characterize visitors to National Wildlife Refuges. Answers are not linked to any individual taking this survey. *****

1. Are you a citizen or permanent resident of the United States?

98% Yes 2% No → *If not, what is your home country?* See Figure 4 in Report

2. Are you? 53% Male 47% Female

3. In what year were you born? 1952 (YYYY)

4. What is your highest year of formal schooling? (*Please circle one number.*)

1 2 3 4 5	6 7 8	9 10 11 12	13 14 15 16	17 18 19 20+
(elementary)	(junior high or middle school)	(high school)	(college or technical school)	(graduate or professional school)
	0%	5%	39%	56%

5. What ethnicity do you consider yourself? [0%] Hispanic or Latino [100%] Not Hispanic or Latino

6. From what racial origin(s) do you consider yourself? (*Please mark **all that apply**.*)

[2%] American Indian or Alaska Native [0%] Black or African American [99%] White

[3%] Asian [1%] Native Hawaiian or Pacific Islander

7. How many members of your household contribute to paying the household expenses? 2 persons

8. Including these members, what was your approximate household income from all sources (before taxes) last year?

[0%] Less than $10,000 [10%] $35,000 - $49,999 [19%] $100,000 - $149,999

[3%] $10,000 - $24,999 [26%] $50,000 - $74,999 [7%] $150,000 - $199,999

[6%] $25,000 - $34,999 [21%] $75,000 - $99,999 [7%] $200,000 or more

9. How many outdoor recreation trips did you take in the last 12 months (for activities such as hunting, fishing, wildlife viewing, etc.)?

15 number of trips

Thank you for completing the survey.

There is space on the next page for any additional comments you may have regarding your visit to this Refuge.

See Appendix B for Comments

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Appendix R

Improving the Aquatic Health of Malheur National Wildlife Refuge

Malheur Lake
©Barbara Wheeler

Improving the Aquatic Health of Malheur National Wildlife Refuge

Authored by Linda Beck, Adam Daniel, and Shannon Hurn

Acknowledgements: Malheur National Wildlife Refuge would like to thank all the collaborators who contributed to the completion of this document. A special thanks goes to Bruce Taylor, Gary Ivey, Jenny Barnett, Peter Sorensen, Bridgette Flanders-Wanner, Joe Engler, Tim Mayer, Lara Bjork, and Sharon Selvaggio for providing edits.

Title page photos, clockwise from top left: 1. Canvasback duck, 2. Western grebes, 3. American white pelican, 4. White-faced ibis and snowy egret, 5. River otter, 6. American coot with chicks, 7. American avocet with chicks.

R.1 Executive Summary

This plan for carp control and improving aquatic health in the Harney Basin (the Basin) was formulated by melding information from the Malheur National Wildlife Refuge 2010 Invasive Common Carp Workshop, the 2008 *Refuge Carp Management Plan* (updated from January 1998), the 2010 *Harney Basin Common Carp Management Plan to Improve Malheur Lake Water Quality*, and the 2012 *Malheur National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Impact Statement*.

The non-native common carp (*Cyprinus carpio*, L.) established breeding populations in the Basin during the first half of the twentieth century. As a result, Malheur Lake (the Lake) and most connecting waterways and water bodies have transitioned from a macrophyte-dominated, clear-water state to a phytoplankton-dominated, turbid-water state. The ecological collapse caused by common carp has reduced waterfowl production at Malheur National Wildlife Refuge (the Refuge) to an estimated one-tenth of the average 100,000 ducklings produced annually in the 1940s, before carp populations reached high densities (Cornely 1982). After decades of opportunistic carp control (including five rotenone treatments), managers, partners, and other collaborators are proposing a Basin-wide, long-term carp control plan to improve water quality not only on the Refuge, but also within the surrounding Basin. The Refuge's highest priority management action is to control the carp population to return the Refuge to its full biological potential as habitat for migratory and resident birds. If the overall aquatic health of Refuge waters is improved, bird populations would have the habitat they need. This document outlines the historical perspective, management action priorities, and a path forward to address this invasive species problem. This plan's integrated pest management control strategy is based on the assumption that eradication is realistic in some areas but not in other areas due to the high degree of complexity and extreme variability in waterway and water body interconnectivity within the Basin. The plan's sustainable carp control priorities and actions are congruent with the Refuge's Comprehensive Conservation Plan aquatic health goals and objectives. Although there is wide recognition and support for a comprehensive carp control management program in the Basin, implementation is challenged by a lack of funding. Sustainable implementation funding would need to be acquired opportunistically and entrepreneurially from public and private funding sources.

The Refuge was established because it provided outstanding habitat for wildlife, particularly migratory birds, but because of common carp, the Refuge's aquatic health has deteriorated greatly since its establishment. Controlling carp is not simple, but the Refuge's carp population *must be controlled*, so that these lands and waters can once again be home to flourishing populations of native species that the Refuge is intended to support.

Figure R-1. Refuge Manager herding carp to sample for fish health and population dynamics at Crane Pond in 2010.

Contents

Figures

Plan continues on following page.

R.2 Introduction

The vast wetlands and wet meadows of the Harney Basin (the Basin) in southeast Oregon have long been recognized as some of the most important wetland habitat for migratory birds in the Pacific Flyway. The lakes, rivers, and marshes within the Malheur National Wildlife Refuge (the Refuge), and other seasonal floodplain wetlands and wet meadows found on private lands across the Basin, are used by hundreds of thousands of migrating and breeding waterfowl, shorebirds, and other water birds. These same wetted habitats sustain a rich diversity of native fish and wildlife, ranging from redband trout to yellow-headed blackbirds and spotted frog. However, invasion of the Basin's wetlands by non-native common carp (*Cyprinus carpio*) in the late 1930s triggered long-term negative ecological changes that have dramatically reduced wetland habitat productivity for migratory birds and other native fish and wildlife.

Figure R-2. East Knox Pond flourishes with life due to water manipulations.

High densities of common carp in Malheur Lake (the Lake), a 32,000-acre marsh at average water levels, have caused increased turbidity in the Lake, which in turn has harmed the Lake in three key ways: the Lake is void of submergent and emergent aquatic vegetation, water quality is degraded, and waterfowl productivity has severely decreased. These impacts can also be found in other wetlands and rivers throughout the Basin. The Lake and its connecting waterways and water bodies have transitioned from a macrophyte-dominated, clear, stable state to a phytoplankton-dominated turbid state. The ecological collapse of this highly productive system is reflected in waterfowl production on the Refuge, which has declined by an estimated 90 percent from its historically documented peak (Cornely 1982).

From an ecological perspective, the highest priority is to restore water quality in the Lake, the biological heart of the Refuge and historically the most productive wetland habitat in the Basin. Efforts to reach this goal will rely on three key principles. First, control is more realistic than complete eradication. Second, collaboration throughout the Basin is essential. Finally, all decisions and actions must be part of a cycle of adaptive management that is informed by scientifically valid data and analysis.

Eradication of common carp in the Basin as a whole is considered nearly impossible using current methods, because of the complexity of the waterways connecting to the Lake and wide annual fluctuations in water levels (Figure 3). Carp control technologies are evolving, and may eventually provide methods to control carp populations over large water systems. The relatively long life-span and high fecundity of common carp will require a multifaceted sustainable approach to population control, including but not restricted to harvesting, trapping, piscicide application, hormone attractants, and barrier infrastructure, all of which could be employed to remove carp from the Basin.

Implementation of carp control efforts to restore the health of aquatic habitats in the Lake and Basin wetland systems will require investments on a scale that is beyond the capacity of any single agency or organization. Successful, sustainable implementation will require partnerships among public agencies, nongovernmental organizations, and private landowners, with funding from a variety of Federal, state, and private sources. Development of these collaborative partnerships is already underway.

In March 2010, the Refuge hosted an invasive common carp workshop that produced broad agreement among a wide variety of stakeholders, collaborators, and interested parties about the pressing need to improve the Refuge's and the Basin's aquatic health by controlling carp. This workshop also spurred the establishment of the Aquatic Health Coalition.

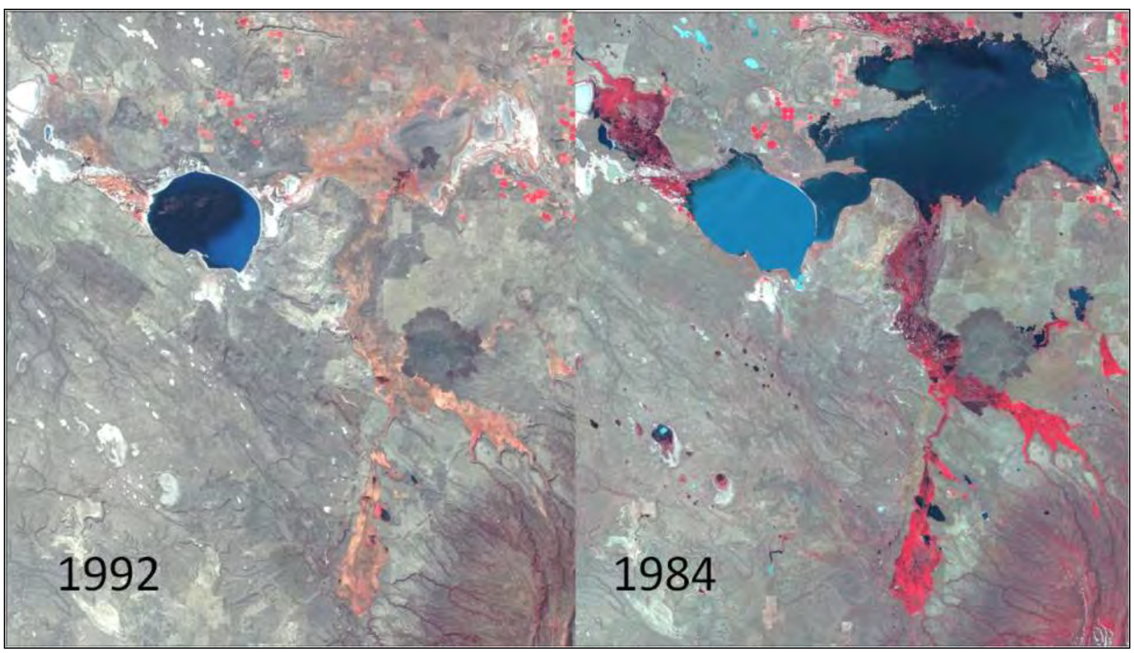

Figure R-3. Examples of the 1992 drought year and 1984 high water levels at Malheur Refuge.

The Refuge, with its 60 collaborators, has drafted a comprehensive conservation plan (CCP) that will guide Refuge management over the next 15 years. This collaborative planning group quickly identified the Refuge's poor aquatic health as the most pressing and immediate issue to address. The CCP's management direction focuses future staff time and resources on reducing the carp density to $\leq$100 pounds per acre. A study by Bajer et al. (2009) suggests that at this biomass level, the negative impacts of carp are mitigated, allowing aquatic plant and animal populations to maintain reasonable levels. The Refuge, in cooperation with its public and private collaborators, will seek to achieve this goal using replicable protocols for data gathering during inventory and monitoring, as well as testable methods of carp control. Through the combination of maintaining biological integrity, using best available science, and employing adaptive management, the Refuge will make data-driven adjustments to carp control.

This document is considered a "step-down" plan from the CCP, which means that this plan provides additional details on how the Refuge will implement strategies to reduce carp biomass to <100 pounds per acre. The CCP goals and objectives that relate to carp management are presented in Chapter 2 of the CCP, and information on the implementation and priorities related to aquatic health is included in Appendix C. This document also complements the 2010 *Harney Basin Common Carp Management Plan to Improve Malheur Lake Water Quality* developed by the Natural Resources Conservation Service (NRCS). The NRCS and the Refuge will work together closely to implement these two plans; in fact, the Refuge is the lead agency for the NRCS plan. The carp control strategy outlined in this document focuses heavily on the Lake and other wetlands within the Refuge. These aquatic habitats were identified as the highest priority for initial control efforts. Initial population assessment work is already underway, and the Refuge has identified specific options for carp control at numerous sites, including some on adjacent lands. In the long run, however, control of carp will require cooperative efforts across the Basin with involvement of private landowners as well as public agencies. Because funding for these efforts will necessarily come from a variety of sources, implementation will occur as opportunities arise. As part of the work of the Aquatic Health Coalition, collaborators will coordinate their efforts to identify, pursue, and direct funding to the highest priority actions.

R.3 The Problem: Carp Impacts

The negative impacts of common carp have been apparent at the Lake for decades. The Silvies River provided an entry point into the Lake, where carp were acknowledged to be invasive in 1952 (Thompson and Littlefield 1980). Due to a lack of natural or artificial physical barriers, carp migrated up the Blitzen River and spread throughout the Blitzen Valley wetlands over the next 10 years. During the years of 1952, 1957, and 1958, the natural land bridge between Harney and Mud lakes was breached, allowing carp to invade the Double-O Unit wetlands. By the early 1960s, carp were established in large numbers throughout the Refuge and began to have an adverse impact on production of aquatic plants and aquatic invertebrates. In the 1980s, high water levels again resulted in a barrier breach. At that time, ice shears may have changed both the bathymetry and chemistry of the Lake; since that time, the water has been very turbid (Figure S-4).

Figure R-4. Carp research being conducted by Refuge staff and a University of Minnesota post-doctoral fellow in Malheur Lake. Notice no vegetation and very turbid water.

Carp have many negative impacts on aquatic habitats, namely by competing with other species for food, causing turbidity to increase, and ultimately decreasing waterfowl productivity and use (Figure S-5). As carp search for aquatic invertebrates, they compete directly with other aquatic wildlife by consuming and uprooting submersed aquatic plants. These plants, especially sago pondweed (*Potamogeton pectinatus*), are important foods for other wildlife and provide a critical part of the subsurface habitat used by aquatic invertebrates and native fish.

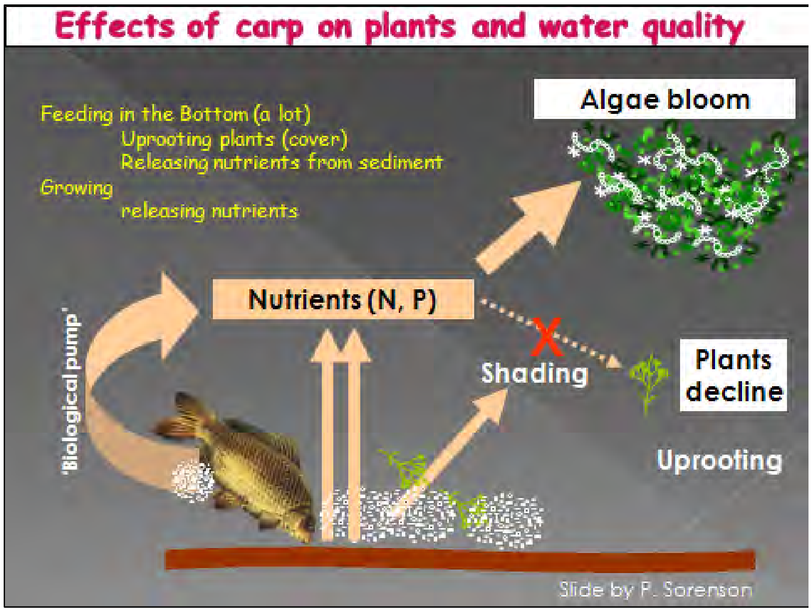

Figure R-5. Explanation of common carp impacts on the aquatic environment.

Carp alter the aquatic ecosystem when feeding by causing water turbidity. While feeding on the bottom, they vigorously roil the water in search of food, which stirs up the sediment and organic material and suspends this material in the water column. Consequently, subsurface sunlight needed for plant growth is reduced or eliminated, and photosynthetic plant production and oxygen levels decrease. With high concentrations of carp, the effects of swimming and spawning also contribute to increased turbidity. Eventually carp can change the physical environment of an aquatic system to a point where only a few species of fish, invertebrates, and plants can survive in low numbers; the Lake and other water bodies on the Refuge have reached these conditions. Even after carp are removed from a wetland system it may take several years for the wetland to return to a clear-water system. This is a result of the long-term presence of carp, the shift from a submerged aquatic vascular plant–dominated system to one dominated by phytoplankton, and the loss of wave dissipation provided by the submerged aquatic plants.

Habitat impacts of carp at the Refuge have been monitored using data collected from annual pond surveys, which measure several factors affecting water quality, including carp numbers, temperature, turbidity, pH, plant cover, abundance, and diversity. These surveys indicate that ponds with high carp numbers have poor quality rating (Wenick 2010).

During the 1940s, duck production on the Refuge averaged over 100,000 ducklings[1] (Cornely 1982). Today, the Refuge annually produces approximately 10 percent of the ducklings (8,000 to 12,000) it

[1] Cornely (1982) notes that methods of estimating duck and goose production varied through the years:

- 1942-1945: Estimates based on general field observations; no standardized sampling procedures were used.

is estimated to have produced annually during the 1940s, with breeding primarily restricted to the managed wetlands in the Blitzen Valley and Double-O units. Waterfowl production and waterfowl use are directly related to the total number of acres of sago pondweed produced annually on the Refuge; the more aquatic vegetation available, the higher the level of waterfowl use. Prior to a major influx of carp in 1952, the Lake was noted for high levels of vegetation, especially sago pondweed. Between 1953 and 1954, sago pondweed declined by 80 percent, with no evidence of this plant remaining in the Lake by 1955 (Ivey et al. 1998). However, sago pondweed will rebound if carp biomass is decreased. As shown from analysis of historical data from the Refuge (see Chapter 6 of the Malheur Refuge CCP/EIS), there is a statistically significant relationship between acres of sago pondweed and breeding pairs of diving ducks on the Lake (Ivey et al. 1998).

Previous Refuge experience has shown that reducing the number of carp has a positive effect on bird populations and vegetation. There have been several good years of production (up to 60,000 birds) after large rotenone projects on the Lake (Ivey et. al.1998). The use of the Lake by dabbling ducks and diving ducks post-rotenone treatment increased by as much as 116 percent and 70 percent, respectively. Sago pondweed acreage has also increased substantially after carp control treatments; in 1955 and 1992, for instance, there was no sago pondweed in the Lake, but after rotenone treatments in those years, sago pondweed covered 16,900 and 10,000 acres, respectively (Ivey et al. 1998). Unfortunately, positive responses to carp control treatments have been short-lived.

Figure R-6. An estimated 1.5 million mortalities caused by 1955 rotenone treatment.

- 1946-1952: Estimates based on nest success from nesting studies. No standardized routes were used for breeding pair or brood counts.
- 1953-1955: Dearth of information. Estimate based on general observations during routine field activities.
- 1956 -1960: Estimates based on pair, nest, and brood observations from sample plots checked twice a month during the breeding and brooding season. Those results were supplemented with general observations during aerial, boat, and ground surveys.
- 1961-1967: Estimates based on random ground and aerial surveys of breeding pairs and random brood counts on the principal brooding areas.
- 1968-1971: Breeding pairs and broods were censused along standard aerial, boat, and ground routes, and nesting success was determined from sample plots. Production estimates were based on extensive brood counts.
- 1972-1980: Estimates calculated by multiplying the breeding pair estimate by nest success by mean brood size just prior to fledging.

Avian species are particularly important because the Refuge was established to protect birds (see Chapter 1). Improved aquatic health results in better habitat for these birds, as well as other native species of fish, macroinvertebrates, plants, and other organisms that are currently being negatively affected by carp.


Figure R-7a. Trumpeter swan with cygnets swimming in a healthy, vegetated water body.
Figure R-7b. A view of a healthy marsh with open water and islands of vegetation.

R.4 Plan Goals and Management Priorities

To improve aquatic health, the Refuge has established a quantitative objective of reducing carp in lacustrine habitats to a level not to exceed 100 pounds of carp per acre. The 100 pounds per acre figure is an estimate of the appropriate threshold, or the theoretical biomass of common carp that can be tolerated by the system and still maintain acceptable conditions for aquatic vegetation and waterfowl use. This estimate was made based on the 100 kilogram per hectare threshold noted in Bajer et al. (2009). The Bajer study was based on observations of a smaller Midwestern system in decline as opposed to a large Great Basin system in recovery, so the figure may need adjustment over time. The Refuge has set this goal as a means to restore the biological integrity of its water bodies and adjacent lands in a way that should be sustainable for the long term. If achieved and sustained over time, the Refuge should have increased bird use, increased vegetation, larger populations of native fish, better water quality, and a healthier ecosystem. Although it is recognized that other factors may be contributing to declining waterfowl use, carp are known to be a dramatic perturbation in the system that must be addressed.

The different areas impacted by carp have been identified by level of importance to help formulate a strategic path forward. The most ecologically important portion of the Basin impacted by carp is Malheur Lake. The Refuge and collaborating members of the Aquatic Health Coalition have agreed that funding should be prioritized based on connectivity and potential impacts to water quality within the Lake, as follows: 1) Malheur Lake, 2) Blitzen Valley, 3) Silvies River, and 4) Double-O (Figure S-8).

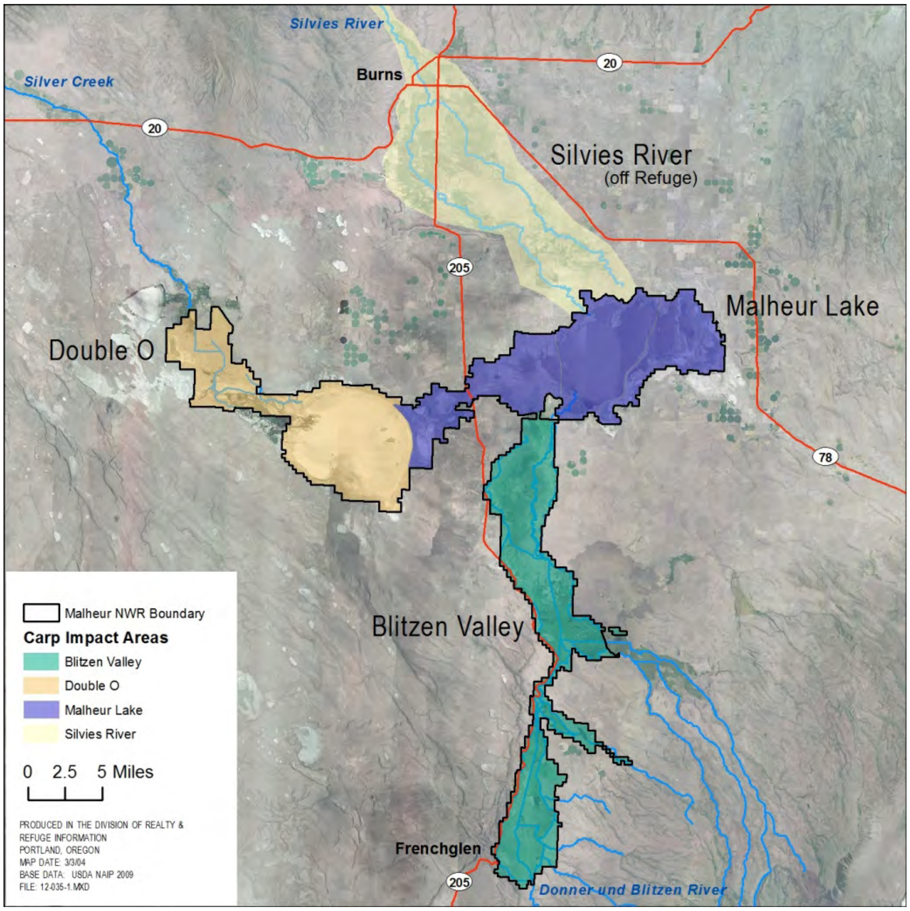

Figure R-8. Common carp impact areas.

R.5 Information Needs

To reach the goal of improved aquatic health (with attendant benefits to waterfowl and other native species), the Refuge needs pre-treatment data (current or baseline conditions) and post-treatment data for the following parameters:

- Water quality, as indicated by dissolved oxygen, conductivity, water temperature, and salinity, pH, turbidity, chlorophyll A, and total suspended solids
- Aquatic vegetation abundance and species types
- Macroinvertebrate abundance and family to genus types
- Point count for passerines and secretive marsh birds
- Total count for large birds (waterfowl, water birds, wading birds)
- Bird brood counts (productivity estimates)
- Fish assemblage
- Carp age structure
- Carp location and movement patterns
- Carp biomass

Estimating the biomass of carp before and after treatment is especially important for assessment of success toward the 100 pounds per acre target. Removing the first 80 percent of the carp population will be exponentially cheaper than eradicating the last 20 percent, so it will be important for managers to determine the most cost-effective methods for reducing carp biomass in the Lake and the Basin. The Refuge has two key questions to answer in pursuing the 100 pounds per acre threshold:

- How many pounds of carp must be removed each year to reach the 100 pounds per acre threshold?
- Do the key biotic and abiotic parameters listed above improve sufficiently with a threshold of 100 pounds per acre, or should the threshold be adjusted? In essence, is 100 pounds per acre the right threshold for the Refuge's water bodies?

To obtain all of this information, the Refuge needs a scientifically valid approach to data gathering. Please see Appendix C for the implementation table of CCP goals and objectives that pertain to aquatic health improvement.

R.6 The Solution: A Scientific, Strategic Approach to Aquatic Health Improvement

This plan differs from previous management plans by acknowledging that complete eradication of common carp is impractical, that much collaboration throughout the Basin is needed for long-term success, and that scientifically valid approaches must be employed. Adaptive management and integrated pest management (IPM) will be applied throughout these efforts to optimize applied science and aquatic health. All protocols and data gathering will follow strict quality control and quality assurance guidelines.

Figure R-9. Refuge fish biologist in the process of implanting a telemetry tag in a fish caught and released in Boca Lake.

R.6.1 Overview of Approach

While exact time lines are dependent on many factors (most notably funding), the Refuge's approach will consist of the following steps:

Figure R-10. Refuge Manager and fish biologist removing fish netted in a trammel net on Boca Lake.

1. Compilation of historical data on aquatic health on the Refuge, evaluation of the protocols used to collect those data, and development of protocols to collect new data that will be comparable to historical data.
2. Pilot study at Boca Lake, because it is similar to Malheur Lake but smaller, easier to access, and therefore more manageable. The pilot study will involve:

   A. Baseline data inventory
   B. Implementation of carp control strategies
   C. Effectiveness evaluation and monitoring

3. Application of Boca Lake protocols to other Refuge locations, with Malheur Lake as the top priority, including the following steps:

   A. Review of Boca Lake results to determine applicability to new setting(s): What adjustments, if any need to be made?
   B. Baseline data inventory
   C. Implementation of carp control strategies
   D. Effectiveness evaluation and monitoring

4. Review of Refuge results to determine applicability to locations in the Harney Basin outside the Refuge. This review will be conducted by the Refuge and collaborating members of the Aquatic Health Coalition, with implementation steps to be followed in the NRCS Harney Basin plan.

Although this approach is presented here as distinct steps, the process of implementation will be more dynamic and iterative, to account for learning, adjustments and funding availability along the way, in part because of the use of adaptive management and IPM.

R.6.2 Role of Adaptive Management and Integrated Pest Management

The Refuge will be melding adaptive management principles with IPM to restore the aquatic health and biological integrity of Refuge habitats. *Adaptive management* is a decision process that promotes flexible, informed decision making and that allows adjustment as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a "trial and error" process but, rather, emphasizes learning while doing. Adaptive management does not represent an end in itself, but is a means to more effective decision making, more efficient management, and other enhanced benefits. It helps meet environmental, social, and economic goals; increases scientific knowledge; and reduces tensions among stakeholders (Williams et al. 2007).

IPM is an interdisciplinary approach using methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on Refuge lands and waters to achieve wildlife and habitat management goals and objectives. IPM is also a scientific, adaptive management process where available scientific information and best professional judgment of the Refuge staff as well as other resource experts are used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. An IPM approach will be used, where practicable, to eradicate, control, or contain pest and invasive species on Refuge lands. IPM involves using methods based upon effectiveness, cost, and minimal ecological disruption, which consider minimum potential effects to non-target species and the Refuge environment in accordance with 517 DM 1 and 569 FW 1.

Adaptive management and IPM both rely on scientifically verifiable information to determine a method's effectiveness, and they both involve taking a system-level perspective to understand impacts. The management approaches differ in that IPM can provide a great deal of detail about particular methods and how to evaluate their impacts, whereas adaptive management takes a broader view of methods and their impacts. For example, IPM provides a structured procedure to evaluate the potential effects of proposed uses of a pesticide on biological resources and environmental quality; an IPM approach to pesticide use involves determining the smallest amount of a chemical that would have the desired effect on the target species. After a pesticide is applied according to an IPM protocol, the adaptive management framework involves evaluating the technique's success and, if appropriate, identifying either modifications to the technique or a new method to be used in the future.

R.6.3 Methods for Baseline Data Inventories and Ongoing Monitoring

Together, baseline inventory data and ongoing monitoring data will present a complete picture of the effectiveness of carp control methods and the state of aquatic health before and after carp control treatments.

Inventory is defined as: "a survey that documents the presence, relative abundance, status, and/or distribution of abiotic resources, species, habitats, or ecological communities at a particular time" (701 FW 2, in draft). Inventories will be conducted prior to any control measures for common carp.

Monitoring is defined as "a survey repeated through time to determine changes in the status and/or demographics of abiotic resources, wildlife or plants, habitats, or ecological communities" (701 FW 2, in draft). The Refuge will monitor all baseline data parameters for specific amounts of time post-treatment. Collaborators will assist the Refuge in determining the methods and duration of monitoring for specific projects.

The following methods will be used to establish baseline data and conduct post-treatment monitoring. Note that these methods may be modified if evaluation of historical collection protocols reveals a meaningful difference that would prevent comparison between new and old data.

Water Quality

Using ArcGIS-generated randomized sampling locations in a given water body, water samples will be collected at the same time as vegetation samples. The number of sampling locations will be determined for each water body, depending on its size. Using a YSI 85 digital meter, the following parameters will be tested: dissolved oxygen (percent and mg/L), conductivity (μS), water temperature (°C), and salinity (ppt); pH will be tested using a Piccolo plus HI 1295 amplified electrode. Turbidity will also be evaluated using a secchi disc. Samples of chlorophyll A and total suspended solids taken at a subset of the randomized points will be collected in accordance with laboratory sampling procedures of the contracted laboratory (available online at http://www.aquaticresearchinc.com/).

Aquatic Vegetation

At the same locations where water samples will be collected for the water body being studied, aquatic vegetation will be sampled following the method described below. The site will be sampled once during the peak annual abundance (mid to late June). A 1 m^2 polyvinyl chloride (PVC) pipe–constructed square will be placed at the global positioning system (GPS)–identified sample location. A visual estimate to the nearest 10 percent of vegetative cover will be made. A rake will be used to sample the benthic vegetation by twisting the rake three times in the square and pulling it up. The water will be drained for 20 seconds, and the weight of the vegetation will be collected using a digital scale. Species collected will be identified, and all data recorded, as outlined in Bajer et al. (2009).

Figure R-11. Submergent vegetation in Malheur Lake.

Macroinvertebrates

Using a D-frame aquatic net, 15 samples of 1 m^2 of benthic environment in a given water body will be sampled for 30 seconds using a randomized sampling design for quantitative numbers of taxa and individuals, as explained by Rabeni (1996). The samples collected will be stored in 1,000-mL heavy-duty, wide-mouth Nalgene high-density polyethylene (HDPE) bottles. Two identical labels will be used, one on the inside and one attached to the outside of the container. The samples will be preserved in 95 percent ethanol and shipped to a contracted lab for

Figure R-12a. Collaboration by USGS and USFWS collecting aquatic macroinvertebrates on the Refuge.
Figure R-12b. Collaboration with retired ODFW biologist on native freshwater mussel monitoring.

identification. Different protocols for flowing water and standing water will be observed, following Rabeni (1996).

Birds

Figure R-14. Pied billed grebe with chicks getting a ride from mom.

The Refuge will use standardized protocols to determine baseline relative bird abundance by habitat type for each water body being studied. These data will be compared to post-treatment data to assess the effects of carp control practices and to determine long-term trends after carp removal. Under the important bird area (IBA) protocol, each observation point will be recorded with a GPS unit and marked with a survey marker around the perimeter of the given water body. Each point shall be monitored for 8 minutes after waiting 1 minute post arrival to the point. The points will be surveyed from sunrise till 10 am during suitable weather conditions. Points will be monitored a maximum of once a week for the duration of the project. Data collected will be the date, name of observer(s), start time and end time of survey, weather conditions (drizzle, overcast, broken, scattered, clear), air temperature at start and end of survey, and wind speed (0-5 miles per hour [mph] or 6-12 mph). Counts of passerines, secretive marsh birds, waterfowl, water birds, wading birds, and broods will be conducted.

Fish

Multiple methods are necessary to obtain all the data needed regarding fish species. At least nine species of fish could be encountered during fish assemblage work. Data collected will be species, length, and sex when visible.

Figure R-13. Youth Conservation Corp students helping collect fish data.

R.6.4 Carp Population Determination

Prior to treatment, it is important to obtain an accurate estimate of the total biomass of carp present in Refuge water bodies. These data will be essential for assessing whether the 100 pounds per acre target has been achieved and whether this threshold of carp biomass is sufficient to the overall goal of improved aquatic health.

For small water bodies, carp population will be determined by sampling annually for 1 year pre-carp removal and 2 years post-removal; these methods are summarized from Hayes et al. (1996). For young-of-the-year and 1-year-old carp and other smaller sized fish, three trap nets will be set for 24 hours at two positions in a given water body pre-carp removal. Post-treatment monitoring will entail using the same protocol and sampling each fall. Fish species and length data will be collected. All carp will be culled from the water body, anesthetized, and measured. Adult carp will be netted using a 100-m trammel net. Any non-carp fishes captured will be identified, measured, and released.

For Malheur Lake, the Refuge will conduct a mark-recapture study. Mark-recapture studies require a significant investment of time and labor that could be used to remove carp from Malheur Lake, but without a solid estimate of carp biomass, such carp removal actions would not be grounded in data and it would be difficult, if not impossible, to assess success or failure.

The mark-recapture study will involve netting fish, taking lengths, clipping a fin or putting a tag in the dorsal muscle, and releasing the fish. It will be important to use numbered tags or unique marks for each tagging location in the mark-recapture study to identify movement within and between management units. It is also important to sample multiple locations within each management unit to better estimate the biomass over varied habitat rather than marking all of the fish at the most convenient location. The recapture phase should be scheduled between 2 weeks and 1 month after marking.

If connectivity exists between Malheur Lake and other management units, it will be important to mark individuals from all connected units. It would be ideal to mark at least 5 percent of the estimated population for each management unit. If Malheur Lake is the only management unit evaluated for a biomass estimate, it will be essential to monitor a subset of fish from connecting management units to estimate immigration (through a habitat use study).

Because access to Malheur Lake can be difficult, it may be advantageous to conduct the marking and/or recapture during freezing temperatures. Carp typically aggregate when temperatures are low and can be easier to find; for instance, if a portion of a lake is frozen, carp will often cluster in the portion that still has open water. Under such conditions, it may be possible to identify aggregations located in deep holes or springs within each management unit. It may be possible to forego the initial mark-recapture study in the Malheur Lake management unit if Malheur Lake is at a very low level and a thorough chemical treatment can be conducted. An aerial count of carcasses could then be conducted (with ground verification in vegetated areas), and population structure could be determined from carcasses (length, weight, and age). However, unless the Blitzen Valley can be treated, it will still be necessary to conduct a separate population estimate and determine immigration rates using telemetry before the chemical treatment.

Figure R-15. Mark and recapture study being conducted by the University of Minnesota. Fish are netted below the ice, fins are clipped, and fish are measured prior to being rereleased.

R.6.5 Carp Movement and Aggregation Determination

Forty-one advanced telemetry systems (ATS) low-frequency body cavity telemetry tags will be surgically implanted into the peritoneal cavity of adult common carp (larger than 1.5 pounds) randomly dip-netted out of the given water body. Fish will be caught, measured, and anesthetized. A 1.5-inch superficial incision will be made behind the pelvic fin in the ventral surface. A telemetry tag will be aseptically planted into the cavity, and the incision will be sutured. The fish will be allowed to recover and then released. The telemetry tracking will be performed once a week to once a month for the life of the tags (~2 years). Results will be tracked by GPS units, and evidence of aggregations will be determined (Guy et al. 1996).

Figure R-16. Summer interns collecting water chemistry and telemetry data.

R.6.6 Carp Dynamics Modeling

Due to the size and the dynamic fluctuations of water in the Harney Basin, a dynamic model of carp population/biomass based on estimated common carp immigration, emigration, growth, mortality, and recruitment (population structure and habitat use data) would be a powerful tool for the management of carp in the Harney Basin. Such a model has been developed by Iowa State University doctoral student Mike Colvin to aid the Refuge in understanding its carp population(s) (Figure S-17). To inform adaptive management decisions, the data collected for the baseline inventory and post-treatment monitoring will be integrated into this model as results are available. It is relatively easy to update models with refined data on an annual basis, and assuming funding is available for ongoing data collection, this model will be a valuable tool for the Refuge and its collaborators to use during ongoing carp management.

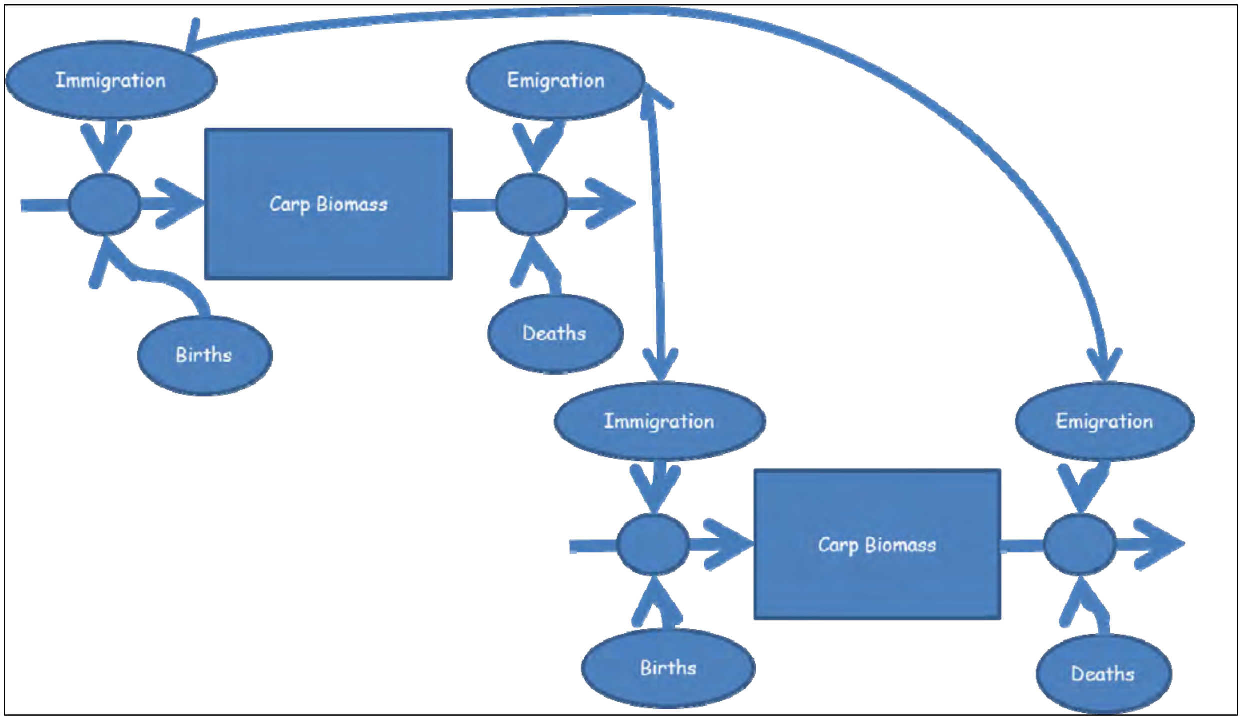

Figure R-17. A simplified visual representation of the carp modeling system.

R.7 Carp Control Strategies

The current aquatic ecosystem of the Refuge is out of balance due to the invasive common carp. Native fish species are being outcompeted by the highly fecund invasive carp. In addition, the environmental instability of the watershed due to extreme drought and wet years constitutes the perfect scenario for carp super-reproduction. Bajer et al. (in review) determined that in a stable environment, native predatory fish species prey on carp eggs and fry to suppress the population. However, in locations around the world that have environmental instability (i.e., winter hypoxia), the native predatory fish die during the winter due to lack of oxygen in cold water, while the carp migrate outside those areas in the winter, moving to deep water. The carp then spawn in the spring where native predation is suppressed. The Refuge's carp control strategy must focus on a long-term sustainable solution, such as increasing native predatory fish species and finding ways to regain the balance of native organisms to keep the carp species suppressed.

Under this plan, carp control will focus not only on immediately suppressing common carp, but also on impeding carp recovery. Carp control at the Refuge will include the following types of strategies, among others:

- Manipulating water levels to reduce amount of carp habitat.

- Annually removing carp, with nets, traps, commercial fishing, or other techniques.
- Removing connectivity between water bodies.
- Improving environmental conditions to favor native predatory fish.
- Preventing successful spawning through chemical spot treatment.

A multifaceted, sustainable approach will be the key to sustaining acceptable water quality in Malheur Lake. Additional techniques for carp control may be added if inventory and monitoring results show that adjustments are appropriate, as is consistent with adaptive management. A more in-depth explanation of the control techniques, and the Refuge's experiences with them, is provided below.

R.7.1 Techniques and Technologies in Use

These techniques have been used at some point on the Refuge and will continue to be part of carp control efforts.

Water Manipulation

The most effective and commonly used method on the Refuge has been seasonal or prescriptive draining of ponds and canals. The irrigation schedule alters from year to year depending on water availability and habitat needs; before manipulating water levels, the Refuge has to consider overall aquatic habitat needs as well as any bird species that have been identified as high priorities for the Refuge (also called focal species) when planning carp control. Yearly seasonal draining of water bodies is optimal, but some water bodies may only be drained and dried every 5 to 6 years due to the need for waterfowl habitat.

Figure R-18. A water control structure at Barn Yard Spring in the Double-O Unit.

Traps

Fish traps used on the Refuge have produced limited success, because they only catch a small proportion of fish and require daily maintenance when in use. Large permanent metal traps have been designed for Sodhouse, Busse, and Grain Camp dams on the Blitzen River to aid in the control of carp movement and will be installed as funding becomes available.

Netting

Multiple types of netting have been used in the past and will continue to be used in the future. Hoop nets have been used in the main channel of the Blitzen River to collect carp. Gill nets have been used experimentally but proved unsuccessful. Trammel nets, which are a modified gill net, are very successful in netting carp and other species of fish. These nets are set up and checked daily for catch. Most fish can be released with minimal or no damage, but some incidental mortality to native species has occurred. Block nets are used to block off sections of the river for population surveys, creating a temporary barrier for all fish passage.

Fish Screens and Barriers

Fish screens and barriers are essential elements for the success of carp control efforts because they prevent movement of carp from one water body to another. A major factor that probably contributed to the short-term benefits to any previous treatments at the Refuge was the lack of properly designed, constructed, and maintained infrastructure to prevent carp re-invasion post-treatment. Vertical rotational screens have been highly effective at decreasing the spread of carp and decreasing the entrainment of native fish species by acting as barriers to fish movement. For smaller diversion ditches off the mainstem of the Blitzen River and canals, these screens have been highly efficacious, require minimal maintenance, and can be fabricated at the Refuge by the maintenance staff.

Figure R-19. Operating fish screen on the West Canal at Page Springs Dam.

Vertical traveling screens have been placed at the west canal diversion at Page Springs Dam. The Highline Ditch, Stubblefield Canal, Rheinman Ditch, and Buena Vista Canal are all in different stages of screen construction. Although these screens are very expensive and require power via solar collector or power line, they are very effective at screening the large water volumes being diverted from the Blitzen River. Priority areas for additional screening, barriers, and/or other infrastructure changes have been identified. These infrastructure elements will be added as time and funding allow.

Electro-shocking

Fish electro-shockers are effective tools for removing carp from water systems that contain non-target species. They are also useful in conducting fish surveys to determine the presence or absence of target and non-target species in a specific project area. The Refuge owns a backpack electro-shocker and an electrofishing barge.

Figure R-20. Electro-shocking for carp below Sodhouse Dam.

Bait Stations

Bags of corn are set out in specific areas of the Refuge to attract higher numbers of fish into the area. Food types that have also been tried, but have not been as successful as corn, include dog food, flavored commercial foods, and dough balls. These stations have been used when trying to catch carp in specific areas in Malheur Lake for telemetry work.

R.7.2 Techniques and Technologies That May Be Used to a Limited Extent

These techniques and technologies have been a part of the Refuge's carp control efforts in the past. As discussed below, their use will be minimal under this plan.

Rotenone

Rotenone is a biodegradable pesticide used to kill undesirable fish. It is extremely toxic to fish and other organisms that require dissolved oxygen. It should be used in closed systems or predetermined reaches of rivers that have been surveyed for non-target species. Rotenone has been used in the Blitzen River and many small ponds, canals, ditches, and lakes on the Refuge from 1955 to 1999. Training is required to plan and execute a rotenone treatment, and a certified applicator is needed. Accurate determination of the volume of water to be treated is essential for calculating the correct amount of rotenone to apply. Normally 1 gallon of rotenone treats 6 acre-feet, or 2 to 8 parts per million of a 2.5 percent concentrate. The amount of rotenone necessary varies depending on the water temperature, turbidity, pH, aquatic vegetation, and oxygen levels. Live-boxes containing the target species provide a test for determining exact levels of toxicity during a project. Any application of rotenone will be conducted consistent with the procedures outlined under the Refuge's IPM plan (see Appendix G of the CCP). Use of rotenone may only occur under low-water conditions and when 100 percent mortality of carp can be achieved. Due to the non-selectivity of fish species targeted by rotenone, the project would have to determine risks and potential successes of the treatment.

Application techniques include backpack pumps, drip stations, all-terrain vehicles (ATV) sprayers, aerial sprayers, and fire engine pumps. Application by boats in deep water requires the use of an ATV sprayer with a weighted discharge hose.

Figure R-21. In 1992 Refuge staff made a huge effort to drain Headquarters Pond with two Crissafulli pumps to remove carp.

Water Pumping

Pumping is the most effective control method for small to medium-sized ponds that cannot be completely drained or treated with rotenone, but the labor required is substantial, especially when compared to the results. Due to the size and bulk of the equipment involved in this type of operation, significant time is required for site preparation. This includes developing access to the site for heavy equipment, construction of a ramp and suction hole, and construction of a trench connecting the deepest part of the pond to the pump intake. Depending on the site, an outlet ditch may be required in conjunction with the use of outlet hoses.

R.7.3 Techniques and Technologies That Are Unlikely to Be Used Again

The Refuge has already determined that certain techniques are not appropriate for carp control. These techniques and technologies have been ruled out as options for future carp control efforts.

Poison Bait Stations

When using carp feeding stations in the past, the Refuge has sometimes laced the food with small amounts of rotenone to kill carp. A feeding station was tested at Double-O Spring, but it was abandoned when large numbers of native fish were observed feeding at the station, which is not consistent with the Refuge's IPM approach. Because this type of control also attracts and kills non-target species, it is unlikely that rotenone or other piscicides will be added to the bait at any carp feeding stations in the future.

R.7.4 Planned New Techniques and Technologies

Commercial Harvest

Seine nets operated by commercial fishing operations are effective for carp removal and for catching carp during mark-recapture studies. After telemetry studies identify carp aggregations, a commercial fisherman will be contracted to fish carp aggregates out with a seine net (see section S.6.3). This will theoretically happen in the winter or early spring. The Refuge will record the total weight of fish caught during commercial fishing, as well as the species of fish (because this method cannot be limited to carp completely). A subset of carp caught during commercial fishing will also be tagged as part of mark-recapture studies.

Robotic Carp

In addition to the techniques and technologies that have already been used at the Refuge, a new method will also be tested. The robotic carp is a proposed technology from the University of Minnesota that attempts to develop a new generation of robotic sensors that could track, record data, and evaluate carp behavior in Malheur Lake. This will be a non-disruptive way to continually track telemetry-tagged fish throughout the year and receive data in real time to determine management actions. The University of Minnesota was recently awarded a grant of $2.2 million by the National Science Foundation to develop and test this technology. Field testing at the Refuge will begin in the summer of 2013.

Figure R-22. Prototype of the robotic carp.

Fish Piscivory

Pending funding, a study will be conducted in collaboration with the University of Minnesota to evaluate the probability that other fish on the Refuge will prey on the invasive common carp eggs and fry. There is evidence that sustainable control may occur if there are enough piscivorous fish species to decrease carp numbers (Bajer et al. in review). The fish that would be evaluated are native tui chub, redband trout, dace, and non-native sunfish.

Figure R-23. Native redband trout.

R.7.5 Potential New Techniques and Technologies

Common carp have invaded water bodies in many locations throughout the world. As a result, there are numerous ongoing efforts to develop new methods of reducing their impact. As is consistent with adaptive management, the Refuge is committed to incorporating new methods that have scientific merit and are appropriate for the Refuge's physical and biological conditions. Generally, upon learning about a new technique or technology, the Refuge reviews available information to determine if the method is likely to be effective in a setting that is present on the Refuge. If a suitable location or use can be identified, the Refuge and other members of the Aquatic Health Coalition will pursue funding. Any of the following new methods could become part of the Refuge's strategy if a suitable use can be found and a corresponding funding source can be secured.

Catchment Basins

A field or pond will be used to attract carp and hold them, and they will be harvested fresh. Carp would be attracted to the area by water temperature, flow, or bait. Crane Pond will be an excellent site to perform this technique.

Barriers

There are two types of barriers that could potentially be used at the Refuge (pending further analysis): electrical barriers and bubble barriers. Electrical barriers restrict upstream migration and can be designed to fit rivers as large as the Blitzen River. They operate on AC or DC power and are the most effective fish barriers because they do not interfere with aquatic debris. State-of-the-art design includes backup generators that provide electricity during power failures; however, these barriers are very expensive, and depending on location, they could pose a safety risk to visitors.

The bubble barrier, which has been used in Minnesota to stop the spread of Asian carp, uses air bubbles to create sound and water displacement to deter carp movement with much success (More information is available at http://carpbarriers.com). These barriers or bubble curtains are safer and more cost effective than other barrier technology and can be portable.

Fish Wheels

In 2010, Industrial Power Systems donated over 200 hours of time to develop an electronic portable fish wheel design for the Refuge's carp control program. This fish wheel will use cutting-edge technology to sort fish species by color. Fish migrating upstream would swim into the fish wheel, and as the wheel rotates, the fish would be picked up by the wheel, sorted by color, and released. Carp would be culled from the wheel, and native fish would be released upstream (Figure S-24). If funding is obtained, a fish wheel will be built according to this design.

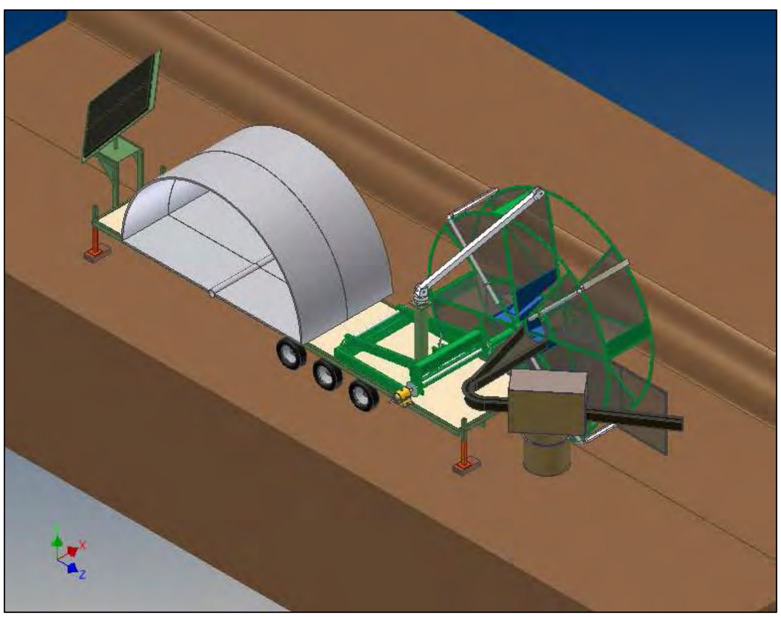

Figure R-24. Computer simulated design of experimental carp wheel.

Sex Pheromones/Attractant

Carp sex pheromone technology developed by Dr. Peter Sorensen's laboratory at the University of Minnesota has been laboratory- and field-tested. This technique uses a pheromone plug surgically implanted into a female to simulate ovulation and to attract other carp. This will be a potential strategy to attract carp in low density areas. Pheromones used for pest control in the United States are considered "pesticides" by the Environmental Protection Agency (EPA) and must pass through the normal pesticide registration process. Normal procedures prior to use of a pesticide would apply, requiring considerable time and funds. Experimental use in the research phase may be possible at the Refuge, but must be approved for use under a special permit. Pheromones and identical or substantially similar compounds labeled for use only in pheromone traps and pheromone traps in which those chemicals are the sole active ingredients are not subject to regulation under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (40 CFR 152.25 (b)).

Figure R-25. Blood sample of common carp submitted to Oregon State University for koi herpes virus genetic testing.

Koi Herpes Virus

Koi herpes virus is a DNA virus that is highly pathogenic to common carp, causing mass mortality. In Australia this biological agent is being tested in laboratory conditions as a potential biological control for common carp. It has not been approved as a biological control in the United States, and it may take years to get approval in the United States if it is proved efficacious in Australia.

Daughterless Carp

A genetic manipulation with aromalase stops estrogen production, which biases the carp population to all males. Daughterless carp technology is just in the beginning phases of being tested by a laboratory in Australia in collaboration with Auburn University.

R.8 Summary

The Refuge is committed to implementing effective solutions for sustainable carp control; the value of the Refuge’s lands and waters to native species demands this commitment. Realizing this goal is possible, but only with the help of other stakeholders who are concerned about the aquatic health of the Refuge and the Harney Basin.

This plan is best viewed as a living document, because each phase of data gathering will change our understanding of the dynamic forces involved in the Refuge’s complex ecosystem. With information grounded in the best available science, the Refuge and its partners will be able to respond to these forces and make decisions that take new information into account, which is a key aspect of applying adaptive management. Together, we will be able to re-establish the biological integrity of the Refuge.

R.9 References

Bajer, P.B., C.J. Chizinski, J.J. Silbernagel, and P.W. Sorensen. In review. Native micro-predator abundance explains recruitment of a mobile invasive fish, the common carp, in a naturally unstable environment. Biological Invasions.

Bajer, P., G. Sullivan, and P. Sorensen. 2009. Effects of a rapidly increasing population of common carp on vegetative cover and waterfowl in a recently restored Midwestern shallow lake. Hydrobiologia 632(1): 235-245.

Beklioglu, M., O. Ince, and I. Tuzun. 2003. Restoration of the eutrophic Lake Eymir, Turkey, by biomanipulation after a major external nutrient control I. Hydrobiologia 490(1): 93-105.

Cornely, J. 1982. Waterfowl production at Malheur National Wildlife Refuge, 1942-1980. K. Sabol, ed. Transactions of the 47th North American Wildlife and Natural Resources Conference. Washington, D.C.

Guy, C.S., H.L. Blankenship, and L. Nielson. 1996. Tagging and marking. Pages 353- 383 in: B.R. Murphy and D.W. Willis, eds. Fisheries techniques, 2nd edition. Bethesda, MD: American Fisheries Society.

Hayes, D.B., C.P. Ferreri, and W.W. Taylor. 1996. Active fish capture methods. Pages 193-220 in: B.R. Murphy and D.W. Willis, eds. Fisheries techniques, 2nd edition. Bethesda, MD: American Fisheries Society.

Ivey, G.L., J.E. Cornely, and B.D. Ehlers. 1998. Carp impacts on waterfowl at Malheur National Wildlife Refuge, Oregon. North American Wildlife and Natural Resources Conference 63:66-74.

Rabeni, C.F. 1996. Invertebrates. Page 336 in: B.R. Murphy and D.W. Willis, eds. Fisheries techniques, 2nd edition. Bethesda, MD: American Fisheries Society.

Thompson, S.P. and C.D. Littlefield. 1980. Historical review and status of colonial nesting birds on Malheur National Wildlife Refuge, Oregon. Proceedings of the Colonial Waterbird Group 3:156-164.

Wenick, J. 2010. Annual pond surveys, Malheur National Wildlife Refuge. Unpublished data on file, Malheur National Wildlife Refuge. Princeton, OR.

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2007. Adaptive management: U.S. Department of the Interior technical guide. Adaptive Management Working Group, U.S. Department of the Interior. Washington, D.C.

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Killdeer
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Appendix S

Response to Comments

Input was encouraged and used throughout the entire development of the Malheur Refuge comprehensive conservation plan/environmental impact statement (CCP/EIS). Input was incorporated through a transparent collaborative process beginning with scoping and continuing with finalization of the CCP/EIS alternatives and through the determination of the final management direction. A formal public comment period was also used upon release of the Draft CCP/EIS in March 2012.

The Service issued a planning update summarizing the CCP/EIS preliminary draft alternatives developed through the collaborative process in March 2012. In this planning update, the Service informed the public that comments and suggestions would continue to be incorporated through the collaborative process with other comments received during the formal public comment period required by the National Environmental Policy Act (NEPA). The Service released the Draft CCP/EIS on March 15, 2012, for formal public review and comment. This comment period closed on May 4, 2012. During the formal comment period, the Service received 136 comments from 41 agencies, organizations, and individuals.

The majority of comments focused on respondents' opinions toward support of the collaborative process and Alternative 2 of the Draft CCP/EIS. Many of the substantive comments were directed toward carp control, grazing and haying management tools, inventory and monitoring processes, and river functionality. Where the opinion expressed provided some level of detail or was based on a real or perceived fact, the Service has provided a response. Where the comment expressed solely an opinion and was not supported by any assertion, the Service considered the comment in selection of the management direction, but did not respond to the comment in this appendix.

A minority of comments provided factual information (both real and perceived), questioned statements and facts presented in the Draft CCP/EIS, or questioned the accuracy of information used in formulating the alternatives and/or conducting analyses as part of the EIS.

Comments received were grouped into 13 categories based upon actions considered in the Draft CCP/EIS alternatives or based on topics of particular interest as indicated by comments themselves. These categories are: Aquatic Health/Carp; Collaboration/Process; Meadow Management/Grazing and Haying; Inventory/Monitoring/Adaptive Management; Wildlife; River Function; Hunting; Fishing; Interpretation; Facilities; Wilderness; Water Management; and General. Comments presented in this appendix have been paraphrased from the originals, and in some cases were consolidated with others where the Service's response is the same.

S.1 Aquatic Health/Carp

1. **Comment:** The Service should consider placing a greater emphasis on water manipulation as a viable carp control method.

   Response: The term "lacustrine" within the CCP addresses Malheur and Mud Lakes. Water manipulation does take place throughout other parts of the Refuge as a means for controlling carp and would continue to be used under this plan (Chapter 2 Objective 4c). The number one focus area for carp control is Malheur Lake; the Blitzen Valley is second and Double-O third inside refuge boundaries. The goal in the next 15 years is to acquire the resources necessary to implement science-based changes for the improvement of bird habitat. The Refuge will pursue carp control strategies in Malheur and Mud Lakes that are science based and enable biological objectives to be met while keeping costs to a minimum. With the development of new technologies for controlling carp, the Refuge will be exploring new alternatives before strategies such as repairing Cole Island dike and pumping water are pursued. Water manipulation/control in other portions of the Refuge that already have existing infrastructure will be a key component of a comprehensive carp management strategy.

2. **Comment:** The Service should consider using commercial harvest of carp as part of a strategy to improve aquatic health on the refuge.

   Response: Commercial harvest is one option for controlling carp. The Refuge has received many inquiries from commercial fish operations since the beginning of the planning process. Many structures within the Refuge and outside of its boundaries, such as along Rue Red Road, have been identified as possible sites for physical barriers/screens through Refuge and The Natural Resources Conservation Service carp management plans.

3. **Comment:** Commercial carp fishing is not a viable option in Malheur Lake because it already failed in the 1980s.

   Response: The Refuge is exploring the possibilities of commercial fishing strategies that have been recently developed specifically for carp. The latest scientific research indicates that carp concentrate in small areas underneath the ice during winter months. Commercial fishermen have developed techniques to net carp under the ice. Other commercial technologies such as fish wheels with electronic scanning eyes and portable fish processing plants are also examples of the more recent technologies the Refuge is exploring.

4. **Comment:** The Proposed Staffing in Appendix C under Alternative 2 does not reflect an adequate number of staff for the fisheries program if aquatic health is a priority.

   Response: All additional positions are aligned with the Refuge Operational Needs database. Positions that will help support the aquatic health program are Geographic Information System Specialist, Natural Resource Specialist, Private Lands Biologist, Volunteer Coordinator, Hydrological Technician, and the Biological Technician (habitat). The Refuge also will continue to hire temporary staff and interns (not reflected in Table C-1) to assist with fieldwork. There is also the possibility that private sector contractors will be engaged in carp control strategies.

5. **Comment:** Tables C-2 and C-3 in Appendix C should be revised to reflect the high priority of aquatic health.

   Response: In the Final CCP, Table C-2 was adjusted to reflect the most recent cost estimates for the aquatic health/carp program. Table C-3 deals specifically with visitor services and cultural resources.

S.2 Collaboration/Process

6. **Comment:** The Service is strongly encouraged to build on the very successful collaborative planning process throughout the entire implementation of the CCP. Implementation needs to include strong facilitation, independent science advisory process and addressing issues in an open transparent manner.

Response: The Refuge recognizes the significance of the highly successful collaborative planning process. Continuing relationships with organizations such as the High Desert Partnership and Oregon Consensus will enable the Refuge to move forward with implementation in a transparent manner. The already established Ecology Working Group and Carp Coalition are examples of how the science advisory process will continue through implementation. A visual of this overall collaborative process can be found in Figure 2.1 in Chapter 2 of the CCP.

S.3 Meadow Management/Grazing and Haying

7. **Comment:** More information is needed about the potential impacts to current refuge haying and grazing permit holders with the expiration of current cooperative land management agreements when the final CCP is signed.

   Response: There will be no impact to Refuge permittees in regard to the land exchange between the Refuge and the Bureau of Land Management (BLM). These areas fall outside of the habitat treated via the haying and grazing program.

8. **Comment:** Include a clause in the compatibility determination for the haying and grazing program that cooperative land management agreements could be modified within the initial 5-year timeframe if significant unanticipated impacts to plant communities are documented.

   Response: Changes to the haying and grazing compatibility determination were made to differentiate between trend and operational changes to CLMAs. Trend involves the 5-year timeline for assessing response of plant communities to treatment. Operational changes will take place within the 5-year window if the physical management of the CLMAs needs to be adjusted (e.g., are non-target habitats being impacted?).

9. **Comment:** The compatibility determination for grazing and haying on the refuge is not supported by information in the CCP.

   Response: In Chapter 6 of the CCP and in the compatibility determination for haying and grazing, the anticipated environmental effects associated with the haying and grazing program are described in detail. Based on the effects disclosed in the CCP, the haying and grazing program as described in the management direction will contribute to achieving Refuge purposes and the Refuge System mission by providing valuable foraging, resting, pairing, nesting, and brood-rearing areas and conditions for the sandhill crane, bobolink, cinnamon teal, and other meadow-dependent species. The benefits of using grazing and haying as appropriate management tools on Malheur Refuge are based on Refuge-specific knowledge from seven former biologists with 50 collective years of experience along with the sound professional judgment of current biologists and ecologists using the best available science to manage the site-specific conditions on Malheur Refuge. The Refuge has also committed to an adaptive management process that allows for future changes based on site-specific science.

10. **Comment:** The Service should conduct pre-treatment inventories of wildlife populations as well as monitoring during and after haying and grazing treatments.

    Response: The following language has been added to the Haying and Grazing Compatibility Determination under Stipulations Necessary to Ensure Compatibility (page B-102): “A pre-treatment inventory of local wildlife populations within the proposed warm season treatment area will take place prior to the initiation of treatments." This will aid in understanding potential wildlife impacts to ensure that the specific habitat improvements that are being sought justify localized, short-term wildlife production losses.

11. **Comment:** In the justification section of the haying and grazing compatibility determination concerning the impacts of treatments on wildlife populations, behavior and welfare were not supported by data currently available from the refuge.

    Response: Conclusions drawn within the second paragraph of the justification found within the haying and grazing compatibility determination are based on 50 collective years of experience of past and present Refuge wildlife biologists and ecologists for dormant season haying and rake-bunch grazing and associated wildlife monitoring. The Refuge has also committed to the implementation of an extensive neutral third-party habitat inventory and monitoring program. The results of this program will be reviewed on an annual base through a continuing collaborative process with Refuge stakeholders. Experimental warm-season treatments will occur only on a very small scale (approximately <500 acres). Please refer to Section B-7 of the CCP, "Overview of the Four Treatment Types."

12. **Comment:** The Service should insert a Table in Appendix K - Wet Meadow Treatment Ratios comparing the present acreages hayed, grazed or farmed under Alternative 1 with the corresponding acres planned for Alternative 2.

    Response: Appendix K now includes a table that will be used to capture all treatments during the life of the CCP.

13. **Comment:** The Service should increase the use of fire and decrease the use of haying and grazing.

    Response: Prescribed fire is a tool that is pursued to the fullest extent feasible within the CCP. Funding limitations, site-specific issues (e.g., dominance of annual grasses in sagebrush lowlands, perennial pepperweed in wet meadows), and strategic containment requirements prevent this tool from being used in a way that replaces other vegetation management strategies such as haying and grazing.

14. **Comment:** The CCP needs to reference the grazing plans developed for the Blitzen Valley and Double-O portions of the Refuge.

    Response: The Blitzen Valley and Double-O management plans were utilized in the development of the CCP. They are cited as Rule et al. 1990 and David J. and Gary Ivey 1995, respectively.

S.4 Inventory/Monitoring/Adaptive Management

15. **Comment:** Through inventory and monitoring data should be collected to determine the effectiveness of all treatment tools such as fire, flooding, prescribed drought, grazing etc.

Response: This suggestion will be given to the Ecology Work Group and will be factored into the continued formulation of the Inventory and Monitoring Plan. It is agreed that documentation of all management activities will be critical in developing the State-and-Transition Model and understanding habitat responses.

16. **Comment:** Are survey transects for wildlife use as outlined in the draft Inventory and Monitoring plan large enough to sufficiently determine the effectiveness of treatment tools.

    Response: The Refuge's inventory and monitoring program will be based on established scientific protocols used to evaluate effectiveness of management strategies.

17. **Comment:** Are species identified in the Draft Inventory and Monitoring plan representative of the full suite of species for which the refuge is managed?

    Response: The process used for selecting priority resources of concern (i.e., focal species) is found in Section 4.2 of the CCP. The tables that follow identify a suite of other benefiting species that are represented by the focal species chosen.

18. **Comment:** The Service needs to consider identifying area-specific vulnerabilities (habitats and species) in developing adaptive management strategies.

    Response: Goals and objectives found within the CCP are organized by habitat types (e.g., lacustrine, wet meadow, etc.). Each objective and corresponding management strategies have been established with consideration to the unique needs and sensitivities of the plant communities and associated wildlife (i.e., habitat) within which they are placed.

19. **Comment:** The use of cattle as a tool to meet habitat objectives needs to scientifically justified.

    Response: In adopting the 60:40 ratio to begin the implementation of the CCP, the Refuge relied on the reasonable opinions of its own qualified experts, both past and present. Appendix K states that "this figure is based on the sound professional judgment of seven past and present Refuge wildlife biologists with 50 collective years of experience managing Refuge meadows. This ratio is relevant only when considering all wet meadows within the Refuge and differs across fields and area-specific management units. The needs of focal species, the suite of wildlife they represent, and the nature of habitats they depend on determines the use and extent of these tools in realizing or maintaining attributes identified under Objective 4a." This ratio provides an understanding of the overall use of haying and grazing but does not address the specific needs of wildlife in specific areas. This is why the ratio is only being used as a starting point. The meadow treatments will be adjusted as area-specific needs and Inventory and Monitoring data are considered during the annual review process involving the agency, the Ecology Work Group, and the collaborative group. This will lead to an adjustment to the ratio to provide clarity regarding the extent of treatments taking place over time. As discussed in Appendix K, the actual ratio currently varies widely from 90:10 in wet meadows within the southern Blitzen Valley to 30:70 in the North Blitzen Valley. The 60:40 ratio is meant to be illustrative, not definitive. The CCP has been revised to eliminate describing the 60:40 ratio as an objective.

20. **Comment:** The implementation priority for studies of seasonally flooded wet meadows should be "very high" instead of "high."

Response: Because inventory and monitoring activities associated with wet meadows are centered on third-party science and are being established based on a commitment of continuity, it is appropriate to classify the implementation priority for this habitat type as "very high."

21. **Comment:** The Service should use the National Vegetation Classification System for identifying vegetation types.

    Response: The Cowardin system (1979) recognizes hydrological features within its classifications, which aligns naturally with the habitat types identified within this CCP (differentiating lakes versus small ponds, wet meadows versus marshes, etc.). The National Vegetation Classification System is based on the expression of vegetation and does not lend itself as naturally to separating habitats across hydrological gradients. Crosswalks can be provided to enable land managers and interested public to understand how habitats and associated vegetation communities fall within both widely used systems.

22. **Comment:** The Service needs to establish a scientifically based inventory and monitoring plan that will allow for informed adaptive management decisions. The inventory and monitoring process needs to be done in collaboration with both scientist and stakeholders.

    Response: The collaborative nature of the Inventory and Monitoring Plan will be a tremendous strength as the Refuge moves forward with the implementation of the CCP. Third-party experts from various universities, nongovernmental organizations, and other government entities have become very active in assisting in the design and methodology of the Inventory and Monitoring Plan to maximize the efficiency of data collection and analysis in addressing whether management actions are meeting objectives and, ultimately, if the objectives themselves are sufficient. Finalizing the Inventory and Monitoring Plan is a top priority for the upcoming 2013 field season.

S.5 Wildlife

23. **Comment:** Additional rational is needed in the compatibility determination for grain farming to show what the impacts would be to sandhill cranes and waterfowl species if farming is not conducted on the refuge.

    Response: The rationale for the use of grain on Malheur NWR is based on both Refuge and Pacific Flyway Council plans (see Farming Compatibility Determination, Section B.10 of the CCP). In the Pacific Flyway Plan, Malheur Refuge is identified as one of only four autumn staging and migration stopover sites for greater sandhill cranes. It is also recognized for the ability to provide the necessary feeding/grain sites adjacent to large isolated wetlands secure from human disturbance. If Malheur Refuge does not provide both feeding and roosting sites for greater sandhill cranes, the birds will be required to seek other areas to meet these needs. These areas will not likely be under management strategies with a primary purpose of providing for the needs of wildlife and therefore are at risk of not being secure in meeting the needs of migrating cranes.

24. **Comment:** The three focal species listed for wet meadows all prefer short vegetation and do not reflect species which may use the taller, untreated vegetation in wet meadows. The focal species

used for monitoring this habitat type should reflect the entire guild of birds which may be present.

Response: Cinnamon teal was selected to represent the suite of species that use idle meadows (tall vegetation for nesting cover). The Draft CCP Table 4-4 did not provide a description of habitat structure and attributes that describe breeding habitat. This has been addressed in the Final CCP.

25. **Comment:** The Service should remove abandoned and interior fences to reduce impacts to wildlife.

    Response: The Refuge incorporates the removal of old fences with any new replacement fence projects. The Refuge continues to work on the removal of fences that were abandoned many years ago as resources are available. Through the use of interior fence the Refuge is better able to achieve habitat objectives. Herding has and will continue to be used in specific situations.

26. **Comment:** The Refuge should use artificial goose nest structures.

    Response: Waterfowl populations nest very successfully on the Refuge. Artificial nesting structures are generally used as a substitute for the lack of proper or sufficient conditions for a group of birds or an individual nesting species. Structures also require cleaning, maintenance, and replacement, which cannot be justified with limited refuge resources available and nesting waterfowl populations doing well.

27. **Comment:** Opening Krumbo reservoir to winter vehicle access will cause negative impacts to wintering waterfowl.

    Response: The Refuge is not known as a large wintering waterfowl area. The birds using the refuge during this period scatter throughout the Blitzen Valley and Double-O area. They remain on the Refuge over the winter period only as long as there is open water available. During the winter, consistent open water is available around hot springs, the river, and a few channels with flowing water. The Refuge has a number of impoundments and water bodies such as Boca Lake used by wintering waterfowl as roosting sites that are close to these open water areas. Opening Krumbo Reservoir to winter vehicle access will not negatively impact refuge overwintering waterfowl populations.

S.6 River Function

28. **Comment:** The CCP should reflect a stronger commitment to the restoration of the Blitzen River to natural conditions.

    Response: The Refuge recognizes the importance of proper functioning ecological systems. The Refuge is committed to prioritizing and refining a set of priority questions/objectives creating a scientific foundation to construct a comprehensive riverine strategy. Based on these questions/objectives the Refuge will take advantage of new resource opportunities to implement appropriate science-based steps to continue the advancement of a comprehensive river strategy. To reflect this, adjustments were made to Goal 2 Objective 2a.

S.7 Hunting

29. **Comment:** The Service should use a 5 year average of hunting conditions on the refuge to better discuss waterfowl hunt days and hunter usage rather than using only 2011 data which only represents one year for a hunting program that has taken place over many years.

    Response: Since the flood events in the late 1980s, the lake topography has been altered due to ice and wave action. Changes in topography combined with dramatic fluctuations in water level and impacts of common carp have had a negative impact to the plant communities that support waterfowl. During this same timeframe, dramatic fluctuations in water levels have also limited hunting access to the lake. These two factors (limited waterfowl food and reduced access) have in general resulted in low hunter use of the area during most years. An exception would be in the year 2011 when higher numbers of waterfowl hunters did use the area because of improved conditions. It is also possible hunter visits may increase with the addition of a stable boat launch site and a larger hunting area. Waterfowl and associated hunting use of the area would also be expected to increase as habitat conditions improve as a result of carp control.

30. **Comment:** The Double-O unit of the Refuge should be opened for public hunting.

    Response: The Double-O Unit was excluded due to the conflict with the values in the area, both biological and cultural. Allowing hunting in this area was not determined to be appropriate through our compatibility determinations.

31. **Comment:** The area between Diamond Lane and Krumbo Lane should be open to upland game hunting.

    Response: The existing upland game hunt in the Buena Vista hunt unit consists of 36,000 acres and is a quality program. Additionally, under Objective 8a, the hunt season will extend the season opener from the fourth Saturday of October to the end of the State pheasant season, which will provide an additional hunting opportunity. The P Ranch Unit was also considered for hunting opportunity, but was rejected due to conflicts with wintering waterfowl, which use the P Ranch Unit more heavily than other units because of the access to open water.

32. **Comment:** The Buena Vista unit should not be open to public hunting to avoid conflicts with photographers.

    Response: The Buena Vista Unit hunt season will be from the fourth Saturday of October to the end of the State pheasant season. The hunt area contains 36,000 acres, which allows hunters to disperse. This dispersed hunting activity is not expected to conflict with other compatible wildlife-dependent recreation, including viewing wildlife or photography.

S.8 Fishing

33. **Comment:** The Service should consider opening Malheur Lake to carp and trout fishing.

    Response: Per the management direction, the Refuge will be creating additional fishing opportunities. Krumbo Reservoir will now be open to year-round fishing and the Blitzen River from Sodhouse Lane to the boat landing bridge will be open from August 1 to September 15 to enhance carp fishing opportunities. The Refuge may at some future point reevaluate fishing in Malheur Lake as carp control strategies become finalized.

34. **Comment:** The Service should consider not opening the Krumbo Road during winter months to vehicle access to prevent road damage.

    Response: Year-round access to Krumbo Reservoir would provide greater opportunity for wildlife viewing, boating, and fishing. As noted in Objective 8d, the access would close when road conditions are hazardous to prevent road damage. We also expect wintertime visitor use to be light, and any road damage that may occur is not expected to significantly impact the road.

35. **Comment:** Opening East canal to vehicle access will ruin the fisheries.

    Response: Prior to 1999 East Canal was open to vehicle access. During this time East Canal was a good fishery. Since 1999 additional habitat improvement projects have occurred in East Canal to improve upon the existing fishery.

36. **Comment:** The East Canal access should allow vehicle access to public lands south of Bridge Creek.

    Response: The opening of East Canal to vehicle access will allow the public to access the crossing south of Bridge Creek that could access Granddad Reservoir on BLM lands (dependent upon BLM regulations). East Canal road north of Bridge Creek will remain closed to vehicle access to enable the Refuge to meet wildlife objectives.

S.9 Interpretation

37. **Comment:** The Service should incorporate interpretive themes that include the importance and connectivity of Basin and upland watershed agricultural flood irrigation practices.

    Response: Please see Objective 7c.

38. **Comment:** A high priority should be placed on interpretation that engages the public in the specific priorities of the CCP (for example carp control) as well as on the cultural, historic, natural history and ecology of the area.

    Response: Please see Objectives 7c and 7d.

39. **Comment:** Outreach materials should be developed that promote the broadest aspirations of the CCP including restoration in the Blitzen River Valley and the Double-O.

    Response: Please see Objective 7c.

40. **Comment:** Brush should be removed to improve wildlife viewing/photography opportunities along center patrol road.

Response: Under Objective 7a, it is stated that we will provide a variety of vehicle pull-offs on the 42-mile Blitzen Valley auto tour route (Center Patrol Road) at key locations to enhance the birding experience, including photography; this will include clearing areas of willow overgrowth.

S.10 Facilities

41. **Comment:** The Service should consider creation of additional pullouts along State Highway 205 north of the Narrows.

    Response: Under Objective 7a, it is stated that we will participate in the Basin and Range Birding Trail on-refuge with Harney County Chamber of Commerce and other partners. This will include providing additional areas for vehicle access and pull-offs. The consideration to provide pull-offs off-Refuge, including along State Highway 205, was addressed. However, to accomplish public use goals and objectives identified within the 15-year plan, we focused on enhancing experiences on-Refuge.

42. **Comment:** Signage should be increased to support direct engagement of Refuge visitors.

    Response: Please see Objective 6a.

43. **Comment:** The wildlife observation blind at the Headquarters should be reconstructed.

    Response: A wildlife observation blind on the pond at Headquarters, with an accompanying trail, was completed in September 2012.

S.11 Wilderness

44. **Comment:** Would wilderness designation benefit Refuge management?

    Response: On a national wildlife refuge, a unit of land must meet the “purpose” for which the refuge was created. If a parcel of land is not meeting refuge purpose it cannot be moved forward for potential wilderness designation. Currently the only portion of Malheur Refuge that is meeting Refuge purpose and has wilderness character is the Harney Lake Unit. Wilderness designation of this unit would not impact Refuge management. Malheur Lake may have wilderness character but is not currently meeting Refuge purposes due to impacts from invasive species.

S.12 Water Management

45. **Comment:** There are opportunities in the Double-O portion of the Refuge to manage water jointly while meeting objectives on both private and Refuge lands.

    Response: Because of a lack of a defined water delivery system in the Double-O area it is necessary to manage water jointly between private and public (Refuge) or private and private water users. There are a variety of mechanisms such as easements, water sharing agreements, etc. that would have to be put in place. For these mechanisms to be implemented there would have to be benefits to the involved parties.

S.13 General

46. **Comment:** Portland Audubon Society's Dave Marshall Internship should be added to the list of objectives under Goal 9a.

    Response: Because the Portland Audubon Dave Marshall Internship is not specific to Malheur NWR, this internship along with all other possible internships is included in the more general heading of building partnerships and public outreach.

47. **Comment:** Maintenance costs and staffing of facilities were not included in the plan under Appendix C - Implementation.

    Response: Staffing needs/costs are reflected in Appendix C Table C-1. Facilities costs are shown in Appendix C Table C-3.

48. **Comment:** CCP/EIS document needs to be formatted in a manner the reader can find important information.

    Response: It is acknowledged that the CCP/EIS is a very large document. The complexity of management at Malheur NWR combined with the legal requirements of the National Environmental Policy Act has resulted in a lengthy document.

S.14 References

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available at: http://www.npwrc.usgs.gov/resource/1998/classwet/classwet.htm (Version 04DEC98).