Western grebe on nest
Addison Mohler/USFWS

Chapter 4 Biological Environment

Chapter 4 Biological Environment

This chapter addresses the biological resources and habitats found on the Refuge. However, it is not an exhaustive review of all species and habitats.

The chapter begins with a discussion of biological integrity (historical conditions and ecosystem function), as required under the Refuge Administration Act (16 U.S.C. 668dd-668ee, et seq.). The bulk of the chapter is then focused on the presentation of pertinent background information for habitats used by each of the priority resources of concern and other benefitting species designated under the CCP. That background information includes descriptions, conditions, habitat trends, and threats (stresses and sources of stress) to the habitats and/or associated resources of concern. This information was used to develop goals and objectives for the CCP.

4.1 Biological Integrity, Diversity, and Environmental Health

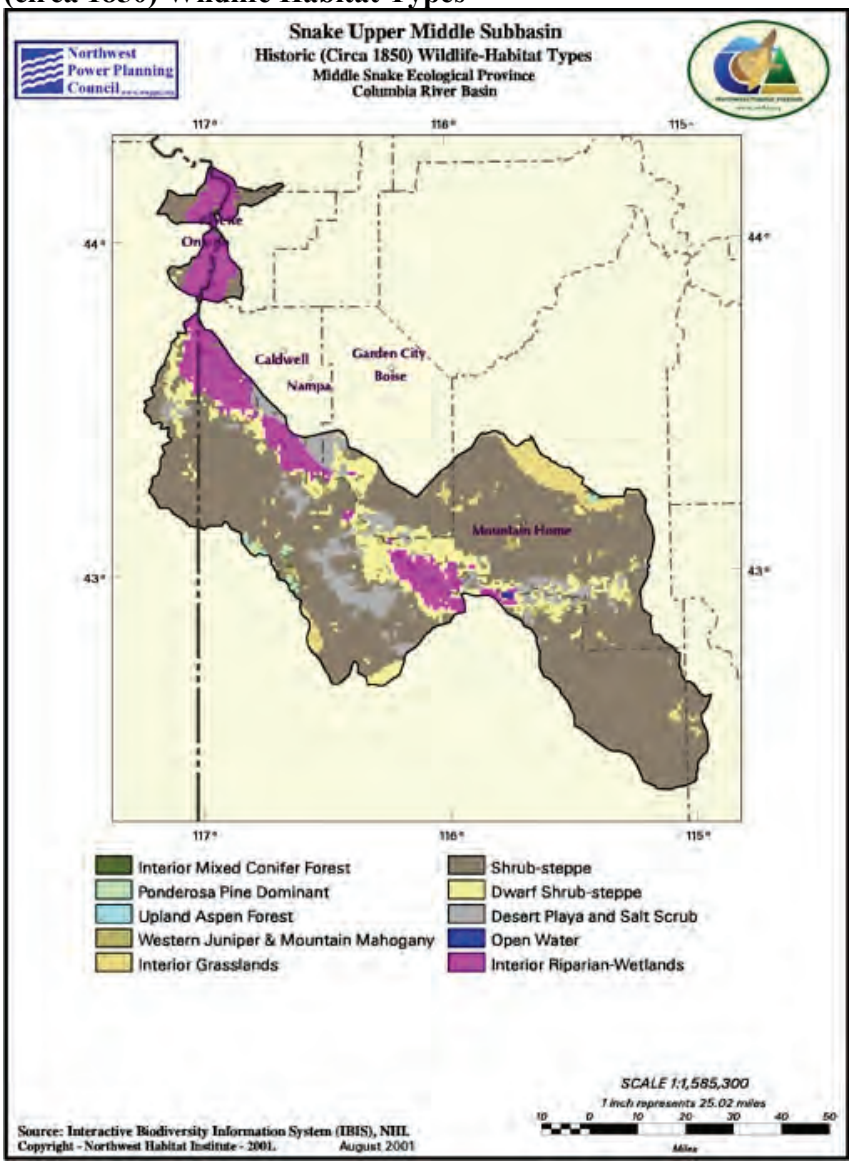
The NWRS Administration Act, as amended, directs the Service to ensure that the biological integrity, diversity, and environmental health (BIDEH) of the NWRS are maintained for the benefit of present and future generations of Americans. Elements of BIDEH are represented by native fish, wildlife, plants, and their habitats, as well as those ecological processes that support them. The Refuge System policy on BIDEH (601 FW 3) also provides guidance on consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges and in associated ecosystems that represents BIDEH.

Deer Flat NWR is located within the Columbia Plateau Ecoregion, which is characterized by a broad expanse of sagebrush-covered volcanic plains and valleys, punctuated by isolated mountain ranges and the dramatic river systems of the Snake, Owyhee, Boise, and Columbia. These large rivers contain islands that provide important habitat for migratory waterfowl and other birds. Almost half of the 226 islands downstream of Swan Falls Dam on the Snake River are part of the Snake River Islands Unit of the Refuge (Zoellick et al. 2004b). Historically, the Lake Lowell Unit of the Refuge was a low-lying area of sagebrush grasslands with natural springs, and the Snake River flowed freely through high-walled canyons and broader terraces shaped by the prehistoric Bonneville Flood event. The natural processes that historically maintained the BIDEH of the region included periodic flooding of the Snake River floodplain and lowland areas; seasonal fluctuations in precipitation and water levels, which supported a diversity of native plant communities in wetland and riverine systems; and periodic fires, which supported a diversity of successional stages of native shrub and forested plant communities.

In the early 1900s, settlers in the region sought to have reservoirs built to irrigate their crops. Several Snake River dams were constructed in the first decades of the 1900s, and Reclamation constructed Lake Lowell between 1906 and 1909. Construction of Lake Lowell was an early modification of BIDEH in the area that was later to be established as the Refuge. Construction of the reservoir also enabled further modifications of BIDEH to occur, as it facilitated increased agricultural use of the surrounding area. Current land use of the areas surrounding the Refuge is dominated by irrigated agriculture, pasture and open-range grazing, and residential development. Human settlement of the Snake River Plain has resulted in changes to vegetation communities and hydrologic regimes from historical conditions, which in turn has affected the wildlife populations they can support. Studies of the ecological integrity of the interior Columbia Basin, conducted by the U.S. Forest Service (USFS) and BLM, have documented that most forests, native grasslands, and shrublands have declined

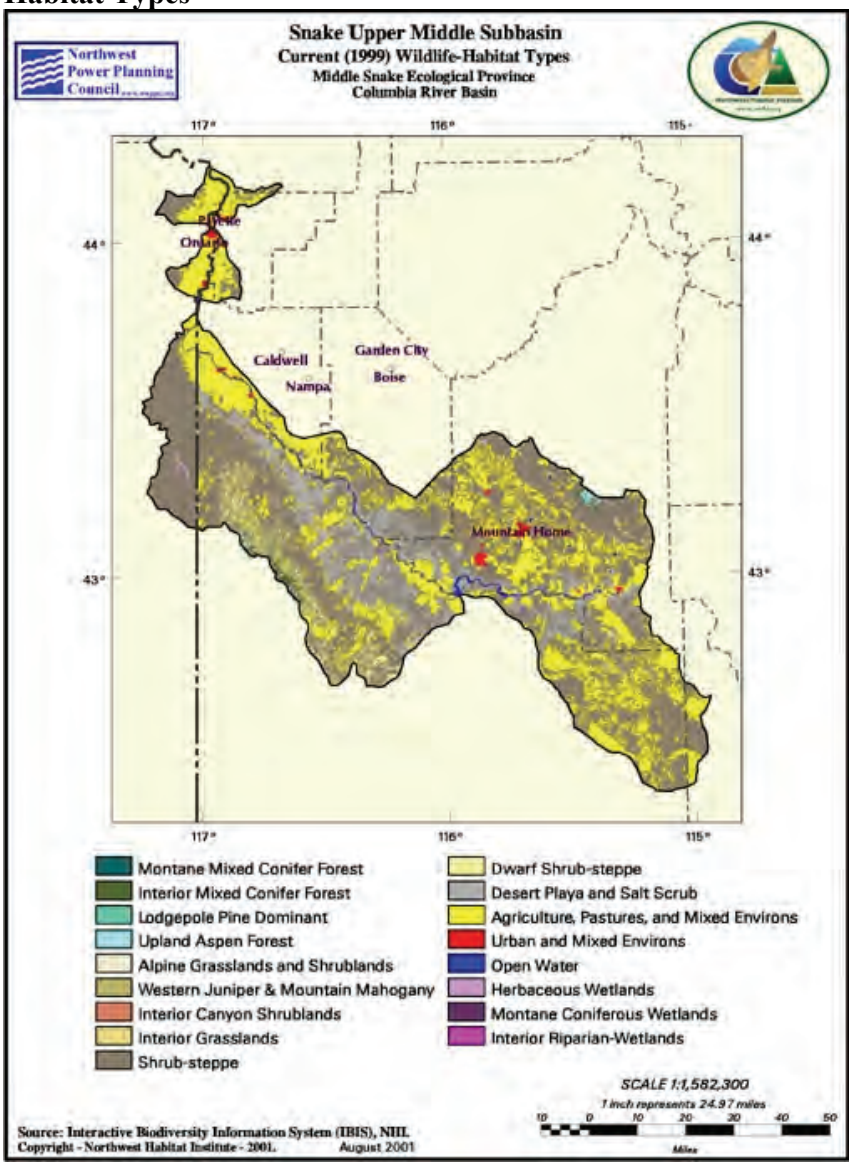
substantially in area, as has connectivity, since the basin was first settled by Euro-Americans. Native grasslands have decreased by 70 percent; native shrublands have decreased by 30 percent; large residual trees and snags have decreased by 20 percent; and old forest structures have decreased by 27 to 60 percent depending on vegetation type (Quigley et al. 1996). Habitat conditions for nearly all species with listing status under the Federal Endangered Species Act were more favorable historically, and the overall likelihood of extirpation has increased from historical to current times (Quigley et al. 1996). The changes in the abundance of wildlife habitat types from historical conditions (circa 1850) to conditions in 1999 are shown in Figures 4-1 and 4-2.

Figure 4-1. Snake River Upper Middle Subbasin Historical (circa 1850) Wildlife Habitat Types



Source: Northwest Habitat Institute (2011).

Figure 4-2. Snake River Upper Middle Subbasin 1999 Wildlife Habitat Types



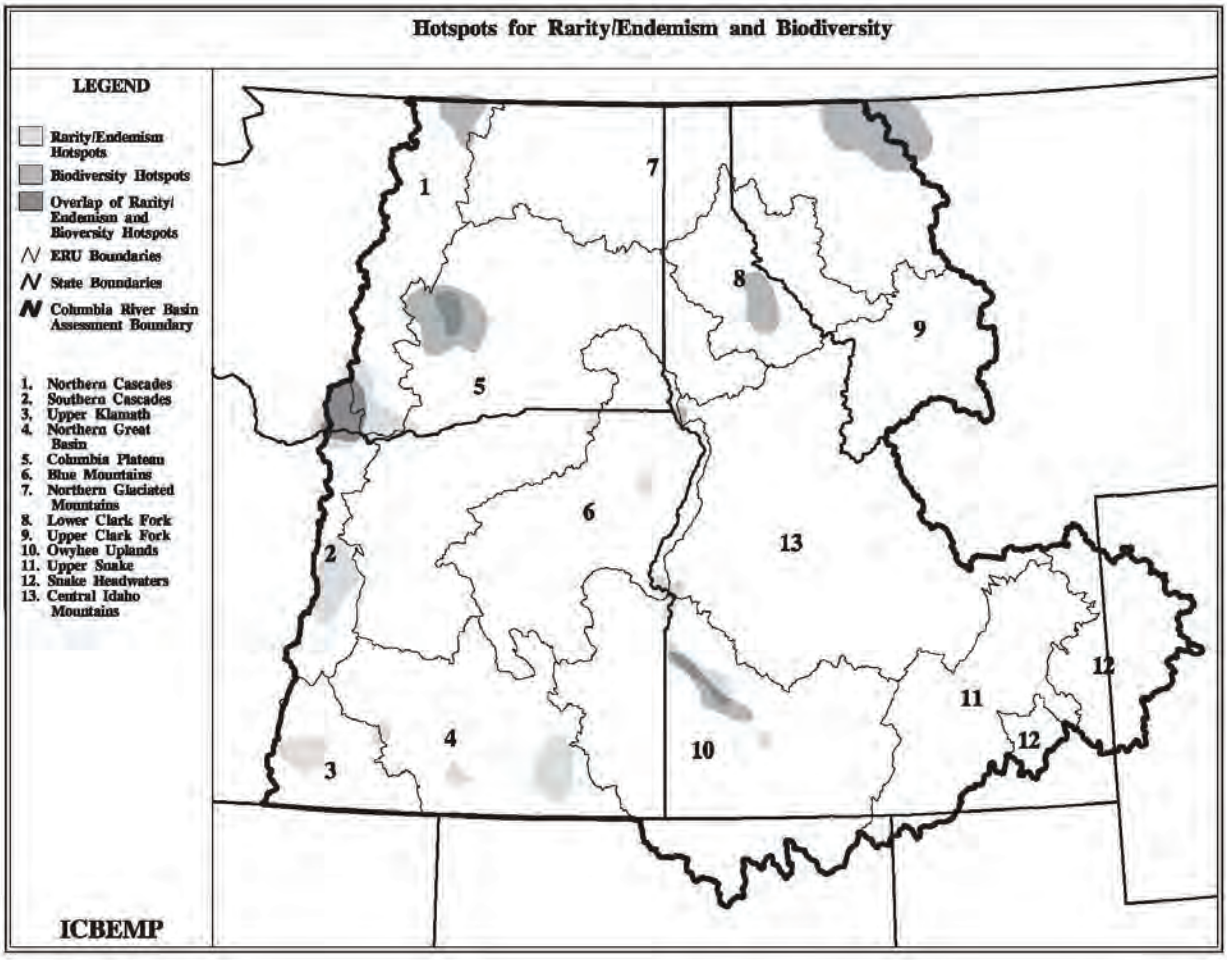
Source: Northwest Habitat Institute (2011).

Despite the effects of human settlement on wildlife habitats, the Snake River in the vicinity of the Refuge was identified in 1996 as one of 12 hotspots of species rarity and endemism and one of seven hotspots of high species biodiversity, as shown in Figure 4-3 (Quigley et al. 1996). Endemic species are those that are found only in a given region or location. An understanding of the importance of the Snake River in providing habitat for rare and endemic species and the biodiversity currently present in Snake River habitats is integral to managing the Refuge to continue providing habitat for these rare and diverse species assemblages.

The BIDEH table prepared by Refuge staff, which explores key aspects and alterations to the biological integrity and diversity of the natural environment encompassed by the Refuge, is included in Appendix E. Several limiting factors have been identified that affect the integrity of habitats on the Lake Lowell and Snake River Islands Units. Limiting factors include altered riverine hydrology and a

nonfunctioning floodplain, loss in perennial species diversity, grazing disturbance and resulting encroachment of invasive species, and altered fire regime.

Figure 4-3. Hotspots for Rarity/Endemism and Biodiversity in the Columbia Interior Basin



Source: Quigley et al. (1996).

4.1.1 Snake River Dams and Altered Hydrology

The Snake River system upstream and downstream of the Refuge has undergone major modifications since the early 1900s, due to the construction of dams. The Snake River Islands Unit is located along the longest free-flowing stretch of the Snake River, an approximately 51-mile section beginning at Swan Falls Dam upstream of the Refuge and continuing downstream to Brownlee Reservoir. The Swan Falls Dam was completed in 1918 and is the oldest dam on the Snake River (Dixon and Johnson 1999). The hydrologic flow record suggests an increase in annual minimum flows on this reach of the Snake River from 1914 until the 1950s, after which annual minimum flows decreased compared to historical flows. This decrease coincided with the completion of the Palisades Reservoir in eastern Idaho in 1957 (Dixon and Johnson 1999). Annual peak flows measured at the USGS gage near Murphy also appear to have declined from the pre-dam to early post-dam period. Peak flows in the interval from 1914 to 1926 averaged higher than peak flows in 1928-1956 and 1958-1990 (Dixon and Johnson 1999). Minimum flows in the mainstem Snake River, from C.J. Strike Dam to Brownlee Dam, have been identified for protecting aquatic, wildlife, and vegetation resources (Ecovista and

IDFG 2004). These minimum flows are often not met during the irrigation season (Ecovista and IDFG 2004). In addition to concerns about low flows, episodic high flows are necessary to maintain riparian and wetland vegetation dependent on periodic flooding.

4.1.1.1 Vegetation Changes

The dams on the Snake River have resulted in decreased scouring and flood disturbance, decreasing the frequency and duration of inundation in the floodplain and decreasing soil moisture from the water's edge to the top of the bank profile (Dixon and Johnson 1999). Decreased peak flows reduce tree mortality due to scouring, and low minimum flows have likely increased plant recruitment in the channel. Plant recruitment may also be heightened at the mouths of reservoirs where sediments fall out and create deltas.

4.1.1.2 Waterfowl Habitat

Historically, large flocks of migrating and wintering waterfowl have used the Pacific Flyway as they have migrated from breeding grounds in Canada, Alaska, and the northern continental United States to wintering areas farther south. The Snake River islands and Great Basin wetland habitats have provided migratory connectivity along the Pacific Flyway as well as critical breeding and wintering areas for waterfowl. Prior to construction of dams on the Snake River, periodic flooding of the Snake River floodplain and lowland areas provided additional areas used seasonally by waterfowl for refuge and forage. Modifications to the river hydrology due to dams reduced the amount of seasonally flooded waterfowl habitat but, overall, human-induced changes to hydrology appear to have been beneficial for waterfowl. For example, the construction of dams and reservoirs, including Lake Lowell, has increased the amount of open-water habitat available for migrating and wintering waterfowl.

4.1.2 Influx of Invasive Species

Invasive species are a major issue on public lands throughout the United States. In the last 100 years, exotic plant species have expanded throughout native forests and rangelands, especially in areas that were once dry native grasslands and shrublands (Quigley et al. 1996). The spread of invasive species across the West can be attributed to changes in land use. Grazing and agriculture alter vegetation communities and create soil disturbance, thereby providing opportunities for invasive species to become established. When shrub-steppe habitats are intensively grazed, native perennial grasses are eliminated and the shrubs, such as big sagebrush, tend to form dense monotypic stands. By 1890, the native perennial grasses, for all practical purposes, were no longer present on southern Idaho range. Soil erosion became a critical problem on Idaho rangelands. Part, but not all, of the void was filled by ever-denser stands of big sagebrush. Continued grazing pressure and an increase in abandoned croplands, set the stage for the invasion of exotic annuals (Yensen 1982).

The Refuge as a whole has been colonized by a variety of noxious weeds and invasive plant species. Several of the more common invasive species on the Refuge, including cheatgrass, Canada thistle, pepperweed, poison hemlock, and purple loosestrife are also common throughout the region. Invasive woody trees and shrubs on the Refuge include Russian olive, tamarisk, and false indigo bush. Refuge management activities such as fire control have inadvertently contributed to the spread of invasive herbaceous species. For many years, fire breaks have been maintained on the Refuge to prevent the spread of a fire both within the Refuge and from the Refuge onto private land, and fire

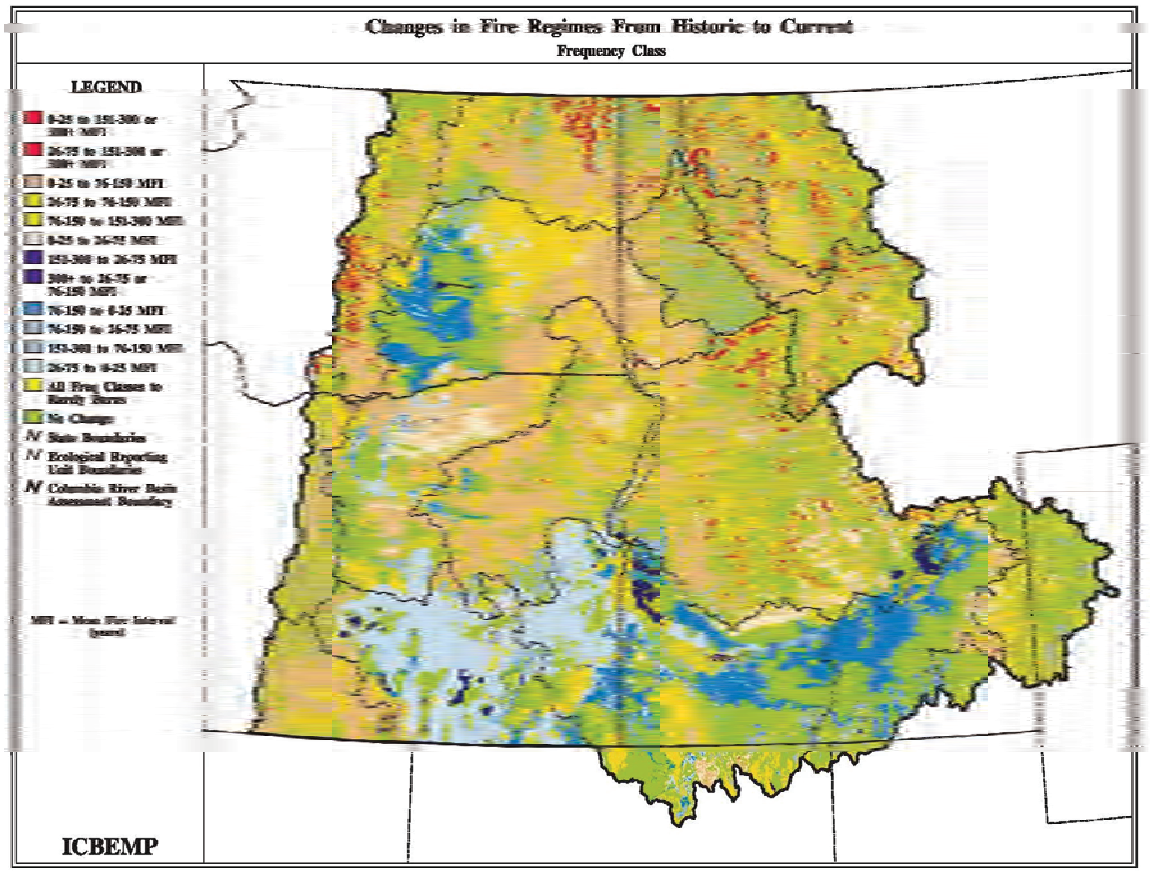
breaks have been colonized by invasive species such as reed canarygrass, Canada thistle, purple loosestrife, and pepperweed (USFWS 2008).

4.1.3 Altered Fire Regime

In prehistory and in the first half of the 1900s, fires were endemic to the Snake River Basin, burning sometimes in one basin and at other times in another, until the fall rains extinguished them. The result was a mosaic of early-seral and mid- to late-seral plant communities (Idaho Power 2003). Biological integrity was maintained historically by natural processes such as lightning strikes or by intentional burning by Native Americans. Periodic fire kept underbrush from accumulating, so that when fires did occur, they burned with lower intensity than fires now, due to large accumulations of fuels in the understory.

The fire regime throughout the Snake River Basin has been modified greatly from prehistoric conditions. As a result of diligent fire suppression activities throughout the Snake River Basin over the last 100 years, higher fuel loads have developed than would exist if wildfires of the prehistoric period and early 1800s had continued (Idaho Power 2003). On lands administered by the USFS and BLM in the interior Columbia Basin, fire severity has generally increased, with lethal fires involving firefighter fatalities increasing by approximately 17 percent.

Figure 4-4. Changes in Fire Regimes in the Columbia Interior Basin



Source: Quigley et al. 1996

In the Great Basin, which adjoins the Snake River Basin to the south, expansion of cheatgrass into disturbed rangelands has resulted in an increase in the frequency and extent of wildfires (Pellant et al. 2004). The increased frequency of wildfires in cheatgrass dominated rangelands is attributed to the early maturation of cheatgrass compared to native species which provides easily ignited fuels that promote a rapid rate of spreading fire.

The primary cause of fire regime changes throughout the West are fire prevention and suppression strategies, selection and regeneration cutting, domestic livestock grazing, and the introduction of exotic plants (Quigley et al. 1996). Fire suppression has resulted in a decrease in the abundance of early-seral communities and an increase in mid-seral communities (Quigley et al. 1996). In addition, the decline in fire frequency has resulted in an expansion of western juniper woodlands during the last 100 years (Quigley et al. 1996). The change in fire regime from the historical period to the current period is shown in Figure 4-4. Fire frequency is categorized in 25-year frequency classes.

4.2 Selection of Priority Resources of Concern

4.2.1 Analysis of Priority Resources of Concerns

Wildlife and habitat goals and objectives were designed directly around the habitat requirements of species designated as *priority resources of concern*. (Resources of concern are called conservation targets or focal species in conservation planning methodologies used by other agencies and organizations.) As defined in the Service's Policy on Habitat Management Plans (620 FW 1), resources of concern are:

> all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern 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 a resource of concern under terms of the respective endangered species acts. (620 FW 1.4G)
>
> Habitats or plant communities are resources of concern when they are specifically identified in refuge purposes, when they support species or species groups identified in refuge purposes, when they support NWRS resources of concern, and/or when they are important in the maintenance or restoration of biological integrity, diversity, and environmental health.

Therefore, resources of concern for a refuge may be a species or species group, or the habitat/plant community that supports a priority species or species group. In the CCP process, the Service reviewed the Refuge's establishment history (Section 1.7.2 and Appendix I) and a variety of plans (Section 1.8) to compile an initial list of these resources. This initial list, known as the list of comprehensive resources of concern, is available in Appendix E.

This list was then pared down to develop a more targeted assemblage, which comprises the priority resources of concern. In developing its list of priority resources of concern, the planning team selected not only species mentioned in establishing documents for the Refuge, but also species that captured the ecological attributes of habitats required by larger suites of species.

The priority resources of concern are listed in Table 4-1 and consist of nine focal species that were selected as representatives or indicators for the overall condition of important Refuge habitats. Most of the biological emphasis of the CCP is focused on maintaining and restoring these priority resources. Several different conservation focal species may be identified for specific habitats to cover the variety of habitat structures and plant associations. In addition, species with specific "niche" ecological requirements may be listed as a focal species. Other species using the habitat will generally be expected to benefit as a result of management for the focal species.

The main criteria for selecting priority resources of concern included the following requirements:

- The resource must be reflective of the Refuge's establishing purposes and the Refuge System mission;
- The resource must include the main natural habitat types found at the Refuge;
- The resource must be recommended as a conservation priority in the wildlife and habitat management review; and/or
- The resource must be federally or state-listed as a candidate for listing, or a species of concern.

Other criteria that were considered in the selection of the resources of concern included the following:

- Species groups and/or Refuge features of special management concern;
- Species contributing to the BIDEH of the ecosystem; and
- Species where it is feasible to estimate population size (needed for future monitoring and adaptive management).

In developing objectives, the team followed the process outlined in the Service's draft *Identifying Resources of Concern and Management Priorities for a Refuge: A Handbook* (USFWS 2009b). This process designs objectives around the needs of priority resources of concern, and sets habitat attributes around the habitat structure, composition, and connectivity required by priority resources.

The comprehensive list of resources of concern in Appendix E includes species and species groups found on the Refuge, whether they nest on the Refuge, their Federal and State listing status, and whether species are covered by management plans prepared by Federal, State, or conservation organizations.

Table 4-1. Priority Resources of Concern at the Refuge

Priority Resources	Focal Species	Other Benefitting Species
Riparian Forests: Lake Lowell and River Islands	Yellow warbler	Bald eagle, wood duck, Lewis's woodpecker, yellow-billed cuckoo, osprey, red-tailed hawk, northern goshawk, olive-sided flycatcher, belted kingfisher, great horned owl, mourning dove, mule deer, red fox
	Song sparrow	White-crowned sparrow, California quail, western tanager, calliope hummingbird, black-throated sparrow, gray flycatcher, vesper sparrow, savannah sparrow, common yellowthroat, western terrestrial garter snake
Marsh wetlands	Mallard	Wood duck, great blue heron, American wigeon, black-crowned night heron, marsh wren, red-winged blackbird, yellow-headed blackbird, western meadowlark, mourning dove, barn owl, pied-billed grebe, sora, American kestrel, painted turtle
Emergent vegetation: Lake	Western grebe	Pied-billed grebe, Clark's grebe, eared grebe, canvasback, American coot
	Canada goose	Tundra swan, double-crested cormorant, Caspian tern, black tern,

Table 4-1. Priority Resources of Concern at the Refuge

Priority Resources	Focal Species	Other Benefitting Species
Lowell		Bonaparte's gull, glaucous gull, Franklin's gull, Sabine's gull
	Mallard	Blue-winged teal, canvasback, ruddy duck, American wigeon, gadwall, green-winged teal, northern shoveler, redhead, common merganser, northern pintail, northern leopard frog
Shoreline mudflats: Lake Lowell	Long-billed dowitcher	American avocet, Virginia rail, sora, Baird's sandpiper, American bittern, great blue heron, killdeer, common snipe, greater yellowlegs, lesser yellowlegs, willet, least bittern, western sandpiper, semi-palmated plover, black-bellied plover, cattle egret, white-faced ibis, great egret, solitary sandpiper, Wilson's phalarope
Open water: Lake Lowell	American white pelican	Osprey, bald eagle, common loon, Clark's grebe, common merganser, double-crested cormorant, Canada goose, mallard, California gull, Caspian tern, ring-billed gull, black tern, common tern, tundra swan
	Western grebe	
Shrub-steppe: Lake Lowell and River Islands	Sage thrasher	Swainson's hawk, northern harrier, ferruginous hawk, prairie falcon, long-billed curlew, killdeer, gray flycatcher, western meadowlark, sage sparrow, brewer's sparrow, green-tailed towhee, rock wren, vesper sparrow, horned lark, grasshopper sparrow, black-tailed jackrabbit, badger, yellow-bellied marmot, mountain cottontail
	Loggerhead shrike	
	Canada goose	Black rosy-finch, gray rosy-finch, green-tailed towhee, yellow-breasted chat, rock wren, canyon wren, vesper sparrow, cliff swallow, chukar, red-tailed hawk, golden eagle, bank swallow, white-throated swift, raccoon, mink
	Mallard	
Agricultural	Canada goose	Greater white-fronted goose, Ross's goose, common goldeneye, great blue heron, American wigeon, barn owl, short-eared owl, Swainson's hawk, red-tailed hawk, coyote, montane vole, mule deer, red fox, mountain cottontail
	Mallard	

4.3 Habitat Types

Habitat types on the Snake River Islands Unit of the Refuge consist of riparian forest, shrub-steppe, and seasonally flooded gravel bars. The Lake Lowell Unit contains emergent wetlands, shoreline mudflats, open water, riparian forest, shrub-steppe, and agricultural croplands and pastures. Acreages for each habitat type on the Refuge are summarized in Table 4-2. Map 9 shows habitats at the Lake Lowell Unit, and Maps 10a-10k show habitats at the Snake River Islands Unit. Habitat mapping was produced using heads up digitizing techniques on National Agriculture Imagery Program (NAIP) orthophotos that were taken on July 21, 2009. Seasonal flooding, rounding of numbers, and digitizing limitations can produce discrepancies in these estimated acreages. These numbers are considered "geographic information system (GIS) acreages" and are provided here for general reference. These acreages have not been formally surveyed.

Table 4-2. Acreages of Habitat Types at the Refuge

Habitat Types	Acres on Snake River Islands Unit	Acres on Lake Lowell Unit
Emergent wetlands (lacustrine)	0	850
Emergent wetlands (palustrine)	0	85
Shoreline mudflats	0	90
Open water	0	6,430
Riparian forest	630	1,910
Shrub-steppe	550	830
Agricultural crops and pastures	0	260
Seasonally flooded gravel bars	25	0

4.3.1 Emergent Wetlands

4.3.1.1 Overview

Emergent wetlands on the Refuge are found in lacustrine, palustrine, and riverine systems. Emergent wetlands are defined in the Cowardin classification system (Cowardin et al. 1979) as being characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. Vegetation is present for most of the growing season in most years and can be either persistent or nonpersistent. Persistent emergent wetlands are dominated by species that normally remain standing at least until the beginning of the next growing season. In contrast, nonpersistent wetlands are dominated by plants that fall to the surface of the substrate or below the surface of the water at the end of the growing season, so that during certain seasons of the year there is no obvious sign of emergent vegetation. Extensive lacustrine emergent wetlands occur along the southern shoreline of Lake Lowell and varied expanses exist on the northern, western, and eastern shorelines. There are approximately 850 acres of lacustrine emergent wetlands surrounding the lake when the water level is low. There are approximately 85 acres of palustrine emergent wetlands adjacent to Lake Lowell. These emergent wetlands include Upper Dam Marsh (25 acres), Rambo Pond (3 acres), and Leavitt (57 acres). Riverine emergent wetlands occur on lower elevations of the islands in the Snake River.

Hydrology sources for emergent wetlands on the Refuge include Lake Lowell, natural springs, and surface water runoff. Most of the Refuge wetlands are seasonal or semipermanent and are variably flooded with cycles of seasonal inundation and drying each year. Seasonal inundation occurs in some wetlands from October through April, whereas semipermanent inundation occurs from October through August in other areas. The largest emergent wetland on the Refuge (Upper Dam Marsh) is inundated year-round.

A diverse assemblage of hydrophytic vegetation is present in the Refuge's emergent wetland communities. Emergent wetlands in the no-wake zone on the east end of Lake Lowell and on the south side of the lake are dominated by smartweed, which provides habitat for nesting grebes and foraging habitat for pelicans and cormorants. Emergent wetland communities also include sedges, rushes, reeds, mannagrass, rough bentgrass, stinging nettle, common cattail, water plantain, milkweed, yellowcress, and goldenrod. Some scrub-shrub cover may also occur in emergent wetlands, and shrub species include smooth sumac, Woods' rose, and peachleaf willow.

4.3.1.2 Regional Distribution, Conditions, and Trends

In Idaho, an estimated 386,000 acres of wetland habitat (56 percent) were lost from 1780 to 1980 (Dahl 1990). This statistic includes multiple habitat types (emergent, scrub-shrub, forested, aquatic bed). Emergent wetlands constitute 17 percent of the wetland habitats along the middle and western Snake River (Jankovsky-Jones 2001). The long-term trends in distribution of freshwater wetlands show that freshwater emergent wetlands have declined by the greatest percentage of all wetland types, with nearly 24 percent lost since the 1950s (Dahl 2000). This is due in large part to Euro-American settlement, which typically started along river channels and expanded outward. Wetlands were regarded as having little economic value, and government programs that encouraged the development of wetlands were enacted. Historically, most wetland losses were due to drainage, land clearing, and conversion to cropland. As populations continue to increase and economies switch from agricultural-based to service-based, losses due to development, including road construction, home building, and flood control, are likely to exceed losses to agriculture (Jankovsky-Jones 2001).

Many of the wetlands that remain today have been degraded due to hydrologic alteration, agricultural activities, and urbanization, which have reduced wetland functions. Human activities, including livestock grazing, ground disturbance, and recreational activities, may introduce exotic plant species, create suitable conditions for the increase of less-desirable native species, eliminate woody tree and shrub cover, and compact wetland soils (Jankovsky-Jones 2001).

Along the middle and western Snake River and the lower reaches of its major tributaries from Milner Dam to the confluence with the Payette River, approximately 34 percent of the wetland and deepwater habitat is within areas with special management such as wildlife management areas or national wildlife refuges (Jankovsky-Jones 2001). Palustrine emergent wetlands constitute only 13 percent of all wetland communities in the wetland habitat in the Middle Snake River hydrologic unit code. Most of these wetlands have been affected by past land use activities, and the Jankovsky-Jones report describing the wetland conservation strategy for the Middle and Western Snake River concluded that maintaining existing wetland functions should be a high priority throughout the survey area (2001).

According to the Refuge's BIDEH analysis, invasive species documented as occurring in riverine and palustrine emergent wetland habitats on the Refuge include purple loosestrife, poison hemlock, white bryony, Russian olive, and tamarisk. Invasive species are discussed further in Section 4.6.

4.3.1.3 Key Species Supported

Emergent wetlands provide nesting, foraging, and loafing habitat for dozens of species of waterfowl, shorebirds, and aquatic migratory birds. Focal species on the Refuge dependent upon emergent wetland habitat include western grebe, Canada goose, and mallard. Other species using emergent wetland habitat on the Refuge include cinnamon teal, northern pintail, lesser scaup, white pelican, tundra swan, red-necked phalarope, American bittern, long-billed curlew, violet-green swallow, marsh wren, and snowy egret. Emergent wetlands also provide habitat for a diverse assemblage of wetland-dependent wildlife (e.g., amphibians, such as the northern leopard frog) as well as important rearing habitat for fish.

Emergent wetland plants are a valuable food source for migrating waterfowl during fall and spring. The smartweed emergent community, in the no-wake zone on the east end and on the south side of the lake, provides habitat for nesting grebes and foraging habitat for pelicans and cormorants. Western and Clark's grebes have nested in emergent vegetation in years when water levels remained high enough to provide nesting conditions. Grebes have at least two nesting colonies on Lake Lowell and raise young on the lake.

4.3.1.4 Refuge Management Activities

The hydrology of existing lacustrine emergent plant beds surrounding Lake Lowell is controlled by water-level management that is under the jurisdiction of Reclamation and managed by the Board of Control. The acreages and extent of emergent plant beds vary seasonally and annually based upon the volume of water withdrawn from the reservoir for irrigation use. Reclamation and the Board of Control manage lake levels solely for irrigation and not for wildlife habitat, so there is no minimum pool level. However, the water levels in the lake have been sufficient to provide habitat for wildlife, including nesting and migrating waterbirds, for the majority of its history.

The hydrology of the palustrine emergent wetland marshes at Upper Dam Marsh, the Leavitt Tract, and Rambo Pond is artificial and is provided by a variety of human activities. Prior to 1991, the Upper Dam Marsh was supported by water seeping from the Upper Dam before a dam safety project conducted by Reclamation altered the hydrology. Currently, wetland hydrology is provided by Reclamation during the irrigation season, April through early October. The marsh was completely dry in the winter of 2007-2008, and Reclamation is currently evaluating options to provide year-round hydrology to the Upper Dam Marsh. Hydrology for the marsh at Leavitt Tract is provided by irrigation runoff and irrigation return, which occur during the irrigation season from April to early October. The marsh can also receive backwater hydrology from Lake Lowell; however, lake levels need to be high for this to occur. Rambo Pond was created in 2005 by installing a water-control structure and diverting water pumped from the adjacent gravel pit. Pumping from the gravel pit needs to be continuous to maintain hydrology to the wetland. It is unknown how long the gravel pit will remain in operation, and at some point this source of hydrology for Rambo Pond may not be available. It may be possible for backwater to reach the marsh when Lake Lowell is at full pool.

Management activities consist primarily of invasive vegetation species control. Over the past several years, biological controls have been used to control purple loosestrife, which has substantially reduced the infestation.

4.3.2 Shoreline Mudflats: Lake Lowell

4.3.2.1 Overview

Mudflats are exposed along the shoreline of Lake Lowell in low-water years when the water level drops below the emergent wetland zone. Water levels in the lake decline as irrigation demands increase through the growing season, with the lake reaching a low point in late August (Figure 3-4). Acreage of mudflats varies annually depending upon the volume of water withdrawn from the reservoir. Hydrology of mudflats ranges from soils that are saturated at the surface to dry soils.

4.3.2.2 Regional Distribution, Conditions, and Trends

Lacustrine and palustrine aquatic bed habitats, which include shoreline mudflat habitats, constitute only 2.6 percent of all wetland communities in the wetland habitat in the Middle Snake River hydrologic unit code (Jankovsky-Jones 2001). During high-water years on the Refuge, minimal mudflat habitat is available for shorebirds during fall migration. The drawdown zones of the Snake River reservoirs evaluated in the Jankovsky-Jones study frequently supported nonnative plant species such as lesser burdock, marshpepper knotweed, curlytop knotweed, and annual rabbitsfoot grass. On the Refuge, the main invasive species occurring on the shoreline mudflats of Lake Lowell is purple loosestrife.

4.3.2.3 Key Species Supported

Shoreline mudflat habitats with a gradual shoreline dropoff and water conditions conducive to large invertebrate populations attract moderate to substantial numbers of shorebirds. Lake Lowell is a notable example of a reservoir important for fall migrants (Oring et al. 2000). In the latter part of the summer, as the lake is drawn down for irrigation, shorebirds, including least sandpipers, godwits, yellowlegs, and plovers, come to feed on the exposed mudflats. A focal species on the Refuge that is dependent upon shoreline mudflat habitat is the long-billed dowitcher. Mudflats support

macroinvertebrates (e.g., chironomids) that provide forage for migratory birds. These exposed mudflats attract large numbers of shorebirds and resident flocks of ducks and Canada geese.

4.3.2.4 Refuge Management Activities

Management activities are similar to those conducted in emergent wetlands and consist primarily of purple loosestrife control.

4.3.3 Open Water: Lake Lowell

4.3.3.1 Overview

Open-water habitat at Lake Lowell is in the lacustrine wetland system. Water depth generally ranges from 2 to 40 feet. Acreage of open-water habitat at Lake Lowell is approximately 6,430 acres at full pool, the vast majority of all Refuge acres. This habitat type does not have vegetation extending above the water surface; however, it does include submergent plant beds (e.g., pondweeds), which occur in shallow water areas where light penetration supports the growth of these species.

4.3.3.2 Regional Distribution, Conditions, and Trends

The construction of dams and reservoirs along the Snake River has resulted in type changes of wetlands along the Snake River. Type changes occur when a wetland is converted from one vegetation type to another. Water development projects have increased water levels at reservoirs, in turn causing riverine and spring-fed wetlands to be replaced with open-water habitat (Jankovsky-Jones 2001). The national trend among all types of wetlands indicates that the open-water category has gained the most area since the 1950s. In 1997, there were 5.5 million acres of open water across the United States, which is more than twice the area of open water reported in the mid-1950s (Dahl 2000). Of the wetland and deepwater habitat within special management areas along the Middle and Western Snake River, the majority (65 percent) is deepwater habitat within lacustrine systems. Much of this is artificially created deepwater habitat, created by impoundments including Lake Lowell and the C.J. Strike Reservoir (Jankovsky-Jones 2001).

Water development projects on the Snake River have resulted in deeper water levels, and many riverine and spring-fed wetlands have been replaced with open-water habitat. In addition, open-water habitat has likely increased in the vicinity of Boise due to the numerous former gravel pits that are filled with water (Jankovsky-Jones 2001).

4.3.3.3 Key Species Supported

Open-water habitat at Lake Lowell provides loafing and foraging habitat for migratory birds (e.g., gulls, grebes, pelicans) during the spring and summer and provides loafing and foraging habitat for ducks and geese during the fall through spring, depending upon the extent of freeze-up. Focal species on the Refuge that depend upon open-water habitat include American white pelican and western grebe. As colder weather drives migrating ducks and geese south, some birds stop over temporarily and others remain for the winter. By mid-November, the goose population peaks at about 12,000. Duck populations peak in mid-December, with up to 120,000 on Lake Lowell (USFWS 2008). Their activity keeps patches of water open, delaying ice formation.

Aside from the abundance of invasive carp, game fish in Lake Lowell include largemouth bass, smallmouth bass, yellow perch, black crappie, bluegill, rainbow trout, Lahontan cutthroat trout, channel catfish, and brown bullhead.

4.3.3.4 Refuge Management Activities

A no-wake zone for boating on Lake Lowell was instituted at the east end of the lake in 1990 to reduce disturbance to nesting bald eagles. The no-wake zone also minimizes disturbance to breeding, migrating, and wintering waterfowl and waterbirds.

Carp removal has occurred intermittently for many years to enhance submergent vegetation and moist-soil plants in Lake Lowell. Through a special use permit (SUP) from the Refuge, a commercial fisherman uses a beach seine to harvest carp and suckers. Seining is usually conducted during the fall and winter because the fish slow down and congregate in the cooler water, making them easier to catch. Current seining operations, which remove an estimated 50 to 125 tons of biomass annually (Cunningham 2012), likely do not remove enough carp (estimated at 4,800 tons of biomass) to result in significant water quality improvements or promote submergent plant growth. However, there have been no studies that have determined the appropriate threshold of biomass removal to achieve habitat improvements.

4.3.4 Riparian Forests: Lake Lowell and Snake River Islands

4.3.4.1 Overview

Construction of Lake Lowell resulted in hydrologic conditions that allowed the establishment of riparian/wetland forested habitat around the edges of the lake; such a habitat would not have been supported by site conditions present in this location prior to construction of the reservoir. The Refuge contains approximately 1,910 acres of riparian forest on the Lake Lowell Unit. Riparian forest is also present in a band around the perimeter of most islands on the Snake River Islands Unit.

The riparian forests on the Refuge are dominated by invasive and nonnative plants with little representation of species native to riparian habitats in the region (e.g., willows). Upper canopy is characterized by cottonwood with an understory dominated by Russian olive, false indigo bush, and some tamarisk, with a small native component of willows (e.g., coyote willow, peachleaf willow), wild rose, golden currant, elderberry, and skunkbush sumac. The herbaceous layer is dominated by invasive species such as reed canarygrass, Canada thistle, perennial pepperweed, and purple loosestrife.

The Refuge islands have a relatively higher quality riparian forest than that surrounding Lake Lowell, as indicated by fewer invasive species issues. Island riparian habitats are characterized by an overstory of native willows (e.g., coyote willow, peachleaf willow) and an understory of native shrubs (e.g., golden currant, skunkbush sumac). Some islands (Feral and Gosling) have cottonwood gallery forests with rookeries inhabited by colonial waterbirds (e.g., egrets, great blue herons, double-crested cormorants).

4.3.4.2 Regional Distribution, Conditions, and Trends

The operation of dams has a significant impact on riparian habitats in Idaho (Jankovsky-Jones 2001). Below Swan Falls Dam, located upstream of the Refuge, the area of riparian woodlands on the Snake

River has quadrupled since 1939 (Jankovsky-Jones 2001). Several factors may be responsible for the increase in riparian habitats from historical conditions. Decreased peak flows reduce tree mortality by altering historical hydrology patterns and eliminating scouring, a historical cause of tree mortality. Riparian plant recruitment is also facilitated by reduced minimum flows, which cause river margins to become exposed for longer periods during the growing season, allowing for riparian vegetation to become established on previously unvegetated surfaces in the channel. Over time, due to natural succession, these alterations in riverine hydrology have led to an expansion of the area of mature woodland (Dixon and Johnson 1999).

Despite the increase in riparian habitat from historical conditions, the abundance of riparian habitat is limited on the middle and western reaches of the Snake River. Riparian habitat is generally characterized as a narrow band of vegetation along the river channel and on islands due to steep canyons and rocky shores with minimal soil development, which limit the area available for colonization by riparian species (Jankovsky-Jones 2001). Impacts to the riparian corridor of the Snake River due to urbanization are mostly limited to lower reaches where valleys are wider. Human activities, including livestock grazing, ground disturbance, and recreational activities, introduce exotic plant species, create suitable conditions for the increase of less desirable native species, eliminate woody tree and shrub cover, and compact soils. Several invasive weeds are well established in riparian areas throughout the middle and western reaches of the Snake River, including musk thistle, Canada thistle, poison hemlock, common teasel, kochia, perennial pepperweed, broadleaved pepperweed, purple loosestrife, and Scotch thistle (Jankovsky-Jones 2001).

4.3.4.3 Key Species Supported

Riparian habitats constitute less than 1 percent of western landscapes but harbor the most species-rich avifaunas found in arid and semiarid portions of the western United States (Knopf et al. 1988). In Idaho, of the 242 naturally occurring bird species, 112 (46 percent) use riparian habitat as their primary nesting habitat. Many of the other 54 percent also use riparian habitat as a source of water, as migratory corridors, or for other purposes (Idaho Partners in Flight 1998).

Riparian forests benefit migratory birds (e.g., focal species such as yellow warbler and song sparrow) and a diverse assemblage of other riparian-dependent species by providing nesting, foraging, and migrating habitat for bald eagle, wood duck, Lewis's woodpecker, yellow-billed cuckoo, osprey, red-tailed hawk, northern goshawk, olive-sided flycatcher, belted kingfisher, great horned owl, mourning dove, a variety of songbirds, mule deer, red fox, and western terrestrial garter snake. Downed and standing dead trees provide nesting and foraging habitat for both resident and migratory birds (e.g., Lewis's woodpecker, wood duck). Riparian habitat also provides cover from predators for a variety of tree-dependent species. Riparian habitat on the Snake River Islands Unit supports Canada geese and ducks (mallards and teal), which nest in riparian shrubs along the interface of the riparian border and shrub-steppe habitat. Studies during the mid-1990s (Zoellick et al. 2004b) indicated that smaller islands that are isolated from the mainland had lower predation rates of waterfowl nests than larger islands, where isolation was a function of channel width, water depth, and water flow. The riparian habitat on Refuge islands provides habitat for nesting landbirds (e.g., yellow warblers, song sparrows, black-headed grosbeaks, willow flycatchers) and other riparian-dependent species. Nests on the Snake River islands are most frequently depredated by raccoons, coyotes, badgers, and mink (Zoellick et al. 2004b). Cowbird parasitism was also identified as a factor affecting nesting success of landbirds on islands (USFWS 2008).

4.3.4.4 Refuge Management Activities

The Refuge manages riparian forests for migratory landbirds and other riparian-dependent species including mammals and herptiles (i.e., inclusive of all reptiles and amphibians). For many years, fire breaks have been maintained along the boundary of the Lake Lowell Unit and extending into the riparian forest. These fire breaks were established to prevent the spread of a fire both within the Refuge and from the Refuge onto private land; they have had the unintended consequence of facilitating establishment of invasive species in these areas. Additionally, some mechanical removal of Russian olive has occurred to reduce ladder fuels that could lead to a running crown fire that would destroy the riparian habitat. These practices have fragmented the riparian forest, and some of the Russian olive removal has resulted in loss of subcanopy for forest landbirds.

The Refuge staff works closely with Canyon County Noxious Weed Control to address noxious weeds on the Refuge. Mechanical removal, application of herbicides, and biological controls are used to control invasive plants at the Lake Lowell Unit with varying degrees of success. Because of the logistical difficulties, limited control efforts have been conducted on the Snake River islands. When manual or chemical weed control has occurred, it has often resulted in the colonization of a different weedy species occurring where the initial weedy species was removed.

4.3.5 Shrub-steppe: Lake Lowell and Snake River Islands

4.3.5.1 Overview

The Refuge contains approximately 760 acres (GIS estimate) of shrub-steppe habitat on the Lake Lowell Unit. The existing upland shrub habitat at the Lake Lowell Unit is relatively isolated as a result of agricultural and urban development surrounding the Refuge. An extensive infestation of cheatgrass is present in the understory of the shrub-steppe habitat around the lake, which has led to an increased frequency and size of wildland fires around the lake compared to historical levels (USFWS 2008). This trend is consistent with the trend observed in cheatgrass dominated rangelands in the Great Basin (Pellant et al. 2004). The overstory canopy cover of sagebrush in this community is variable depending upon the fire history. Habitat is characteristic of Great Basin shrub-steppe habitat, and shrub species typically include sagebrush, bitterbrush, fourwing saltbush, gray/green rabbitbrush, greasewood, spiny horsebrush, and spiny hopsage.

The Snake River Islands Unit contains approximately 550 acres (GIS estimate) of shrub-steppe habitat. The upstream-most islands are predominantly shrub-steppe with little riparian forest. In contrast, downriver islands are bordered with a riparian band with interior uplands characterized by shrub-steppe habitat. Island shrub-steppe habitat is characterized by native bunchgrasses (Great Basin wildrye, beardless wildrye, saltgrass) interspersed with sagebrush and greasewood. As is the case with riparian forest, the Refuge islands have a relatively higher quality shrub-steppe, as indicated by fewer invasive species, than the surrounding mainland. Invasive species on Refuge islands include cheatgrass, Scotch thistle, teasel, Russian olive, and tamarisk.

4.3.5.2 Regional Distribution, Conditions, and Trends

Shrub-steppe habitat once covered approximately 156,000,000 acres of the western United States; however, very little now exists undisturbed or unaltered from its condition prior to Euro-American settlement (Knick et al. 2003). Shrub-steppe habitat has been lost or degraded as a result of a number of factors including agricultural conversion, overgrazing by livestock, invasive species (e.g.,

cheatgrass), expansion of pinyon and juniper woodlands, uncharacteristic wildfires, and fragmentation (Rich et al. 2005). This habitat loss has led to an increasing number of special-status species, including 630 plant and animal species of conservation concern (Rich et al. 2005). As shown in Figure 4-5, conversion of the Snake River Plain to agriculture has disconnected regions north of the Snake River from sagebrush habitat in southern Idaho and northern Nevada.

Virtually all sagebrush lands are managed principally for livestock grazing (Knick et al. 2003). In 2010, over 15,000 permits were issued for more than 8.7 million animal unit months of forage consumption on BLM lands (BLM 2010). Livestock grazing can change the habitat features that directly influence its suitability as habitat for birds by reducing plant species diversity and biomass.

Euro-American settlement changed the composition of many native plant communities in the Great Basin, most notably that of shrub-steppe habitat. Introduction of livestock in the late 1800s resulted in the loss of herbaceous understory species, and these areas were quickly colonized by cheatgrass. A significant impact of cheatgrass on shrub-steppe habitats is its role in increasing the frequency and extent of wildfires in the Great Basin (Hull and Pechanec 1947). In the Great Basin, wildfires and associated invasive plant species have caused ecological degradation on a large scale. Extensive wildfires in the summer of 1999 burned nearly 1,700,000 acres of public land. This record fire year was followed by another large fire year in 2000, with approximately 990,000 acres of public land burned (Pellant et al. 2004). The complex interaction of cheatgrass, wildfires, and invasive weeds is the greatest concern of the Great Basin's largest land manager, BLM (Pellant et al. 2004).

4.3.5.3 Key Species Supported

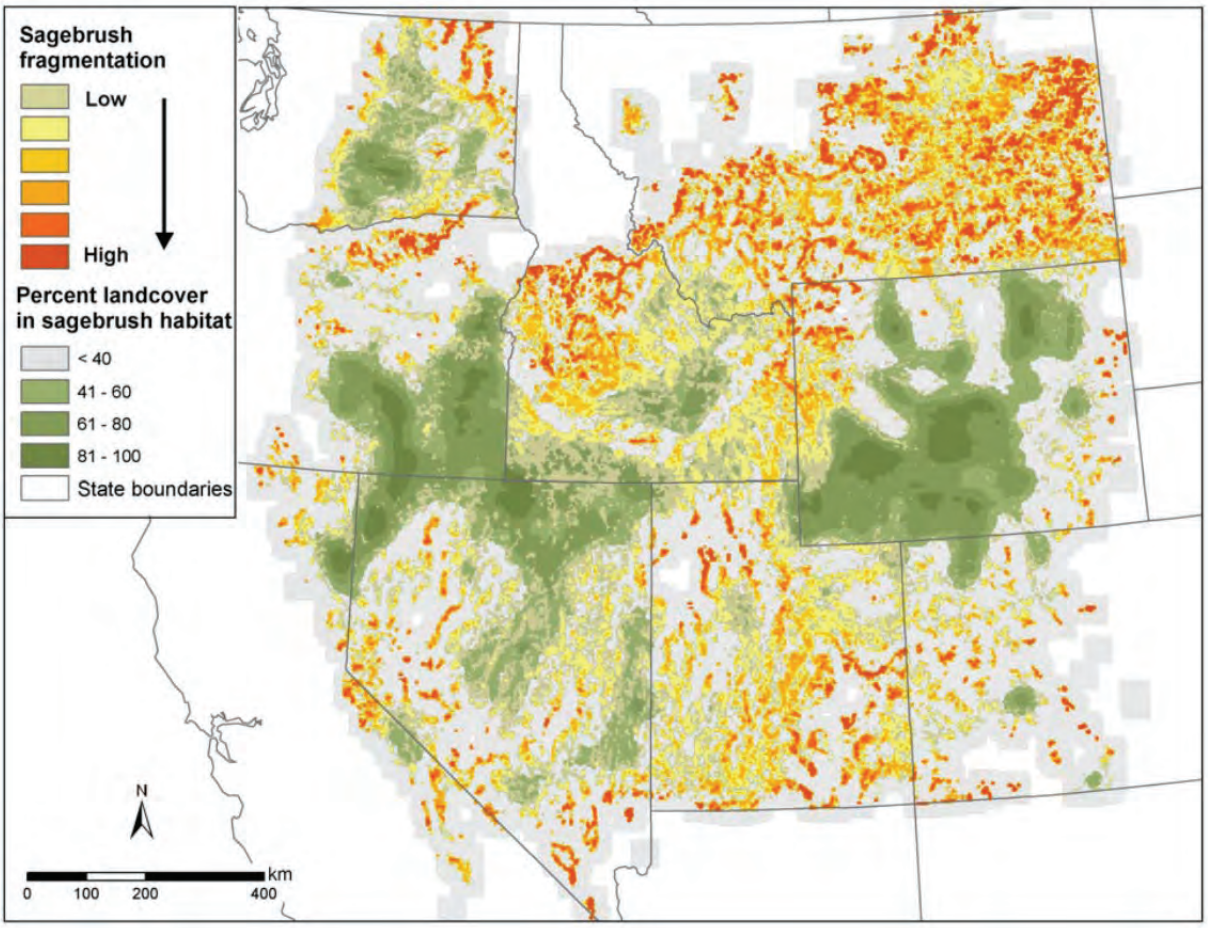
Shrubland and grassland bird populations are declining faster than any other group of species in North America (Dobkin 1994; Knopf 1994; Saab and Rich 1997; Vickery and Herkert 1999). These species represent an important component of the biodiversity of the western United States but have seen little conservation action until recently. Now, Brewer's sparrow, sage sparrow, and sage thrasher, the three primary passerine species of sagebrush habitats, receive special conservation status in one or more western states (Knick and Rotenberry 2002).

Focal species on the Refuge that depend upon shrub-steppe habitat include sage thrasher and loggerhead shrike on shrub-steppe habitat adjacent to Lake Lowell and Canada goose and mallard on shrub-steppe habitat on the Snake River Islands Unit. Other species dependent upon shrub-steppe habitat include a variety of raptors, sparrows, horned lark, and western meadowlark.

4.3.5.4 Refuge Management Activities

Control of invasive species and restoration of native bunchgrass and forb communities under a sagebrush-shrub canopy is a priority management activity at the Refuge. Chemical control of cheatgrass followed by reseeding of a mix of native shrubs and grasses has been successful on the Refuge. After recent fires, rehabilitation work has included chemical control and reseeding with native species. Although cheatgrass reinvades after several years, this approach has resulted in the

Figure 4-5. Sagebrush Fragmentation in the Western United States



Source: Knick et al. (2003).

establishment of a population of native shrubs and grasses in areas previously dominated by cheatgrass. There is a biological control agent for cheatgrass (the soil fungus *Pyrenophora semeniperda*) that may be considered for future management of cheatgrass in shrub-steppe habitat, should it be approved for use.

4.3.6 Agricultural Pastures and Croplands

4.3.6.1 Overview

For nearly 70 years, Refuge staff and cooperative farmers have planted agricultural crops to provide forage for migratory waterfowl and resident wildlife. On the Refuge, a rotation of five crops has been grown in recent times including corn, beans, peas, wheat (winter and spring), and alfalfa. At one time, approximately 400 acres were farmed on the Refuge. In 2011, two cooperators farmed approximately 260 acres, which comprised approximately 65 acres in alfalfa, 65 acres in corn, 40 acres in beans, and 90 acres in wheat.

4.3.6.2 Regional Distribution, Conditions, and Trends

The transformation of parts of the Snake River Plain from sagebrush desert to agricultural lands began in the mid-1800s and was made possible through irrigation (Dixon and Johnson 1999). As indicated in Figure 4-2, approximately 15 percent, or 1,298,189 acres, of the Middle Snake River Subbasin is used for agricultural purposes (Ecovista and IDFG 2004). Agricultural use in the subbasin is concentrated in areas of flat terrain adjacent to the Snake River, with irrigation water coming from the Snake River or its tributaries.

Substantial changes in agricultural practices in recent years have been noted on lands surrounding the Refuge. These changes include growing higher-valued specialty crops such as seed alfalfa, onions, and mint; using more efficient harvesting equipment so little waste grain remains in the field; and fall plowing and tilling often by mid-November, which is prior to the peak of waterfowl concentrations. As a result, the availability of winter browse and nutritional foods off-refuge has been substantially reduced. Because this trend is likely to continue in the future, on-refuge cropland management will be essential for waterfowl management in future years.

4.3.6.3 Key Species Supported

The key species supported at the Refuge by agricultural pastures and croplands are migratory birds (e.g., focal species such as Canada geese and mallard) and other resident wildlife (e.g., deer, pheasant, and quail).

4.3.6.4 Refuge Management Activities

Special conditions related to agricultural crop management include restrictions on pesticide use, limits to the types of crops grown, preventing alfalfa harvesting from May 1 through June 15 to reduce the risk of destroying nests of ground-nesting birds, and a requirement to have 6 inches of green browse by October 1.

4.4 Major Species Groups

4.4.1 Fish

Game fish in Lake Lowell include largemouth bass, smallmouth bass, yellow perch, black crappie, bluegill, rainbow trout, Lahontan cutthroat trout, channel catfish, and brown bullhead. The IDFG conducts fisheries management activities such as regulating harvest, fish population monitoring, and fish stocking at Lake Lowell. Lake Lowell is managed under general regulations, except for largemouth bass, which are managed under a no-harvest regulation from January 1 through June 30 and a two-fish limit, with none between 12 and 16 inches, from July 1 through December 31 (IDFG 2009b).

Due to its proximity to Idaho's population center, Lake Lowell receives substantial fishing pressure, with largemouth bass being of primary interest to recreational and tournament anglers (IDFG 2009b). The lake has been stocked by IDFG with species both nonnative (i.e., channel catfish) and native (i.e., Lahontan cutthroat from a hatchery source) to Idaho in recent years. The current practice of stocking nonnative fish is inconsistent with USFWS policies (7 RM 10 and 601 FW 3). Because Lake Lowell is an artificially created reservoir, there were no fish that were originally native to its waters. Fish native to Idaho and historically stocked (i.e., naturalized) species come as close to

meeting the policy as possible given the human-made quality of the lake. Since 2003, approximately 6,000 to 9,000 fingerling channel catfish have been planted annually. Additionally, recent plants of Lahontan cutthroat trout fingerlings have ranged from 40,000 to 103,000 annually (IDFG 2009b). Panfish (black crappie, bluegill, and yellow perch) are also popular despite widely fluctuating populations that have led to inconsistent use.

Fish population surveys conducted in 2008 (IDFG 2009b) indicate that the Lake Lowell fish community has become dominated by carp and sucker. Carp represented 58 percent of the catch by number, followed by channel catfish at 27 percent and black crappie at 6 percent. Yellow perch, bluegill, largemouth bass, smallmouth bass, largescale sucker, and northern pikeminnow, represented cumulatively 8 percent of the catch (IDFG 2009b). Results further indicated that Lake Lowell supports few prey-size fish. Younger age classes of panfish, especially black crappie and yellow perch, were nearly absent. In other systems, carp are known to degrade water quality, alter food webs, and negatively impact native or recreationally important fish populations (Jackson et al. 2010; Zambrano et al. 2001). Carp control has intermittently occurred for many years to enhance submergent vegetation and moist-soil plants in Lake Lowell.

4.4.2 Birds

The Refuge provides habitat for over 215 bird species including waterfowl, waterbirds, shorebirds, raptors, and passerines. The Refuge is an important resting and wintering area for birds migrating along the Pacific Flyway. Because of its value to birds, the Refuge has been declared a State Important Bird Area by the National Audubon Society. The Lower Snake River, including the Refuge, has been identified as a bird habitat conservation area in the *Coordinated Implementation Plan for Bird Conservation in Idaho* (Intermountain West Joint Venture 2005). A complete list of all birds documented on the Refuge is included in Appendix E.

4.4.2.1 Waterbirds

The Intermountain West's dispersed lakes, marshes, playas, rivers, streams, riparian zones, and freshwater and brackish wetlands host about 40 waterbird species. The region supports approximately 500,000 breeding waterbirds and a few million migrants, including many or most of the world's California gulls, eared grebes, white-faced ibises, and American white pelicans (Ivey and Herziger 2006). Waterbirds are a diverse group of species and include cranes, rails, coots, gulls, terns, grebes, cormorants, herons, egrets, bitterns, ibises, pelicans, loons, and others—essentially, all aquatic bird species except waterfowl (i.e., ducks, geese, and swans) and shorebirds (e.g., sandpipers and plovers). To complete portions of their life cycles, waterbirds are dependent on aquatic habitats, which, in the arid Intermountain West, include wetlands that are susceptible to natural cycles of droughts and floods.

The competing demands for water in support of human uses such as agriculture, development, and recreation pose the greatest threats to regional waterbird populations (Ivey and Herziger 2006). Because of the erratic water regime in the arid Intermountain West, wetland habitats are often insufficient to support waterbirds during drought periods (Ivey and Herziger 2006). Human-made reservoirs have a primary purpose of water delivery for irrigation and/or power generation, but they also have a secondary benefit to waterbirds and waterfowl by providing nesting habitat. Water levels of reservoirs are not managed for waterbird habitat, and as a result water-level management activities can impact nesting areas. This management practice can cause productivity problems for waterbirds as a result of the loss or abandonment of eggs or young due to flooding or stranding. On the Refuge,

western and Clark's grebe nesting colonies have been surveyed in the smartweed emergent wetland community in the no-wake zone on the east end and on the south side of the lake. This area also provides foraging habitat for pelicans and cormorants. Wakes created by motorized boats can inundate grebe nests, contribute to shoreline erosion, and degrade smartweed and emergent vegetation, making these habitats less suitable for waterbird nesting and foraging. Invasive exotic plants also pose a threat to many waterbird habitats in the region by replacing native vegetation and reducing wetland habitat quality for waterbirds.

4.4.2.2 Waterfowl

Numbers of wintering waterfowl on the Refuge peaked in the early 1960s between 500,000 and 750,000 birds (USFWS 2008). Refuge estimates of current wintering waterfowl populations at Lake Lowell are approximately 15,000 geese in mid-November and up to 150,000 ducks in mid-December. The Snake River also provides wintering waterfowl habitat for a variety of species including goldeneyes, scaup, mergansers, buffleheads, wood ducks, green-winged teal, and a large number of mallards. The conversion of large areas of local grasslands and wetlands to intensive farming, which has occurred since the 1960s, and changes in agricultural practices (as described in Section 4.3.6) have reduced the amount of local habitat available for waterfowl and may explain the reduction in waterfowl populations using the Refuge.

Waterfowl breeding population surveys of the Snake River are conducted annually by IDFG from Guffey Bridge to Farewell Bend, Oregon, and on the Payette River from its mouth to Emmett, Idaho. The three-year average from 2007 through 2009 of 692 breeding pairs of all species of geese is below the minimum goal of 900 breeding pairs identified in the IDFG 1991-1995 waterfowl management plan (IDFG 2009a). A total of 1,584 Canada geese and 664 breeding pairs were observed in 2009, in addition to large flocks of white-fronted geese (14,154 birds), snow geese (13,395), and Sandhill cranes (1,100) (IDFG 2009a).

The population index for the Pacific population of Canada goose in 2011 was 166,300, 15 percent higher than in 2010 (USFWS 2011c). These indices increased by 4 percent per year over the past 10 years. The index for the western Central Flyway population of snow and Ross's geese was a count of 196,100, 18 percent fewer than in 2010. These populations have increased 10 percent per year from 2002 through 2011. For the second year in a row, major swan areas could not be surveyed during the Service's waterfowl population survey, which likely accounts for the low counts of the past few years. Despite variation in survey coverage, population estimates have shown no trend over the last 10 years (USFWS 2011c). Numbers of tundra swans on breeding grounds increased in 2011 from 2010, and the nest index was 40 percent greater than the 10-year average. However, the total bird index for tundra swans was 28 percent lower than in 2010 (USFWS 2011c). The total population estimate for all duck species was approximately 45.6 million birds, which represents an 11 percent increase over the 2010 estimate and was 35 percent above the long-term average from 1955 through 2010 (USFWS 2011c).

4.4.2.3 Shorebirds

The Intermountain West provides breeding habitat for 11 species of shorebirds and stopover habitat for an additional 23 species during their annual migration (Oring et al. 2000). Perhaps a million shorebirds breed in the Intermountain West, and millions of additional shorebirds migrate annually through the area (Oring et al. 2000). The Great Basin is one of six bird conservation regions in the

Intermountain West, and it stands out as enormously important for both breeding and migrating shorebirds (Oring et al. 2000).

The Refuge is included on the list of managed shorebird sites in the *Intermountain West Shorebird Plan*. Shorebirds that breed on the Refuge include American avocet, black-necked stilt, killdeer, spotted sandpiper, and Wilson's snipe. Shorebirds that stop over at the Refuge include Wilson's phalarope, red-necked phalarope, long-billed dowitcher, marbled godwit, western sandpiper, and least sandpiper. Lake Lowell is documented as having peak shorebird numbers ranging from 10,000 to 20,000 (Oring et al. 2000).

4.4.2.4 Raptors

The Morley Nelson Snake River Birds of Prey National Conservation Area, encompassing 485,000 acres along 81 miles of the Snake River, contains the highest concentration of noncolonial-nesting raptors of any location in the world (Kochert and Pellant 1986). This area provides habitat for approximately 800 pairs of falcons, eagles, hawks, and owls to breed and raise their young from mid-March through June (Visit Idaho 2011).

Raptors documented as breeding on the Refuge include osprey, bald eagle, northern harrier, Cooper's hawk, Swainson's hawk, red-tailed hawk, and American kestrel. Results from autumn raptor migration counts conducted at Boise Ridge, Idaho, from 1993 through 2005 suggest an increasing trend in the numbers of turkey vulture, osprey, Cooper's hawk, red-tailed hawk, and merlin. A decreasing trend in the numbers of northern goshawk, Swainson's hawk, and American kestrel was observed, and counts of northern harrier, sharp-shinned hawk, and golden eagle were relatively stable (Smith et al. 2008).

4.4.2.5 Passerines

Passerine populations have declined throughout the Intermountain West due to conversion of shrub and grassland habitats to agriculture, habitat fragmentation, and degradation of riparian habitats due to grazing. In a recent study of the distribution and abundance of bird populations dependent upon shrub-steppe habitats in the Intermountain West, significant declining population trends were found for 16 of the 25 upland bird species examined (Dobkin and Sauder 2004). Many of the species with declining populations were passerines including horned lark, green-tailed towhee, chipping sparrow, Brewer's sparrow, lark sparrow, black-throated sparrow, sage sparrow, grasshopper sparrow, white-crowned sparrow, western meadowlark, and Brewer's blackbird.

Many neotropical migratory landbirds that occur on the Refuge are dependent upon riparian habitat as their primary nesting habitat. Dobkin and Sauder (2004) found populations of many riparian-dependent species to be in decline in the Intermountain West, including willow flycatcher, orange-crowned warbler, Wilson's warbler, song sparrow, and Bullock's oriole.

4.4.3 Mammals

Over 25 species of mammals have been observed on the Refuge. The Refuge supports a population of mule deer; however, the herd size is unknown. White-tailed deer and elk also occur on the Refuge but are far less common. As deer habitat adjacent to the Lake Lowell Unit has been lost to urbanization, deer have become more concentrated on the Refuge and remaining adjacent rural lands. This concentration has resulted in conflicts with the surrounding community, due to depredation on

agricultural lands (including orchards) and increases in collisions with vehicles. Deer cross major roads (e.g., Lake Shore Drive, Orchard Avenue) as they travel from the cover and shelter on the Refuge to forage areas in adjacent agricultural fields and orchards.

Statewide, mule deer populations have declined since the 1950s and 1960s, and the long-term outlook for mule deer is that of slowly diminishing habitat quantity and quality over time (IDFG 2010b). The Refuge is located in the IDFG Snake River Population Management Unit (PMU). According to the IDFG report, the deer population has probably changed very little since historical times in this PMU, and accounts of trappers through this area in the mid-1800s indicated that buffalo, elk, pronghorn, and bighorn sheep were far more common than mule deer. Given the low densities of deer and low priority for deer in this PMU, little data are available to indicate what population trends have occurred over time (IDFG 2010b).

Other commonly occurring species on the Refuge include North American river otter, coyote, red fox, striped skunk, raccoon, long-tailed weasel, mink, yellow-bellied marmot, fox squirrel, northern pocket gopher, North American beaver, mountain cottontail, and various mice.

A complete list of all mammals documented on the Refuge is included in Appendix E.

4.4.4 Reptiles and Amphibians

Reptiles documented on the Refuge include western terrestrial garter snake, gopher snake, racer, striped whipsnake, western rattlesnake, and painted turtle. Amphibians documented on the Refuge include bullfrog, Pacific tree frog, and Great Basin spadefoot toad. A complete list of all reptiles and amphibians documented or potentially occurring on the Refuge is included in Appendix E.

4.4.5 Invertebrates

Invertebrate surveys conducted on the Refuge in 2010 and 2011 documented 13 scientific orders, consisting of the following: beetles (Coleoptera); earwigs (Dermaptera); flies (Diptera); true bugs (Hemiptera); aphids and relatives (Homoptera); bees, wasps, and ants (Hymenoptera); butterflies and moths (Lepidoptera); nerve-winged insects (Neuroptera); grasshoppers and relatives (Orthoptera); springtails (Collembola); dragonflies and damselflies (Odonata); thrips (Thysanoptera); and caddisflies (Trichoptera) (Castrovillo 2010). Other orders have been found on the Refuge and are listed in Table E-5 in Appendix E.

Mosquito control using aerial application of the larvicide *Bacillus thuringiensis israelensis* (Bti) was begun in 2004. Applications begin in the spring as soon as the identified thresholds of six larvae per dip are found. Applications are site specific to areas with high larval levels. Areas treated with Bti have been primarily along the south edge of Lake Lowell, Upper Dam Marsh, and a few other wetland areas. Most treatments occur in water less than 18 inches deep. In some years, more than 250 acres have been treated at one time, with several applications over the course of spring and summer.

4.5 Threatened, Endangered, and Sensitive Species

One goal of the Refuge System is “to conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.” In the policy clarifying the mission of the Refuge System (601 FW 1), it is stated that “we protect and manage

candidate and proposed species to enhance their status and help preclude the need for listing." In accordance with this policy, the CCP planning team considered species with Federal or State status and other special-status species in the planning process.

Table 4-3 includes special-status species that are known to occur or are likely to occur at the Refuge. "Special status" in this discussion includes species that are federally or state-listed, candidates for Federal listing, or species of concern at the State or Federal level.

Table 4-3. Federally and State-listed Species Potentially Occurring on the Refuge

Species	Federal Status[a]	Idaho Status[b]	Breeds on Refuge[c]
Birds			
American avocet		G5/S5B	X
American white pelican		G3/S1B	
Bald eagle		G4/S3B,S4N	X
Black-crowned night heron		G5/S2B	X
Black rosy-finch		G4/S3	
Black tern		G4/S1B	X
Black-necked stilt		G5/S3B	X
Brewer's sparrow		G5/S3B	
Burrowing owl	SOC	G4/S2B	
California gull		G5/S2B, S3N	X
Caspian tern		G5/S2B	X
Cattle egret		G5/S2B	
Clark's grebe		G5/S2B	X
Common loon		G5/S1B, S2N	X
Ferrugionous hawk		G4/S3B	
Flammulated owl		G4/S3B	
Forester's tern		G5/S1B	
Franklin's gull		G4G5/S2B	
Grasshopper sparrow		G5/S2B	
Great egret		G5/S1B	X
Greater sage-grouse	Candidate	G4/S2	
Harlequin duck		G4/S1B	
Hooded merganser		G5/S2B, S3N	
Lesser scaup		G5/S3	
Lewis's woodpecker		G4/S3B	
Loggerhead shrike	SOC		X
Long-billed curlew	SOC	G5/S2B	
Merlin		G5/S2B, S2N	
Northern goshawk	SOC		
Northern pintail		G5/S5B, S2N	X
Peregrine falcon		G4T3/S2B	
Sandhill crane		G5/S3B	
Short-eared owl		G5/S4	
Snowy egret		G5/S2B	X
Swainson's hawk		G5/S3B	X
Trumpeter swan	SOC	G4/S1B,S2N	
Western grebe		G5/S2B	X
White-faced ibis	SOC	G5/S2B	
Wilson's phalarope		G5/S3B	
Yellow-billed cuckoo	Candidate	G5/S2B	
Fish			
Bull trout	T (CH)	G3/S3	

Table 4-3. Federally and State-listed Species Potentially Occurring on the Refuge

Species	Federal Status[a]	Idaho Status[b]	Breeds on Refuge[c]
Lahontan cutthroat trout	T		
Herptiles			
Columbia spotted frog	Candidate	G4,T2,T3/S2	
Northern leopard frog	SOC	G5/S2	
Western toad	SOC		
Mammals			
Gray wolf	Recovery	G4/S3	
North American wolverine	Candidate	G4,T4/S2	
Northern Idaho ground squirrel	T	G2,T2/S1	
Southern Idaho ground squirrel	Candidate	G2,T2/S1	
Mollusks			
Bruneau hot springsnail	E	G1/S1	
Snake River physa snail	E	G1/S1	
Plants			
Howell's spectacular thelypody	T	G5,T4Q/S2	
Packard's milkvetch	Candidate	G5,T1/S1	
Slickspot peppergrass	T (PCH)	G2/S2	
Whitebark pine	Candidate	G3,G4/S3	

[a] Federal Status: T = Threatened; E = Endangered; Candidate = Candidate; SOC = Species of Concern; (CH) = Designated critical habitat; (PCH) = Proposed critical habitat.
[b] Idaho Status: G1 or S1 = Critically imperiled: at high risk because of extreme rarity (often five or fewer occurrences), rapidly declining numbers, or other factors that make it particularly vulnerable to rangewide extinction or extirpation; G2 or S2 = Imperiled: at risk because of restricted range, few populations (often 20 or fewer), rapidly declining numbers, or other factors that make it vulnerable to rangewide extinction or extirpation; G3 or S3 = Vulnerable: at moderate risk because of restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors that make it vulnerable to rangewide extinction or extirpation; G4 or S4 = Apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors; G5 or S5 = Secure: common, widespread, and abundant; Q = Questionable taxonomy: taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower conservation priority.
[c] Nests on Refuge: X = Known to nest on Refuge on either Lake Lowell or Snake River Islands Units.

Some of the species in the table above are listed as special status species that occur in counties that contain or are adjacent to Deer Flat NWR. Those species are discussed in further detail below.

Yellow-billed Cuckoo (*Coccyzus americanus*): Taylor (2000) published the following "Status of the Yellow-Billed Cuckoo in Idaho":

> In southwestern Idaho the Yellow-billed Cuckoo has historically been considered a "rare summer visitor and breeder, perhaps erratic, in the western part of the Snake River Valley" (Larrison et al. 1967). Sites of records in the last quarter century include Battle Creek and Crane Creek Reservoir, Owyhee Co. (Svingen 1996, T. Rich pers. comm.), an island in the Snake River, Fort Boise Wildlife Management Area (W.M.A.), and Lake Lowell, Canyon Co. (Rogers 1978, Taylor and Trost 1987, J. Gatchette pers. comm., G. Kaltenecker pers. comm.), Prairie, Elmore Co. (Rogers 1979), Swan Falls Dam, Ada Co. (Rogers 1985), Hayspur Fish Hatchery, Blaine Co. (Svingen 1997), and the Twin Falls area, Twin Falls Co. (Rogers 1984). Yellow-billed Cuckoos have not been recorded more than once at any of these locations, except for the single records from the 1970s, 1980s, and 1990s at Lake Lowell.

> There are probably not more than a few dozen pairs breeding annually in the state, and quite possibly fewer than ten pairs. The Yellow-billed Cuckoo should be considered one of the most endangered bird species in Idaho. It could easily become extirpated from the state in the near future. In Idaho, Yellow-billed Cuckoo occupy riparian areas with a well-developed understory. Little ecological research has been conducted on the riparian vegetation of the Snake and other rivers in Idaho, but much of this vegetation has undergone modification and deterioration (Dixon and Johnson 1999). Restoration of large areas of riparian cottonwood with a thick understory, particularly willow (Marshall et al. 1996), would probably benefit the Yellow-billed Cuckoo in Idaho greatly.

Bull trout (*Salvelinus confluentus*): Historically, bull trout used the Snake River for foraging, migration, and overwintering habitat; the Snake River currently plays an important role in providing a corridor for exchange of bull trout among populations in its tributaries (USFWS 2010a). Critical habitat for bull trout in the Snake River is located from the mouth upstream to Brownlee Dam (50 C.F.R. 17), approximately 55 miles downstream from the lower end of the Refuge. In sampling conducted between 1998 and 2001, no bull trout were documented in the mainstem Snake River above Brownlee Dam (Chandler et al. 2003). Bull trout do not occur in Lake Lowell.

Bull trout can exhibit either a resident or migratory life history strategy. Resident bull trout complete their entire life cycle in the streams and tributaries where they spawn and rear. Migratory bull trout spawn and rear in streams for one to four years before migrating to a lake (adfluvial) or river (fluvial) seasonally, and then returning to the stream to spawn. Bull trout are found primarily in colder streams, although individual fish are found in larger river systems throughout the Columbia River Basin (USFWS 2007a). All life history stages are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (USFWS 2007a).

On the mainstem Snake River, the downstream-most islands in the Refuge (Fenzl Island and Darrows Islands/Rapids #1 and #2) are within the upstream-most end of Brownlee Reservoir. The Powder River Basin, which contains designated critical habitat for bull trout, flows into Brownlee Reservoir approximately 45 miles downstream of the Refuge. Brownlee Reservoir contains potential foraging, migration, and overwintering habitat for fluvial populations of bull trout in the Powder River Basin (USFWS 2010a), although most bull trout in the Powder River are currently believed to exhibit resident life histories (USFWS 2002b). It is also likely that bull trout will use the reservoir if migratory individuals become re-established in the drainage of the Weiser River (USFWS 2005), which enters the Snake River at RM 352. This is within the Refuge, but the extent and nature of use and quality of habitat provided are not well understood (USFWS 2005). To function as migratory and overwintering habitat, the mainstem Snake River and reservoirs must provide holding water with adequate temperature, depth, and cover to ensure successful bull trout movement, as well as provide sufficient foraging opportunity (USFWS 2005).

Other tributaries that flow into the Snake River either within, downstream, or upstream of the Refuge also contain or have the potential to support bull trout (e.g., Indian Creek, Payette River, Malheur River, and Boise River). However, bull trout populations in most of these basins are extremely low and/or isolated in headwater areas due to impassable barriers and poor water quality in lower reaches. As bull trout populations increase and restoration actions continue in these basins, the mainstem Snake River will provide an important migratory corridor between upstream and downstream populations of bull trout.

Lahontan cutthroat trout: Although native Lahontan cutthroat trout occur within Malheur County in southeastern Oregon, they are not known to occur in the Snake River or Lake Lowell (USFWS 1995). IDFG has historically stocked Lahontan cutthroat trout in Lake Lowell; however, these fish are of hatchery origin and not considered part of the federally protected species.

Columbia spotted frog (*Rana luteiventris*): Spotted frogs inhabit spring seeps, meadows, marshes, ponds, streams, and other areas where there is abundant vegetation. They often migrate along riparian corridors between habitats used for spring breeding, summer foraging and winter hibernation. The largest known threat to spotted frogs is habitat alteration and loss, specifically loss of wetlands used for feeding, breeding, hibernating, and migrating. Other threats to this species include development, disease, and predation by nonnative species (USFWS 2011f).

Columbia spotted frogs range from extreme southeast Alaska south through British Columbia and Alberta, Canada, western Montana and Wyoming, Idaho, northeastern Oregon, and eastern Washington. Under the Endangered Species Act, there are currently four recognized Distinct Population Segments (DPS) of Columbia spotted frogs: Northern, Great Basin, Wasatch, and West Desert. Columbia spotted frogs in the Nevada, southwestern Idaho, and southeastern Oregon portion of the Great Basin are geographically separate from the remainder of the species and are considered to be the Great Basin DPS. Columbia spotted frogs appear to be widely distributed throughout southwestern Idaho (mainly in Owyhee County) and southeastern Oregon (Malheur and Harney counties) but local populations tend to be small (USFWS 2011f). Occupied habitat for the Great Basin population is characterized by sagebrush with stream and pond environments. Columbia spotted frogs in Nevada have been reported from elevations between 5,600 and 8,700 feet, but elevations vary between populations (USFWS 2011f).

Although there is suitable Refuge habitat for this species, there are no known populations here, and it was not documented during amphibian surveys conducted in 2005 and 2006. Additionally, the Refuge is at a lower elevation than nearby populations.

Southern Idaho ground squirrel (*Urocitellus brunneus endemicus*): The southern Idaho ground squirrel occurs in native shrub-steppe habitat containing big sagebrush, bitterbrush, and a variety of native forbs and grasses. Areas of localized abundance are typically associated with human-altered landscapes such as golf courses and row crop or farmed fields (particularly alfalfa and clover). Adult ground squirrels are active from late January or early February to late June or early July when they return to their burrows for hibernation. Threats to the southern Idaho ground squirrel include exotic grasses and weeds, altered fire regime resulting from nonnative grass invasions, habitat fragmentation, competition with the Columbian ground squirrel (*Spermophilus columbianus*), direct killing from shooting, trapping or poisoning, and predation (USFWS 2011d).

Idaho ground squirrels occur in a 38-square-mile area in Idaho that extends from Emmett northwest to Weiser and the surrounding area of Squaw Butte, Midvale Hill, and over to the Henley Basin in Gem, Payette, and Washington counties (USFWS 2013). The range of the southern Idaho ground squirrel is bounded on the south by the Payette River, on the west by the Snake River and on the northeast by lava flows with little soil. Within the Refuge, the northern portion of the Snake River Unit lies along the western boundary of its range. The Lake Lowell Unit is located to south of the known range of this species.

Snake River physa snail (*Haitia [Physa] natricina*): This species occurs on the underside of large cobble- to boulder-sized substrate in swift currents in the mainstem Snake River, generally in the

deepest parts of the river at the margins of rapids (USFWS 2005). Historically, this species has been known to occur from RM 487 to 673.5, but currently it is only known to be present from RM 666 (tailwaters of the Milner Pool) to 673.5 (Minidoka Dam) (USFWS 2005). There is potential for the species to be present downstream to RM 553, but no live specimens have been collected in this area since 1981 (USFWS 2005). The Refuge extends upstream to approximately RM 448.5; therefore, it is not within the known range of Snake River physa snail distribution. It is not known if the Snake River portions within the Refuge historically supported populations of the Snake River physa snail.

Bruneau hot springsnail (*Pyrgulopsis bruneauensis*): This species is endemic to thermal springs and seeps that occur along 5 miles of the Bruneau River in southwest Idaho (USFWS 2007b), located entirely outside of the Refuge. The Bruneau River enters the Snake River at RM 495, approximately 46.5 miles upstream of the Refuge.

Howell's spectacular thelypody (*Thelypodium howellii* ssp. *spectabilis*): Howell's spectacular thelypody occurs in wet alkaline meadows in valley bottoms, usually in and around woody shrubs that dominate the habitat on the knolls and along the edge of the wet meadow habitat between the knolls (Federal Register 1998). Associated species include greasewood, saltgrass, basin wildrye, and alkali bluegrass (ORBIC 2010). All known remaining populations occur within or directly adjacent to agricultural fields or urban areas. The plants are threatened by habitat modification such as grazing during spring and early summer, trampling, urban development, and competition from nonnative plants (Federal Register 1998).

Howell's spectacular thelypody is known to occur on fewer than 12 small sites located within 100 acres of private lands near North Powder and Haines in eastern Oregon (Baker and Union counties). It formerly also occurred in the Willow Creek Valley in Malheur County (Federal Register 1998). The Refuge is not located within the known range of this species.

Packard's milkvetch (*Astragalus cusickii* var. *packardiae*): Packard's milkvetch is a narrow endemic plant that occurs in habitat characterized by rolling uplands and steep slopes that descend to terraced at elevations ranging from 2,600 to 3,000 feet. This species occurs on sedimentary outcrops which are largely devoid of other native shrubs, grasses, and forbs (Mancuso 1999). It is associated with vegetation dominated by Wyoming sagebrush and native bunchgrasses including bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. However, due to habitat impacts from a century of wildfires, livestock use, and invasive nonnative plant species, much of its historical habitat has been converted to annual grassland dominated by cheatgrass and medusahead (USFWS 2011e). Primary threats to this species and its associated habitat include off-road recreational vehicle use, invasive nonnative grasses, wildfire, and livestock.

This species is only known to occur in the northeastern corner of Payette County, about 15 miles north of the town of Emmett and approximately 15 miles east of the town of Payette, in southwestern Idaho. Its entire known range, which lies between Big Willow Creek to the south and Little Willow Creek to the north, is only approximately 10 square miles (USFWS 2011e). The Refuge is not located within the known range of this species.

Slickspot peppergrass (*Lepidium papilliferum*): Slickspot peppergrass is associated with slickspots, distinct small habitat patches with a clay subsurface soil horizon within the sagebrush-steppe ecosystem. Slickspots are visually distinct openings in the sagebrush-steppe community characterized by soils with high sodium content and distinct clay layers that appear to have formed during the Pleistocene epoch (USFWS 2011g). It occurs in relatively intact habitat dominated by

Wyoming sagebrush and native bunchgrasses including bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. Threats to this species in southwest Idaho include the invasion of nonnative annual grasses including cheatgrass, increased fire frequency, development or destruction of slickspot microsites, habitat fragmentation, and livestock (Federal Register 2009).

Slickspot peppergrass is known to occur only in the Snake River Plain and its adjacent northern foothills in Ada, Canyon, Elmore, Gem, Owyhee, and Payette counties in Idaho (USFWS 2011g); critical habitat has been designated to protect known populations (Federal Register 2011). The Refuge is not located within the known range of this species.

Whitebark pine (*Pinus albicaulis*): Whitebark pine is typically found in cold, windy, high-elevation or high-latitude sites found at or slightly lower than alpine timberline in the upper montane zone in western North America (Tomback et al. 2001). Whitebark pine is ecologically very significant in maintaining snowpack and regulating runoff, initiating succession after fire or other disturbance events, and providing seeds that are a high-energy food source for many species of wildlife. Threats to this species include climate change, white pine blister rust, and mountain pine beetles, or the combination of effects from some or all of these threats.

The species is distributed in Coastal Mountain Ranges (from British Columbia, Washington, Oregon, down to east-central California) and Rocky Mountain Ranges (from northern British Columbia and Alberta to Idaho, Montana, Wyoming, and Nevada) (Tomback et al. 2001). Subalpine habitats likely to support this species do not occur on the Refuge.

4.6 Invasive and Nuisance Species

Both the Lake Lowell and Snake River Islands Units of the Refuge have been colonized by invasive plants and animals. Invasive plant species displace native vegetation, altering the composition and structure of vegetation communities, affecting food webs, and modifying ecosystem processes, thus resulting in considerable impacts to native wildlife.

4.6.1 Plants

Refuge habitats have been colonized by a variety of noxious weeds and invasive plant species, including cheatgrass, Canada thistle, Scotch thistle, rush skeletonweed, perennial pepperweed, purple loosestrife, puncturevine, tamarisk, and Russian olive. Invasive plant species occurring on the Refuge are included in Table E-5 as part of the current wildlife and plants occurring on the Refuge (Appendix E). Currently, a combination of hand removal, mechanical removal, herbicide application, and biological controls are used to help control invasive plants at the Lake Lowell Unit with varying degrees of success. Efforts around the lake have focused on Russian olive, perennial pepperweed, Scotch thistle, Canada thistle, white bryony, and poison hemlock. False indigo bush is the predominant understory species in riparian areas. Its dense growth form and vigorous resprouting prevent any other understory species from establishing. Little work has been done specifically to reduce this species. In upland area, cheatgrass chokes out native and desirable species and is so prevalent that only broad application of a control method (e.g., herbicide, biological control, prescribed fire) will work to reduce this species.

The lake edges in some locations and the Upper Dam Marsh have been invaded by purple loosestrife. Over the past several years, biological controls have substantially reduced the infestation. A

biological control agent for Canada thistle was released many years ago with unknown results. A biological control agent is being considered for tamarisk. There also is a potential biological control agent, a soil fungus (*Pyrenophora semeniperda*), for cheatgrass that is being considered for shrub-steppe habitat on the Refuge, should it be approved for use.

Because of the logistical difficulties, limited control efforts have been conducted on the Snake River Islands Unit. When manual or chemical weed control has occurred, it has often resulted in the removed weedy species being replaced by another weedy species. Many weeds are best controlled by injection, spot spraying, or painted application of herbicide. These applications are time consuming and are most effective when several people work together. Despite the Refuge's application of considerable resources to controlling invasive species, existing budgets and staffing levels do not allow as many acres to be treated for weeds as would be desirable. As a result, weeds are kept in check on areas of the Refuge that receive treatment, but they are spreading elsewhere.

4.6.2 Animals

Several species of nonnative mammals, fish, amphibians, and invertebrates are present within the Lake Lowell and Snake River Islands Units of the Refuge. IDFG has historically stocked Lake Lowell with nonnative channel catfish, black crappie, and Lahontan cutthroat trout, among other species. Carp populations are described in Section 4.4.1. Invasive species present on the Refuge include bullfrog, New Zealand mudsnail, common carp, oriental weatherfish, and feral cats and dogs. Zebra and quagga mussels have not established in the Snake River or Lake Lowell to date; however, these species have been found in neighboring states (Utah and California) and are at risk of becoming established on the Refuge in the future.

Bullfrog: This species is an invasive amphibian that occurs in very warm and sunny ponds, marshes, slow-moving streams and rivers, and ponds (Corkran and Thoms 1996). The range of this species in North America is east of the Rocky Mountains. It was introduced into the West in the 1900s as a source of food (frog legs) and has since spread to other continents. It has also been introduced for sport, for pest control, and accidentally through trout stocking. This species tolerates a wide range of water temperatures and consequently has become invasive across a wide range of aquatic habitats. Control measures include the removal of individuals, introduction of predator species (e.g., largemouth bass), and egg collection. The removal of bullfrogs is unlikely to be a viable management option due to the difficulty of removing all bullfrog eggs, tadpoles, and adults, and preventing surrounding bullfrogs from invading a water body. However, this may be feasible in smaller water bodies isolated from other sources of bullfrog invasions.

Many factors have contributed to the successful invasion of bullfrogs and their negative impacts to native wildlife in North America and elsewhere. In a single season, bullfrogs lay up to 20,000 eggs, while native species lay far fewer eggs. This has led to direct competition with native species for food and habitat. Bullfrogs are opportunistic predators, and prey on any animal smaller than themselves. Their diet consists of fish, reptiles, small mammals, birds, amphibians, and insects. They are also cannibalistic. Bullfrog tadpoles mostly graze on aquatic plants (Bruening 2002). Bullfrogs and Columbia spotted frogs rarely co-occur, but these findings could be the result of competitive exclusion or predation, and it is suspected that bullfrogs likely have contributed to the decline of this species (USFWS 2011f). Additionally, bullfrogs are thought to be carriers of the pathogenic fungus *Batrachochytrium dendrobatidis* (chytrid), which causes the lethal disease chytridiomycosis. This is a fungal disease that has caused mass mortalities and population declines in North America and Europe, and as the cause of at least one, and possibly several, species extinctions (Daszak et al.

2004). Large numbers of bullfrogs were collected at Lake Lowell during amphibian monitoring in 2005 and 2006 (Burch and Koch 2006; Smithers 2006).

New Zealand mudsnail: This species was first found in the Snake River in 1987 and within two years became the dominant snail in the area (EPA 2011). The mudsnail flourishes in degraded water and reproduces quickly, impacting native invertebrate populations by competing for food and habitat. The mudsnail is detrimental to fish populations, vegetation, and other native biota (ODFW 2010). They are established in most large river systems, and educating the public on proper equipment decontamination after use in infested waterways will help prevent the spread into new habitats.

Common carp: This species has been present in the United States since 1877 and in Lake Lowell since at least the 1950s (Kozfkay 2011; USFWS 2010b). Unlike the Asian carps that have been introduced in Oregon and Idaho to control aquatic vegetation in lakes and ponds, common carp are naturally reproducing in most waterways of the northwest.

Common carp directly compete with other species for food (aquatic invertebrates and plankton), while their feeding behavior can cause significant changes in the composition of macrophyte, phytoplankton, and invertebrate communities, altering the food web and trophic structure of aquatic systems (USFWS 2010b). As carp root around in muddy substrates while feeding, they stir up the sediment and damage roots, causing otherwise clear waters to become muddy (Kozfkay 2011). Sediment and organic material suspended in the water column causes subsurface sunlight needed for plant growth to be reduced or eliminated, and photosynthetic plant production and oxygen levels decrease. This results in a decrease of aquatic vegetation and plankton that serve as food and habitat for migratory birds, aquatic invertebrates, and other fish species (Kozfkay 2011; USFWS 2010b).

Fishery managers realized the negative impact carp were having on other fish populations and the aquatic ecosystem of Lake Lowell and began trying to remove the carp, ultimately treating the lake with rotenone in the 1960s (Kozfkay 2011). Carp populations remained low enough for other game and panfish numbers to rebuild, until the 1990s, when a severe drought caused a decline in panfish numbers and an explosion in the carp population (Kozfkay 2011). After several years of poor fishing, IDFG studied ways to improve the lake's fishery, and by 2010 concluded that the carp population was so high that the only way to remove them was to treat the lake with rotenone (Kozfkay 2011). Due to the large size of Lake Lowell, treating with rotenone would be expensive and would kill all of the fish in the lake, not just the unwanted carp. To reduce the amount of rotenone needed and to increase the efficiency of the treatment, the lake would need to be drawn down to extremely low levels, either by extended drought or planned drawdowns (Kozfkay 2011). This could result in temporary negative impacts to birds and wildlife, recreational users, and irrigation districts. Rotenone has been historically used at the Malheur Refuge to control carp populations with varying success, because the treatments have failed to completely eradicate the entire carp population due to the complex network of waterways (USFWS 2010b). If successful at removing carp from Lake Lowell, the rotenone treatment would have a positive long-term benefit to birds and wildlife, game and panfish species, and recreational users of the lake. IDFG, Refuge personnel, and other groups are in the initial stages of determining whether a rotenone treatment is desirable or achievable (Kozfkay 2011). Refuge managers continue to work with Malheur Refuge personnel who are experienced in carp management to develop and implement a carp management strategy for Lake Lowell. Currently, carp are being removed through commercial fishing activities. The amount of carp being removed by these activities is not enough to create any appreciable decrease to the carp population. IDFG is working with other commercial fisherman to increase the number of carp being removed, but as of yet IDFG has not been able to begin a larger removal effort.

Oriental weatherfish: This species is common and widespread in the Snake River Basin. Large numbers of Oriental weatherfish were collected at Lake Lowell during amphibian monitoring in 2006 (Smithers 2006). This species competes with native species for food and habitat, has the potential to transmit disease to other organisms, and preys on native benthic invertebrates (ODFW 2011). Educating the public on proper identification and potential impacts to the ecosystem will help prevent the spread of these fish into new habitats.

Feral cats and dogs: Feral populations of domestic dogs and cats form when people either release their animals or they run away. Feral cats and dogs survive and breed in the wild without any support from humans and depend on native wildlife as their primary food source. Feral animals are not uncommon in rural or urbanized areas and are of conservation concern because of their effects on native prey (Crooks and Soule 1999). Exact numbers are unknown, but scientists estimate that, nationwide, cats kill millions of birds and over a billion small mammals, such as rabbits, squirrels, and chipmunks, each year (Coleman et al. 1997). Feral dogs have also been witnessed chasing large mammals (deer) and feeding on small mammals (Causey and Cude 1980). In addition to preying on wildlife, feral animal populations may also disturb wildlife that may be feeding or nesting nearby.

The occurrence of feral animals on the Refuge has not been studied and is not known at this time; however, it is anticipated that the numbers are high. Feral animals, such as cats and dogs, are regularly seen within the Refuge boundaries. Staff and visitors frequently pick up and/or call in stray dogs and cats that have been dumped on the Refuge by people who presumably cannot care for the animals any longer and assume that they will be cared for there. The Refuge's proximity to the urban interface makes it vulnerable not only to feral animals seeking resources but pets that are uncontrolled and allowed to wander freely. It is also a popular place for locals to exercise with dogs, and, even though there are regulations requiring visitors to keep pets on leash, the incidence of this rule being violated is very high. Dogs allowed to roam at large, even within an owner's voice command range, can kill or injure wildlife.

4.7 Wildlife and Habitat Research, Inventory, and Monitoring

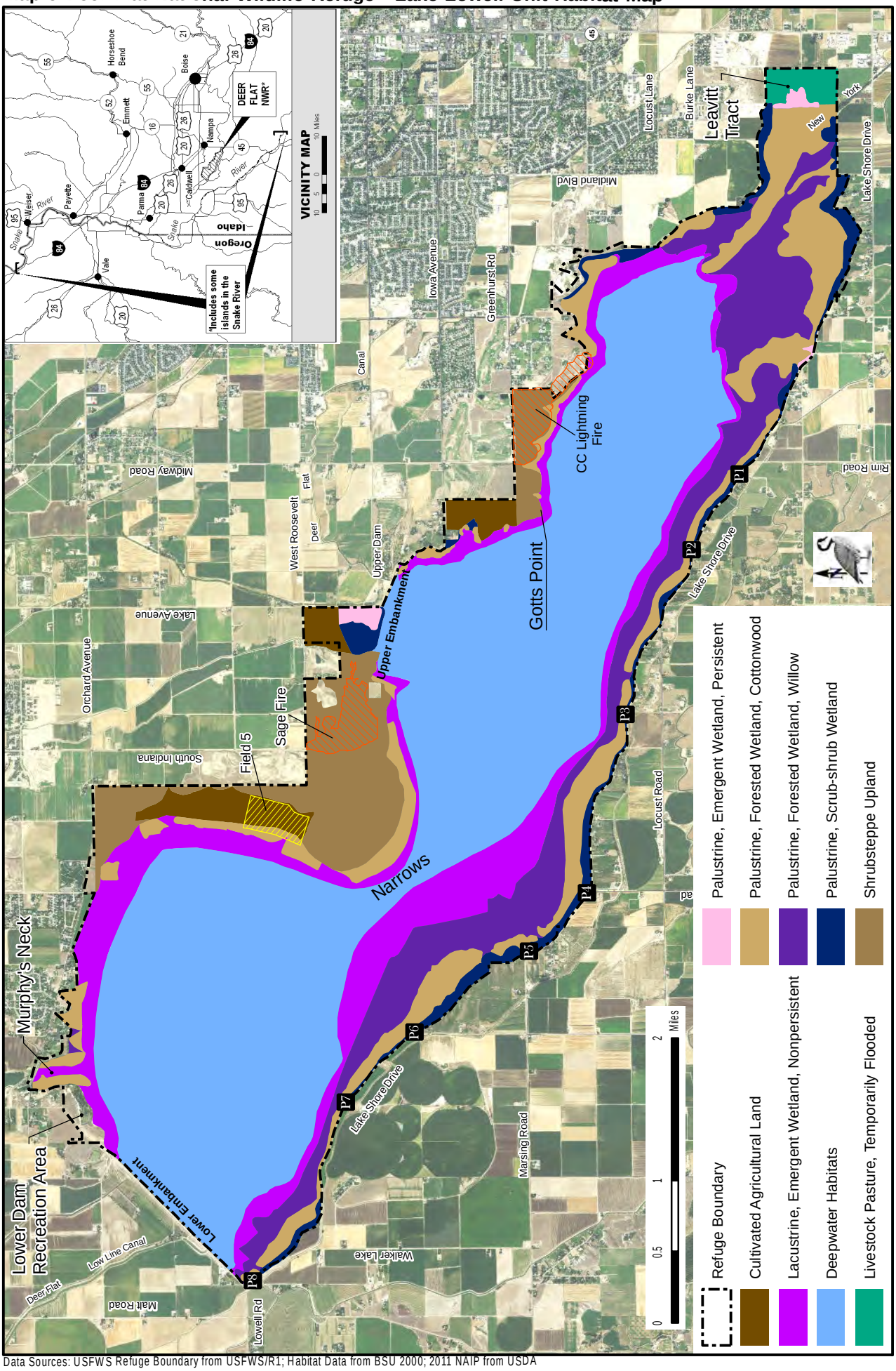
The Refuge lacked an on-staff biologist from 1996 through 2009. Thus, compared with other refuges, there has been little inventory and monitoring data collected. Data that do exist are focused on waterfowl. For wintering waterfowl, there are long-term data from the mid-winter waterfowl survey and weekly ground counts. Refuge staff and volunteers survey waterfowl populations throughout the year to monitor the health of the regional population and help IDFG set hunting limits. Each winter, waterfowl are surveyed weekly at Lake Lowell. Each spring, goose nests are surveyed on the Snake River islands. Each fall, migratory ducks are caught and banded.

A pilot grebe nesting survey was initiated in 2010 to capture the characteristics of nesting grebe population on the Lake Lowell Unit of Deer Flat NWR. The survey includes a pre-nesting inventory, a nesting survey, and a brood count.

In order to inventory the deer population on the Lake Lowell Unit, a deer spotlight survey has been implemented to capture population dynamics.

The Refuge conducted amphibian monitoring at Lake Lowell in 2005 and 2006 as part of the nationwide malformed amphibian survey project. The objective of the survey project was to learn more about declining amphibian populations and determine the prevalence of malformed amphibians in frog populations on national wildlife refuges.

Map 9 Deer Flat National Wildlife Refuge - Lake Lowell Unit Habitat Map



Data Sources: USFWS Refuge Boundary from USFWS/R1; Habitat Data from BSU 2000; 2011 NAIP from USDA
File: 12-005-6 Map Date: 05/14/2012

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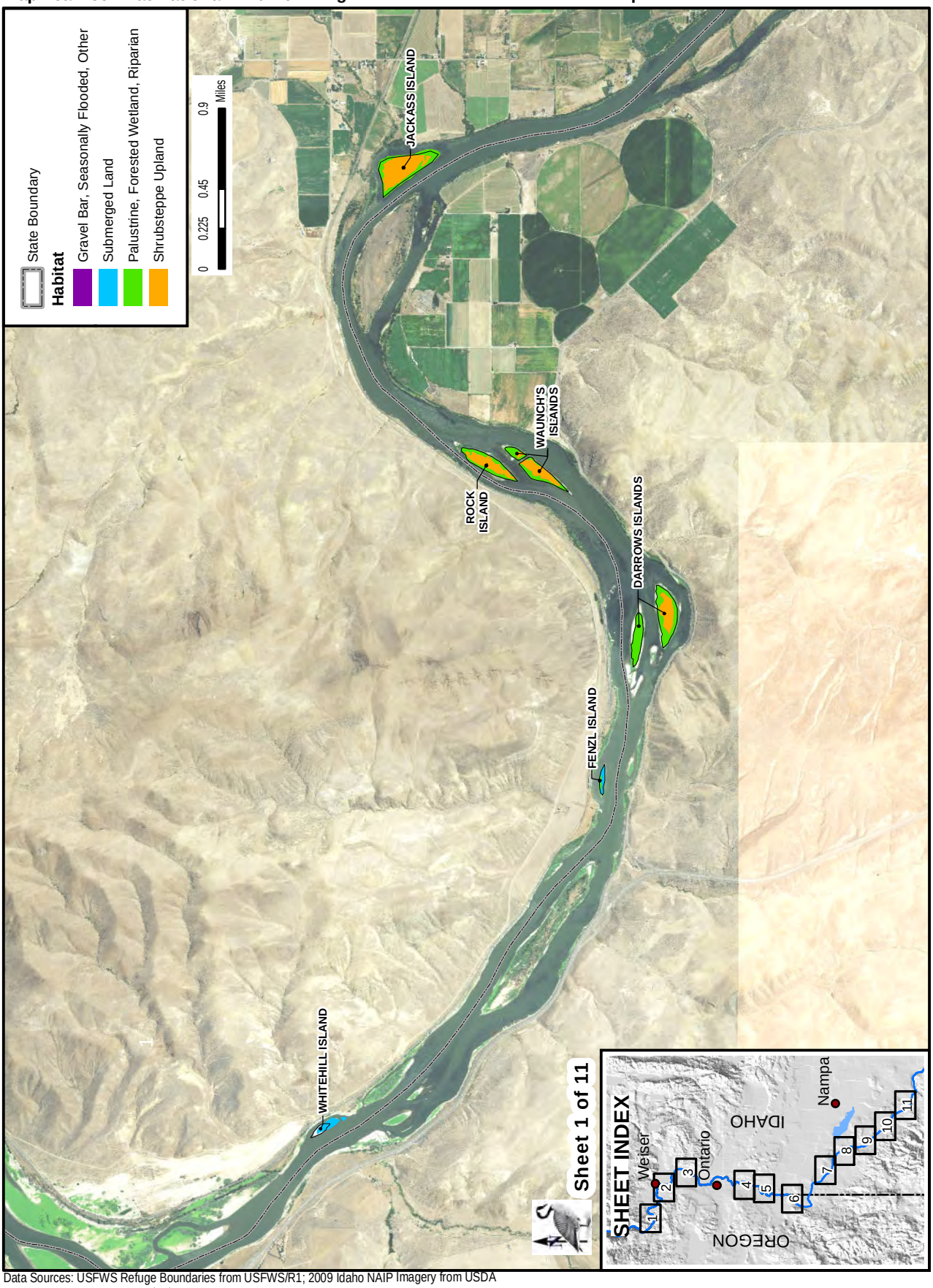
Map 10a Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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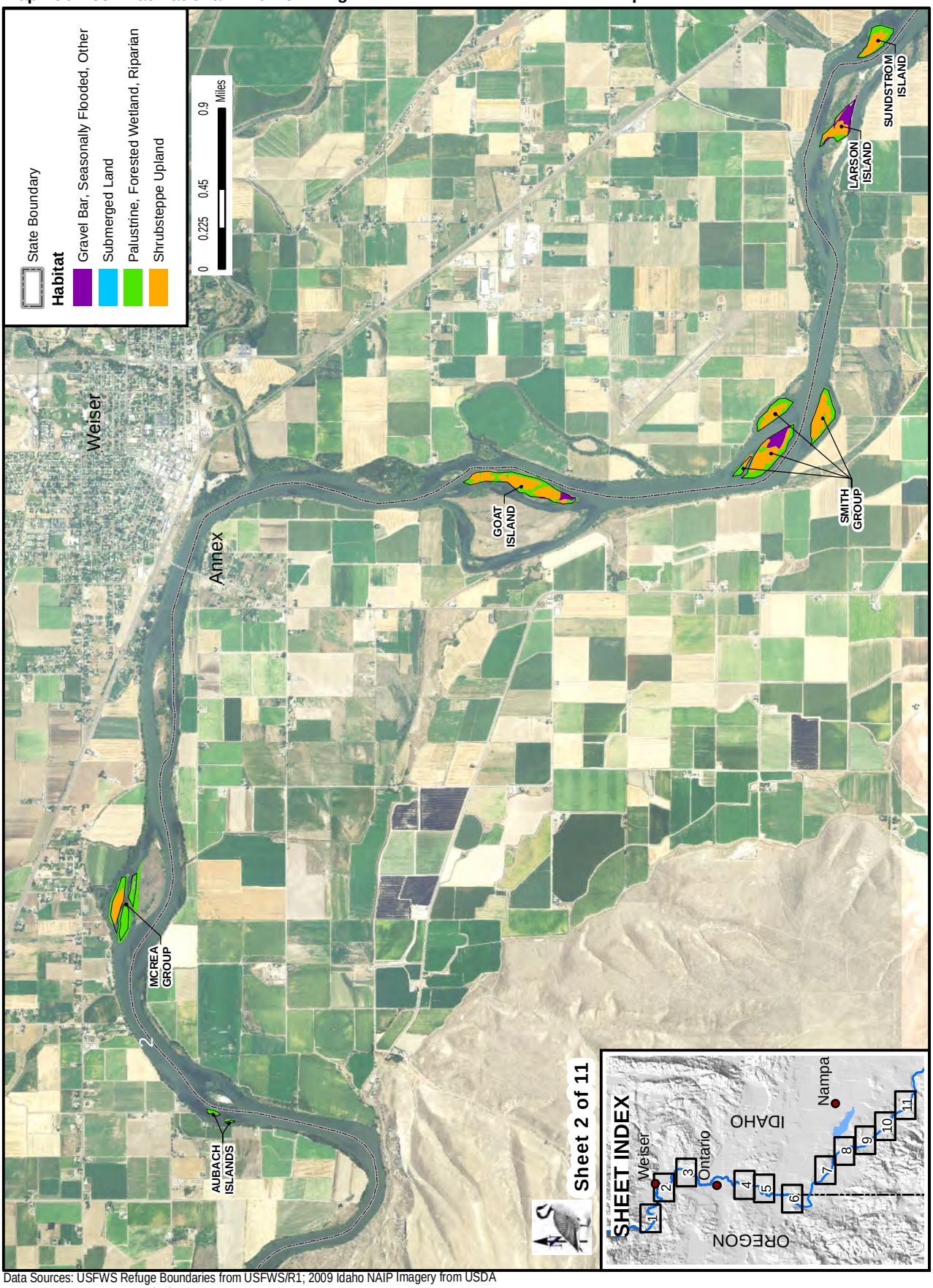
Map 10b Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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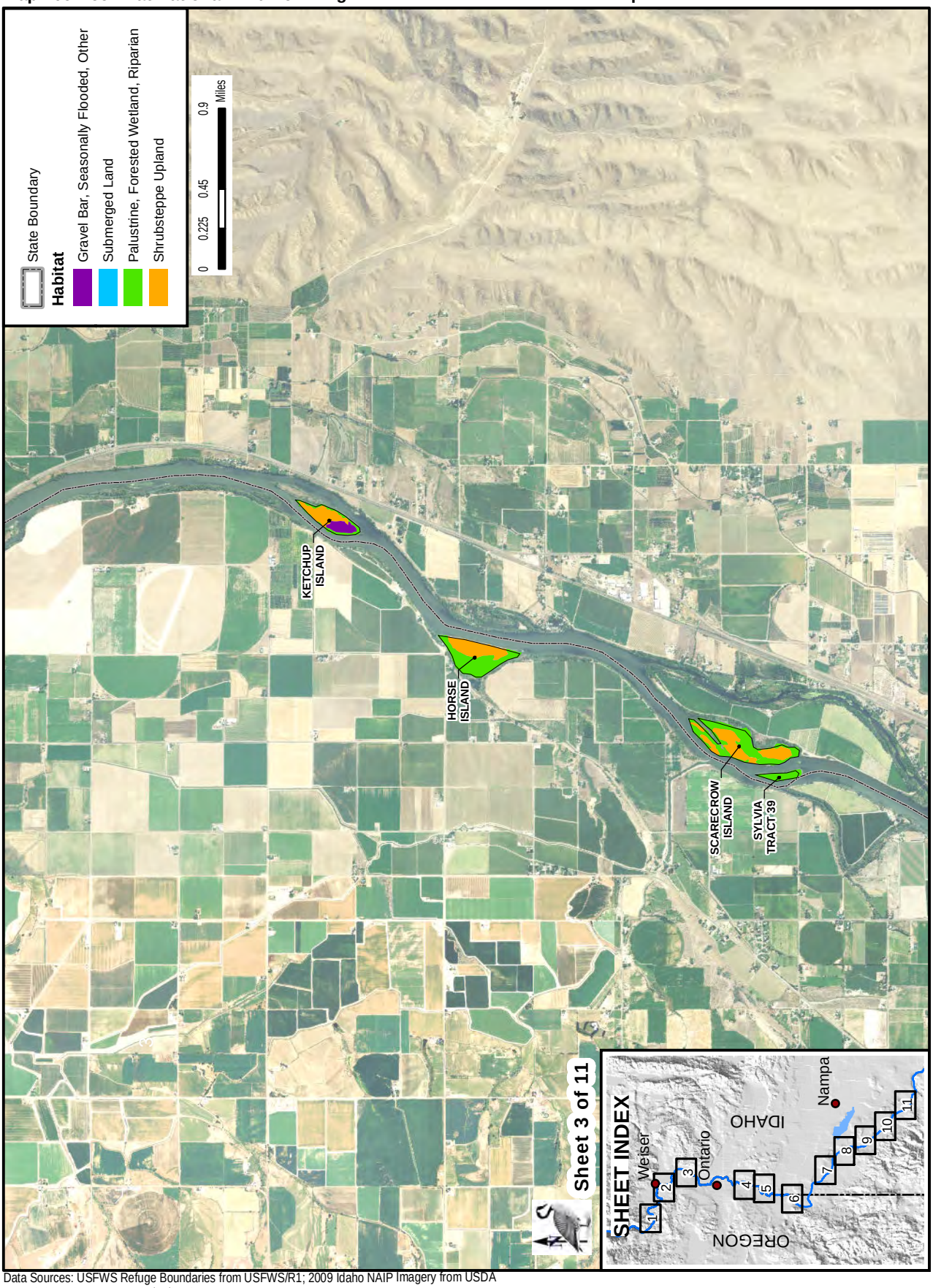
Map 10c Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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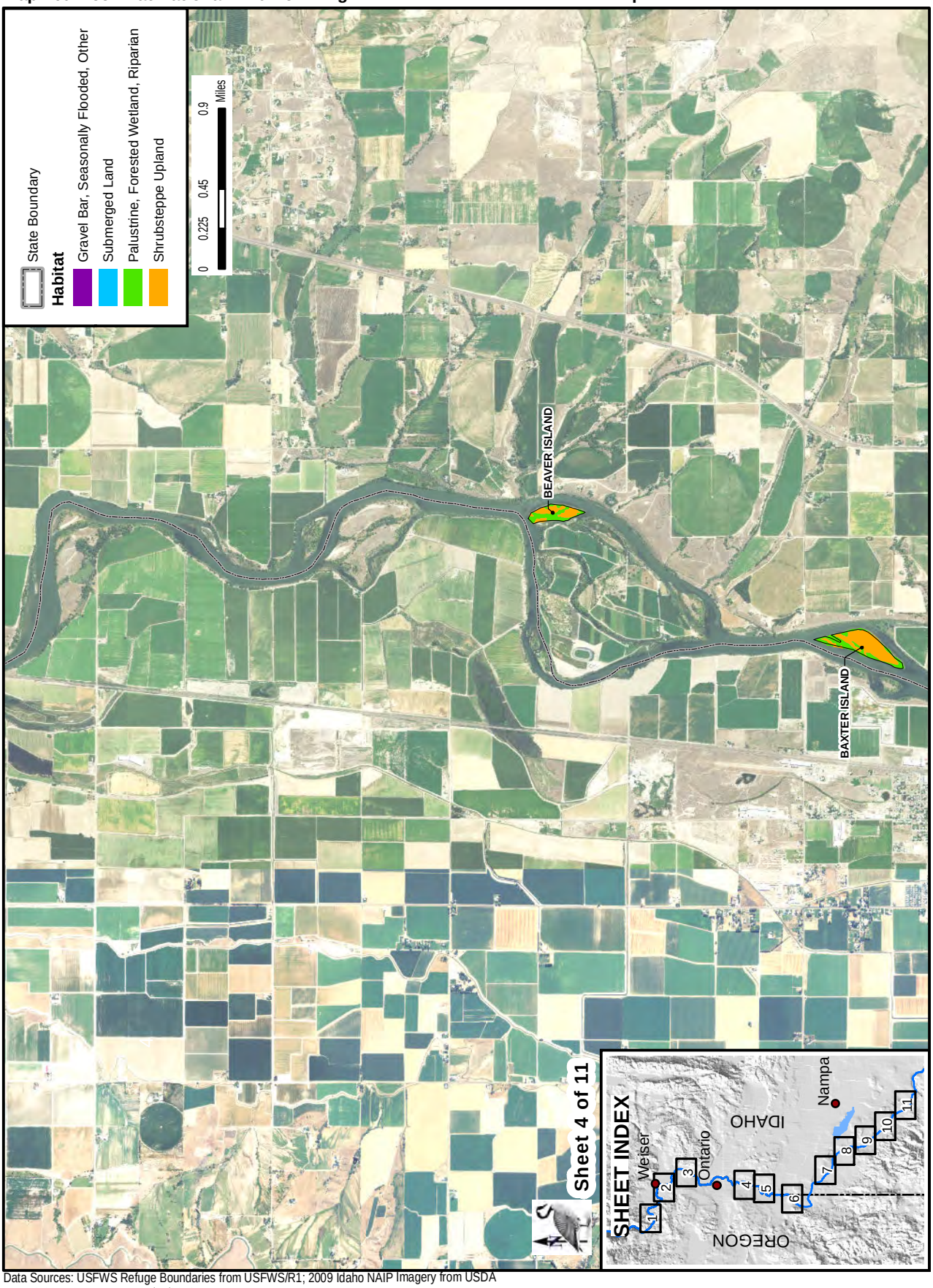
Map 10d Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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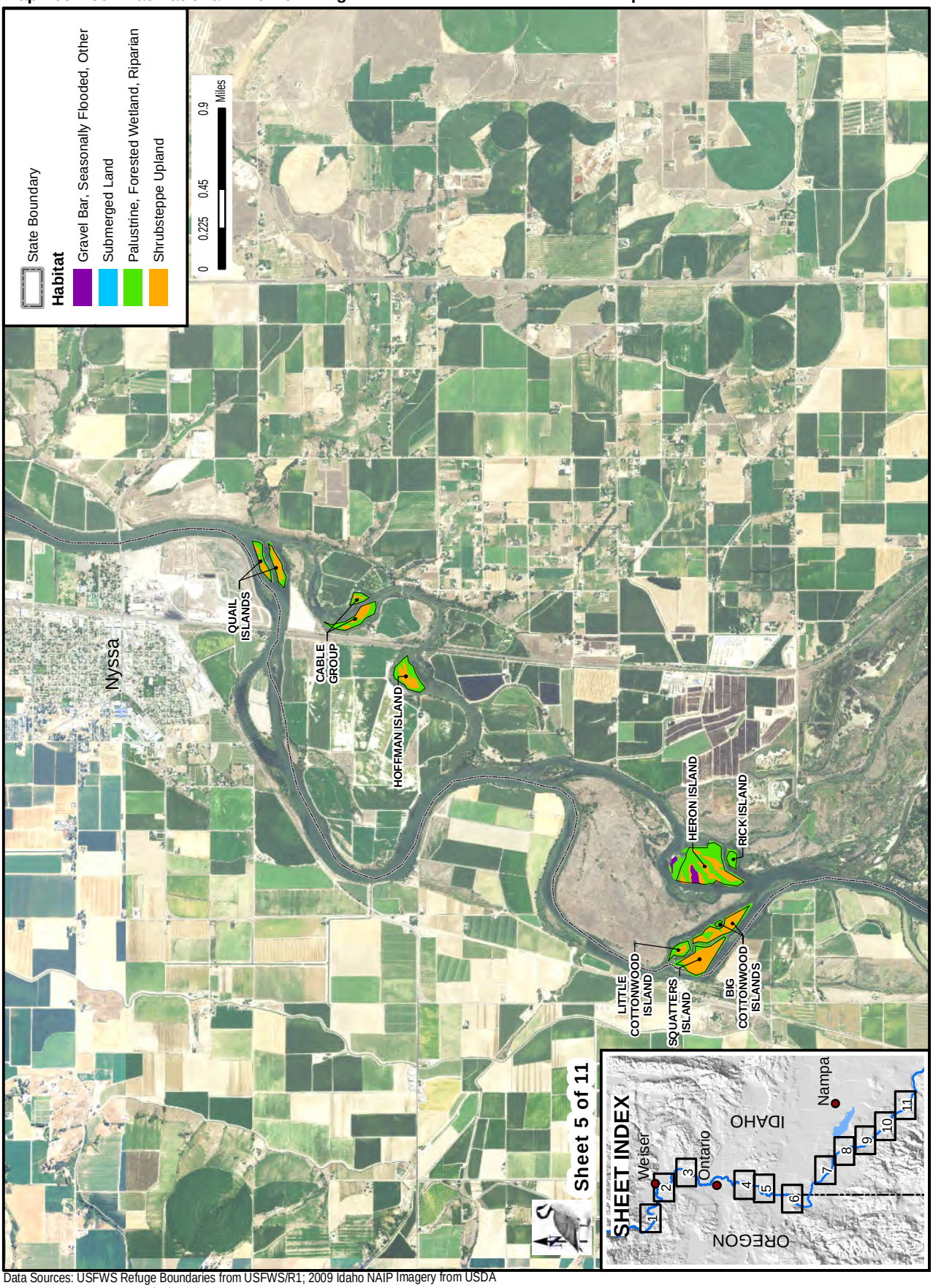
Map 10e Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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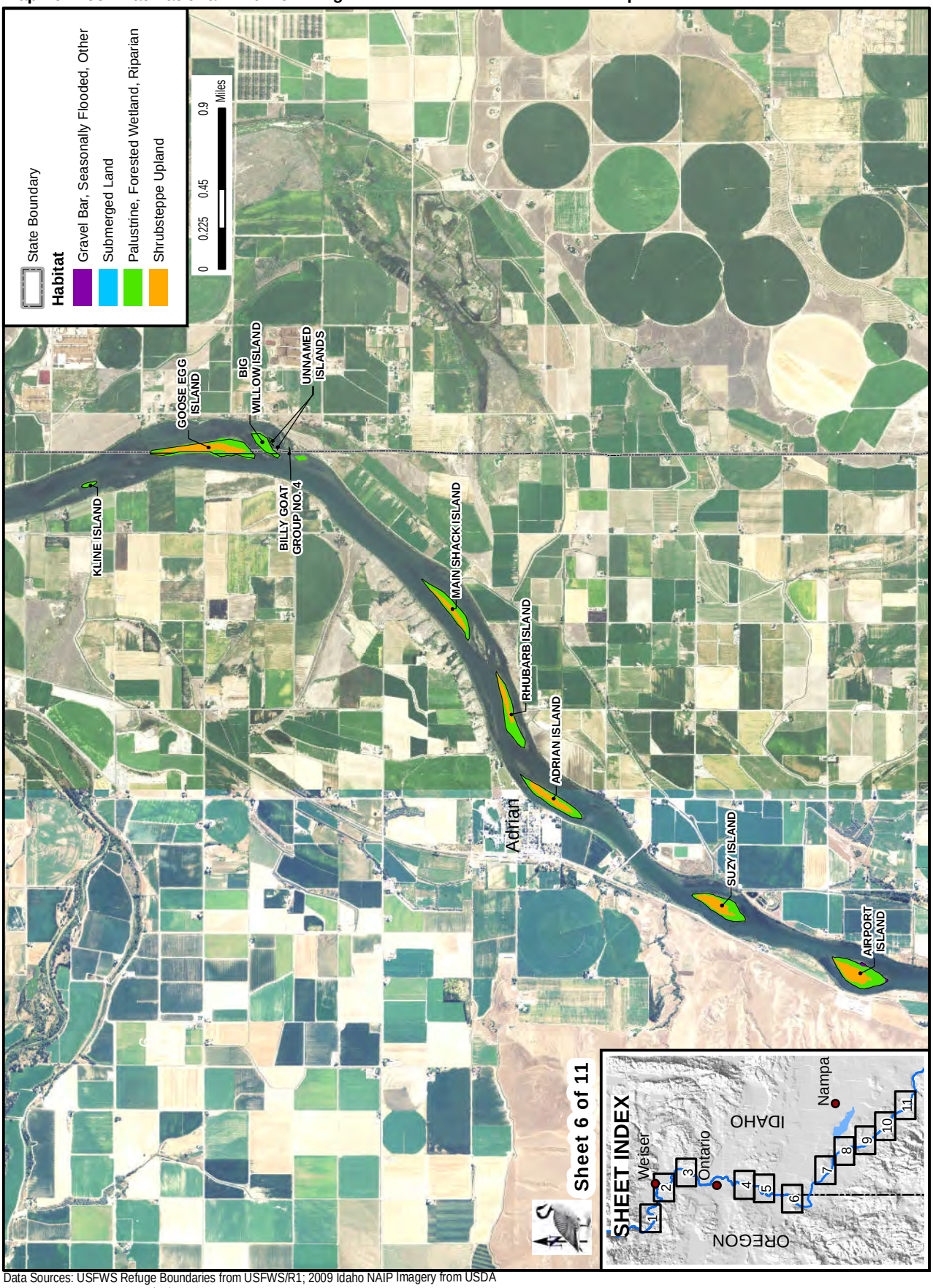
Map 10f Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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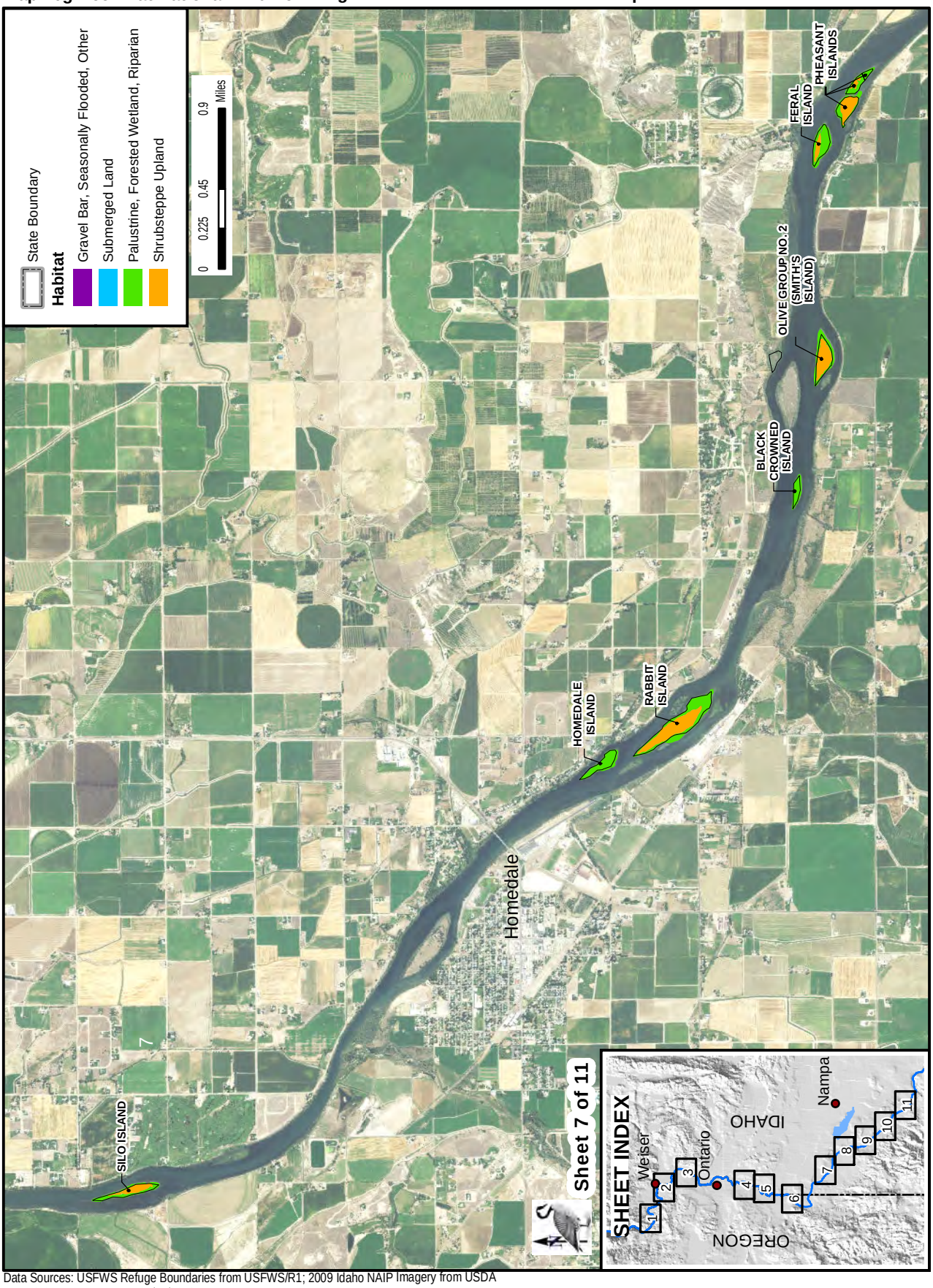
Map 10g Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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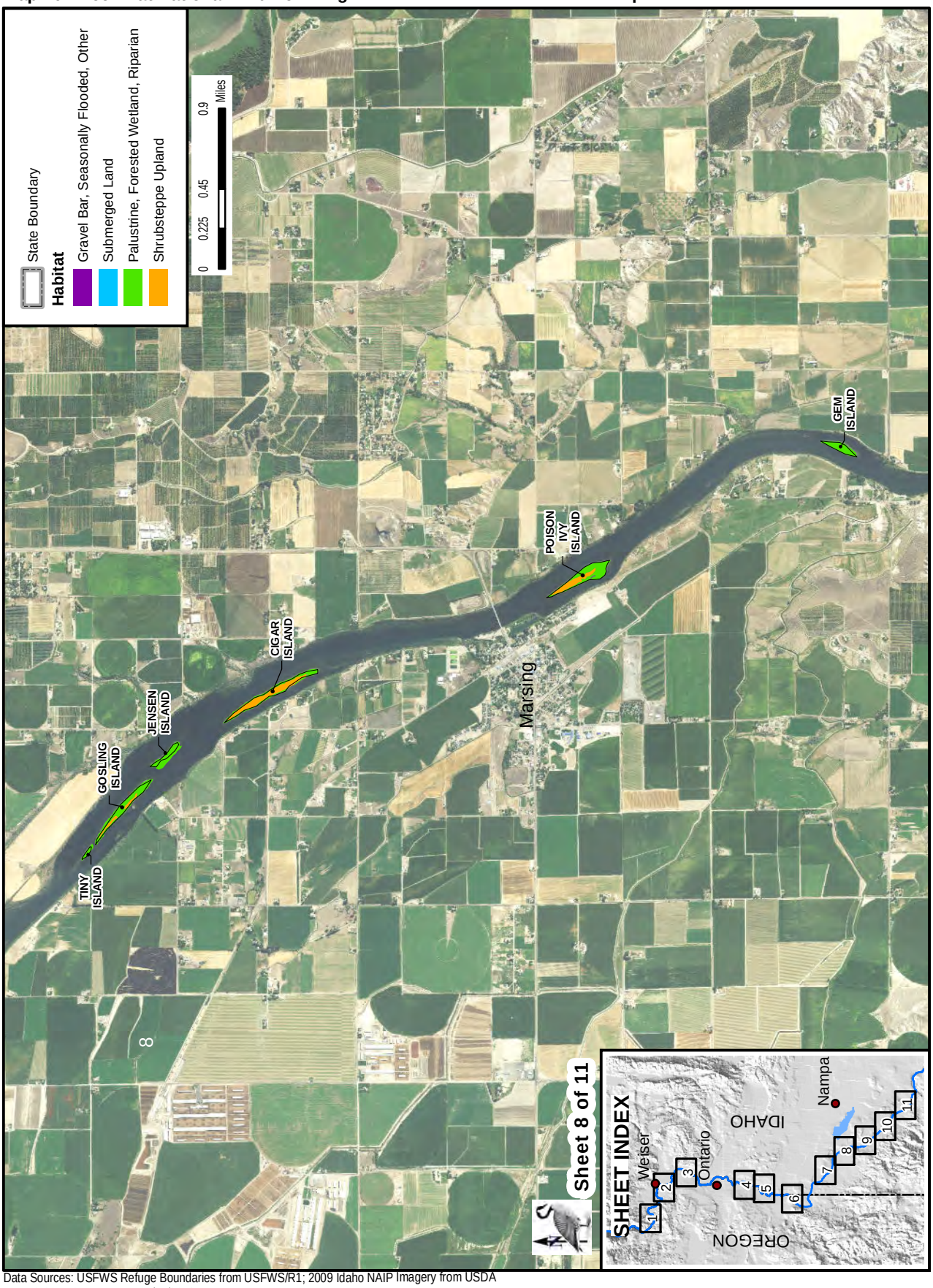
Map 10h Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
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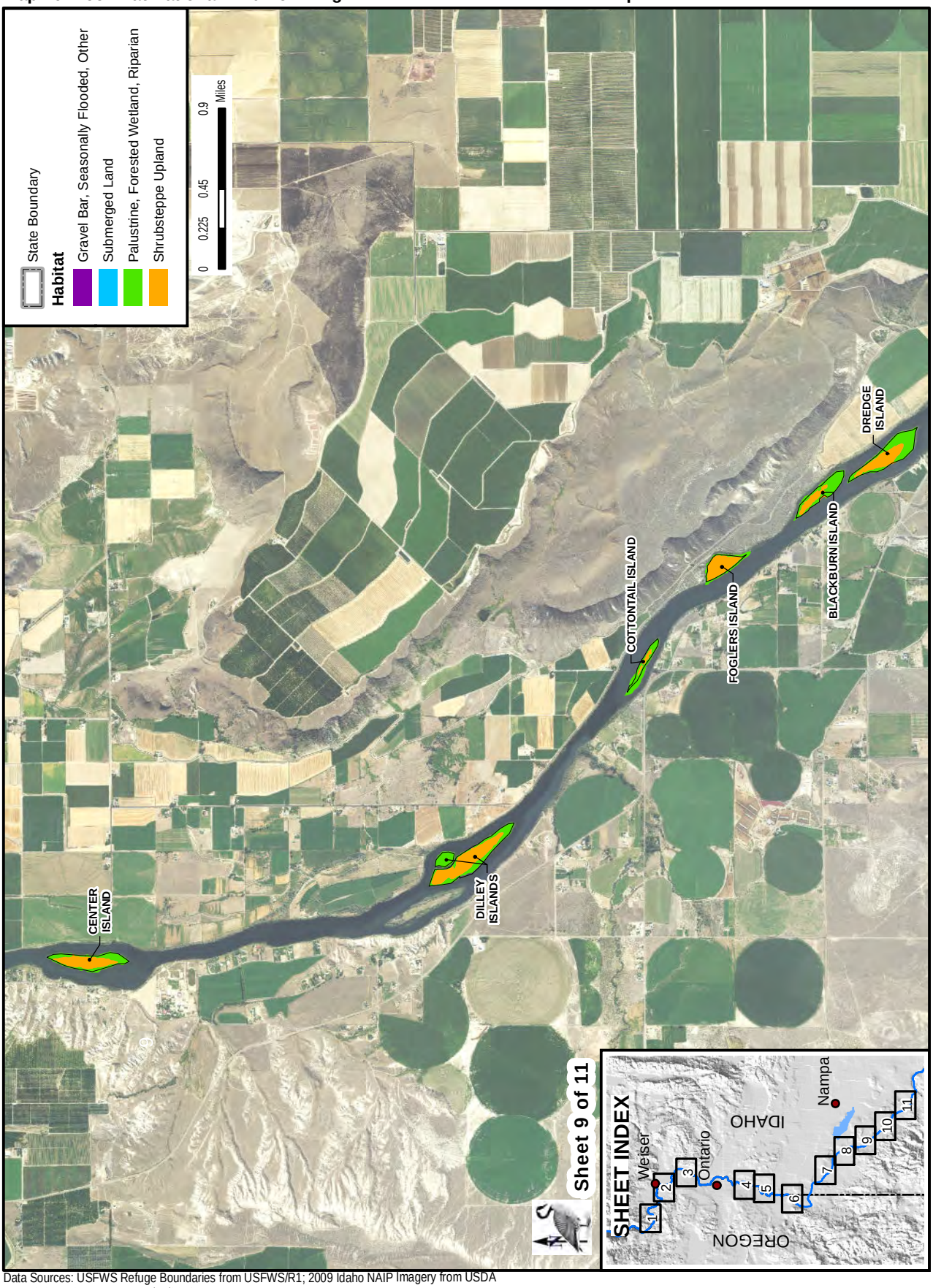
Map 10i Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
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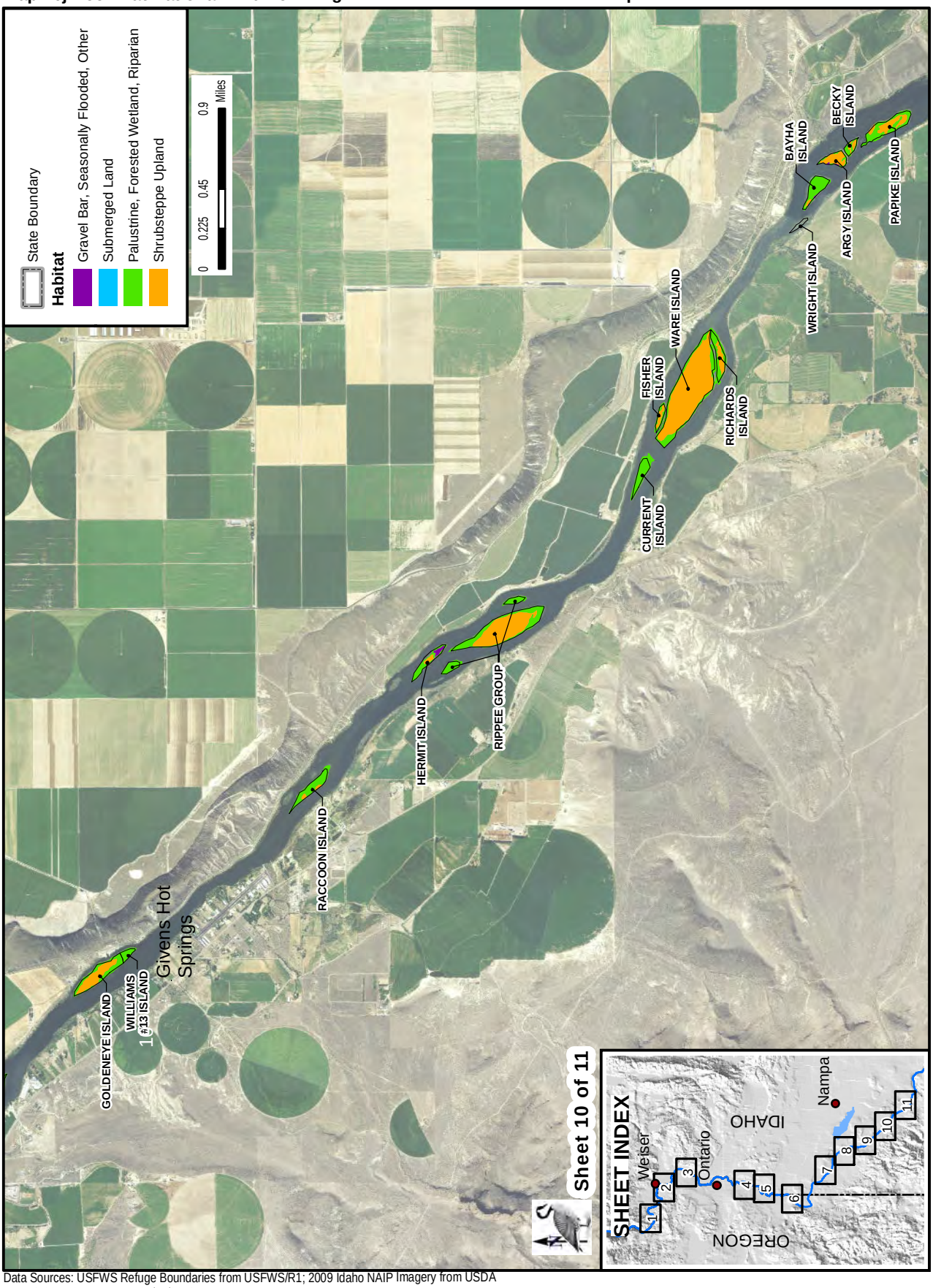
Map 10j Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
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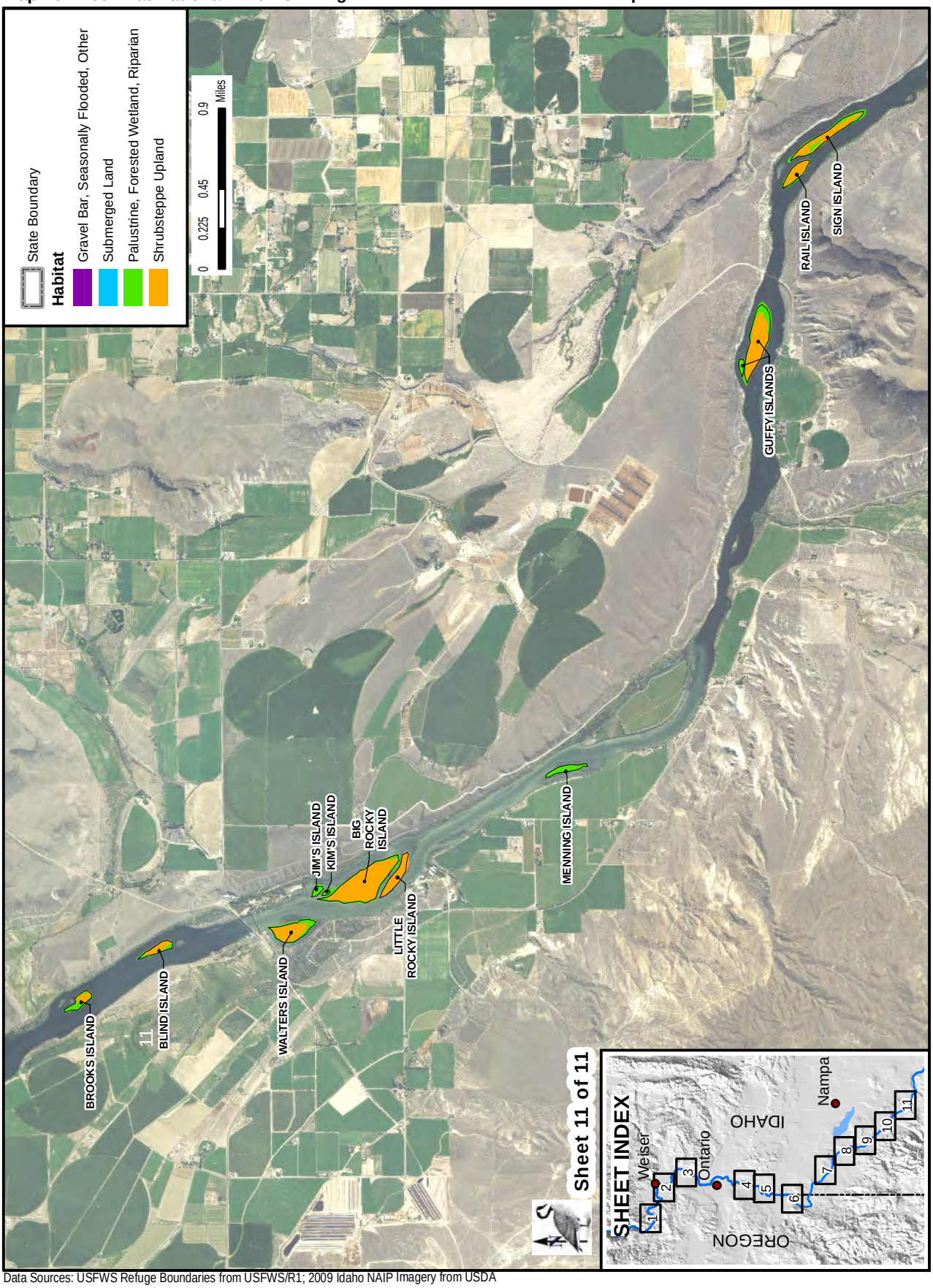
Map 10k Deer Flat National Wildlife Refuge - Snake River Islands Habitat Map



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-10 Map Date: 05/17/2012

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