

Appendix F.
Goals, Objectives, and Strategies
for Preferred Alternative

Ash Meadows National Wildlife Refuge

Species Management (Goal 1). Restore and maintain viable populations of all endemic, endangered and threatened species within the Refuge's Mojave Desert oasis ecosystem.

Objective 1.1: Within three years complete baseline population density, presence/absence, abundance and/or cover on all plants, listed endemic invertebrates and nonnative fish. Collect the same baseline data for non-listed endemic invertebrates within ten years.

Rationale: Obtaining baseline information on the distribution and abundance of Refuge plants and wildlife will inform management as well as monitoring and evaluation of restoration efforts.

Strategies

1.1.1	Conduct baseline inventories on vegetation communities, small mammals, and pollinators
1.1.2	Complete a four year baseline inventory and monitoring for endemic fish species and a three year baseline inventory and monitoring for the southwest willow flycatcher
1.1.3	Conduct a two-year refuge-wide reptile survey
1.1.4	Continue and improve inventory of native species diversity and distribution
1.1.5	Continue and improve inventory of non-native species diversity and distribution
1.1.6	Implement monitoring for all non-listed endemic and game species
1.1.7	Characterize faunal associations of plant communities
1.1.8	Characterize historic changes in species and habitat distribution
1.1.9	Work with USGS for determination of crayfish distribution and for monitoring recommendations
1.1.10	Utilize IPM techniques for long-term management of invasive species
1.1.11	Continue current monitoring strategies for special status plants and wildlife
1.1.12	Conduct baseline and periodic monitoring of endangered or threatened bird species
1.1.13	Conduct periodic monitoring of secretive marsh birds and sensitive species of waterfowl

Objective 1.2: Within seven years create, test and implement monitoring protocols for all listed endemic species and non-native species that are negatively impacting endemic species and within 15 years complete the same protocols for all non-listed endemic and game species.

Rationale: Monitoring the distribution and abundance of native and non-native species on the Refuge will allow analysis of trends in distribution and abundance over time. Analysis of trends in distribution and abundance of Refuge species will allow managers to gage the effects of restoration and management actions and to identify species that require additional or intensive management.

Strategies

- 1.2.1 Utilize independent science review to develop and apply rigorous statistical sampling techniques for all native endemic and non-native species
- 1.2.2 Work towards the use of key ecosystem health indicator species as a reasonable alternative to comprehensive ecosystem sampling and analysis

Objective 1.3: Within fifteen years restore endemic fish populations to 25-50% of historic range as described in the Recovery Plan for the Endangered and Threatened Species of Ash Meadows Nevada.

Rationale: From the 1990 Recovery Plan for the Endangered and Threatened Species of Ash Meadows Nevada, the pre-1950 estimated amount of occupied aquatic habitat was; Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*) (0.49 acres = net loss of 0.05 acres), Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) (599.90 acres = net loss of 592.81 acres), Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) (599.11 acres = net loss of 597.95 acres), Devil's Hole pupfish (*Cyprinodon diabolis*) (0.019 acres = no change) (USFWS 1990). Restoration of historic flows and aquatic habitat type should increase native fish populations and decrease non-native fish populations simultaneously (Scoppettone et al. 2005) since native fish species are best adapted to historic flows.

Negative impacts to endemic fish and naucorids have occurred from the introduction of crayfish and other human treatments (i.e.. habitat alteration: leveling land for crops, stripping riparian vegetation and well drilling for irrigation water [Pister 1974]). Restoration of natural flows (21.7cm/sec - 30cm/sec) should favor pupfish and speckled dace over non-native fish (i.e.. sailfin molly and mosquito fish, which prefer flows of <9.0 cm/sec) (Scoppettone et al. 2005).

Strategies

- 1.3.1 Develop and implement habitat restoration and translocation protocols for target species, including consideration of timing of habitat restoration and genetics
- 1.3.2 Consider and implement if practical, captive refugia for all sensitive species
- 1.3.3 Develop life history and habitat conservation models of target species
- 1.3.4 Monitor success of species post-restoration and correlate with habitat parameters (ex. flow, depth, temperature, etc.)
- 1.3.5 Update MOU with NDOW, USFWS Ecological Services, and NPS on management responsibilities under the Ash Meadows Recovery Plan
- 1.3.6 Complete and implement restoration plans for Upper Point of Rocks, Jackrabbit Spring, the Warm Springs Unit (North and South Indian Springs and School Springs), Lower Point of Rocks, Lower Kings Pool, North and South Scruggs, Big, and Fairbanks Springs
- 1.3.7 Develop a restoration plan for Crystal Spring Unit
- 1.3.8 Manage and monitor previously restored springs
- 1.3.9 Develop and implement restoration plans for Tubbs, Bradford, Crystal, Forest, and Marsh Springs
- 1.3.10 Based on outcome of Carson Slough Restoration Plan, develop and implement restorations plans for Longstreet and Rogers Springs

Objective 1.4: Within 10 years restore Ash Meadow's naucorid (*Ambrysus amargosus*) population to 200% of current population size by doubling the current range to a minimum of 20-40 square meters within the 10 acre watershed that they inhabit.

Rationale: Habitat alteration is the stated cause of Ash Meadows naucorid (*Ambrysus amargosus*) decline from historic levels (USFWS 1990). Currently the Ash Meadows naucorid population is limited to 10-20 square meters, within a 10 acre watershed, with numbers fluctuating from summer highs to winter lows (Goodchild 2006). It may be more practical to focus on acres restored to suitable habitat with Ash Meadows naucorids present instead of an absolute number or Ash Meadows naucorids, but staff should still monitor for the number of Ash Meadows naucorids present. While little is known about the Ash Meadows naucorid habitat needs, similar species feed on aquatic insect larvae as they swim over and through substrate (USFWS 1990). Approximately 10 acres at Point of Rocks Spring are designated critical habitat for this species (USFWS 1990). It will take approximately 10 years to restore Point of Rocks habitat and other springs with tolerable temperature to suitable habitat that can support at least some naucorids.

Strategies

1.4.1 Restore Point of Rocks spring outflow channel habitat to known suitability and monitor parameters (ex. temperature, flow, depth, etc.) to inform adaptive management

Objective 1.5: Maintain or expand current endemic plant population densities and distribution by identifying suitable habitat for range expansion within 10 years and within 15 years begin appropriate out planting.

Rationale: Of the endemic plants found on the Refuge, one plant species is listed as endangered and six are listed as threatened under the Federal Endangered Species Act. The Amargosa niterwort (*Nitrophila mohavensis*) is listed as endangered. The six threatened plant species found on the Refuge are Ash Meadows milk-vetch (*Astragalus phoenix*), Spring-loving centaury (*Centaureum namophilum*), Ash Meadows sunray (*Enceliopsis nudicaulis* var. *corrugata*), Ash Meadows gumplant (*Grindelia fraxino-pratensis*), Ash Meadows ivesia (*Ivesia kingii* var. *eremica*) and Ash Meadows blazing-star (*Mentzelia leucophylla*). Much of the Refuge's plant habitat has been degraded due to agricultural grading, off road vehicles and trampling by wild horses (USFWS 1990). Limited understanding of plant species life history and uncertainty about the suitability of degraded sites for restoration makes test plots an efficient method for site assessment. Tasks 224 and 225 in the Ash Meadows Species Recovery Plan (USFWS 1990) recommend actions consistent with this objective.

Strategies

1.5.1 Control non-native invasive plants, prioritizing areas with listed plant species and monitor the response of listed plant species with low-impact methods

1.5.2 Perform experimental planting and monitoring on test sites, representative of Refuge habitat

1.5.3 In addition to monitoring plant health, monitor environmental parameters that may be associated with establishment success (ex. % soil moisture, soil bulk density, texture, salt content, etc.)

1.5.4 Based on range of suitable restoration sites, nursery grow endemic species for out planting

1.5.5 Out plant endemic species to habitats with similar parameters to successful test plot sites

1.5.6 Look for sites where listed plants (ex. Niterwort) could occur and try to determine why they are not present

1.5.7 Complete a feasibility study for construction of an on-site greenhouse to supply plants for restoration on the Refuge

Objective 1.6: Within five years establish refugium population of Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) and complete a feasibility assessment of refugia for other endemic species based on population trends and threats.

Rationale: All four endemic Refuge fish species are currently listed as endangered. Devil's Hole pupfish (*Cyprinodon diabolis*) live in a unique habitat, restricted to a limestone cave situated on the east central border of Ash Meadows (USFWS 1990). Refugium for Devil's Hole pupfish and Warm Springs pupfish will be constructed under the No Action Alternative. The necessary refugia requirements for Devil's Hole pupfish would not be suitable for other species that may require refugia. Ash meadows speckled dace (*Rhinichthys osculus nevadensis*) and Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) historically shared the same habitat (USFWS 1990), but within different thermal niches (Goodchild 2006). The Ash Meadows speckled dace, which inhabit cooler water than Ash Meadows Amargosa pupfish, have not recovered as well after Refuge establishment and should be prioritized for refugia space. Additional research is required to determine if a single refugia could suit all or multiple other endemic species simultaneously.

Strategies

- 1.6.1 Maintain and monitor the one established pupfish refugium
- 1.6.2 Conduct quarterly fish counts and periodic water quality measurements
- 1.6.3 Within five years of CCP approval assess the feasibility and necessity of a refugium for the Ash Meadows speckled dace and implement if funding is available
- 1.6.4 Within five years, complete a feasibility assessment of on-site and off-site refugia for all other Ash Meadows NWR endemic species
- 1.6.5 Investigate feasibility and funding for captive populations of all sensitive species (ex. naucorids, aquatic snails, plants, etc.)
- 1.6.6 Investigate the use of private aquaria as refugia

Objective 1.7: Within two years complete evaluation of the Recovery Plan for the Endangered and Threatened Species of Ash Meadows Nevada progress and create contingency strategies for Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) and Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*) protection.

Rationale: Tasks 253, 2531 and 2532, of the Recovery Plan for Ash Meadows species, recommend actions to monitor and assess factors controlling population size of Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*), Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) and Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) (USFWS 1990). While species monitoring has been ongoing, in the sixteen years since approval of the Recovery Plan for Ash Meadows species (USFWS 1990) no comprehensive evaluation of plan progress has been completed. Evaluating Recovery Plan progress and species status is essential to focus future recovery activities where they are most needed. Establishing a formal process to review and approve scientific protocols will allow valuable input from interdisciplinary scientists yet allow research and monitoring to proceed when uncertainty exists. Developing contingency strategies for endangered fish species, under advisement of the Recovery Team, can hedge against unforeseen events that could imperil a single, isolated population.

Data from past and current refugia such as: refugia at Hoover Dam; Ash Meadows pupfish station; and Point of Rocks Spring should provide valuable information on the habitat requirements of particular species. Preliminary review of information indicates that School Springs could be a favorable site for a multiple aquatic species refugia.

Strategies

1.7.1	Work with Recovery Team to assess progress on Recovery Plan
1.7.2	Work with Recovery Team to develop a contingency plan for Ash Meadows speckled dace and Warm Springs pupfish protection
1.7.3	Establish scientific review process and protocols
1.7.4	Same as 1.3.5

Habitat (Goal 2). Restore and maintain the ecological integrity of natural communities within the Ash Meadows National Wildlife Refuge.

Objective 2.1: Improve Refuge wide vegetation map through ground surveys and updating of GIS layers and initiate long-term, annual vegetation monitoring.

Rationale: Vegetation mapping is essential to plan for desired future conditions, to monitor vegetation recovery after restoration, for adaptive management and to plan for and monitor success of invasive species eradication.

Strategies

2.1.1	Obtain normal color aerial photography on a decadal scale or more frequently if necessary
2.1.2	Supplement and improve on 2006 Geomorphic and Biological Assessment
2.1.3	Improve Refuge-wide vegetation map through ground surveys and updating of GIS layers and initiate long-term, annual vegetation monitoring by establishing permanent, long-term vegetation monitoring plots/transsects
2.1.4	Obtain funding for and hire: 1 IPM Coordinator/Botanist, biological technician and 1 GIS specialist (part-time)
2.1.5	Obtain 1-2 foot contour data for Refuge to aid in restoration and planning activities

Objective 2.2: Maintain natural average and range of variability in spring discharge (annual discharge of 17,000 acre/feet per year from 30 known springs), flood frequency, water quality, historic spring temperature range between springs of 18-34 °C (64-93 °F), and water table elevation on Refuge.

Rationale: Ash Meadows endemic fish species have evolved and adapted to the historic natural conditions for flow, flooding and water elevation. Endemic aquatic community health is likely dependent on habitat characteristics including discharge, flood frequency and groundwater elevation. Studies have shown that restoration of natural channel configuration, temperature and flow favors native Ash Meadows endemic fishes and may reduce non-native fish populations (Scoppettone et al. 2005). Temperatures were probably historically very stable within particular springs, but variable between springs. According to the AMNWR Water Monitoring Plan, the discharge from approximately 30 springs is 17,000 acre-feet annually of which the Service has water rights for 16,360

acre-feet. Water temperatures vary between springs from 64 to 93° F (e.g., Cold Spring = 65° F, Bradford = 68-70° F, Tubbs = 70° F, North Scruggs = 93° F; all of the Warm Springs Complex is above 90° F) (Baldino 2006). Importantly, Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) require relatively warmer temperatures for reproduction, and Ash Meadows Speckled dace (*Rhinichthys osculus nevadensis*) require relatively cooler temperatures. According to Scopettone et al. (2005) Ash Meadows Speckled dace reproduce in temperatures ranging from 17.5 to 24° C (64 to 75° F). On the Refuge, Bradford Springs with a temperature of 69° F currently holds the largest population of Ash Meadows Speckled dace. The Ash Meadows Amargosa pupfish population has been found in relatively warmer springs ranging in temperature from 21.2-33.1 °C (70-92 °F) (Brown and Feldmeth 1971). Obtaining baseline information on habitat parameters and monitoring for changes should, over time, clarify the relationship between variable parameters and aquatic community health. In addition, alteration of natural conditions can favor non-native species and disrupt habitat features essential for survival and reproduction of endemic species. Tasks 114, 211, 212 and 213 of the Ash Meadows Species Recovery Plan recommend actions to restore historic spring conditions (USFWS 1990).

Strategies

2.2.1	Convene hydrologists to analyze existing spring discharge and groundwater elevation data
2.2.2	Maintain appropriate water temperature through techniques including restoration of historic stream channels, alternation of channel depth/width, increasing channel length, and re-establishing historic overstory plant communities
2.2.3	Protect spring discharge and groundwater elevation in both valley-fill and carbonate by working with partners to monitor spring discharge rates and other techniques similar to strategy 2.2.2
2.2.4	Within 10 years obtain baseline data on spring discharge, flood frequency, and groundwater elevation for seventeen springs identified in the Refuge Geomorphic and Biological Assessment
2.2.5	Evaluate nutrient input to streams from roads
2.2.6	Work with local land owners to develop more efficient water transport systems to manage water flow
2.2.7	Continue to monitor and assess water flows, levels, and temperatures at springs and wells identified in the current Water Monitoring Plan
2.2.8	Analyze water quality and quantity biannually, and implement measures in coordination with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
2.2.9	Maintain the existing spring outflow structures and stream channels at monitoring sites
2.2.10	Pursue funding for and implement the Ash Meadows embedded model within the Death Valley Regional Flow Model

Objective 2.3: Manage and monitor previously restored springs (Point of Rocks and Kings spring) and continue restoration of at least 17,400 linear feet of four spring systems and outflow channels (Jackrabbit Spring, Warm Springs, Fairbanks Spring and Big Spring and others if possible) to a series of riffles and runs, with open channels free of emergent vegetation and surrounding riparian plant communities with approximately 75% deciduous multiple story channel canopy cover including: 50% native tree cover of mesquite (*Prosopis spp.*) and leather-leaf ash (*Fraxinus velutina*); 75% shrub

cover of willow (*Salix spp.*), Emory baccharis (*Baccharis emoryi*) and associated species; and 20% bare soil or alkali sacaton (*Sporobolus airoides*).

Rationale: Ash Meadows aquatic and terrestrial habitat was altered from historic conditions as development occurred in the late 1960s and 1970s. At least through 1972 significant habitat destruction was ongoing in Ash Meadows including; leveling land with heavy equipment, stripping streams of riparian vegetation, installing irrigation structures and well drilling (Pister 1974). The major impact was occurring from a lowering of the water table and decreased spring flows (Pister 1974). The Recovery Plan for Ash Meadows Species states that the greatest threats to endemic species are non-native introduced aquatic animals and exotic terrestrial plants. The Recovery Plan also emphasizes the importance of protecting spring outflows and restoring historic channels to enable free movement of listed fish between springs (USFWS 1990).

To allow native species to thrive it is necessary to restore habitats to approximate conditions that existed prior to significant human disturbance. A critical part of any restoration effort is the maintenance of water table levels similar to historic levels. Restoration of hydrologic conditions will increase the residence time of waters throughout the Refuge (Otis Bay 2006). Increasing this residence time should improve access to water resources by resident plant and animal communities as well as migratory birds.

The Refuge is recognized as an Important Bird Area (IBA) by Bird Life International, highlighting its importance to restricted range, migratory bird species and the use of habitat by Federal endangered species. The yellow-breasted chat (*Icteria virens*), a Nevada Partners in Flight focal species that is confined to the use of riparian and shrubby areas in the arid southwest and would benefit from riparian restoration. Habitat associated with spring outflows is also important for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), which would also benefit from riparian restoration.

Tasks 21 and 211 of the Ash Meadows Species Recovery Plan recommend actions to restore spring flows to historic channels (USFWS 1990). There are: 1,200 ft. of Fairbanks spring channel: Jackrabbit spring to the service road is 6,625 ft of channel; there are 2,346 feet of channel at Warm springs (North and South Indian springs and the associated marsh); and 7,300 feet of channel at Big Spring.

In 1997 Kings Pool water was routed into an excavated channel simulating the historic outflow stream. After the conversion of Kings Pool outflow to approximate historic conditions there was a shift in species composition from 23% to 91% native fish (Scoppettone et al. 2005), suggesting that restoration of habitat may be an effective recovery strategy for endangered fish on other parts of the Refuge. Removal of Ash Meadows Road is recommended to restore the historic outflow channels of Point of Rocks, Kings and Forest Springs and to reconnect ash and mesquite forest patches (Otis Bay 2006).

Strategies

- 2.3.1 Conduct an assessment of berms, ditches, dams, impoundments, and reservoir basins
- 2.3.2 After assessment initiate removal of berms, ditches, dams, impoundments, and unnecessary roads within the Warm Springs, Jackrabbit/Big Springs, Upper Carson Slough, and Crystal Springs units to restore natural hydrology on a landscape scale
- 2.3.3 Minimize and control impacts of cattail on aquatic habitat as detailed in the Refuge IPM plan (USFWS 2006), including removal from outflow channels at Kings, Point of Rocks, and Crystal springs

- 2.3.4 Restore natural average and range of variability, flood frequency, water quality and water table elevation for open water at Peterson Reservoir and Horseshoe Reservoir
- 2.3.5 Restore Crystal Spring outflow to historic channel, through the administrative area, when the office/visitor center is relocated
- 2.3.6 Incorporate the hydrologic and geomorphic restoration recommendations from the Geomorphic and Biological Assessment (Otis Bay 2006) into restoration and management activities
- 2.3.7 Identify and develop partnerships with providers of restoration nursery stock
- 2.3.8 Design control structure to allow water management and invasive species management as needed for restored springs
- 2.3.9 Evaluate nutrient input to streams from roads
- 2.3.10 Implement the plan for the modification or removal of Crystal Reservoir that minimizes adverse environmental impacts
- 2.3.11 Same as 1.5.7
- 2.3.12 Install temporary fish barriers until bass eradication is complete at Big and Jackrabbit springs
- 2.3.13 Inventory, assess, and mitigate landscape disturbances including graded lands, mines, fences and other disturbances

Objective 2.4: Within 10 years, reduce salt cedar (*Tamarix spp.*) and Russian knapweed (*Acroptilon repens*) distribution by 50 to 95% of the 2006, baseline distribution on 4,000 acres of Refuge land and work with the Bureau of Land Management (BLM) to control Russian knapweed and salt cedar on the adjacent BLM Area of Critical Environmental Concern.

Rationale: While many non-native species may impact native species and ecosystem function, salt cedar (*Tamarix spp.*) and Russian knapweed (*Acroptilon repens*) have been identified, by Refuge staff, as the most invasive, noxious weeds on the Refuge. Salt cedar is a Category C (currently established and widespread) noxious weed in Nevada and Russian knapweed is a Category B (established in scattered populations in State) noxious weed in Nevada (NDOA 2006). Both species degrade Refuge habitat and controlling Russian knapweed is a necessary partnership with Nevada resource agencies, to prevent its further spread. The Refuge has received funding, from the Southern Nevada Public Land Management Act, to implement an integrated pest management (IPM) plan to control salt cedar, knapweed and other invasive plant species on the Refuge. Currently the NDOW recommends that goats not be used for invasive plant control, due to possible transmission of diseases carried by goats and domestic sheep to wild, big horn sheep (*Ovis canadensis nelsoni*) populations. The relative risks and benefits of various invasive species control methods have been analyzed in the course of finalizing the Refuge IPM Plan.

Strategies

- 2.4.1 Implement non-native plant species control as outlined in the IPM plan for all habitat types
- 2.4.2 Within ten years, reduce salt cedar and Russian knapweed distribution by 75 to 95% of the 2006 distribution on 4,000 acres of Refuge land and work with BLM to control salt cedar and Russian knapweed on adjacent BLM land
- 2.4.3 Same as 1.5.1
- 2.4.4 Coordinate with the Service's Private Lands Program to assist private landowners with the removal of salt cedar and planting native species within the Refuge boundary

Objective 2.5: Reduce or contain crayfish populations, Refuge wide, such that current distributions are not exceeded.

Rationale: Crayfish directly prey on native endemic species, such as fish, invertebrates and aquatic vegetation, directly impacting those species. Crayfish may also indirectly impact native invertebrate species through competition. Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*), which typically occur near the bottom of spring systems are thought to be particularly vulnerable to predation by crayfish (Williams and Sada 1985). Crayfish have also been observed feeding on Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) (Williams and Sada 1985). Removal of crayfish is necessary to sustain healthy populations of native endemic species. Task 2322 of the Ash Meadows Species Recovery Plan recommends actions consistent with this objective (USFWS 1990). On the Refuge crayfish are known to occur in all aquatic systems except for a few Warm Springs areas and a few seeps (Goodchild 2006).

Strategies

- | | |
|-------|--|
| 2.5.1 | Regularly trap and remove crayfish from spring habitats by implementing crayfish control strategies identified during development of the Refuge IPM plan. Focus on 10 most infested and important aquatic systems (Marsh, N & S Indian, N & S Scruggs, Jackrabbit, Kings, Point of Rocks, Big, Crystal springs, and Bradford Spring) and expand program as necessary |
| 2.5.2 | Evaluate alternative crayfish control strategies (sterilization, biological control) in cooperation with other agencies |

Objective 2.6: Manage 7,850 acres and within fifteen years restore 650 acres of alkaline meadow/wet meadow habitat for native plant communities dominated by alkali sacaton (*Sporobolus airoides*) and salt grass (*Distichlis spicata*) with other native vegetation cover ranging from 10-90% cover including Hall's meadow hawksbeard (*Crepis runcinata*), alkali cordgrass (*Spartina gracilis*), Baltic rush (*Juncus balticus*), foxtail barley (*Hordeum jubatum*), *Atriplex spp.* and associated native plant species.

Rationale: Several endemic species are predominately found in alkaline wet meadow habitat including the threatened spring loving century (*Centaurium namophilum*) and Ash Meadows Ivesia (*Ivesia kingii var. eremica*) (Otis Bay 2006). Increasing the wet meadow to alkaline meadow ratio will more closely approximate historic conditions and mitigate historic human impacts to select areas. Restoring historic conditions should also minimize distribution of non-native plant species and favor native, endemic terrestrial and aquatic species. Restoration of native grassland conditions will increase suitable habitat for Ash Meadows montane voles (*Microtus montanus nevadensis*) a Species of Conservation Priority, which use this habitat type for foraging and nesting (NDOW 2005). In the Mojave Desert, alkali meadows are restricted to areas where the water table is 1-3 meters deep, making groundwater maintenance essential to the sustenance of this habitat type (Otis Bay 2006) and the resulting contribution to the biological integrity, diversity and environmental health of the Refuge ecosystem. Seasonally inundated wet meadows produce large quantities of insects that are a rich food source for bats and insectivorous birds (NDOW 2005). Lowland wet meadows also provide valuable habitat for amphibians which use the habitat as late-summer refugia and winter hibernacula (NDOW 2005).

In coordination with the FHA and Nye County a transportation plan is being developed that, in part, will address the impact of roads, on-road vehicles and off-road vehicles on habitat maintenance and

restoration. Wet meadows are highly susceptible to damage by motorized recreation. Rutting from off road vehicles and soil compaction can alter the natural hydrology of the meadows reducing their value for wildlife (NDOW 2005). Poor road placement has also led to degradation of wet meadow habitat through erosion, changes in hydrology and other direct impacts (NDOW 2005).

Strategies

2.6.1	Restore and maintain historic hydrology
2.6.2	Actively revegetate where appropriate with salt grass and alkali sacaton
2.6.3	Monitor changes over time as restoration is implemented
2.6.4	Same as 1.5.1
2.6.5	Develop restoration plan for entire Carson Slough
2.6.6	Remove and revegetate roads deemed unnecessary
2.6.7	Inventory, assess, mitigate, and initiate restoration of roads
2.6.8	Evaluate current land uses such as utility corridors and ensure regulatory compliance
2.6.9	Maintain Spring Meadows Road and allow non-commercial through traffic
2.6.10	Maintain existing boundary fence as a wild horse enclosure
2.6.11	Repair post and cable barriers and install other barriers where needed to protect resources
2.6.12	Replace or add gates on service or fire roads and sign them
2.6.13	Maintain closure of nonessential roads
2.6.14	Increase law enforcement to prevent off highway vehicles, fires, collecting of species, and other inappropriate activities
2.6.15	Add 11 to 15 road gates to prevent unauthorized use of roads and resource damage
2.6.16	Same as 1.5.7
2.6.17	Same as 2.4.1
2.6.18	Complete the Refuge Transportation Plan

Objective 2.7: Within fifteen years restore 550 acres of lowland riparian habitat with native plant communities including an overstory of leather-leaf Ash (*Fraxinus velutina*), narrow-leaved willow (*Salix exigua*), Goodding’s willow (*Salix gooddingii*), Fremont cottonwood (*Populus fremontii*), quailbrush (*Atriplex lentiformis*), arrow weed (*Pluchea sericea*), Emory baccharis (*Baccharis emoryi*) and other associated native plant species.

Rationale: Lowland riparian habitat is important for many Federal endangered species act listed or species of concern including the endangered southwest willow flycatcher (*Empidonax traillii extimus*), American peregrine falcon (*Falco peregrinus*), vermilion flycatcher (*Pyrocephalus rubinus*), Phainopepla (*Phainopepla nitens*), long-eared myotis (*Myotis evotis*) as well as many other migratory birds and resident animals (Recon 2000). The Final Recovery Plan for Southwest Willow Flycatchers requires the establishment of 25 southwest willow flycatcher territories in the Amargosa management unit (an increase of 22 territories, from 2002 levels) to meet the recovery objectives (SWFRTTS 2002). The Refuge is listed as one of five river reaches, within the Amargosa unit, where southwest willow flycatcher habitat restoration efforts should be focused (SWFRTTS 2002). Riparian habitat is also critical to migratory species such as the yellow-breasted chat, a Partners in Flight focal species.

Restoring 550 acres of lowland riparian habitat on the Refuge would support the Nevada Steering Committee Intermountain West Joint Venture (NSCIWJV) Priority A objective for lowland riparian habitat to "Permanently protect and/or restore 300 linear miles of lowland riparian habitat in Nevada" (NSCIWJV 2005). Lowland riparian habitat is quite limited in the region and restoring lowland riparian habitat will contribute to the biological integrity, diversity and environmental health of the surrounding region and the National Wildlife Refuge System as a whole. The BLM plans to manage public lands, adjacent to the Refuge, to complement spring and aquatic habitat for special status species (Recon 2000). Restoring lowland riparian habitat to natural dynamic, heterogeneous conditions will simultaneously benefit many imperiled species (USFWS 2002c).

Strategies

2.7.1	Same as 2.4.1
2.7.2	Revegetate with native Ash, willows, cottonwood, etc.
2.7.3	Restore historic hydrologic conditions
2.7.4	Obtain historic plant distribution through pollen analysis and refine restoration acreage targets
2.7.5	Same as 2.6.7
2.7.6	Same as 2.3.10
2.7.7	Same as 1.5.7

Objective 2.8: Manage 2,000 acres of mesquite bosque for native habitat with a complex overstory of predominantly honey mesquite (*Prosopis glandulosa torreyana*), screw bean mesquite (*Prosopis pubescens*), narrow-leaved willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*), Emory baccharis (*Baccharis emoryi*) and understory plants including saltbush (*Atriplex spp.*), bushy bluestem grass (*Andropogon glomeratus*), ryegrass (*Elymus cinereus*), foxtail barley (*Hordeum jubatum*), pine blue grass (*Poa scabrella*), salt grass (*Distichlis spicata*), aster (*Aster spp.*) and other associated native plant species.

Rationale: In many areas mesquite bosques are being lost to urban and suburban development, woodcutting, sand and gravel mining, human-caused wildfires and have been significantly invaded by non-native plants including salt cedar (*Tamarix spp.*) (NDOW 2005). Mesquite bosques are found in areas with deep soil and shallow water tables, such as riparian areas and the edges of dry lake beds and were historically dominated by honey mesquite (*Prosopis glandulosa*) (NDOW 2005). Mesquite bosques support a disproportionately greater number of wildlife species than the surrounding desert scrub (BLM 1999) and are especially critical in the summer and during drought years because often they retain the only green vegetation left in the Mojave landscape (NDOW 2005). Mesquite bosques are known to provide valuable habitat for many migratory bird species, as well as resident species native to the Mojave ecosystem. At least 65 species of birds have been observed using mesquite bosques as migratory stopover sites, breeding sites or wintering areas (BLM 1999) including species of concern such as Phainopepla (*Phainopepla nitens*), Lucy's warbler (*Vermivora luciae*) (NDOW 2005) and priority birds like the loggerhead shrike (*Lanius ludovicianus*) (NSCIWJV 2005). Lucy's warbler is also on the Partners in Flight watch list of Species of Continental Importance for the U.S. and Canada (Rich et al. 2004). Bats such as the California Leaf-nosed bat (*Macrotus californicus*), a species of concern, spend the majority of forage time in desert washes within bosques and other bat species use ephemeral water sources in washes seasonally (Altenbach et al. 2005). In addition, another species of concern, the Ash Meadows montane vole uses mesquite bosque habitat for burrowing and foraging (NDOW 2005).

An objective of the State of Nevada Comprehensive Wildlife Conservation Strategy is to: "Expand protected status for mesquite bosque and desert wash ecological systems through 2015 with stands in stable or increasing condition trend" (NDOW 2005). Managing mesquite bosque habitat on the Refuge supports a Priority A goal of the Coordinated Implementation Plan for Bird Conservation in Nevada to "Minimize the loss of mesquite and catclaw habitats whenever possible" (NSCIWJV 2005).

Strategies

2.8.1	Same as 2.4.1
2.8.2	Restore historic hydrology and revegetate mesquite bosques and dunes along spring channels and in former agricultural fields
2.8.3	Same as 2.6.7
2.8.4	Maintain policy of no mesquite wood collection on the Refuge through law enforcement as well as educational outreach to visitors
2.8.5	Use prescribed fire where appropriate to create, improve or maintain desired plant and animal communities, as well as to treat hazardous fuels
2.8.6	Manage wildland fires on the refuge using the fitting Appropriate Management Response which considers resource values at risk and potential negative impacts of various fire suppression measures (firefighter and public safety will be the highest priority on every incident)
2.8.7	Rehabilitate 30-45% of old agricultural fields by controlling invasive species and installing native plants

Objective 2.9: Manage 11,000 to 11,500 acres for a range of native upland desert plant communities including gradations between: warm desert scrub communities including creosote bush (*Cryptantha angustifolia*), white bursage (*Ambrosia dumosa*), white bursage four winged salt bush (*Atriplex canescens*), desert holly (*Atriplex hymenelytra*), beaver tail cactus (*Opuntia basilaris*), indigo bush (*Psoralea fremontii*), Mojave aster (*Xylorhiza tortifolia*) and desert chikory (*Rafinesquia neomexicana*); dry ridgetop plant communities of predominately cotton top (*Echinocactus polycephalus*), bevertail cactus (*Opuntia basilaris*), cholla (*Opuntia spp.*) and associated native plant species; shrub/scrub habitat including arrow saltbush (*Atriplex phyllostegia*), desert saltbush (*Atriplex polycarpa*), alkali rabbitbrush (*Chrysothamnus albidus*), box-thorn (*Lycium shockleyi*), greasewood (*Sarcobatus vermiculatus*) and other associated native plant species.

Rationale: Over 12,400 acres of the Refuge is currently passively managed as desert upland habitat (Otis Bay 2006). Two species of concern, chuckwalla (*Sauromalus ater*) and burrowing owl (*Athene cunicularia hypugea*) respectively use creosote dominated upland habitat for protection from predators and burrowing sites (NDOW 2005). After fencing to exclude wild horses and burrows, major threats to this habitat type on the Refuge include soil compaction and damage to shrubs by off-highway vehicles and invasive understory species (NDOW 2005).

Strategies

2.9.1	Same as 2.4.1
2.9.2	Same as 2.6.14
2.9.3	Develop and implement plan to remove dikes in uplands

2.9.4	Same as 2.6.7
2.9.5	Same as 2.6.10
2.9.6	Same as 1.5.7

Objective 2.10: Within fifteen years restore 150 acres of emergent marsh, as outlined in the 2006 Biological Assessment, through removal of barriers between stream channels and manage for plant communities dominated by bulrushes (*Scirpus spp.*), saw-grass (*Cladium californicum*) and rushes (*Juncus spp.*) with only minimal, sporadic patches of southern cattail (*Typha domingensis*).

Rationale: Refuge marshes provides rich habitat for native endemic fish, migratory birds, resident amphibians and resident aquatic invertebrates (NDOW 2005). Marsh habitat that is inundated year round, with spring water sources, is of particular importance for resident amphibians and endemic fish species of conservation priority including the Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) (NDOW 2005). Breeding populations of the endangered Yuma clapper rail (*Rallus longirostris yumanensis*) and species of concern such as the black tern (*Chlidonias niger*) require marsh habitat for nesting and feeding (NDOW 2005). In addition, the threatened bald eagle (*Haliaeetus leucocephalus*) is known to find prey in marsh habitat (NDOW 2005), but have only inconsistently been reported at Ash Meadows (Baldino 2006).

Early successional stage cattail marsh is considered essential to maintain and expand breeding populations of Yuma clapper rail (USFWS 1983). Native, cattail species were not historically abundant in Ash Meadow’s marshes. Historically Ash Meadows marshes were dominated by bulrushes (*Scirpus spp.*), saw-grass (*Cladium californicum*) and rushes (*Juncus spp.*), but changes in hydrology and nutrient dynamics have led to marshes dominated by native cattail (*Typha domingensis*). According to Dr. Frank Coville, a botanist with the Death Valley Expedition of 1891, cattail occurred "...sparingly at several points...". Returning marshes to historic states will require replicating historic conditions such as open water, low nutrient input and short-term control of cattail until historic plant communities can become established.

Restoring Refuge marsh wetlands supports the statewide Priority A wetlands objective of the Coordinated Implementation Plan for Bird Conservation in Nevada to "Permanently protect and/or restore 25,000 acres of high-quality wetlands and associated habitats in Nevada" (NSCIWJV 2005). An objective of the State of Nevada Comprehensive Wildlife Conservation Strategy is: "(an) Increase in wetland management potential through purchase of water rights and wetland improvement projects by 2015" (NDOW 2005).

Strategies

2.10.1	Restore spring systems as described in the 2006 Geomorphic and Biological Assessment
2.10.2	Design marsh habitat restoration with emphasis on bird and bat forage
2.10.3	Same as 2.5.1
2.10.4	Same as 2.4.1
2.10.5	Same as 2.6.7

Objective 2.11: By 2011, develop a step-down plan for the modification and/or removal of Crystal Reservoir and implement the plan if funding is available.

Rationale: Carson Slough and the associated riparian area was severely degraded due to late twentieth century agriculture, peat mining and construction of a dam which resulted in the creation of

Crystal Reservoir. The artificial habitat formed by the impounded Crystal Reservoir is a site infested by predacious, non-native fish, which are identified within the Ash Meadows Recovery Plan for removal. The inadequately engineered Crystal dam shows signs of failing and poses a serious liability issue for the Refuge and a number of safety issues for Refuge visitors.

The Crystal Reservoir dam has the potential for catastrophic failure, and there is a need to remove the structure. Failure of this dam would scour habitat below the reservoir, which would likely destroy the largest population of the endangered Amargosa niterwort within Nevada. Other listed plants, including the Ash Meadows ivesia, spring-loving centaury and the Ash Meadows gumplant, also occur downstream of the dam and are in danger, as is a large population of the endangered Ash Meadows Amargosa pupfish. The unique alkaline soils below the reservoir also support a unique ecosystem, which would be lost if Crystal dam failed. Riparian areas on the Refuge provide valuable habitat for migratory and resident bird species. Any restoration of riparian habitat, including Crystal Spring restoration, will increase the acreage of habitats used by migratory and resident birds.

Crystal Reservoir has also tended to attract uses that are unrelated to or that directly conflict with Refuge purposes. Ongoing public safety issues at Crystal Reservoir have included swimmers itch (dermatitis caused by parasite infection), large uncontrolled public fires, waste generated by large public barbeque events, stolen car disposal, waste dumping and illegal firearms discharge. Activities at this area are a potential liability risk for the Refuge and consume resources that would more appropriately be used for management activities related to Refuge purpose.

Strategies

- 2.11.1 Obtain biological and geomorphic data to inform demolition and restoration plan for Crystal Reservoir
- 2.11.2 Develop methods to remove Crystal Reservoir that minimize environmental impacts, including impacts to threatened and endangered species
- 2.11.3 Consult independent science advisory team for review and improvement of the ecosystem approach to Refuge management
- 2.11.4 Refuge Manager will direct changes in management after consideration of science advisor team recommendations

Objective 2.12: Continue ongoing efforts to acquire remaining lands within the authorized Refuge boundary from willing sellers.

Rationale: The Service currently owns 13,827 acres within the approved refuge boundary. Another 9,460 acres are managed under cooperative agreement with the BLM. Approximately 40 acres of Refuge lands are managed by the NPS. The pending land and mineral withdrawal would transfer these lands to the Service. Another approximately 680 acres of land within the approved refuge boundary remain under private ownership. Completing acquisition of contiguous land within the Refuge boundary will optimize the Service’s ability to manage the Refuge for its intended purposes.

Strategies

- 2.12.1 Continue coordination with private landowners to protect Refuge resources
- 2.12.2 Establish conservation agreements or acquire in-holdings from willing sellers
- 2.12.3 Complete the pending land and mineral withdrawal with the BLM
- 2.12.4 Continue ongoing efforts to acquire remaining lands within the approved Refuge boundary from willing sellers

Research (Goal 3). Encourage and provide opportunities for research which supports Refuge and Service objectives.

Objective 3.1: Monitor the impacts of non-native aquatic animals including red-rim melania (*Melanoides tuberculata*), bullfrog (*Rana catesbeiana*), crayfish (*Procambarus clarkii*) and non-native fish on Refuge native aquatic species through laboratory/field experiments and adaptively develop/test eradication technologies in all Refuge aquatic environments.

Rationale: Loss of endemic, aquatic species is likely to occur due to non-native invasive aquatic animal predation on and competition with native species. Non-native fish that have been documented on the Refuge include; sailfin mollies (*Poecilia latipinna*), mosquito fish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*) and arawana (*Osteoglossum bicirrhosum*) (Williams and Sada 1985). By 1990 the arawana were not detectable, but the other exotic fish remained (USFWS 1990). Convict cichlids (*Archocentrus nigrofasciatus*, surviving), green sunfish (*Lepomis cyanellus*, surviving), koi (*Cyprinus carpio*, may not survive, but reported), goldfish (*Carassius auratus*, surviving) have been reported in Refuge reservoirs or have been detected in spring systems. Crayfish are not native to the Refuge or surrounding area, but have been introduced and have established breeding populations. By the early 1980s red swamp crayfish (*Procambarus clarkii*) were established in larger spring systems on the Refuge (Williams and Sada 1985). Crayfish have been observed feeding on endangered Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*). Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) are thought to be particularly vulnerable to crayfish predation due to the dace's benthic habit (Williams and Sada 1985). Presently crayfish are known to be present in at least 10 spring systems on the Refuge (Otis Bay 2006). The bullfrog (*Rana catesbeiana*) is not native to the Refuge or surrounding area and bullfrogs prey on, compete with and displace native species. The red-rim melania snail (*Melanoides tuberculata*) is not native to the Refuge or surrounding area and can compete with and displace native species. The red-rim melania is also a transmission vector for parasites that can impact resident species (GSMFC 2006).

Information obtained during adaptively managed control of invasive aquatic animals could also be applicable to numerous other Refuges and other locations throughout Nevada and the western US. The State of Nevada's Comprehensive Wildlife Conservation Strategy (2005) emphasizes preventing the spread of crayfish to new locations and eradicating introduced crayfish where they threaten other aquatic species. Tasks 232 and 2321 of the Ash Meadows Species Recovery Plan (USFWS 1990) recommend removal of non-native aquatic species and conducting research if necessary to determine the best removal methods while minimizing any impacts to listed and candidate species.

Strategies

- 3.1.1 Conduct a literature review of aquatic invasive species ecology, trophic interactions and eradication treatments, for species identified as detrimental to native Refuge species
- 3.1.2 Conduct experiments on Refuge habitat and species impacts and trophic interactions due to aquatic invasive species
- 3.1.3 Develop funding partnerships for aquatic invasive species eradication studies
- 3.1.4 Conduct a study of crayfish ecology on Refuge
- 3.1.5 Conduct laboratory and field experiments on eradication/control techniques

- 3.1.6 Study exclusion methods to restrict movement of non-native fish (ex. large mouth bass, green sunfish, etc.) into native fish habitat
- 3.1.7 Use study results to inform an IPM plan for aquatic invasive species
- 3.1.8 Continue working with USGS, USFWS Endangered Species program, NDOW and other partners

Objective 3.2: Experiment with a variety of control methods for each invasive plant species on Refuge and monitor effectiveness of treatment.

Rationale: Invasive plants displace native and endemic plant species and alter fire regime, plant community composition and wildlife diversity. More precise and effective means of control are necessary in order to minimize impacts to desirable native species and maximize efficient use of Refuge resources while controlling or eradicating invasive plant species. Salt cedar (*Tamarix spp.*), an invasive tree species, dominates significant portions of habitat on the Refuge (Otis Bay 2006). Although southern cattail (*Typha domingensis*) is a native species, alteration of hydrologic and nutrient dynamics on the Refuge has caused cattail to form dense monocultural stands, degrading marsh habitat. Until restoration of the Refuge is complete, cattail will require management to reduce stands and to maintain cattail in an early successional state that is considered essential for breeding populations of endangered Yuma clapper rail (*Rallus longirostris yumanensis*) (USFWS 1983). According to Otis Bay (2006), many of the native plants on the Refuge may be fire sensitive and slow to recover from prescribed burning. By contrast non-native plant species such as salt cedar and annual grasses can regenerate and spread quickly after fires (Otis Bay 2006). It is likely that general use of prescribed burning would favor established non-native plant species such as salt cedar and annual grasses. For these reasons it will be necessary to carefully apply prescribed burning with full consideration of integrated pest management strategies for non-native plant species. Task 2221 of the AM Species Recovery Plan (USFWS 1990) recommends consultation with the agency most experienced with removal of salt cedar and Russian olive (*Elaeagnus angustifolia*) for advice and conducting supplemental research as needed.

Strategies

- 3.2.1 Establish invasive plant control monitoring plots
- 3.2.2 Evaluate salt cedar control methods
- 3.2.3 Evaluate cattail control methods
- 3.2.4 Evaluate knapweed control methods
- 3.2.5 Evaluate control methods for other invasive plant species
- 3.2.6 Same as 2.8.5
- 3.2.7 Same as 2.8.6

Objective 3.3: Conduct an ongoing study of Refuge ecosystem dynamics, energetics, taxonomy and ecology focusing on alkali meadow/springs habitat.

Rationale: Increased scientific knowledge of alkali meadow/springs habitat may support the legal protection of groundwater resources. Most Refuge endemic plant species occur in alkali meadow habitat and enhancing understanding of alkali meadow ecosystem dynamics will contribute to optimal management of this important habitat type.

Strategies

- 3.3.1 Work to obtain funding for trophic level studies
- 3.3.2 Complete studies and analysis of historic data to link uplands, alkali meadows, and springs habitats
- 3.3.3 Conduct studies to obtain basic life history information for endemic and listed plant species
- 3.3.4 Conduct taxonomic studies of Refuge plant species
- 3.3.5 Conduct monthly monitoring of groundwater (ex. wells and flumes)
- 3.3.6 Conduct monthly monitoring of discharge from springs

Objective 3.4: Obtain baseline data on local climate within the three major Refuge drainage basins. Model climate change impact scenarios and develop adaptation strategies.

Rationale: Obtaining reliable and accurate climate data can support species recovery efforts, provide legal protection of water resources and can inform the evaluation of dams and impoundments. Currently Refuge staff have inadequate data on local climate trends to adequately support management decisions, necessitating the need for more accurate and reliable local climate data information.

Strategies

- 3.4.1 Install a weather station within each of the three major drainage basins
- 3.4.2 Obtain core samples from old spring mounds, Carson Slough, etc.
- 3.4.3 Conduct tree ring studies on local species to determine growth patterns over long periods of time, to infer past climate conditions, climate change over time and to inform fire management by determining past, natural fire regimes
- 3.4.4 Conduct studies of past pollen and spore distribution (palynology studies) to infer past climate conditions and climate change over time
- 3.4.5 Maintain a GIS based weather database
- 3.4.6 Model climate change impact scenarios and develop adaptation strategies

Objective 3.5: Refine understanding of terrestrial habitat use by mammals, herpetofauna, birds and invertebrates through ongoing faunal inventory.

Rationale: To fulfill the Refuge purpose, the Service needs reliable data on Refuge habitat use by threatened and endangered species. Accurate data on habitat use by Federal endangered species act listed species, bats, reptiles, amphibians and other native species is currently lacking. Little is known about the distribution and abundance of terrestrial fauna, making species management difficult or impossible. Of particular importance is an assessment of the population status of the Ash Meadows montane vole (*Microtus montanus nevadensis*), a species of conservation priority (NDOW 2005). The Ash Meadows montane vole may already be extinct, but was known to live on the Refuge property historically. Task 6512 of the Ash Meadows Species Recovery Plan recommends conducting surveys to determine the location, extent and size of existing terrestrial species populations (USFWS 1990).

Strategies

- 3.5.1 Develop funding sources and partnerships
- 3.5.2 Conduct comprehensive Refuge terrestrial species inventory

- 3.5.3 Conduct bat studies
- 3.5.4 Obtain baseline information on reptiles and amphibians
- 3.5.5 Conduct a one-year assessment on the relationship between coarse woody debris and terrestrial invertebrates and continue annual monitoring if feasible
- 3.5.6 Assess contribution of invertebrates associated with coarse woody debris to terrestrial macrofauna diet

Objective 3.6: Conduct a two year study of impacts of road-generated dust on each listed plant.

Rationale: Roads often lead to direct wildlife mortality, through vehicle collisions as well as indirect impacts through habitat fragmentation. Refuge roads cross known areas of endemic plant species critical habitat, likely having a negative impact on that critical habitat.

Strategies

- 3.6.1 Develop funding sources and partnerships
- 3.6.2 Evaluate dust impacts to listed plants through two-year studies (lab and field work) and generate recommendations to inform road management

Objective 3.7: Conduct a study to assess the composition, distribution, fire regimes, drought patterns and flood regimes of Refuge vegetation communities prior to circa 1850.

Rationale: Increasing scientific understanding of vegetation community change through time will inform Refuge staff and improve the efficiency of restoration and recovery efforts. Given the range of disciplines necessary for the successful completion of a complex study of historic vegetation patterns, it will likely be necessary to partner with others to achieve this objective. Tasks 221, 2211 and 2212 of the Ash Meadows Species Recovery Plan recommend actions consistent with this objective (USFWS 1990).

Strategies

- 3.7.1 Same as 3.6.1
- 3.7.2 As funds become available establish a cooperative agreement with a university program to complete studies leading to a final report
- 3.7.3 Use disciplines such as paleontology, and archeology to research historic conditions
- 3.7.4 Same as 3.4.3
- 3.7.5 Same as 3.4.4
- 3.7.6 Attempt to determine the historic fire regime for Ash Meadows prior to broad establishment of invasive species

Objective 3.8: Develop and implement an information management system at the Refuge, in part through GIS database creation and management.

Rationale: Significant progress has been made on a GIS database in the course of completing the Refuge Geomorphic and Biological Assessment (Otis Bay 2006). Allowing access to as much relevant data as possible in a single location on the Refuge will allow Refuge staff and partners access to the information necessary for applied research and monitoring of Refuge resources. Increasing the accessibility of information such as vegetation monitoring data, wildlife monitoring data and water

resource data at a single location on Refuge will facilitate the best possible management of Refuge resources.

Strategies

3.8.1	Develop funding sources and partnerships
3.8.2	Develop a data management plan and adopt relevant data standards
3.8.3	Identify and archive existing datasets, including hard copy only data (ex. maps, photos, diaries, etc.)
3.8.4	Partner with NPS, BLM and State

Objective 3.9: By 2010, complete a feasibility study to clarify the need for construction of an on-site research facility.

Rationale: Lack of facilities at the remote Refuge site has limited the ability of scientists to conduct research that would enhance Refuge management. Given that wetlands on the Refuge are recognized as of international importance, by the Ramsar convention on wetlands treaty, it is likely that providing facilities and access to independent scientists would result in an increase in applied research on resident species. Providing adequate facilities for visiting researchers, on the remote Refuge, should increase understanding of resident Refuge species and communities. Ongoing and planned restoration activities will provide a wealth of opportunities to monitor the response of managed species and their habitats and additional monitoring by independent researchers would likely yield useful information for adaptive management.

Strategies

3.9.1	Secure funding for a feasibility study for an on-site research facility
3.9.2	Contract a feasibility study for location and design of an on-site research facility

Visitor Services (Goal 4). Provide visitors with wildlife-dependent recreation, interpretation, and environmental education opportunities that are compatible with, and foster an appreciation and understanding of Ash Meadows National Wildlife Refuge’s wildlife and plant communities.

Objective 4.1: Develop and begin implementing an Environmental Education Plan by 2011.

Rationale: Environmental education is a priority public uses identified in the NWRS Improvement Act of 1997 and is an important component of resource protection, conservation and wildlife-dependent recreational opportunities available at the Refuge. Development of an Environmental Education Plan will provide a management tool for Refuge staff to evaluate opportunities for education on and off the Refuge. Providing scientifically based, age-appropriate education to the public on the unique species and habitats present on the Refuge should enhance understanding and increase appreciation of Refuge resources. Providing environmental education at local community events would continue to inform the public about recreational opportunities on the Refuge and could increase the number of visitors to the Refuge. The development, implementation and ongoing improvement of a program for education, interpretation, and outreach will require additional resources, as well as coordination with local schools, other resource agencies as well as conservation and user groups.

Strategies

4.1.1	Incorporate volunteers in habitat restoration and maintenance efforts, such as litter removal
4.1.2	Provide visitor information on endangered species protection measures at the visitor contact station and entrance kiosk
4.1.3	Assess visitor education needs and opportunities
4.1.4	Incorporate environmental education goals of Ash Meadows Recovery Plan, Clark County Multiple Species Habitat Conservation Plan and Ramsar Convention on Wetlands
4.1.5	Contact local schools and provide at least three to five on-site programs a year
4.1.6	Work with possible public, NGO, and private partners to develop off-site refugium for pupfish to promote awareness of the endangered pupfish and other endemic species at the Refuge
4.1.7	Develop cooperative agreements with public, non-government entities and private partners to provide off-Refuge educational outreach to the local public on the value of the Refuge for wildlife and the public
4.1.8	Have staff provide off-Refuge educational outreach to the local public on the value for wildlife and the public of Ash Meadows NWR by participating in two to three local community events annually
4.1.9	Create and maintain a list of local community events
4.1.10	Contact event organizers to arrange for not for profit booth/table space or other opportunities for participation
4.1.11	Handout Refuge related educational materials and/or make presentations at local events
4.1.12	Develop an outreach Plan to support the Carson Slough Restoration Plan
4.1.13	Develop a an educational video on the endemic fish and other wildlife of Ash Meadows NWR
4.1.14	Obtain funding for and hire: 1 interpretive staff

Objective 4.2: Begin implementation of the Ash Meadows NWR Interpretation Plan.

Rationale: Interpretation is a priority public use identified in the NWRS Improvement Act of 1997 and is an important component of visitor recreational opportunities available at the Refuge. Providing both user-directed and staff facilitated high quality interpretation of the unique species, habitats and other resources present on the Refuge will enhance the visitor's passive and active experience. Development of an Interpretation Plan will provide a structure for the Refuge staff to evaluate opportunities for visitor experiences while engaging in interpretation related recreation on the Refuge. The implementation and ongoing improvements of an Interpretive Plan will require additional resources, as well as coordination with other resource agencies, tribes and user groups.

Strategies

4.2.1	Design and construct boardwalks to follow Kings Pool Stream from parking lot to Kings Pool, with a pool overlook
4.2.2	Design and construct interpretative displays for new boardwalks to be installed at Point of Rocks

4.2.3	Design and construct boardwalk to the Longstreet Cabin and an overlook for the Longstreet Spring pool
4.2.4	Maintain designated roads and visitor use areas
4.2.5	Improve Point of Rocks and Longstreet Cabin parking areas
4.2.6	Maintain current visitor services for wildlife-dependent recreational activities in accordance with existing Public Use Management Plan
4.2.7	Conduct a study of Refuge visitation to determine the number and purpose of visits
4.2.8	Improve signs on Refuge boundary
4.2.9	Include sensitive plant and pupfish life history information in Refuge brochures, fact sheets, and maps
4.2.10	Coordinate with Death Valley National Park staff to provide Devils Hole pupfish interpretive materials
4.2.11	Develop multi-lingual interpretative materials and construct new interpretive facilities at Point of Rocks, Longstreet, and Crystal Springs and entrances to Refuge.
4.2.12	Design and construct other interpretive facilities identified in the Interpretive Plan
4.2.13	Staff visitor contact station five days per week
4.2.14	Improve existing roadways and parking areas to good condition as described in the Ash Meadows Refuge Roads Inventory (2004), based on Geomorphic and Biological Assessment

Objective 4.3: Develop and begin implementing a Refuge Visitor Services Plan by 2012.

Rationale: Visitation of the Refuge has been increasing over time despite minimal Refuge outreach actions. An increase in the regional population and ongoing efforts to inform the public about recreational opportunities have resulted in increasing numbers of visitors to the Refuge. Increasing visitation creates the need for an effective method to evaluate and manage compatible public uses and to assess visitor impacts to the fragile ecosystems on the Refuge. Visitor use facilities need to be designed to accommodate increasing visitation and to promote appropriate wildlife-dependent activities on the Refuge. A Visitor Services Plan will evaluate and prescribe strategies to develop and manage compatible wildlife-dependent recreational opportunities, related infrastructure, and associated staffing and funding needs on the Refuge. A Visitor Services Plan will be useful to engage, educate and coordinate with private property owners, local governments and user groups, and other agencies with jurisdictional responsibilities for Refuge resources.

Strategies

4.3.1	Same as 4.2.7
4.3.2	Same as 4.2.15
4.3.3	Identify and develop funding sources and partnerships
4.3.4	Design and implement visitor services that enhance visitor satisfaction and optimize protection of Refuge resources
4.3.5	Same as 2.6.15
4.3.6	Same as 4.2.8
4.3.7	Same as 4.2.1

4.3.8 Same as 4.2.3

Objective 4.4: Coordinate with Death Valley National Park to provide a consistent message regarding Refuge and Park resources, focusing on Devils Hole pupfish and influences upon its unique environment.

Rationale: The National Park Service manages 40 acres on the Refuge and has staff with responsibility for interpretation and environmental education regarding Devil’s Hole pupfish (*Cyprinodon diabolis*) and their environment. As a globally significant natural feature located within the Refuge and far from Death Valley National Park (Park) proper, the protection and conservation of the fragile Devil's hole ecosystem can be improved through increased coordination between the Refuge and the Park. While Devils hole pupfish can not be viewed by the public in their protected environment, visitors to the Refuge can view related pupfish such as the Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*) in restored Refuge environments. By allowing visitors to view related pupfish, the Refuge offers a unique opportunity to teach visitors about the Devil's hole pupfish and about threatened and endangered pupfish in general. A Cooperative Management Agreement between the Refuge and the Park can optimize protection of the Devil’s Hole ecosystem by defining partnership roles and responsibilities, decreasing counter productive and duplicative efforts, standardizing research methods and enhancing conservation and environmental education strategies.

Strategies

4.4.1 Meet with Park staff to discuss challenges and opportunities for optimizing interpretation of Devil’s Hole resources

4.4.2 Create and distribute interpretative materials about threatened and endangered pupfish

Objective 4.5: Obtain baseline hunting information and within three years create a hunting step-down plan.

Rationale: Development of a step-down hunt plan is necessary to balance stakeholder requests for hunting access with Refuge purposes and other visitor services. Hunting is a priority public use identified in the NWRS Improvement Act of 1997, but hunting must be managed to assure human safety and compatibility with Refuge purposes. Several Refuge areas used by interpretative programs physically overlap with areas of existing hunting use. For safety, other uses should be separated from hunting and an appropriate buffer zone between any interpretative program area and hunting area should be maintained. Little baseline information exists on hunting, so it will likely require in excess of two years to obtain baseline information, analyze the information and create a realistic step down hunting management plan. To protect public safety it will also be necessary to assure an adequate buffer is maintained between Refuge hunting areas and private lands.

Hunting was a public use on some private land at Ash Meadows before the Refuge was established, in 1984. In 1986, an interim Hunt Plan was approved. The interim Hunt Plan authorized hunting until a master plan could be written in 1989. Although the Hunt Plan did not specify where hunting was to occur, it did allow small game, upland game and waterfowl to be hunted. The plan also prohibited off-highway vehicle (OHV) use, swimming in springs and streams, and dispersed camping. In 1994, a revised Compatibility Determination for migratory bird, upland game and waterfowl hunting at Ash Meadows was approved. It was anticipated in the stipulations section of the Compatibility Determination that hunting areas would be restricted to the northern portion of the Refuge to also allow for Refuge use by environmental educators, photographers, hikers, the general public as well as hunters during the hunt season.

Strategies

- 4.5.1 Continue hunt program under the Interim Hunt Plan until a revised Hunt Plan is completed
- 4.5.2 Obtain baseline information on Refuge hunting and within 3 years create a hunting step-down plan that addresses waterfowl and upland game hunting
- 4.5.3 Obtain funding for and hire: 2 law enforcement officers and 1/2 wildlife biologist
- 4.5.4 Have Complex law enforcement officer monitor hunting occurring on refuge

Objective 4.6: Within five years, complete design and construction of a new Refuge Headquarters/Visitor Contact Station building.

Rationale: Increasing staffing levels will require additional office and storage space and increasing public visitation will require additional facilities to provide visitor services. The historic drainage of the Crystal spring outflow passed through the current office location. To maintain consistency with Refuge purposes, any new facility should be designed with consideration of the historic Crystal Spring drainage and the likely benefits of restoring the historic drainage.

Strategies

- 4.6.1 Contract for a feasibility study for location and design of new building
- 4.6.2 Contract for construction of the new facility

Cultural and Historic Resources (Goal 5). Manage cultural resources for their educational, scientific, and traditional cultural values for the benefit of present and future generations of refuge users, communities, and culturally affiliated tribes.

Objective 5.1: Create and implement a basic Cultural Resources Management capability at the Refuge to respond to the basic compliance requirements of federal cultural resources legislation.

Rationale: Cultural resources are a non-renewable resource and need to be protected and preserved on the Refuge. Relatively little is known about cultural resources that may be present on the Refuge. Cultural resources discovery, planning, protection and interpretative are generally the result of a habitat- or visitor use-related project effort, but efforts to improve conservation and interpretation of cultural resources should be a priority. The Refuge will require additional resources to conduct the develop of a Cultural Resources Management Plan with appropriate site and project prioritization, surveys, documentation, and conservation, restoration and interpretation strategies. The story of the Refuge and its historic role in the region and the nation are important and exciting elements to be shared with visitors both on- and off-Refuge.

Strategies

- 5.1.1 Notify the Regional Office Archaeologist when site-specific projects are initiated so that appropriate resource assessments and coordination with Nevada State Historic Preservation Office (SHPO) and culturally affiliated tribes are conducted
- 5.1.2 Update Refuge brochures and interpretive signage, as staffing and funding allow, with appropriate cultural resources information

- 5.1.3 Solicit funding for site-specific project efforts from non-Refuge sources, such as Federal Highway Administration, Southern Nevada Public Lands Management Plan, Nevada SHPO, etc.
- 5.1.4 Incorporate cultural resource values, issues, and requirements into design and implementation of the other habitat, wildlife, and public use activities and strategies conducted by the Desert NWR Complex
- 5.1.5 Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near, the Ash Meadows NWR and create secure digital, GIS, and hard copy databases, maps, and a library. Share data with the Nevada SHPO as developed.

Objective 5.2: Create and implement a proactive historic preservation program in compliance with Section 110 of the National Historic Preservation Act.

Rationale: The National Historic Preservation Act requires the inventory and evaluation of cultural resources on Ash Meadows NWR for planning, scientific, educational, and preservation purposes, and mitigation of adverse impacts caused by erosion and deterioration at significant cultural resources. Creating a proactive cultural resources preservation program is the most effective way to assure compliance with Section 110 of the National Historic Preservation Act. Fulfilling this objective will require incorporation of expertise in cultural resource interpretation and archaeology, beyond current Refuge staff.

Strategies

- 5.2.1 Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and areas that would be affected by Refuge projects
- 5.2.2 Inventory, evaluate, and nominate to the National Register Traditional Cultural Properties and sacred sites in consultation with culturally affiliated tribes
- 5.2.3 Inventory, evaluate, and mitigate adverse effects and stabilize samples of cultural resources on Ash Meadows NWR using a research design prepared in consultation with culturally affiliated tribes and the scientific community
- 5.2.4 Conduct a study of ethnobotany and traditional plant use locations on Ash Meadows NWR in consultation with culturally affiliated tribes
- 5.2.5 Create a cultural resource layer in the Complex's GIS that aids in the identification, planning, monitoring and interpretation of cultural sites
- 5.2.6 Secure Refuge System and non-Refuge System funding to develop and implement mitigation, stabilization, or research projects

Objective 5.3: Manage cultural resources and cultural resource information for research, education and interpretation in consultation with appropriate tribes and the public.

Rationale: Many sites on the Refuge may be considered sensitive due to cultural significance for Tribes and the public or susceptibility to damage from visitation. Cultural sites selected for interpretation should be the least sensitive as determined through best professional judgment of the Refuge manager after consultation with a Service archaeologist, relevant tribes and the public. The majority of Ash Meadows NWR was Southern Paiute Aboriginal land, prior to European settlement (SWCA 2004). A small portion of the northern section of the refuge was Western Shoshone Aboriginal land, prior to European settlement (SWCA 2004). Both Tribes should be consulted to assure cultural

sensitivity of management activities and to enhance the cultural perspective of interpretation. Accomplishing this objective will require hiring an interpretative specialist.

Strategies

5.3.1	Identify and evaluate cultural resources that can educate Refuge visitors on how humans have interacted with wildlife and habitats in the past
5.3.2	Consult with culturally affiliated tribes, the SHPO, and other stakeholders on ways to use these resources to achieve educational, scientific, and traditional cultural needs
5.3.3	Forge partnerships with culturally affiliated tribes and cultural interest organizations
5.3.4	Cultivate the Consolidated Group of Tribal Organizations to assist in the development of educational, scientific, and traditional cultural needs for cultural resources management
5.3.5	Work with culturally affiliated tribes on projects to restore habitats of important native plants and to harvest (for traditional non-commercial purposes) native plant foods
5.3.6	Coordinate with the Complex's recreation and education planners and programs to incorporate cultural resources information into education and interpretive programs and media
5.3.7	Consult with culturally affiliated tribes and other stakeholders to design and implement educational materials, programs and activities that would address traditional or sacred resources, and to increase awareness on- and off-Refuge about the sensitivity of cultural resources to visitor impacts and the penalties for vandalism
5.3.8	Update Refuge brochures and interpretive signs with appropriate cultural resources information
5.3.9	Implement projects to restore habitats associated with important native plants and to harvest (for traditional, non-commercial purposes) native plant foods in coordination with culturally affiliated tribes
5.3.10	Conduct a study of ethnobotany and traditional plant use on Ash Meadows NWR in consultation with culturally affiliated tribes
5.3.11	Coordinate with existing site stewardship volunteer programs to assist in site monitoring, educational and interpretive programs, and to promote cultural resources conservation in neighboring communities

Objective 5.4: Protect cultural resources by decreasing or preventing looting, vandalism, and deterioration.

Rationale: Protecting Refuge cultural sites will benefit the current and future public by providing them with information on historic human uses of Refuge lands and the importance of preserving the Refuge land and its unique cultural resources. All of the cultural resource sites on the Refuge are currently susceptible to vandalism because of inadequate Refuge staff and funding. Vandalism is likely to increase as Refuge visitation increases with the growing regional and local population and will likely result in damage or destruction of non-renewable cultural resources, preventing those resources from being enjoyed by future generations of Americans. Once the Refuge has been surveyed for cultural resources in the course of developing the Cultural Resources Management Plan, Refuge staff should evaluate the known resources and select a sub-set of cultural resources for both on and off Refuge

interpretation. Additional resources would be necessary to develop the interpretive materials, the sites themselves and to monitor the selected sites for visitor use-related impacts.

Strategies

- 5.4.1 Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration and implement steps, including barriers and signs to reduce these threats and preserve the resources
- 5.4.2 Coordinate with the Nevada SHPO, tribes, special interest groups, and neighboring land management agencies to support cultural resources monitoring and enforcement activities and to decrease impacts to cultural resources
- 5.4.3 Coordinate future research, management, and planning on cultural resources with culturally affiliated tribes, the Consolidated Group of Tribal Organizations, the Nevada SHPO, neighboring land management agencies, and other special interest groups

Desert National Wildlife Refuge

Bighorn Sheep (Goal 1). Maintain and, where necessary, restore healthy population levels of bighorn sheep on Desert National Wildlife Refuge within each of the six major mountain ranges.

Objective 1.1: Increase the bighorn sheep (*Ovis canadensis nelsoni*) populations in the Sheep Range up to 1,000 individuals, increase the East Desert Range up to 100 individuals, increase the Desert and Pintwater Range subpopulations up to 250 and 300 individuals each and maintain the remaining subpopulations at or near their current levels over the next 15 years.

Rationale: Desert National Wildlife Refuge was established to protect, enhance, and maintain wildlife resources, including bighorn sheep (*Ovis canadensis nelsoni*). The Service and the Nevada Department of Wildlife (NDOW) have conducted annual comprehensive helicopter surveys of the Desert Refuge since 1974. The refuge-wide desert bighorn sheep population objective, as listed in the Refuge Management Plan, Part II (1987) and draft Sheep Management Plan (1990), is 2,000. Based on helicopter survey data gathered between 1974 and 1988, the refuge-wide desert bighorn population was typically at or very near the population objective. During the last fifteen years, 1989-2003, the refuge-wide desert bighorn population was approximately 1,000 individuals below the objective level. Therefore, a 100% increase, from the current baseline, is required to reach the objective level.

Most of the shortfall is accounted for by declines in the Sheep Mountains sub-population and the smaller, more transitory sub-population of the adjunct East Desert Mountains. Highly variable environmental factors play the major role in determining bighorn sheep population levels. Additionally, sheep regularly shift from one range on the refuge to another as natural conditions change from year to year. Due to this natural habitat variation, specific range population goals for bighorn sheep are difficult to achieve.

Appendix J contains a detailed review of desert bighorn sheep population status and management on Desert NWR, including factors potentially affecting distribution and abundance on the Refuge.

Strategies

- 1.1.1 Maintain all existing water sources (springs and rainwater catchments)
- 1.1.2 Protect bighorn habitat which encompasses upper alluvial fans, canyon bottoms and ridge tops as well as the precipitous mountain flanks from unauthorized uses, including off-road vehicle use, by installing signs, barricading/fencing and patrols by Law Enforcement Officers.
- 1.1.3 Minimize the potential for disease transmission to the bighorn sheep by continuing to prohibit domestic stock grazing on the Desert Refuge, particularly sheep and goats.
- 1.1.4 Continue current –NDOW-managed hunt program based on annual population surveys
- 1.1.5 Conduct a minimum of one annual fall helicopter survey to estimate the adult sex ratio, ram age structure, lamb survival/recruitment and populations size with NDOW.
- 1.1.6 Continue to allow bighorn sheep research on the refuge through special use permits.
- 1.1.7 Conduct yearly spring helicopter survey to identify lambing and recruitment sites.
- 1.1.8 Monitor vegetation response to burns in the Sheep Refuge.

- 1.1.9 Determine connectivity between sub-populations and their habitats on- and off-Refuge using historical records, random sightings, and radio-tracking data. Identify those corridors where exclusion removal of obstacles is most important to maximize connectivity and coordinate with appropriate partners to develop an approach to improve connectivity between subpopulations.
- 1.1.10 Document monitoring protocols so that they are consistently implemented when personnel changes occur in the Desert Refuge staff and/or in the NDOW staff.
- 1.1.11 Remove vegetation around catchments as needed to protect from wildfires and limit cover for bighorn sheep predators
- 1.1.12 Evaluate and adjust as necessary the current population monitoring methodology to determine adequacy for trend analyses.
- 1.1.13 Construct additional rainwater catchments if existing sources are determined to be inadequate.
- 1.1.14 Translocate bighorn sheep to the Refuge and outside of the Refuge to maintain desert bighorn sheep sub-populations and provide genetic diversity, as necessary based on the best information available, in coordination with NDOW; all sheep should receive health assessments, as time and funding allow.
- 1.1.15 Conduct a radio telemetry study to assess bighorn sheep mortality factors, particularly mountain lion predation, home ranges and habitat utilization/abandonment, and other research priorities. Coordinate radio telemetry with Air Force so that an appropriate band can be assigned to prevent transmission problems or equipment failure.
- 1.1.16 Collect blood and fecal samples to determine general health of herd, diet composition and nutrient uptake, and genetic diversity.
- 1.1.17 Monitor mountain lion populations on the Refuge
- 1.1.18 Develop and implement a Sheep Management Plan in cooperation with NDOW. The Plan would be flexible and address a number of issues such as management of water developments, herd health, predator management, habitat management (prescribed fire) and population management (translocations).
- 1.1.19 Develop formal agreement with NDOW covering management of desert bighorn sheep on the Refuge
- 1.1.20 Continue monitoring well water use and spring discharge at Corn Creek
- 1.1.21 Work with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
- 1.1.22 Regularly monitor flow rates for springs throughout the Refuge

Wildlife Diversity (Goal 2). Maintain the existing natural diversity of native wildlife and plants, including special-status species, at Desert National Wildlife Refuge.

Objective 2.1: Within five years of the plan’s approval, conduct baseline presence-absence surveys of federally listed, proposed, candidate and species of concern on the refuge and develop and implement monitoring plans for these species. Within the same period, conduct baseline inventories of Refuge plant communities to determine plant and wildlife species composition and abundance. Repeat inventories every five years to track long term trends in community composition.

Rationale: Situated at the transition between the Mojave and Great Basin Deserts, with over 9,000 feet of elevation range, the Desert National Wildlife Refuge is a rich reservoir of biodiversity. A total of 702 plant species representing 80 different families have been documented on the refuge. However,

despite being protected for over 70 years, little is known about the natural communities or listed and candidate species use of the Refuge. Desert is an important expanse of Mojave Desert lowland and montane habitat. In order to properly manage the Desert Refuge, Refuge staff need to obtain presence and population data on wildlife and plant species and their habitats. The existing baseline information for species in the Desert Refuge is rather limited, but includes birds (Audubon Society cooperative surveys, Great Basin Bird Observatory) and bighorn sheep (*Ovis canadensis nelsoni*) (NDOW cooperative surveys). This data does not provide adequate information on the wide diversity of species that are likely present on the Refuge.

Long term monitoring on the Refuge will be critical to understanding trends in plant and animal communities and informing adaptive management. Monitoring data will also be important to understanding the effects of global climate change on refuge resources. For example, hotter, drier weather could increase the frequency and intensity of wildfires, threatening Refuge plant communities. Climate changes could also alter the distribution of forest and woodlands (EPA) and increase the vulnerability of desert bighorn sheep populations inhabiting lower and drier mountain ranges to extinction (Epps et al 2004).

Strategies

- 2.1.1 Continue current partnerships with federal and state agencies, academic institutions, and public and private interest groups to assist in the survey and assessment efforts.
- 2.1.2 Continue to monitor the health of Pahrump poolfish (*Empetrichthys latos*) in refugium.
- 2.1.3 Conduct regular bird surveys at Corn Creek and maintain a record of raptors observed during helicopter surveys for bighorn sheep.
- 2.1.4 Develop survey and mapping data using GIS tools and following the standards provided in the USFWS WH8 Promises Team report regarding biotic and abiotic data layers.
- 2.1.5 Develop and implement an inventory and monitoring plan in coordination with FWS Endangered Species Program, NDOW, DOD and academic institutions.
- 2.1.6 Establish permanent, representative sample plots in each major plant community on the Refuge. At each site, conduct baseline inventory of plant and animal species composition and abundance. Repeat inventories every five years.
- 2.1.7 Model climate change impact scenarios and develop adaptation strategies

Objective 2.2: Within 2 years of the plan’s approval, eliminate 75 percent of the illegal recreational activities occurring along the southern boundary and prevent them from occurring along the eastern boundary to protect plant communities and wildlife, including the threatened desert tortoise (*Gopherus agassizii*). Within 15 years after plan approval, develop and implement a plan to rehabilitate areas along the southern and eastern boundaries that have damaged by these illegal activities (such as off-road vehicle use).

Rationale: Non-compatible recreational uses on the Refuge, such as off-road vehicles, degrade or functionally destroy habitat and adversely affect wildlife and plant species. Refuge System policy and the National Wildlife Refuge Improvement Act of 1997 also provide that “...the biological integrity, diversity, and environmental health of the System (Refuge) are maintained for the benefit of present and future generations.” A variety of non-compatible recreational uses are currently occurring on the Desert Refuge; however, the limited resources available to monitor these activities prevent prohibitions of these activities from being enforced. Enhanced law enforcement and improvements to signs along designated roads are critical to the initial stage of protecting species and habitats on the

Desert. Installing adequate fencing along the Refuge boundaries or where new, un-designated roads have been formed by off-road vehicles would additionally aid in protecting the Refuge resources.

Strategies

- 2.2.1 Maintain designated roads and visitor use areas as staffing and funding allow.
- 2.2.2 Maintain and replace regulatory signs along boundaries and designated roadways.
- 2.2.3 Continue utilization of volunteers for habitat restoration and maintenance efforts.
- 2.2.4 Promote awareness of and solicit support to combat trespassing and ESA violations along the boundaries in cooperation with Law Enforcement staff, various SNPLMA conservation initiative teams, FWS-ES, Clark County MSHCP and Clark County Metropolitan Police.
- 2.2.5 Use aerial photography, satellite imagery, and/or GPS to monitor damage caused by off-road vehicle trespass on refuge lands.
- 2.2.6 Install boundary signs at regular intervals along the entire southern, eastern, and northern boundary. Include regulatory, direction and interpretive elements as appropriate.
- 2.2.7 Expand litter removal efforts with increases in staffing and volunteer recruitment.
- 2.2.8 Increase law enforcement presence and patrols on the Refuge with an emphasis on the southern boundary.
- 2.2.9 Construct and maintain a steel post and cable fence along the southern boundary, with consideration for desert tortoise movement between suitable habitat.
- 2.2.10 Designate one or two points of entry on the southeast boundary of the Refuge and enforce it as the only access routes.
- 2.2.11 Coordinate with local jurisdictions to ensure development adjacent to boundary is compatible (ex. green belt, walled residential).
- 2.2.12 Where necessary, fence and maintain the eastern boundary using a steel post and cable construction method. Ensure that fence design does not act as wildlife barrier, especially for sheep.
- 2.2.13 Increase law enforcement patrols throughout the Refuge with an emphasis on the eastern boundary.
- 2.2.14 Develop and implement plan to close illegal trails and rehabilitate damaged habitat along the southern boundary in coordination with NDOW and adjacent land owner(s).
- 2.2.15 Track citations issued by law enforcement to estimate changes in trends of illegal activities on the Refuge.

Objective 2.3: Within 3 years of plan approval, begin restoration of vegetation characteristics including cover, composition, and structure characteristic of a natural fire regime within appropriate plant communities on the refuge.

Rationale: Typically, ponderosa pine communities are favorably affected by fire. Exclusion of fire has been shown to allow encroachment of shade tolerant species such as various fir and oak species which often act as ladder fuels during a fire. These ladder fuels change the characteristics of a fire from one of low to moderate intensity with positive overall effects to one of high intensity with negative overall effects.

Studies need to be conducted in the ponderosa pine communities to determine the historic fire return interval, and what impacts a lack of fire has had (if any) on species composition and density. Based on

these studies, a plan to use fire (prescribed or natural) may be developed that will maintain or improve the health of the ponderosa pine systems on the refuge.

Strategies

- 2.3.1 Manage wildland fires on the refuge using an Appropriate Management Response which considers resource values and Service and Air Force assets at risk and potential negative impacts of various fire suppression measures. Response may range from monitoring high elevation fires to full suppression. Firefighter and public safety will be the highest priority on every incident, regardless of other resources at risk
- 2.3.2 Use prescribed fire and naturally ignited fires to restore vegetation characteristics representative of a natural fire regime
- 2.3.3 Work with partners to fill data gaps in fire ecology of Desert NWR plant communities
- 2.3.4 Consider habitat needs of Gilbert's skink (*Eumeces gilberti*), an NDOW species of conservation priority as well as Partners in Flight Priority Birds such as pinon jay (*Gymnorhinus cyanocephalus*) and gray vireo (*Vireo vicinior*) when doing prescribed burns in pinon-juniper habitat.
- 2.3.5 Prepare Integrated Pest Management Plan and associated NEPA compliance

Specially-designated Areas (Goal 3). Manage specially-designated areas such that they augment the purposes of the Desert Refuge.

Objective 3.1: Renegotiate the Memorandum of Understanding (MOU) with the U.S. Air Force by 2012.

Rationale: The U.S. Air Force effectively co-manages a portion of the Desert Range and a Memorandum of Understanding is in place that provides both agencies with specific directives for managing the resources on their respective portions of the Desert Range. The MOU enables a more effective and coordinated management of the unique wildlife and plant species and the wilderness character of the Desert Range. Public Law 106-65 requires the Service and the Air Force “. . . to extend the memorandum of understanding for a period that coincides with the duration of the withdrawal of the lands constituting Nellis Air Force Range . . .”. Amendments to the memorandum of understanding “. . .take effect 90 days after the date on which the Secretary of the Interior submits notice of such amendments to the Committees on Environment and Public Works, Energy and Natural Resources, and Armed Services of the Senate and the Committees on Resources and Armed Services of the House of Representatives.”.

Strategies

- 3.1.1 Work with the Air Force to update the MOU as required by Public Law 106-65.
- 3.1.2 Offer opportunities for the DOD staff and Refuge staff to cooperate more effectively through shared management, biological efforts, and site visits.
- 3.1.3 Maintain access restrictions on DOD-withdrawn lands.

Objective 3.2: Within three years of plan completion develop a research and management program to utilize the existing Research Natural Areas (RNAs) per Refuge System policy as test plots for research on habitat health and community succession.

Rationale: The five RNAs designated on the Desert Refuge have not been fully utilized as Refuge System policy prescribes. The purpose of RNAs is to allow natural processes to predominate without human intervention. Depending on the specific RNA, compatible recreation opportunities may be allowed within the RNA. To satisfy their purpose, the RNAs on the Desert Range could be employed as test plots for prescribed burn methodologies, as baseline experimental controls for fire management, and as baseline data plots for habitat restoration and habitat health research efforts. Additional resources will be needed to develop appropriate research protocols for these areas.

Strategies

- 3.2.1 Survey and rectify the RNA boundaries with accurate legal descriptions and ground markers.
- 3.2.2 Conduct photographic reconnaissance and documentation of all RNAs.
- 3.2.3 Use the RNAs as experimental control habitat/vegetation communities baseline data plots to assist in development and testing of habitat restoration methodologies.
- 3.2.4 Encourage academic and agency scientists to conduct non-manipulative research in the RNAs to support Refuge management.
- 3.2.5 Submit a request to the FWS Director to de-designate Papoose Lake RNA.

Objective 3.3: Protect and maintain the wilderness character of the proposed 1.37 million-acre Desert Wilderness Area. Within five years of plan completion, initiate discussions with the Air Force regarding a revised wilderness proposal which includes technical corrections such as: correcting overlaps with the bombing range; allowing repair or relocation of hazardous sections of road; and allowing the use of helicopters to repair and maintain water developments and access remote areas for wildlife surveys.

Rationale: In 1974, the President Nixon submitted a wilderness proposal to Congress recommending 1.4 million acres of the Desert Refuge be designated wilderness. Congress has never acted on the proposal. Since then, Refuge staff have been managing the areas to protect its wilderness values. Clarification of the status of the Desert Range area will allow long-term planning for the Refuge to proceed with more certainty.

Strategies

- 3.3.1 Prohibit all public motorized activities within the proposed wilderness unless authorized by stipulations in 1974 proposal or an approved minimum tool analysis, until Congress acts on the wilderness proposal.
- 3.3.2 Prepare a revised wilderness proposal which includes technical corrections such as: correcting overlaps with the bombing range; allowing repair or relocation of hazardous sections of road; and allowing the use of helicopters to repair and maintain water developments and access remote areas for wildlife surveys.

Visitor Services (Goal 4). Provide visitors with opportunities to understand, appreciate, and enjoy the fragile Mojave/Great Basin Desert ecosystem.

Objective 4.1: By 2010, provide quality environmental education and interpretive opportunities for the public accommodate up to 200,000 visits per year.

Rationale: The Refuge Improvement Act of 1997 identifies six priority public uses of the Refuge System (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) and encourages refuge managers to facilitate these uses when compatible with refuge purposes. Providing environmental education opportunities on and off the Desert Refuge is key to helping traditional and nontraditional user groups understand the importance of the Desert Refuge and its resources and can engender appreciation for all of the refuges in southern Nevada. A Refuge volunteer program is an effective way for Refuge staff to engage the public. Additional resources will be necessary to manage and monitor the compatible wildlife-dependent visitor activities accurately and effectively.

Strategies

- 4.1.1 Continue to coordinate promotion of the Refuge and operation of the Visitor Contact Station with the Southern Nevada Conservancy (SNC).
- 4.1.2 Utilize volunteers, as available, to provide interpretation and guidance to visitors at the visitor contact station in coordination with the Desert Complex outdoor recreation coordinator.
- 4.1.3 Continue to utilize SNIA volunteers to provide interpretation and environmental education programs for refuge visitors.
- 4.1.4 Create environmental education program using Southern Nevada Public Land Management Act (SNPLMA) funds.
- 4.1.5 Expand volunteer program on refuge with a target of staffing visitor contact station full time during peak use and 4 hours/day during other seasons.
- 4.1.6 Establish seasonal volunteer resident campground host/docent at Mormon Wells picnic area.
- 4.1.7 Develop cultural resources interpretive and environmental education materials in coordination with the Native American tribes.
- 4.1.8 Develop live “sheep cam” at water development and stream video through website and to visitor contact station/center. Apply for SNPLMA funds, or other appropriate sources to develop the webcam.
- 4.1.9 Develop and install interpretive panels and signs at designated entry point(s) (ex. the importance of Corn Creek as a migratory bird stop over site).
- 4.1.10 Complete planning, design, and construction of a visitor center and office space at Corn Creek.

Objective 4.2: Increase public awareness and appreciation of the Desert Refuge by participating in at least three local community events annually.

Rationale: Public outreach provides a way for the community to learn about the natural and cultural resources on the Desert Refuge and to encourage them to participate in recreational opportunities on the Refuge. Increasing participation in the number of local community events would allow Refuge staff to interact with the public and promote the Refuge.

Strategies

- 4.2.1 Develop and install a permanent environmental education/interpretive display at a prominent public venue such as McCarran International Airport
- 4.2.2 Conduct an annual public open house.
- 4.2.3 Develop and distribute a Desert Refuge video in the community.
- 4.2.4 Prepare and distribute an annual Congressional briefing summary.
- 4.2.5 Develop a quarterly Refuge newsletter.
- 4.2.6 Conduct annual surveys to measure program effectiveness.
- 4.2.7 Coordinate outreach activities with the Air Force, as appropriate

Objective 4.3: By 2011, provide opportunities, including adequate facilities, for up to 200,000 visitors per year visitors to view, photograph, and enjoy the Refuge's unique natural communities and wildlife during all seasons.

Rationale: The Refuge Improvement Act of 1997 identifies six priority public uses of the Refuge System (hunting, fishing, wildlife observation, photography, environmental education, and interpretation) and encourages refuge managers to facilitate these uses when compatible with refuge purposes. According to the Refuge Recreation Act of 1962 as amended, recreational uses on refuges must be compatible with the purpose(s) for which the refuge was established. Providing compatible wildlife-dependent recreational opportunities on the Desert Refuge is important to management of the resources because it aids in educating the public about the importance of preserving the natural environment.

Strategies

- 4.3.1 Maintain visitor facilities (Mormon Well and Alamo Roads, parking areas, camping areas, and picnic areas) in current condition and as staff and funding allow.
- 4.3.2 Maintain and replace regulatory, directional, and interpretive signs as needed and as staff and funding allow.
- 4.3.3 Evaluate potential sites and construct blinds for wildlife observation and photography.
- 4.3.4 Improve and maintain Mormon Well and Alamo Roads to fair condition based on the 2002 Refuge Road Inventory.
- 4.3.5 Map existing trails using GPS. Manage trails to ensure impacts to bighorn sheep and other wildlife are minimized.
- 4.3.6 Use post and cable fencing to designate specific parking turnouts along Alamo, Mormon Well and Gass Peak Roads.
- 4.3.7 Construct an entrance sign and information kiosk at the east end of Mormon Well Road.
- 4.3.8 Evaluate the impacts on staff and the management benefits resulting from implementation of a recreation-fee program.

Objective 4.4: In partnership with NDOW and the Air Force, provide safe opportunities for hunting bighorn sheep (*Ovis canadensis nelsoni*) on the Refuge.

Rationale: Hunting, one of the six priority public uses identified in the Refuge Improvement Act, has occurred on Desert Refuge since it was established in 1936. Sustainable hunting programs can

promote understanding and appreciation of natural resources and their management on lands and waters in the Refuge System.

The hunt program on Desert Refuge is administered by NDOW. The majority of the refuge is contained within six hunt units (280, 281, 282, 283, 284, and 286). During the 14 year period between 1992 and 2005, a total of 182 tags were issued for these units with an average of 13 per year. The average success over the same period was 61 percent. The tags issued on the Desert NWR hunt units represent about 10 percent of the 128 on average issued State-wide each year. In this objective, *safe* means that there are no hunting-related safety incidents.

Strategies

- 4.4.1 Maintain current hunting program.
- 4.4.2 Conduct annual surveys and reporting of game species population numbers and the number of hunters, and species harvested in coordination with NDOW.
- 4.4.3 Provide Refuge-specific and NDOW hunting guidelines and regulations material to the public at the Refuge Headquarters.
- 4.4.4 Post and maintain designated hunting area signs on Refuge and provide hunting information to the public through brochures, fact sheets, and maps.

Cultural and Historic Resources (Goal 5). Manage cultural resources for their educational, scientific, and traditional cultural values for the benefit of present and future generations of refuge users, communities, and culturally affiliated tribes.

Objective 5.1: Create and implement a basic Cultural Resources Management capability at Desert NWR Complex to respond to the basic compliance requirements of federal cultural resources legislation

Rationale: Cultural resources are a non-renewable resource and need to be protected and preserved on the Refuge. The extent of valuable cultural resources present on the Desert Refuge is relatively unknown but likely to be considerable given the vastness of the Refuge lands, the presence of springs and some riparian habitat and the diversity of desert vegetation communities that could have supported prehistoric and historic peoples. Little is known about cultural resources on the Desert Refuge; therefore, Refuge staff need to obtain additional resources to conduct the necessary surveys. Once these resources are evaluated, some of them may be included in the interpretation and education of the Desert Refuge to explain their importance to the public.

Strategies

- 5.1.1 Incorporate cultural resource values, issues, and requirements into design and implementation of the other habitat, wildlife, and public use activities and strategies conducted by the Desert NWR Complex.
- 5.1.2 Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near Desert NWR and create secure digital, GIS, and hard copy databases, maps, and library.
- 5.1.7 Communicate and consult with culturally affiliated Tribes, academic institutions, advocacy organizations, Agencies, and the Nevada SHPO for basic informational, compliance, research, and “government-to-government” purposes.

Objective 5.2: Create and implement a proactive historic preservation program in compliance with Section 110 of the National Historic Preservation Act (NHPA) on Desert NWR. This requires; inventory and evaluation of cultural resources on the Desert NWR for planning, scientific, educational, and preservation purposes, and mitigation of adverse impacts caused by erosion and deterioration at significant cultural resources.

Rationale: The cultural sites on the Refuge may currently be impacted by both vandalism and degradation from exposure to the natural elements. Additional resources are necessary to clean-up the littered and vandalized sites, stabilize eroded and deteriorated cultural features, and to monitor sites on a regular basis. The establishment of partnership and volunteer opportunities to assist in site restorations, stabilizations, and interpretation efforts would engender a sense of resource stewardship and increase compatible and productive types of interactions both on the Refuge and with the Refuge staff.

Strategies

- | | |
|-------|---|
| 5.2.1 | Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and Areas that would be affected by Refuge projects. |
| 5.2.2 | Inventory, evaluate, and nominate Traditional Cultural Properties and sacred sites to the National Register, in consultation with culturally affiliated Tribes and the Nevada SHPO. |
| 5.2.3 | Inventory, evaluate and mitigate adverse effects and stabilize samples of cultural resources on Desert NWR using a research design prepared in consultation with culturally affiliated Tribes and the scientific community. |
| 5.2.4 | Conduct a study of ethnobotany and traditional plant use at locations on Desert NWR in consultation with culturally affiliated Tribes. |
| 5.2.5 | Create a cultural resource layer in a NWR complex GIS database that aids in the identification, planning, monitoring, and interpretation of cultural sites. |
| 5.2.6 | Secure Refuge System and non-Refuge System funding to develop and implement a mitigation, stabilization, or research project. |

Objective 5.3: Manage cultural resources and cultural resource information for research, education, and interpretation in consultation with culturally affiliated Tribes and the public.

Rationale: Many sites on the Refuge may be considered sensitive due to cultural significance for Tribes and the public or susceptibility to damage from visitation. Cultural sites selected for interpretation should be the least sensitive as determined through best professional judgment of the Refuge manager after consultation with a Service archaeologist, culturally affiliated Tribes and the public. There are 451 recorded prehistoric sites on the Refuge; many of these are on lands administered by the U.S. Air Force. These include sites from virtually all categories and time periods, including campsites, lithic scatters, rock shelters, rock art, quarries, special activity sites, and multi-component sites (Fergusson and DuBarton 2003). The Refuge also contains two National Register Archeological Districts, the 620,000 acre Sheep Mountain District and the 1,000 acre Corn Creek Campsite District.

Strategies

- 5.3.1 Identify and evaluate cultural resources that can educate refuge users on how humans have interacted with wildlife and habitats in the past. Consult with culturally affiliated Tribes and other stakeholders on ways to use these resources to achieve educational, scientific, and traditional cultural needs.
- 5.3.2 Form partnerships with culturally affiliated Tribes and cultural interest organizations. Cultivate the Consolidated Group of Tribal Organizations to assist in the development of educational, scientific, and traditional cultural Refuge needs for cultural resource management.
- 5.3.3 Coordinate with the Consolidated Group of Tribal Organizations and the Nevada SHPO to identify potential critical/priority cultural sites on the non-military overlay of the Desert Refuge. Develop a cooperative program to survey and record these sites.
- 5.3.4 Work with culturally affiliated Tribes on projects to restore habitats of important native plants and to harvest (for traditional non-commercial purposes) native plant foods.
- 5.3.5 Coordinate with the Complex and Refuge recreation and education planners and programs to incorporate cultural resource information into education and interpretive programs and media.
- 5.3.6 Consult with culturally affiliated Tribes, the Nevada SHPO, and other stakeholders to design and implement educational materials, programs and activities that would be used to address traditional or sacred resources, and to increase awareness on- and off-Refuge about the sensitivity of cultural resources to visitor impacts and the penalties for vandalism.

Objective 5.4: Protect cultural resources by decreasing or preventing looting, vandalism, and deterioration.

Rationale: Protecting Refuge cultural sites will benefit the public by providing them with information on historic human uses of Refuge lands and the importance of preserving the Refuge land and its unique cultural resources. All of the cultural resource sites on the Refuge are currently susceptible to vandalism. Vandalism is likely to increase as Refuge visitation increases with the growing regional and local population. This would result in damage or destruction of non-renewable cultural resources, preventing those resources from being enjoyed by future generations of Americans. Additionally, the establishment of partnership and volunteer opportunities to assist in site restorations, stabilizations, and interpretation efforts would engender a sense of resource stewardship and increase compatible and productive types of interactions both on the Refuge and with the Refuge staff. This objective assumes that Objective 5.1 is adopted.

Strategies

- 5.4.1 Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration and implement steps, including barriers and signs to reduce these threats and preserve the resources
- 5.4.2 Coordinate with the Regional Office, the Nevada State Historic Preservation Office, the DOD, culturally affiliated tribes, special interest groups, and neighboring land management agencies to support cultural resources monitoring and enforcement activities and to decrease impacts to cultural resources.
- 5.4.3 Coordinate future research, management, and planning on cultural resources with culturally affiliated tribes, the Consolidated Group of Tribal Organizations, the Nevada State Historic Preservation Office, neighboring land management agencies, and other special interest groups.

5.4.4 Coordinate with existing site stewardship volunteer program to assist in site monitoring, delivery of educational and interpretive literature and programs, and to promote cultural resources conservation in the region.

Moapa Valley National Wildlife Refuge

Endemic and Special Status Species (Goal 1). Protect and restore, when possible, healthy populations of endemic and special status species, such as the endangered Moapa dace, within the Muddy River headwaters.

Objective 1.1: Complete the restoration of the springheads and outflow channels on the the Pedersen Unit by 2009 and on the Apcar Unit by 2015 where: water temperatures are maintained at 30-32 °C (86-89.6 °F), flows range from 0.3-1.0 m/s, native plant communities include herbaceous plants [e.g. *Chara* and other algae, waternymph (*Najas sp.*), watercress (*Nasturtium sp.*), spikerush (*Eleocharis sp.*), sedges (*Carex sp.*) and grasses] in and surrounding spring sources, and herbaceous and woody communities [e.g. velvet ash (*Fraxinus velutina*), Cottonwood (*Populus sp.*), willow (*Salix spp.*), screwbean mesquite (*Prosopis pubescens*) and understory sedges (*Carex sp.*)] near larger channels and other water parameters are within acceptable levels for Moapa dace (3.4-8.4 mg/L dissolved oxygen, 606-867 mg/L total dissolved solids and pH of 7.1-7.9).

Rationale: The endangered Moapa dace (*Moapa coriacea*) depends on the health and integrity of the local hydrologic system to survive. Suitable Moapa dace habitat consists of: consistent springhead and outflow channel water temperature in the range of 30-32°C (86-89.6 °F), water velocity of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9 (USFWS 1995). Suitable native plant communities vary from areas surrounding spring source and small outflow areas including *Chara spp.* and other algae, waternymph (*Najas sp.*), watercress (*Nasturtium sp.*), spikerush (*Eleocharis sp.*), sedges (*Carex sp.*) and grasses to communities lining larger channels including velvet ash (*Fraxinus velutina*), willow (*Salix spp.*), screwbean mesquite (*Prosopis pubescens*) and understory sedges (*Carex sp.*) (USFWS 1981). Non-native plants, in particular non-native palm trees such as *Washingtonia filifera* and *Phoenix dactylifera*, have largely replaced native plant communities surrounding spring heads and outflow channels, degrading aquatic habitat and crowding out desirable native plant species (SWCA 2004). Restoration of historic hydrology and native plant communities should not only favor Moapa dace and other native species (Moapa White River springfish, Moapa pebblesnail, grated tryponia, Moapa warm spring riffle beetle, Amargosa naucorid, and Moapa naucorid), but should also discourage non-native fish species such as Tilapia (*Oreochromis aureus*) which energetically favor lower flow, lentic systems (Scoppettone 2006). Non-native mosquito fish (*Gambusia affinis*) will likely continue to co-exist in springhead and outflow channels even after habitat restoration and will require additional effort for control or eradication. Coordinated planning and implementation of Moapa dace habitat improvement strategies will benefit other resident and migratory bird species that also rely on the Refuge springs and streams.

Lowland riparian habitat is important for many ESA listed or species of concern that occur on the Refuge including the southwest willow flycatcher (*Empidonax traillii extimus*), vermilion flycatcher (*Pyrocephalus rubinus*), Phainopepla (*Phainopepla nitens*), long-eared myotis (*Myotis evotis*) as well as many other migratory birds and resident animals (Recon 2000). Completing restoration of the lowland riparian habitat on the Plummer, Pedersen and Apcar units will support the Nevada Steering Committee Intermountain West Joint Venture (NSCIWJV) Priority A objective for lowland riparian habitat to "Permanently protect and/or restore 300 linear miles of lowland riparian habitat in Nevada" (NSCIWJV 2005). Lowland riparian habitat is quite limited in the region and restoring this important lowland riparian habitat will contribute to the biological integrity, diversity and environmental health of the surrounding region and the National Wildlife Refuge System as a whole. Restoring spring systems as outlined in this objective is consistent with the first recovery action

recommended by the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996). Additional resources are vital to achieve the objectives defined in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996).

Strategies

- 1.1.1 Continue channel restoration on the Pedersen Unit by planting native species.
- 1.1.2 Complete restoration of the spring heads and channels on Apcar Unit.
- 1.1.3 Restore native overstory, mid-level and understory vegetation (using local seed and/or seedlings) to riparian corridors, transitional upland sites and any disturbed or newly exposed areas.
- 1.1.4 Consider habitat needs of other special status fish and invertebrates when designing and implementing restoration projects (Moapa White River springfish, Moapa pebblesnail, grated tryponia, Moapa warm spring riffle beetle, Amargosa naucorid, and Moapa naucorid)
- 1.1.5 Monitor streams before and after rehabilitation, to determine benefits or detriments to endemic fish and invertebrate populations.
- 1.1.6 Continue to solicit and utilize volunteers to assist with habitat restoration projects.
- 1.1.7 Coordinate with BLM for local seed collection and National Park Service for germination/production of native species.
- 1.1.8 Develop strategies to remove non-native fish species, including mollies and mosquito fish, from Refuge streams in coordination with the USFWS Endangered Species program and NDOW.
- 1.1.9 Maintain restored habitat after restoration activities are completed

Objective 1.2: Continue to conduct annual surveys and monitoring of Moapa dace (*Moapa coriacea*) and annual surveys of Moapa White River springfish (*Crenichthys baileyi moapae*).

Rationale: Critical monitoring of Moapa dace (*Moapa coriacea*) and snorkel surveys of Moapa White River springfish (*Crenichthys baileyi moapae*) have been conducted annually although uncertainty exists about long-term staff levels. Collecting regular monitoring data on Moapa dace and their habitats within the Refuge is vital to achieve the Refuge purposes, for staff to properly conserve and manage Refuge resources and to develop visitor use opportunities in the future. Annual monitoring of Moapa dace is recommended as recovery action number two in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996). Moapa White River springfish is a species of concern that requires monitoring on the Refuge to assess long-term population trends.

Strategies

- 1.2.1 Coordinate with USFWS Endangered Species program and NDOW for technical and financial assistance with inventories and monitoring of listed fish species and fish species of concern.
- 1.2.2 Inventory Refuge habitat consistent with the Moapa Dace Recovery Plan
- 1.2.3 Develop a GIS-enabled species inventory program, beginning with Moapa dace inventory data.
- 1.2.4 Develop and implement an inventory and monitoring plan for listed fish species and fish species of concern.
- 1.2.5 Model climate change impact scenarios and develop adaptation strategies

Objective 1.3: Collect monthly monitoring data for water flow and temperature of Pedersen and Pedersen East springs and Warm Springs West flume and collect monthly monitoring data for water quality parameters including temperature, flow, dissolved oxygen, pH and total dissolved solids at other Refuge springs as needed by 2009.

Rationale: The springs and outflow channels provide habitat for resident birds, reptiles, amphibians, mammals and migratory bird species. Many factors have historically affected water levels and water quality, including on and off Refuge human impacts from resource developments as well as natural climatic conditions. Water resource impacts will be ongoing considerations during planning and management of finite water resources. Preventing deleterious changes in the condition of water resources is critical to fulfilling the Refuge purposes, thus they require constant and increasing monitoring efforts. Increasing and diversifying monitoring efforts will provide timely direction and guidance to Refuge staff as they continue habitat enhancement and restoration and investigate the potential for visitor use opportunities. Water quality characteristics suitable for Moapa dace (*Moapa coriacea*): springhead and outflow channel temperatures of 30-32 °C (86-89.6 °F), flows of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9 (USFWS 1995) are a target for suitable habitat and a baseline for assessing significant changes from suitability that may require mitigation.

Strategies

- 1.3.1 Participate in local and regional water resource management efforts to assess impacts and to protect water resources on the Refuge.
- 1.3.2 Participate in the Muddy River Regional water monitoring planning process.
- 1.3.3 Coordinate with Regional Office hydrology staff, USFWS Endangered Species program, USGS, Moapa Valley Water District, and other entities as appropriate to share monitoring data and maintain monitoring equipment and sites.
- 1.3.4 Collect monthly monitoring data for water flow and temperature of Pedersen and Pedersen East springs and Warm Springs West flume and collect monthly monitoring data for water quality parameters including temperature, flow, dissolved oxygen, pH and total dissolved solids at other Refuge springs as needed.
- 1.3.5 Develop a long-term water resources management plan for the Refuge by 2011.
- 1.3.6 Obtain basic water quality data collected by other agencies; share data with other agencies
- 1.3.7 Purchase and install equipment.
- 1.3.8 Continue monitoring water quality parameters if other agencies stop.
- 1.3.9 Determine appropriate equipment needs and monitoring site locations within each spring area.
- 1.3.10 Determine appropriate water quality parameters to be measured in coordination with Regional Office hydrology staff and Moapa dace fish biologists.

Objective 1.4: Protect and maintain historic natural habitat including water quality and quantity in the Refuge springs and channels suitable for Moapa dace (*Moapa coriacea*) survival, reproduction and recruitment: springhead and outflow channel temperatures of 30-32°C (86-89.6 °F), flows of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9.

Rationale: Protection of existing, enhanced, and restored/created Moapa dace (*Moapa coriacea*) habitat is a fundamental component of the recovery and conservation of this species (USFWS 1983). Threats to Moapa dace and their habitat occur on and off Refuge and include fire, floods, recreational/commercial/agricultural developments, water resources development, invasive species encroachment, vandalism and visitor activities. Suitable water quality required for Moapa dace includes: consistent springhead and outflow channel water temperature in the range of 30-32°C (86-89.6 °F), water velocity of 0.3-1.0 m/s, dissolved oxygen of 3.4-8.4 mg/L, total dissolved solids of 606-867 mg/L and pH of 7.1-7.9 (USFWS 1995). Maintaining adequate water quality will also require ongoing control of non-native invasive plants within corridors surrounding springheads and outflow channels (SWCA 2004). In order to achieve this objective, efforts will need to be comprehensive and range from increasing public knowledge of the fragility and uniqueness of the Refuge ecosystem to improving signs, developing visitor access infrastructure and dismantling over 40 years of pre-Refuge resort-related infrastructure.

Strategies

- 1.4.1 Maintain existing boundary fencing and gates, and replace as needed.
- 1.4.2 Maintain regulatory signs on the Refuge in good condition and replace as needed.
- 1.4.3 Remove dead fan palm fronds and thin the underbrush and overgrowth as needed to reduce risk of fire
- 1.4.4 Extinguished unwanted fires as fast as safely possible in order to minimize potential negative impacts to Moapa dace.
- 1.4.5 Continue periodic removal of nonnative aquatic species
- 1.4.6 Develop and implement an Integrated Pest Management Plan to control and eradicate invasive species encroachment.
- 1.4.7 Use prescribed fire where appropriate to reduce hazardous fuels and treat unwanted vegetation.
- 1.4.8 Participate in community based fire safe planning both on and off the Refuge. Explore other options for protecting the Refuge from fire.
- 1.4.9 Develop regulatory, directional, interpretative signs and materials, such as brochures and fact sheets, to guide and enhance the visitor experience.
- 1.4.10 Monitor habitat changes, maintain and continue improvements for restoration efforts and other landscape improvements, and provide adequate level of monitoring and maintenance for invasive species control and fire management.
- 1.4.11 Work with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
- 1.4.12 Continue to participate in the Muddy River Recovery Implementation Program and the Biological Advisory Committee

Objective 1.5: Within five years of the CCP's approval, conduct baseline inventories of federally listed, proposed, candidate and species of concern on the refuge; conduct baseline inventories of aquatic habitat for invertebrates and amphibians to determine species composition and abundance; and inventory existing upland habitat for migratory birds, mammals, and reptiles.

Rationale: Collecting data on the species and their habitats within the Refuge is vital to achieve the Refuge purposes, for staff to properly conserve and manage Refuge resources and to develop visitor use opportunities in the future. A comprehensive understanding of the diversity, presence and habitat

needs of wildlife species is currently lacking. To date, species inventories on the Refuge have been limited by limited staff availability. Inventories have only been conducted on a project-by-project basis. Additional resources will be needed to fulfill this objective.

Strategies

- 1.5.1 Conduct baseline inventories of federally listed, proposed, candidate and species of concern on the refuge; conduct baseline inventories of aquatic habitat for invertebrates and amphibians to determine species composition and abundance; and inventory existing upland habitat for migratory birds, mammals, and reptiles.
- 1.5.2 Coordinate with USFWS Endangered Species program and NDOW for technical and financial assistance with species inventories and monitoring.
- 1.5.3 Repeat inventories every 5 years to track long term trends in community composition.
- 1.5.4 Develop a GIS-enabled species inventory program.
- 1.5.5 Develop a long-term inventory and monitoring plan for federally listed, proposed, candidate and species of concern on the Refuge
- 1.5.6 Coordinate with NDOW to conduct surveys for the presence and use of fan palm habitat by migratory and resident bat species.

Objective 1.6: Work with partners to protect 1,765 acres of habitat within the Muddy River Headwaters area for the Moapa dace and other special status species.

Rationale: Protection of the lands considered would fulfill the habitat criterion of the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (Recovery Plan) (USFWS 1995). The proposed expansion area includes about 1,665 acres of spring, riverine, riparian, wetland, and mesquite bosque habitats land adjacent to the Refuge that are occupied by species listed as threatened or endangered under the Endangered Species Act of 1973, The proposed expansion area also contains other species of concern including yellow-billed cuckoo, and southwestern willow flycatcher. The proposed project provides opportunities for Federal, Tribal, State, and local government partnerships with private property owners. These partnerships are the basis for achieving mutual conservation goals while maintaining the rural lifestyle and economic vitality of the Moapa Valley.

Strategies

- 1.6.1 Expand the Refuge Acquisition Boundary by 1,765 acres and work with partners to protect habitat within the expanded boundary through purchase, transfer, and/or agreement (see Land Protection Plan, Appendix L)
- 1.6. Prepare step down habitat management plan for lands acquired within the expansion area.

Visitor Services (Goal 2). Provide opportunities for local communities and others enjoy and learn about the resources of Moapa Valley NWR and participate in its restoration.

Objective 2.1: Open the refuge to the general public every day for interpretive self-guided or Refuge staff guided tours with a capacity of up to 1,000 visits annually and continue providing opportunities for volunteers to assist in habitat restoration projects with oversight from Refuge staff.

Rationale: The sensitivity of the natural resources on the Refuge to visitor impacts is an issue that must be evaluated prior to opening the Refuge to the general public and monitored after any additional visitation policy changes. Appropriate interpretive and educational materials should be developed and provided to the local communities and area schools to increase people's awareness and minimize impacts to fragile Refuge habitats and restoration efforts. The Refuge grounds are currently unsafe for the general public due to the deteriorating condition of pre-Refuge, resort related structures, the lack of visitor use facilities such as potable water and shade structures and the lack of staff to plan for, coordinate and supervise wildlife-dependent recreation activities. Opening the Refuge to the public will increase their understanding and appreciation of the unique endemic wildlife species and other resident and migratory species found in the Warm Springs area. Guided tours along designated trail routes would allow visitors to enjoy the Refuge resources while limiting disturbance to riparian habitat. Visitors would also benefit from interactions with knowledgeable staff. Providing public information and education is recommended as recovery action number four in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996). Additional resources will be required to achieve this objective.

Strategies

- 2.1.1 Complete volunteer needs assessment, create position descriptions, and coordinate with outdoor recreation planner to recruit, hire, and train volunteers
- 2.1.2 Continue participation in local community events (e.g., Clark County Fair, Moapa Day Celebration, Earth Day) as staff and funding allow.
- 2.1.4 Organize local school contacts to generate enthusiasm for the Refuge and its endemic species.
- 2.1.5 Develop one environmental education program at the Refuge by 2009.
- 2.1.6 Develop interpretive and environmental education materials.
- 2.1.7 Work with NDOT to erect signs on Interstate-15 and US-93 promoting the Refuge and directing the public to the Refuge.
- 2.1.8 Erect a Refuge entrance sign near Warm Springs Road.
- 2.1.9 Plan and construct a self-guided trail system along the spring head, pools and riparian corridor on the Plummer and Pedersen Units
- 2.1.10 Conduct an annual public open house to encourage interactions and foster relationships between Refuge staff and the local community.
- 2.1.11 Coordinate with Desert Complex Outdoor Recreation Coordinator to recruit docents to staff the Refuge and to facilitate visitor interpretative tours.
- 2.1.12 Monitor the number of refuge visitors.
- 2.1.13 Seek opportunities for community based outreach, such as participation in off Refuge activities.

- 2.1.14 Develop regionally focused cultural resources environmental education and interpretation materials for self guided tours.
- 2.1.16 Confer with the Moapa Band of Paiutes to incorporate their history and native plant and animal species knowledge as part of the interpretive program at the Refuge.
- 2.1.17 Coordinate the installation of a permanent environmental education display at the Moapa Valley Community Center or other suitable public venue
- 2.1.18 Construct an overlook trail with interpretive panels and shade structure on top of the hill on the Plummer unit for viewing the Refuge and the Moapa Valley.
- 2.1.19 Design and install new interpretive panels.

Pahrnagat National Wildlife Refuge

Wetland Habitat (Goal 1). Restore and maintain wetland habitat for waterfowl and other migratory birds with an emphasis on spring and fall migration feeding and resting habitat requirements.

Objective 1.1: By 2012, complete and implement a habitat restoration and management plan for Pahrnagat NWR.

Rationale: The Pahrnagat Valley, originally inhabited by Native Americans, began to be farmed in the 1850's when pioneers arrived in the area. The past 150 years of human activity have dramatically altered ecological and hydrological functioning of the valley. On the Refuge, most of the remaining dams, levees, dikes and irrigation ditches currently in use were constructed over 50 years ago when the area was an active farm.

Where the Refuge now sits, the wetlands are degraded and no longer support a diverse aquatic community including the Federally endangered Pahrnagat roundtail chub (*Gila robusta jordani*) that once inhabited the lakes, streams and springs on the Refuge. With fewer than 6 individuals of this fish species surviving in the wild and approximately 2,000 in a refugium on the State of Nevada's Key Pittman Wildlife Management Area (Nevada Department of Wildlife 2006), establishing a second refugium population on the Refuge is an important step towards saving the species from extinction. Additionally, much of the habitat for migratory waterfowl and the Federally endangered southwestern willow flycatcher (*Empidonas traillii extimus*) are showing signs of senescence and have an increased risk of fire (Maxwell pers. obsrv.).

Active long-term management is needed to bring the lakes and wetlands on the Refuge to a healthy state that can support diverse aquatic and terrestrial communities. Today, the North Marsh and Upper Lake are contaminated with pesticides and heavy metals from agricultural runoff entering upstream. A population of non-native common carp (*Cyprinus carpio*) limits the development of emergent wetland vegetation keeping the lake ecosystem in a continuous, disturbed, early successional state characterized by high turbidity.

In 1995 the U.S. Fish and Wildlife Service initiated a study to describe and quantify contaminants that might be impacting endangered species, species of concern, migratory birds and Service Lands. Results from the study suggest that water quality may be a limiting factor for endemic fishes and that elevated selenium, arsenic and boron in aquatic vegetation and in aquatic invertebrates may represent a concern for aquatic birds (Tuttle et al. 1999).

Currently there is a need to reevaluate Refuge operations and develop resource management strategies to restore and provide for long-term ecosystem health. In 2006, the Service received approval for a Pre-Proposal Planning request under the Southern Nevada Public Land Management Act to develop a comprehensive management vision for the Refuge using wetlands hydrology and biology to guide planning and management decisions. This plan, which was initiated in 2008, will integrate many different aspects of Refuge operations and encompass resource conservation and protection, recreation, environmental education and public safety.

Strategies

- 1.1.1 Inventory biological and hydrological resources to inform the planning and design of the wetlands restoration
- 1.1.2 Acquire and process satellite imagery and elevation modeling to prepare engineering plans for the wetlands restoration;
- 1.1.3 Plan and design wetlands restoration at the Refuge that will improve existing water quality, water control and conveyance structures and ensure water use is compatible with public safety, Refuge purposes and biological resource management goals
- 1.1.4 Prepare a long-term integrated wetlands management plan that provides an overall management framework for resource conservation, recreation and public safety. This plan will outline specific maintenance tasks and a schedule that spans a 20 year period
- 1.1.5 Plan and design a refugium and public viewing chamber for the endangered Pahrana gat roundtail chub
- 1.1.6 Hire a term project manager and a term project biologist to oversee and coordinate all project activities
- 1.1.7 Inventory biological and hydrological resources to inform the planning and design of the wetlands restoration
- 1.1.8 Model climate change impact scenarios and develop adaptation strategies

Objective 1.1: Until the restoration and management plan is completed and implemented, manage the 640 acres of open water in North Marsh/Upper Pahrana gat Lake to optimize the growth of submerged aquatic vegetation as foraging habitat for waterfowl while using the water primarily to manage habitats downstream.

Rationale: Several species of waterfowl require open water for resting and foraging during their annual migrations. Because of the importance of open water for insects, many species of birds and bats forage over open water. Open water habitats are also particularly important to nesting and staging grebes, and as foraging sites for fish-eating waterbirds (Ivey and Herziger 2005).

Currently, the quality of waterfowl habitat in Upper Lake and North Marsh is limited due to the lack of submerged aquatic vegetation. Non-native carp (*Cyprinus carpio*) uproot aquatic vegetation when spawning and feeding and suspend benthic sediments resulting in limited light for plant growth. Upper Pahrana gat Lake draw downs in spring and summer would promote the growth of submerged aquatic vegetation, by warming soils and increasing available sunlight. In addition, draw downs during peak spring migration would benefit migrating shorebirds and other migratory birds. Since no inflow is currently available during the summer, water is stored in Upper Pahrana gat Lake at a level of between 4 feet in October and 11 feet in April to maintain the sport bass fishery and water is released into areas south of Upper Pahrana gat Lake including Middle Marsh and Lower Pahrana gat Lake to provide waterfowl habitat during spring and fall migrations. Draw downs are likely to reduce warm water sport fisheries in Upper Pahrana gat Lake. A comprehensive Refuge water budget and an evaluation of different habitat management strategies is planned to formulate options for improving open water habitat for waterfowl, waterbirds, shorebirds and other migratory birds and to develop alternative management strategies for relatively wet and dry years. In addition the two levees that maintain water levels in Upper Pahrana gat Lake may pose a threat to human safety, as they are

compromised by vegetation and leaks due to the exclusive use of gravels and rock to maintain the levees.

Pahranagat NWR is a Focal Area for the lake and reservoir ecological systems in Nevada's Comprehensive Wildlife Conservation Strategy (CWCS). This CCP objective directly addresses the CWCS objective to "Manage lakes and reservoirs to benefit associated fish and wildlife, and meet population objectives established in regional plans" (NDOW 2006). Scattered patches of cottonwoods (*Populus fremontii*) on the Refuge provide some of the last remaining habitat where the yellow-billed cuckoo (*Coccyzus americanus*), a species of conservation priority, can be found (NDOW 2006). While the yellow-billed cuckoo was thought likely to be present, its presence on the Refuge was not documented until July, 2006 (Maxwell per. comm. 2006). Many other bird species that are endangered, threatened or of concern also regularly utilize habitat on the Refuge. The rarity and isolation of lakes in the Mojave Desert makes the lakes on the Refuge of great importance for wildlife (NDOW 2006).

Strategies

1.1.2	Discharge water into Middle Marsh and Lower Pahranagat Lake to provide migratory waterfowl habitat during spring and fall.
1.1.3	Initiate annual clearing of irrigation ditches by all available methods.
1.1.4	Draw down water levels in Upper Lake in summer to control carp and encourage growth of submerged aquatic vegetation.
1.1.5	Manage carp populations
1.1.6	Collect surface water data from the Upper Pahranagat Lake flume if additional staff becomes available.
1.1.7	Continue current maintenance, repair, and improvement efforts on North Marsh and Upper Pahranagat Lake appurtenances.
1.1.8	Encourage the routine reduction of carp populations on private and state-managed lands through coordination with upstream water resources management entities and users.
1.1.9	Implement a geotechnical engineering study of Upper Pahranagat Lake to evaluate levee integrity and water loss through the lake bottom.
1.1.10	Continue regular monitoring and reporting for structural integrity of the North Marsh levee and Upper Pahranagat Lake dam.
1.1.11	Develop a rainfall-runoff analysis for Upper Pahranagat Lake to support management decisions on lake capacity and species and habitat enhancements.
1.1.12	Monitor carp populations and submerged aquatic plant species health using GIS tools, with the assistance of NDOW.
1.1.13	Develop and implement a habitat management plan to improve quality of existing open water habitat for waterfowl, waterbirds, shorebirds and other migratory birds.
1.1.14	Every three years, conduct surveys of nesting colonial waterbirds (great blue heron, black-crowned night heron, western grebe) (from Ivey and Herziger 2005).

Objective 1.2: Maintain seasonal flooding in marshes fringing Middle Marsh and North Marsh with a target ratio of 60 percent open water and 40 percent emergent vegetation, including hard-stemmed bulrush (*Scirpus acutus*), cattail (*Typha domingensis*) and other vegetation to support waterfowl.

Rationale: Marshes are some of the most diverse and productive wildlife habitats in Nevada. They are critical to both breeding and migratory resting and forage needs of many species of birds. Seven bat species of concern may occur in and around marsh habitat on the Refuge (see Appendix G). The Pahrnagat Refuge protects about 10 percent of this relatively rare habitat in the Mojave Desert portion of Nevada. Dabbling ducks prefer to feed in shallow water, between 2 to 10 inches deep, with an equal ratio of open water and emergent vegetation (Fredrickson and Reid 1988). Deeper water habitats provide foraging sites for diving ducks. This range of wetland and aquatic habitat, equally interspersed with tall emergent vegetation such as cattail and hardstem bulrush, provides excellent cover and loafing habitat for a variety of waterfowl. A variety of strategies are available to reduce decadent vegetation and increase open water habitat for migratory birds, while simultaneously providing sufficient foraging and nesting habitat around the edges of open water. Pahrnagat Refuge is listed as a Focal Area for the marsh habitat type in Nevada’s Comprehensive Wildlife Conservation Strategy (NDOW 2005). Implementation of this objective and its supporting strategies help meet CWCS and Intermountain West Joint Venture objectives for wetland management and protection (NDOW 2005, Ivey and Herziger 2005).

Strategies

- 1.2.1 Use prescribed fire, mechanical, and chemical methods to control vegetation as needed.
- 1.2.2 Supplement flows into Middle Marsh with pumped well water to help maintain water levels.
- 1.2.3 Every three years, coordinate surveys of birds and bats

Objective 1.3: Until the restoration and management plan is completed and implemented, maintain approximately 700 acres of wet meadow habitat north of the Middle Marsh; including Baltic rush (*Juncus balticus*), saltgrass (*Distichlis spicata*) and yerba mansa (*Anemopsis californica*) and grassland habitat in a diversity of successional stages to provide foraging and nesting habitat for migratory waterfowl such as Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), pintail (*Anas acuta*), teal (*Anas spp.*) and greater sandhill crane (*Grus canadensis tabida*).

Rationale: The Refuge meadow and grassland habitats support a variety of waterfowl, and other birds during fall and spring migrations. There is also some use of the wet meadow habitat for nesting and by mallards, gadwall, and cinnamon teal (*Anas cyanoptera*). The Pahrnagat Valley montane vole (*Microtus montanus fucosus*) is a BLM Nevada State Sensitive species and a Nevada Species of Conservation Priority (NDOW 2005) endemic to the Pahrnagat Valley which also occurs in wet meadow, alkaline and grassland plant communities. The vole occupies shallow burrows and surface runways and eats grasses, sedges, and a wide variety of forbs (NDOW 2005). Providing a variety of successional stages in these communities greatly increases the variety of birds that can use them. For example, short grass habitat in recently burned areas provides forage for sandhill cranes and geese while areas with tall grasses provide nesting habitat for waterfowl. Implementation of this objective will help meet the Nevada CWCS goal for wet meadow habitat and conservation priority species, to achieve: “Thriving self-sustaining wildlife populations in healthy plant communities on saturated soils maintained by high water tables; residual plant cover maintained to meet the life history needs of species dependent on this habitat type.” (NDOW 2005).

Strategies

- 1.3.1 Use prescribed fire and mowing as needed to maintain productivity
- 1.3.2 Investigate methods to increase efficiency of water delivery from Upper Lake.

- 1.3.3 Conduct spring waterfowl surveys using volunteers and refuge staff.
- 1.3.4 Continue to coordinate with NDOW for fall and winter waterfowl surveys, to support ongoing monitoring and research.
- 1.3.5 Obtain waterfowl data collected by other agencies on a seasonal basis.
- 1.3.6 Continue limited IPM efforts in existing 112-acre grassland habitat to contain spread by knapweed and reduce its extent.
- 1.3.7 Continue project to determine population status, distribution and demography of Pahrnagat Valley montane vole
- 1.3.8 Add spring and fall surveys and breeding pair and brood counts to current fall and winter surveys
- 1.3.9 Monitor avian species abundance during fall and spring migration for response to habitat manipulation

Objective 1.4 Until the restoration and management plan is completed and implemented, maintain approximately 350 acres of alkali flat habitat including saltgrass (*Distichlis spicata*) and alkali sacaton (*Sporobolus airoides*) dominated plant communities, flooded from for 0 to 1.5 feet for breeding and migrating waterfowl, waterbirds and shorebirds including: avocet (*Recurvirostra americana*), black necked stilt (*Himantopus mexicanus*), grebe (*Aechmophorus spp.*, *Podiceps spp.*), mallard (*Anas platyrhynchos*), green-wing teal (*Anas crecca*), gadwall (*Anas strepera*) and redhead (*Aythya americana*).

Rationale: About a million shorebirds breed in the Intermountain West and millions more migrate through the area each year (Oring et. al. 2000). Lower Pahrnagat Lake provides important habitat for shorebirds, dabbling ducks, grebes and other waterbirds. During wet years, when water persists on the alkali flats through early summer, Avocet, black necked stilt and green-wing teal have been observed using the habitat for breeding. Nevada’s marshes have astonishing capability to produce prolific populations of macro invertebrates that provide food resources for migratory birds, resident fish, shorebirds and small water birds. Hundreds of thousands of shorebirds migrate north and south through Nevada annually and are dependent on the availability of these high quality invertebrate stocks to enhance fat reserves critical to reaching their breeding and wintering destinations.

Strategies

- 1.4.1 Control salt cedar and other invasive species near Lower Pahrnagat Lake and the Pahrnagat Wash/Lower Lake area and restore Lower Pahrnagat Lake edge with native plant species.
- 1.4.3 Develop and implement a species inventory and monitoring plan to identify species composition, relative abundance, seasonality, health and distribution of waterfowl, waterbirds and shorebirds as staff and funding become available.

Objective 1.5: By 2020, protect and maintain existing water supplies, pursue additional water rights, and maintain and improve management and use of surface and groundwater by repairing, or removing infrastructure to restore and improve the water delivery and storage system. Update and implement the Water Resources Management Plan for the Refuge by 2009.

Rationale: Pahrnagat Refuge encompasses one of the most significant wetland habitats in southern Nevada and is an important resting site for waterfowl, waterbirds, shorebirds and other migratory birds along the Pacific Flyway. Additionally, the Refuge purpose and past management plans mandate

the conservation and enhancement of these wetlands for migratory waterfowl and other birds. To fulfill the Refuge purpose, water resources should be managed to restore native habitats for waterfowl, waterbirds, shorebirds and other migratory birds. To date, staffing and other resources have been inadequately allocated to fully realize this mandate. Refuge surface and groundwater resources must be inventoried and opportunities for obtaining additional water must be assessed. Furthermore, the staffing and funding necessary to fulfill these goals must be secured. Additional water supplies and/or the restoration of water diversion systems from seasonal to year-round would improve waterfowl breeding habitat and fisheries during the dry summer months, create opportunities for managing aquatic vegetation through manipulation of water levels, support irrigation of grasslands and grain crops that provide forage for migratory waterfowl and upland birds such as sandhill cranes, and help to restore riparian habitats crucial to the survival of the endangered Southwestern willow flycatcher and other riparian dependant breeding and migrant song birds.

Strategies

- 1.5.1 Monitor water inflow at Upper Pahrnagat Lake to support water rights.
- 1.5.2 Pursue 1996 application to the Nevada Division of Water Resources (DWR) for year-round water discharges.
- 1.5.3 Survey existing groundwater wells and repair or cap as appropriate.
- 1.5.4 Install a new pump in Well No. 3 and monitor for flow to document beneficial use of allocation and support the water right.
- 1.5.5 Install a flume or weir at the outflow of Lower Pahrnagat Lake to assist in development of the water budget.
- 1.5.6 Install and monitor flow meters and data loggers on each of the three groundwater wells located on the Refuge.
- 1.5.7 Complete a Refuge-wide water budget
- 1.5.8 Install gages and data logging equipment at springs adjacent to Middle Marsh.
- 1.5.9 Maintain water rights through annual reporting of beneficial use of allocation to the Nevada State Engineer.
- 1.5.10 Repair existing water infrastructure as staffing and funding allow.
- 1.5.11 Determine the status of groundwater wells of record, and repair and/or abandon as appropriate, and apply for change(s) in point of use with Nevada Division of Water Resources.
- 1.5.12 Determine the appropriate water restoration delivery system changes, prioritize restoration and develop an implementation strategy
- 1.5.13 Work with the State Engineer to defend water rights and mitigate substantial changes in temperature or flow
- 1.5.14 Acquire additional water rights from willing sellers.

Objective 1.6: By 2012, assess the needs of sandhill crane use between Upper Pahrnagat Lake and Middle Marsh to determine the foraging and roosting habitat needs for migrating sandhill cranes (*Grus canadensis*).

Rationale: Pahrnagat NWR is one of two known migration staging areas for the Lower Colorado River Valley (LCRV) population of greater sandhill cranes (*Grus canadensis tabida*). Anecdotal

reports suggest that in 2003 and 2004 migrating sandhill cranes remained on the Refuge for less than 24 hours but in 2006 sandhill cranes remained in the Middle Marsh area for approximately 30 days (Maxwell per. comm.). During the 1990's, almost 25 percent of the Lower Colorado River population used the Refuge. The longer stopover may be related to the availability of grain crops in previous years that are no longer being provided on the Refuge. Native grasslands on the Refuge could provide better foraging and resting habitat for migrating cranes and thus contribute to their overall survival. In addition, upland game hunting must be accessed during fall migration in order to understand the possible disturbance effects on sandhill cranes.

Strategies

- 1.6.1 Implement recommendations of habitat restoration and management plan
- 1.6.2 Informally monitor sandhill crane usage of the refuge.

Objective 1.7: Complete and implement a Refuge Integrated Pest Management (IPM) Plan by 2012.

Rationale: Several different invasive plant species have been documented on the Refuge. Some of these species possess the potential to detrimentally impact sensitive, endemic and/or listed species, while others have gained a foothold in various vegetation communities and are out-competing native plant species. The primary invasive weeds found on the Refuge include salt cedar, Russian olive (*Elaeagnus angustifolia*), Scotch thistle (*Onopordum acanthium*), and Russian knapweed (*Acroptilon repens*). Salt cedar (*Tamarix spp.*) and Russian olive can invade riparian areas and out-compete native cottonwoods (*Populus fremontii*) and willows (*Salix spp.*); Scotch thistle invades wet meadow habitat; and Russian knapweed can dominate grassland habitat and outcompete native grasses. An integrated pest management plan is necessary to guide Refuge staff in efficiently and effectively combating invasive species and restoring the habitat to historical plant species composition and diversity. Refuge staff should confer with the Regional IPM Coordinator to develop the IPM Plan, which should include appropriate, integrated methods to control or eradicate plant species (mechanical, cultural, chemical, etc.) and establish adaptive management strategies for monitoring native habitat succession as invasive species control or eradication proceeds. Additional resources will be necessary to complete the IPM Plan and implement its strategies.

Strategies

- 1.7.1 Continue to control salt cedar, Russian olive, Russian knapweed, Scotch thistle, and other invasive species using appropriate methods (mechanical, chemical, cultural, biological, etc.).
- 1.7.2 Continue to coordinate invasive plant surveys and mapping efforts with county, state, and Federal agencies
- 1.7.3 Apply for SNPLMA and other funding to support development and implementation IPM plan
- 1.7.4 Complete and implement an IPM Plan.
- 1.7.5 Coordinate IPM Plan projects with upstream property owners.

Wildlife Diversity (Goal 2). Restore and maintain the ecological integrity of natural communities within Pahrangat Refuge and contribute to the recovery of listed and other special status species.

Objective 2.1: Maintain 100 acres of existing riparian habitats; including cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*) and Gooding's willow (*Salix gooddingii*) around the North Marsh and Upper Pahranaagat Lake to provide breeding habitat for southwestern willow flycatcher (*Empidonax traillii extimus*) and other migratory birds. By 2012 complete habitat restoration and management plan and begin implementation of recommendations for willow flycatcher habitat.

Rationale: The Pahranaagat River drainage is one of only five Southwestern willow flycatcher breeding sites in Nevada. The southwestern willow flycatcher is listed as endangered, and the primary cause of its decline has been loss and modification of habitat (USFWS 2002c). In the Pahranaagat valley, habitat has been lost primarily to water diversions and land conversion to agricultural uses. The southwestern willow flycatcher usually breeds in patchy to dense riparian or wetland habitat with common native plant species such as willows (*Salix spp.*), mulefat (*Baccharis spp.*) and cottonwood (*Populus fremontii*) as well as non-native species such as salt cedar (*Tamarix spp.*) and Russian Olive (*Eleagnus angustifolia*) (USFWS 2002c). Nest sites typically have dense foliage to 4 meters in height, but the dense foliage may only be at the shrub level or as a low dense canopy (USFWS 2002c).

The Refuge currently supports about 100 acres of cottonwood/willow riparian habitat (Fremont's cottonwood, coyote and Gooding's willows). Riparian habitat in around the North Marsh and Upper Pahranaagat Lake provides nesting, breeding and foraging habitat for neotropical migrants including the Southwestern Willow Flycatcher. An additional 430 acres could be restored to native willow habitat potentially suitable for the flycatcher and other species. In 2004, 29 Southwestern willow flycatchers were recorded at the Refuge nesting in a total of 14 territories (with one non-breeding adult). Thirteen of the nests were found in coyote or Goodings willow and one was found in a cottonwood; no nesting was observed in salt cedar or Russian olive thickets. The dense salt cedar thickets dominating Lower Pahranaagat Lake, that are slated for restoration, were surveyed and no willow flycatcher nests were found though flycatchers have been known to nest in salt cedar when other habitat is unavailable.

Recovery criterion for the southwestern willow flycatcher focus on include increasing populations and nesting territories in geographically distributed locations throughout the West (USFWS 2002c). As of 2001 there were 34 nesting territories in the Pahranaagat Valley. The Recovery Plan sets a target of 50 nesting territories, in the Pahranaagat Valley, as part of the overall criteria to down-list the southwestern willow flycatcher to threatened status (USFWS 2002c). Expanding native willow riparian habitat on the Refuge would provide more potential nesting habitat for the flycatcher and help support the recovery of this endangered species. In addition, management strategies designed to benefit the Southwestern Willow Flycatcher would also benefit blue grosbeak (*Passerina caerulea*), yellow warbler (*Dendroica petechia*), yellow-breasted chat (*Icteria virens*), and Bell's vireo (*Vireo bellii*) – all species considered for prioritization by Nevada Partners in Flight (Neel 1999).

Strategies

- 2.1.1 Complete and implement habitat restoration plan recommendations for willow flycatcher habitat
- 2.1.2 Continue to cooperate with USBR on limited presence-absence surveys for the southwestern willow flycatcher.
- 2.1.3 Continue to cooperate with the U.S. Bureau of Reclamation on surveys for the southwestern willow flycatcher
- 2.1.4 Conduct riparian vegetation surveys that include percent cover, density, age, and structure.

- 2.1.5 Continue to coordinate with USFWS Endangered Species Program (USFWS-ES) for technical and financial assistance with plant species and/or habitat inventories and monitoring.
- 2.1.6 Monitor impacts of fishing on bird habitat use and adopt seasonal closures of sensitive areas as necessary
- 2.1.7 Monitor the response of migratory birds, the southwestern willow flycatcher in particular, to restoration efforts.

Objective 2.2: By 2012 complete and begin implementation of restoration and management plan recommendations for the degraded springs on the Refuge.

Rational: The spring habitats on Pahrnagat Refuge are important elements of the Refuge’s biodiversity. In surveys conducted during 1986, a unique form of the endemic Pahrnagat speckled dace was found in Cottonwood Spring North and Lone Tree Spring (Tuttle et. al. 1990). The current status of these populations is not known. Elsewhere in Nevada, similar spring and spring outflows support important populations of endemic gastropods and other aquatic invertebrates. Three of the spring outflows; Cottonwood Spring, Cottonwood Spring North and Lone Tree Spring have been dredged or trenched to varying degrees. The Pahrnagat Valley is a focal area for spring and springbrook habitat type in the Nevada CWCS (NDOW 2005). Implementation of this objective will help achieve the CWCS objectives for spring/springbrook function and spring/springbrook dependant species of conservation priority.

Strategies

- 2.2.1 Apply for SNPLMA and other funding to support the development and implementation of a restoration plan for springs.
- 2.2.2 Conduct fish, invertebrate, bird, mammal and plant inventories of each spring head.
- 2.2.3 Investigate historic photos and other records to determine pre-development characteristics of springs.
- 2.2.4 Complete and begin implementation of restoration and management plan recommendations for each spring in coordination with NDOW and USFWS Endangered Species Program.

Objective 2.3: Protect or restore the existing 1,000 acres of Mojave mixed scrub and creosote-bursage habitat throughout the Refuge for resident and migratory species.

Rationale: A variety of migratory birds such as Gambel’s quail (*Callipepla gambelii*) and roadrunner (*Geococcyx californianus*) utilize the larger shrubs, cacti, and yucca for nesting and foraging, and some raptors use the habitat to hunt. The threatened desert tortoise (*Gopherus agassizii*) may also occur in the upland areas at low densities. Two species of concern, chuckwalla (*Sauromalus ater*) and burrowing owls (*Athene cunicularia hypugea*) respectively use creosote dominated upland habitat for protection from predators and burrowing sites (NDOW 2005). Upland habitat should be protected from degradation due to unauthorized off-road and other vehicle use and encroachment by cattle grazing primarily on adjacent lands. Ungrazed desert/scrub vegetation adjacent to grasslands and wetlands is not well represented in the Pahrnagat Valley and can contribute significantly to native biodiversity.

Strategies

- 2.3.1 Continue enforcing prohibitions for off-road vehicle traffic.
- 2.3.2 Continue maintaining Refuge fence to reduce encroachment from cattle on adjacent BLM lands.

- 2.3.3 Close unused roads, as necessary.
- 2.3.4 Install physical barriers to prevent vehicle traffic in closed areas.
- 2.3.5 Inventory and monitor upland habitat on a regular basis.
- 2.3.6 Coordinate road closures with BLM
- 2.3.7 Prepare wilderness study report and NEPA document which evaluates options for preserving wilderness values of three wilderness study areas along the western boundary
- 2.3.8 Manage wildland fires on the refuge using the Appropriate Management Response which considers resource values at risk and potential negative impacts of various fire suppression measures; firefighter and public safety will be the highest priority on every incident
- 2.3.9 Restore native upland habitat adjacent to Lower Pahranaagat Lake, Black Canyon, and other areas as appropriate..

Objective 2.4: Establish a self-sustaining population of the endangered Pahranaagat roundtail chub (*Gila robusta jordani*) and associated native fish such as the Pahranaagat speckled dace (*Rhinichthys osculus velifer*) by planning a refugium on the Refuge by 2012.

Rationale: The endangered Pahranaagat roundtail chub and the associated species of concern, the Pahranaagat speckled dace, are not currently found on the Refuge. However, historical records indicate that the roundtail chub’s range once encompassed all major waters of the Pahranaagat Valley (USFWS 1998). The most important factor currently limiting adult Pahranaagat roundtail chub is thought to be a lack of relatively cool, shaded, summer water. Spawning of Pahranaagat roundtail chub peaks in mid-February and occurs in pools with gravel substrate, at depths of 0.58 to 1.04 meters (1.9 to 3.4 feet), water velocity ranging from 0.08 to 0.54 meter per second (0.25 to 1.2 feet per second), with temperature in the range of 17.0 to 24.5 °C (63 to 76 °F) and dissolved oxygen concentrations from 5.2 to 6.3 milligrams per liter (parts per million) (USFWS 1998). One study of adult Pahranaagat roundtail chub in the Ash Springs outflow found that they varied seasonally in habitat preference between a total depth of 0.82 to 0.73 meters and a mean stream velocity of 0.25 to 0.36 meters per second with adults occupying significantly deeper and slower water in summer than in spring and winter (Tuttle et al. 1990). The two major threats to the Pahranaagat roundtail chub are the introduction of non-native aquatic species and riparian habitat degradation, primarily the partial conversion of Pahranaagat Creek to irrigation ditches.

Strategies

- 2.4.1 Plan and design a refugium on the Refuge in coordination with NDOW and FWS-ES
- 2.4.2 Construct a refugium for the roundtail chub on the refuge

Visitor Services (Goal 3). Provide visitors with compatible wildlife-dependent recreation, interpretation, and environmental education opportunities that foster an appreciation and understanding of Pahranaagat NWR’s wildlife and plant communities.

Objective 3.1: The Refuge will provide safe opportunities for hunting upland game species such as mourning dove (*Zenaida macroura*) and Gambel’s quail (*Callipepla gambelii*), waterfowl and rabbits (*Lepus sp.*) on approximately 2,000 acres, where hunters will have a reasonable chance of success in uncrowded conditions.

Rationale: Hunting, one of the six priority public uses identified in the Refuge Improvement Act, has occurred on Pahrnagat Refuge since it was established in 1963. Hunting programs can promote understanding and appreciation of natural resources and their management on lands and waters in the Refuge System. In this objective, *safe* means that there are no hunting-related safety incidents. *Reasonable chance of success* means that the average harvest per hunter visit would be greater than or equal to the State average. *Uncrowded* means that there would be no more than one hunter per 20 acres.

Strategies

- 3.1.1 Provide Refuge-specific and NDOW hunting guidelines and regulations material to the public at the Refuge Headquarters.
- 3.1.2 Post and maintain designated hunting area signs on Refuge and provide hunting information to the public through brochures, fact sheets and maps.
- 3.1.3 Monitor the number of hunters using the Refuge each day by establishing a registration box at multiple Refuge entry points along US Hwy 93 for visitors engaging in hunting activities.

Objective 3.2: By 2015, update and begin implementation of the Fisheries Management Plan for the Refuge.

Rationale: Fishing, one of the six priority public uses identified in the Refuge Improvement Act, has been permitted on the Refuge since the early 1970s. In general fishing programs promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System.

After attempting to eradicate carp (*Cyprinus carpio*) from the refuge in 1969, Florida strain largemouth bass (*Micropterus salmoides floridanus*) were introduced to the refuge during 1971. Despite several stocking attempts, fluctuating water levels and large carp populations kept bass populations low during the 1970s. After a draw down (1976-1978) and rotenone treatment during 1978, white crappie (*Pomoxis annularis*) and black bullhead (*Ictalurus melas*) were stocked during 1979 and redear sunfish (*Lepomis microlophus*) during 1980. Although bass were not restocked by NDOW at this time, they either remained in the system after drawdown and rotenone treatment or were reintroduced into the system. During the 1980s the Service requested the assistance of NDOW in maintaining the fishery on the refuge. The 1989 Fisheries Management Plan indicated that “Water manipulation needed to maintain feed and habitat for migrating waterfowl can affect the water levels on the refuge creating a negative impact on the fishery, especially during drought years.” As a result, a compromise was reached and a cooperative agreement developed during 1990 with NDOW to maintain a minimum depth, of 4.0 ft. on the outlet structure gauge, to maintain water levels for fish.

Currently, the Refuge supports a bass fishery that is relatively well known in the region. Though stocking was allowed on the refuge in the past, current Refuge System policy prohibits the stocking of exotic species on a refuge (7 RM 10, 7 RM 12, and 601 FW 3) and requires that refuges be managed to “...ensure that the biological integrity, diversity, and environmental health of the System are maintained...”. The Fisheries Management Plan needs to be updated to reflect current Refuge policies and to address the likely impact that proposed draw downs, of Upper Pahrnagat Lake to enhance bird habitat, will have on warm water fisheries in Upper Pahrnagat Lake.

Strategies

- 3.2.1 Continue to allow sport fish in Upper Pahrnagat Lake and Middle Marsh

- 3.2.2 Update the Fisheries Management Plan for the Refuge in coordination with NDOW
- 3.2.3 Conduct carp and other invasive fish control and eradication efforts in Upper Pahranaagat Lake
- 3.2.4 Coordinate with NDOW to implement state fishing regulations
- 3.2.5 Develop strategy to reinstall fish screens for upstream control of fish passage.
- 3.2.6 Continue to maintain visitor facilities and structures at Upper Pahranaagat Lake.
- 3.2.7 Maintain swimming prohibitions at all open water locations and maintain regulatory signs at those locations.
- 3.2.8 Monitor impacts of fishing on bird use of riparian and wetland habitats and adopt seasonal closure of sensitive areas if necessary.
- 3.2.9 Improve and maintain existing restroom facilities for visitor use at Upper Pahranaagat Lake.
- 3.2.10 Assess the effects of increased water withdrawals from Upper Pahranaagat Lake and North Marsh for wetlands management in Middle Marsh and Lower Pahranaagat Lake on sport fisheries
- 3.2.11 Close the existing campground and convert to a day use area
- 3.2.12 Close boat ramps and designate an alternative car-top boat launch site

Objective 3.3: The Service will provide wildlife dependant recreational opportunities, including maintenance and management of current and anticipated new Headquarters facilities, sufficient to accommodate from 30,000 to 60,000 visitors per year to view, photograph, learn about, appreciate and enjoy the Refuge’s unique natural communities and wildlife during all seasons.

Rationale: The Refuge is well known, by the public, for the diversity of migratory bird species that stop at the Refuge to rest, feed and breed. Wildlife observation and photography are priority public uses identified in the National Wildlife Refuge System Improvement Act. Visitor participation in wildlife observation and photography can instill an appreciation for the value of and need for fish and wildlife habitat conservation. Pahranaagat Refuge can enhance visitor opportunities to view wildlife in their natural habitat by providing observation trails, platforms, viewing equipment and brochures.

Strategies

- 3.3.1 Maintain existing visitor facilities and anticipated addition to Headquarters building.
- 3.3.2 Monitor the number of visitors using the Refuge each day.
- 3.3.3 Design and construct a wildlife viewing trail system possibly along historic farming and ranching roads and trails.
- 3.3.4 Construct photography and observation blinds along the trail route.
- 3.3.5 Maintain the observation deck, on the south levee of Upper Pahranaagat Lake, and trail throughout the Refuge to accommodate visitors.
- 3.3.6 Continue to offer wildlife lists at the Refuge headquarters.

Objective 3.4: The Refuge will encourage educators from the southern Nevada region to use Pahranaagat Refuge’s unique natural communities as an outdoor environmental education and interpretation classroom, with a target of 25 school groups annually within five years.

Rationale: Environmental education and interpretation are priority public uses of refuges identified in the National Wildlife Refuge System Improvement Act. Environmental education is a process

designed to teach citizens and visitors the history and importance of conservation and the biological and the scientific knowledge of our Nation's natural resources. Through environmental education, we can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively towards the conservation of our Nation's environmental resources. Interpretive programs include activities, talks, publications, audio-visual media, signs, and exhibits that convey key natural and cultural resource messages to visitors. By providing opportunities to connect to the Refuge resources, interpretation provokes participation in resource stewardship. It helps refuge visitors understand their relationships to, and impacts on, Refuge resources.

Strategies

- 3.4.1 Monitor the number of visitors using the Refuge each day and the number of people participating in Refuge-related off-site activities.
- 3.4.2 Develop and implement an interpretive plan for the Refuge by working with partners.
- 3.4.3 Develop Refuge-specific environmental education materials.
- 3.4.4 Develop signs, such as "least-wanted" posters, for invasive plant species.
- 3.4.5 Construct office space to accommodate additional staff.
- 3.4.6 Coordinate with Nevada Department of Transportation (NDOT) to install directional signage for US Hwy 15 and US Hwy 93 to promote Refuge visitation, prevent accidents, improve circulation, and decrease inappropriate visitor uses.
- 3.4.7 Construct a new visitor contact station and office space at refuge headquarters unit or other appropriate location
- 3.4.8 Construct interpretive walking trail that connects Upper Pahrnagat Lake with the Headquarters Unit
- 3.4.9 Coordinate with NDOT to create turn lanes so visitors can safely exit highway to visit the Refuge

Objective 3.5: Within three years, the Refuge will offer a minimum of 6 outreach activities each year.

Rationale: Offering additional outreach events on the Refuge is one method to increase community awareness of the Refuge and its unique resources, especially among nontraditional user groups. While offering additional outreach and outreach events can not guarantee additional Refuge visitors, over time it is likely to.

Strategies

- 3.5.1 Coordinate with NDOT to install directional signage for US Hwy 15 and US Hwy 93 to promote Refuge visitation, prevent accidents, improve circulation, and decrease inappropriate visitor uses.
- 3.5.2 Focus outreach effort on six major Refuge System events: International Migratory Bird Day, the Junior Duck Stamp Program, and the National Wildlife Refuge Week, Public Lands Day, Earth Day, National Fishing Day

Cultural Resources (Goal 4). Manage cultural resources for their educational, Scientific, and traditional cultural values for the benefit of present and future generations of Refuge users, communities, and culturally affiliated tribes.

Objective 4.1: Create and implement a basic Cultural Resources Management capability at Pahrnagat NWR Complex to respond to the basic compliance requirements of federal cultural resources legislation.

Rationale: Cultural resources are a non-renewable resource and are protected under federal law and Service/refuge policy. The full extent of cultural resources on Pahrnagat Refuge is relatively unknown but likely to be considerable given the location of the Refuge lands, the abundance of springs and riparian habitat and the diversity of desert vegetation communities that could have supported prehistoric and historic peoples. A cultural resources inventory and evaluation is necessary to characterize and manage these non-renewable resources and improve our understanding of past human use of this area. Once Refuge cultural resources are evaluated, some of them may be included in the interpretation and education of the Refuge to explain their importance to the public.

Strategies

- 4.1.1 Incorporate cultural resource values, issues, and requirements into design and implementation of the other habitat, wildlife, and public use activities and strategies conducted by the Desert NWR Complex.
- 4.1.2 Compile all existing baseline data on cultural resources sites, surveys, and reports within, and near, Pahrnagat NWR and create secure digital, GIS, and hard copy databases, maps, and library.
- 4.1.3 Communicate and consult with culturally affiliated Tribes, academic institutions, advocacy organizations, Agencies, and the Nevada SHPO for basic informational, compliance, research, and “government-to-government” purposes.

Objective 4.2: Create and implement a proactive historic preservation program in compliance with Section 110 of the National Historic Preservation Act (NHPA). Inventory and evaluate of cultural resources on the Pahrnagat NWR for planning, scientific, educational, and preservation purposes, and mitigation of adverse impacts caused by erosion and deterioration at significant cultural resources.

Rationale: The cultural sites on the Pahrnagat Refuge may currently be impacted by vandalism and degradation from exposure to the natural elements. Additional resources are necessary to clean-up the littered and vandalized sites, stabilize eroded and deteriorated cultural features, and monitor them on a regular basis. Additionally, the establishment of partnership and volunteer opportunities to assist in site restorations, stabilizations, and interpretation efforts would engender a sense of resource stewardship and increase compatible and productive types of interactions both on the Refuge and with the Refuge staff.

Strategies

- 4.2.1 Prepare evaluation criteria and conduct a cultural resource inventory at all public use facilities and Areas that would be affected by Refuge projects.
- 4.2.2 Inventory, evaluate, and nominate Traditional Cultural Properties and sacred sites to the National Register, in consultation with culturally affiliated Tribes and the Nevada SHPO.
- 4.2.3 Inventory, evaluate, mitigate adverse effects on and stabilize samples of cultural resources on Pahrnagat NWR using a research design prepared in consultation with culturally affiliated Tribes, the Nevada SHPO, and the scientific community.
- 4.2.4 Conduct a study of ethnobotany and traditional plants use locations on Pahrnagat NWR in consultation with culturally affiliated Tribes.
- 4.2.5 Create a cultural resource layer in the NWR complex GIS that aids in the identification, planning and monitoring, and interpretation of cultural sites.

- 4.2.6 Secure Refuge System and non-Refuge System funding to develop and implement a mitigation, stabilization, or research project.

Objective 4.3: Manage cultural resources and cultural resource information for research, education, and interpretation in consultation with culturally affiliated Tribes and the public.

Rationale: Many sites on the Refuge may be considered sensitive due to cultural significance for Tribes and the public or susceptibility to damage from visitation. Cultural sites selected for interpretation should be the least sensitive as determined through best professional judgment of the Refuge manager after consultation with a Service archaeologist, culturally affiliated Tribes and the public. Twenty-five pre-historic archeological sites have been documented on the Refuge including several lithic debris (stone tool) sites, campsites and the Black Canyon Petroglyphs, a National Register of Historic Places listed rock art site (SWCA 2004). At least one historic house still exists on the Refuge and other historic sites could provide researchers with information related to mining, the development of ranching and the relationship between Native Americans and Euro-Americans during the Protohistoric Period (SWCA 2004).

Strategies

- 4.3.1 Identify and evaluate cultural resources that can educate refuge users on how humans have interacted with wildlife and habitats in the past. Consult with culturally affiliated Tribes, the Nevada SHPO, and other stakeholders on ways to use these resources to achieve educational, scientific, and traditional cultural needs.
- 4.3.2 Forge partnerships with culturally affiliated Tribes and cultural interest organizations. Cultivate the Consolidated Group of Tribal Organizations to assist in the development of educational, scientific, and traditional cultural needs for the cultural resources management.
- 4.3.3 Work with culturally affiliated Tribes on projects to restore habitats of important native plants and to harvest (for traditional non-commercial purposes) native plant foods.
- 4.3.4 Coordinate with the Complex and Refuge recreation and education planners and programs to incorporate cultural resources information into education and interpretive programs and media.
- 4.3.5 Consult with culturally affiliated Tribes, the Nevada SHPO, and other stakeholders to design and implement educational materials, programs and activities that would address traditional or sacred resources, and to increase awareness on- and off-Refuge about the sensitivity of cultural resources to visitor impacts and the penalties for vandalism.

Objective 4.4: Protect cultural resources by decreasing or preventing looting, vandalism, and deterioration.

Rationale: Protecting Refuge cultural sites will benefit the current and future public by providing them with information on historic human uses of Refuge lands and the importance of preserving the Refuge land and its unique cultural resources. All of the cultural resource sites on the Refuge are currently susceptible to vandalism. Vandalism is likely to be ongoing and will likely result in damage or destruction of non-renewable cultural resources, preventing those resources from being enjoyed by future generations of Americans. Once the Refuge has been surveyed for cultural resources Refuge staff should work with stewardship volunteers to assist in site monitoring and the delivery of interpretative programs.

Strategies

- 4.4.1 Identify and evaluate cultural resources subject to looting/vandalism, erosion, or deterioration

and implement steps, including barriers and signs to reduce these threats and preserve the resources.

4.4.2 Coordinate with the Nevada SHPO, culturally affiliated Tribes, special interest groups, and neighboring land management agencies to support cultural resources monitoring and enforcement activities and to decrease impacts to cultural resources.

4.4.3 Coordinate future research, management, and planning on cultural resources with culturally affiliated Tribes, the Consolidated Group of Tribal Organizations, the Nevada SHPO, neighboring land management agencies, and other special interest groups.

4.4.4 Coordinate with existing site stewardship volunteer program to assist in site monitoring, delivery of educational and interpretive literature and programs, and to promote cultural resources conservation in neighboring communities.