4. Management Direction: Goals, Objectives, and Strategies

The Service manages fish and wildlife habitats considering the needs of all resources in decision-making. The following goals, objectives, and strategies are the Service's response to the issues and concerns expressed by the planning team, the public and our partners; unless otherwise noted in the text, they are expected to be implemented throughout the 15-year term of this CCP. Goals and objectives are the unifying elements of successful refuge management. They identify and focus management priorities, provide a context for resolving issues, guide specific projects, provide rationale for decisions, and offer a defensible link among management actions, refuge purpose(s), Service policy, and the National Wildlife Refuge System mission. Goals define general targets in support of the vision, followed by objectives that direct effort into incremental and measurable steps toward achieving those goals. Finally, strategies identify specific tools or actions to accomplish objectives. The Service organized the goals into five broad categories of ecoregional, habitat, wildlife, visitor services, and facilities.

Even though the objectives and strategies in this Chapter are intended to guide future management, the Service acknowledges that the future remains uncertain. Understanding interactions on the Complex, anticipating effects of changing climate, recognizing that there are gaps in available data, and anticipating changes in funding make future management planning difficult and complex. For this reason, the Complex will use this chapter as a guide to stay on track with its overall goals and with the intent to achieve current objectives; however, the most effective approach to resource management over the long-term is an adaptive one. Adaptive management is a management style in which the effectiveness of management actions is frequently monitored and evaluated, and future management is modified as needed based on the results of this evaluation or other relevant information as it becomes available. The Complex will use adaptive management and implement strategic habitat conservation on a landscape-level throughout the lifetime of this CCP.

4.1 Ecoregional Goal

To implement conservation efforts and foster the ecological integrity of the Gulf Coast Prairies and Marshes Ecoregion (including the Columbia Bottomlands) through proven and innovative restoration, enhancement and management practices across the Complex to preserve essential habitats for migratory birds and resident wildlife.

Objective 1 - Managing Landscapes

To increase knowledge through research and collaboration to evaluate the impacts and trends of accelerated climate change on refuge habitats and wildlife populations including site-specific sea-level rise with corresponding sediment accretion, invasive species and habitat shifts, to implement best management practices to adapt and mitigate the impacts of a changing climate, and the anticipated effects, over the life of the CCP on native flora and fauna.

Rationale:

The Refuge Complex within the Gulf Coast Prairies and Marshes Ecoregion recognizes the critical nature of conserving and managing remaining wildlife and habitat within a fragmented landscape with multiple anthropogenic threats. Regional modeling of how long-term global warming patterns might emerge in the U.S. suggests that future climates along the Texas Gulf Coast could be very different than those of the past. Climate researchers used unique, state-of-the-art, high resolution nested climate simulation models to explore the importance of fine scale processes in determining climate change hotspots in the continental United States and Mexico (Texas Climate Initiative). In addition to sea-level rise, many climate change studies predict changes to tropical storm events, precipitation rates, and temperature levels at rates that can affect habitat conditions and species distributions along the Gulf Coast (USFWS, 2009). In order to accomplish our goals, the Complex must continue to work with partners. Current partners include TPWD, U.S. Army Corps of Engineers, Texas General Land Office, Texas Commission on Environmental Quality, as well as other national wildlife refuges, The Texas Nature Conservancy, Houston Audubon, Texas RICE, The Conservation Fund, Trust for Public Land, Houston Wilderness, Houston Regional Group of the Sierra Club, other Marine Protected Areas, and Scenic Galveston.

Eagle Nest Lake , acquired in 2012, is a natural freshwater wetland which will be restored to an emergent marsh. More than 1,000 acres of adjacent pasture and farm fields will be restored to native coastal prairie habitats through control of invasive species and planting. Photo Credit: USFWS

Strategies:

1. Participate in the Mid-coast Initiative of the Gulf Coast Joint Venture, bringing project proposals and success stories to share.
2. Monitor sea level rise and accretion of sediments in the coastal marshes to further evaluate impact of rising sea-level in Mid-coast marshes.
3. Map freshwater resources on an annual basis.
4. Monitor native and non-native species range shift (i.e., black mangrove in estuaries) to compensate for changes in floristic composition.
5. Exercise best management practices based on results of monitoring sea level rise, fresh water shifts, and species range shifts.
6. Continue to partner with state and federal agencies as well as nonprofit organizations and private land owners to share biological information including species trends, habitat management techniques, and land conservation strategies.
7. Support research from partners that would contribute to scientific information benefiting the ecoregion.

8. Support land conservation efforts of partners through coordination of opportunities and resources.
9. Assist sister agencies and organizations with the implementation of prescribed fire to benefit native habitats through established agreements.
10. Within three years, initiate modeling of the Columbia Bottomlands in response to a changing climate.

Objective 2 - Conservation of Columbia Bottomlands Ecosystem
Conserve approximately 1,000-2,500 acres annually through Service acquisition authorities, while working with partners to conserve an overall minimum of 10 percent of the historic Columbia Bottomlands forest.

Rationale:
The Columbia Bottomlands is a unique forested hardwood species ecosystem within the Gulf Cost Prairies and Marshes Ecoregion which extends to within 4 miles of the Gulf of Mexico. This ecosystem, recognized for its importance for migratory songbirds, is threatened by agricultural and commercial development and encroachment of invasive species. Plant and animal diversity is tied to topography, differences in soil, hydrology, and succession stages across the larger landscape. Thereby conservation of tracts spread across the historic ecosystem is required to ensure diversity and functionality of this already fragmented forest is maintained.

The bottomland forests are critical for migratory songbirds and native wildlife (Barrow, W. et.al. 2000). The bottomland forests store large amounts of carbon in their foliage, roots and soil (195.7 tons of carbon/hectare average total found on Dance Bayou Unit), and offers opportunities for carbon-offsets with local industry (Delaney, M. et. al. 2002). Natural bottomland forests buffer flooding related to heavy rainfall common on the Texas coast, protecting human communities.

Strategies:
1. Acquire fee title from will sellers of high priority lands as outlined in the LPP through the use of Migratory Bird Conservation Funds, Land and Water Conservation Funds, grant funding, mitigation for loss of natural habitats and/or wildlife, and donation.
2. Acquire conservation easements on high priority lands as outlined in the LP through donation, grants, and mitigation opportunities
3. Work with partner agencies and organizations to conserve, protect and manage Columbia Bottomlands to promote the integrity of the ecosystem.

4.2 Habitat Management Goal

To conserve, restore, enhance, and protect refuge habitats by implementing appropriate management programs to benefit native flora and fauna, including threatened and endangered species and other species of concern.

Objective 1 – Bottomland Hardwood Forests

Manage all bottomland forests to promote natural succession toward old growth stages (80+ year old forest) which increases diversity and reduces the impacts of catastrophic events, including; droughts, wildfire, invasive species and flooding and high winds on species diversity and populations.

Linville Bayou unit is a naturally aging bottomland forest providing maximum benefit to resident and migratory wildlife. Photo Credit: USFWS

Rationale :

Agricultural, commercial development, and the encroachment of invasive species continually threaten the Columbia Bottomlands, a regionally limited ecosystem. Plant and animal diversity is tied to topography, differences in soil, hydrology, and successional stages across the larger ecosystem rather than to individual tracts. Therefore, conservation of tracts spread across the ecosystem is preferred rather than one large unit.

The 649-acre Dance Bayou Unit is a structured, diverse, and well-functioning representative of what the Complex is striving to achieve in managing toward old growth bottomland hardwood forests. An inventory conducted from 2002 to 2005 on the Dance Bayou Unit produced 356 species of trees and shrubs, vines, grasses, and herbaceous plants (Rosen, D.; Miller M., 2005). The Dance Bayou Unit also self-manages hardwoods 100-plus years old, characterized by frequent tree falls followed by gap succession, large vines, and abundant epiphytic growth. This is the type of understory, mid-story, and canopy diversity the Complex is striving to achieve on all larger tracts. The Complex also manages smaller hardwood tracts, although limited by size, toward an older stage forest, but may not have the luxury of such species diversity although management will still strive to achieve a multi-layer diverse older forest.

The bottomland forests are critical for migratory songbirds and native wildlife (Barrow, W. et. al. 2000). The bottomland forests store large amounts of carbon in their foliage, roots, and soil (195.7 t C/ha average total found on Dance Bayou Unit), and offers opportunities for carbon-offsets with local industry (Delaney, M. et. al. 2002). Natural bottomland forests buffer flooding related to heavy rainfall common on the Texas coast, protecting human communities.

Strategies:

1. Where appropriate, restore degraded habitats through removal of grazing pressure, mowing, and human encroachment, allow natural regeneration of hardwood species and where necessary, plant hardwood species to encourage succession and or diversity.
2. Eradicate invasive plant species within the bottomland habitats.
3. Control invasive fauna populations by means approved in management plan that minimize environmental damage of habitat and native wildlife resources.

4. Where appropriate, restore natural hydrological processes, including storage basins and waterways.
5. Continue outreach efforts to local communities, explaining the benefits of natural bottomland forests.
6. Explore opportunities to partner with industry to protect and restore bottomland forests through the exchange of carbon credits.
7. Monitor rare and endemic populations occurring within the Columbia Bottomlands and focus strategies, including acquisition, toward protecting remaining populations.
8. Continue research collaboration with state and federal agencies, universities, and NGOs.
9. Immediately suppress all wildfires in bottomland hardwood forests throughout the Complex.
10. Within two years, complete a Habitat Management Plan.

Objective 2 – Coastal Prairie

Throughout the life of this CCP, protect, restore and manage 19,000 acres of coastal prairie habitat toward a climax prairie community, while promoting rare endemic species such as prairie coneflower and sharp gay feather through planting or seed dispersal (of refuge produced seed) on 100 acres annually.

Rationale:

Once part of an immense ecosystem covering 9 million acres from Mexico through Texas and into Louisiana, the coastal prairie underwent intensive manmade development starting in the mid-20th century (Allain et. al. 1999) and now totals approximately 250,000 acres in Texas, which includes areas that contain natives prairies species that have been managed and/or restored. Less than 1 percent of (unaltered) natural coastal prairies remain in existence and remaining prairie are continually threatened by agricultural and commercial development, invasive species, and suppression of wildfire (Grace et. al. 2000). The once wide-spread prairies were extremely diverse, including nearly 1,000 floral species (Allain L. et. al. 1999). Today, these highly fragmented and degraded prairies support a lower population and decreased diversity of plant and animal species. As more species continually disappear from a prairie, the entire health of the ecosystem declines as well, compounding the challenges of managing a functional community well represented by both native flora and fauna.

Multiple lighting strikes ignited a wildfire near the mouth of Cedar Lake Creek in June 2008, which burned more than 4,500 acres of salty prairie, marsh and coastal prairie habitats. Photo Credit: USFWS

Long-lived perennials that form a dense mat of intertwined roots should dominate coastal prairie. Due to a variety disturbances (drought, flooding, fire, haying, mowing and/or grazing), the prairie should exhibit structural heterogeneity across the landscape. Annuals are less than 25 percent of

total species and woody species such as eastern baccharis and wax myrtle should make up no more than 10 percent of cover, with optimal being below 5 percent. Multiple species should co-dominate, including little bluestem, bushy bluestem, fall switchgrass, rattlesnake master, goldenrod, and Jamaican sawgrass with beak sedges and freshwater needle rush in the swales.

Although the focus of the acquisition program is bottomland forests, the Complex acquired adjacent prairie habitat in conjunction with the forest on several units; all of which require restoration. Restoration of native coastal prairie generally involves: 1) preparation by herbicide, solarization, or tillage; 2) planting by haying, seeding, sodding, or transplanting; or 3) management by mowing irrigation, grazing, and fire (nwrc.usgs.gov/prairie/tcpr.htm).

Restoration of prairies presents a variety of challenges including the constant assault of non-native vegetation and their ability to out-compete native flora and introducing a seed source to encourage diversity. As conversion from farmlands to prairies progresses, the Complex moves into a transitional mode from restoration to management and continues to successfully rehabilitate disturbed areas into functional, diverse, and productive prairies; producing a native seed source used to continue the restoration process on newly acquired lands.

Strategies:

1. Within 3 years, have an approved Preliminary Project Proposal (PPP) for Brazoria NWR, focusing on conservation of coastal prairie habitats for reclamation and restoration of prairie species.
2. Monitor and inventory shifts in species composition within prairie habitats due to a changing climate and/or other influences, e.g. contaminants, catastrophic event, and disease.
3. Mimic historic fire regimes through application of prescribed fire across prairie habitats, promoting a diversity of seral stages across the refuges.
4. Maintain diversity across the refuge prairies by promoting hydrological and topographical differences.
5. Prepare a grazing management plan, to add grazing as a management option to be utilized in conjunction with fire to promote structural heterogeneity and species diversity.
6. Continue research collaboration with state and federal agencies, universities, and NGOs
7. Eradicate invasive plant species across the prairie through mechanical, herbicide, and fire applications.
8. Control invasive fauna populations by means approved in management plans that minimize environmental damage of habitat and native wildlife resources.
9. Encourage native species diversity through reseeding and transplanting native grasses and forbs.
10. Promote prairie restoration off-refuge through provision of seed and assistance in prescribed burning for partners.
11. Protect communities through control of fuel loading in WUI areas through haying and application of prescribed fire and maintenance of fire breaks.
12. Within 2 years, complete a Habitat Management Plan.
13. Acquire prairie and former prairie habitat associated with Columbia Bottomland Forest Ecosystem.

14. Restore fallow fields and non-native pasture to native prairie habitat.

Objective 3 – Wetlands
Throughout the life of the CCP, protect and manage 59,000 acres of wetlands, including 9,500 acres of open water across the Complex, promoting a diversity of wetland types, including saline marshes, Gulf cordgrass dominated saline prairie, freshwater ponds moist-soil units, and natural waterways.

Rationale:
Natural wetland functions across the region have been altered by drainage, commerce, pollution, erosion, subsidence, agriculture, and grazing activities. Preservation of remaining wetland habitats are essential to maintaining plant and wildlife diversity, including nursery grounds for shell and fin fish, buffering storm surges, and filtering pollutants. The impacts of preserving refuge wetlands extend beyond refuge boundaries by supporting large populations of migratory birds and sustainable commercial and recreational fisheries. The primary cause of loss of marsh (conversion to open water) appears to be subsidence and faulting. Subsidence and sea-level rise are natural processes that contribute to marsh deterioration and loss, but in some cases, humans exacerbate them. The Slop Bowl on Brazoria NWR is severely degraded due to influences from oil and gas (including pipelines) developments physically manipulating the marsh.

Freshwater wetlands are the most essential habitat the refuges provide, especially during extended droughts. A brood of mottled ducks makes their way to freshwater. Photo Credit: USFWS

The Complex supports a vast variety of both fresh and salt water wetlands that make it a destination for thousands of migratory birds. The Complex has a diversity of salt, brackish, and fresh water wetlands including wet prairies, forested wetlands, tidal flats, salt marsh, intermediate marsh, coastal prairie, ephemeral ponds, estuarine bays, bayous, and rivers. The existence and extent of specific plant species within these different wetland types depends on their tolerances to fluctuating salt concentrations and variability in water depth attracting specific species of wildlife.

Saline marsh management objectives throughout the Complex include 75 percent vegetated and 25 percent open water or mudflats. Gulf cord grass dominated saline prairie is managed for less than 25 percent woody plants with 50 percent hydrophytes such as rushes and sedges and fresh water ponds are managed for no more than a 50:50 ratio of vegetation and water.

Strategies:

1. Maintain or enhance natural hydrological functions of marshes through restoration, erosion control, and reduction of saltwater intrusion into brackish and freshwater wetlands.
2. Seek opportunities to protect wetlands from shoreline erosion through partnerships with state and federal agencies and NGOs.
3. Protect refuge shorelines and dunes from human disturbance to maintain the natural function of these areas by restricting vehicle traffic above high tide lines.
4. Work with GLO to limit access to San Bernard Beach.
5. Provide freshwater habitat through maintenance of existing and additional freshwater impoundments, across the Complex.
6. Restore degraded salt marsh habitat in the Slop Bowl and Salt Lake areas using multiple approaches, including planting smooth cord grass, dredge placement, and blocking channels that lead to salt water intrusion.
7. Within 5 years, have an approved PPP for lands surrounding Big Boggy NWR through an independent PPP or included in the Aransas NWR PPP, protecting additional wetlands in Matagorda County.
8. Control native and non-native invasive species and maintain managed wetlands in an early seral stage through herbicide, mechanical, water level manipulation, fire, and biological control.
9. Supplement rainfall in managed wetlands by trapping runoff, groundwater and channel pumping, and purchase of irrigation water, particularly in drought conditions.
10. Continue research collaboration with state and federal agencies, universities, and NGOs.
11. Encourage natural flow of surface water, including protection of riparian vegetation along waterways and natural sheet-flow to the marshes.
12. Within 2 years, complete a Habitat Management Plan.

The refuges will utilize a variety of wetland management options including roller chopping. Photo Credit: USFWS

4.3 Wildlife Goal

To protect, maintain, and enhance populations of migratory birds and resident fish and wildlife, including federal and state threatened and endangered species.

Objective 1 – Waterfowl
Increase annual winter waterfowl use across the Complex five percent over the term of this CCP by providing quality nesting, resting, feeding, and molting habitats including 2,000 acres of seasonally flooded freshwater habitats, such as coastal prairie swales, ponds, impoundments and flooded farm fields for wintering and migrating waterfowl. Increase annual mottled duck production on the Complex 10 percent over the life of this CCP by providing 600 acres of freshwater with adjacent prairie habitat (less than two miles away) during the late spring and summer months.

Rationale:
Coastal wetlands of Texas (including the Complex) are the primary wintering site for ducks using the Central Flyway, wintering more than half of the Central Flyway waterfowl population (Wilson et al. 2002). Many species including resident mottled duck populations have declined from historic populations (Stutzenbaker, C.E. 1988). The census numbers reflect these declines across the refuges for the past 20 years (Haukos. et al. 2004). Resident mottled ducks are present year round on the Complex and depend on freshwater marsh and prairie habitat to meet their annual cycle needs. Fresh marsh provides feeding and resting sites to many species of ducks and geese and USFWS considers it the most valuable marsh type to waterfowl (Wilson et al. 2002).

The Complex plans on managing a variety of freshwater habitats to benefit wintering waterfowl. Photo Credit: Dave Sanders

Strategies:
1. Provide freshwater habitats throughout the year; through water management activities including purchase, pumping, and holding of freshwater in impoundments.
2. Manipulate freshwater impoundments using disking, shredding, roller-chopping, fire, and or herbicide to disturb perennial vegetation, control exotic vegetation, and encourage production of wetland annual plants.
3. For mottled ducks, provide nesting (prairie) and 600 acres of brood habitats (freshwater with less than 5ppt salinity content) in proximity of each other (less than two miles) to encourage nesting and increase nesting success.

4. Increase managed wetlands at San Bernard NWR by expanding the Wolfweed and Sargent wetland complexes an additional 400 acres.
5. Manage the farmland/wetlands at Brazoria NWR in such a manner as to provide a combination of high-energy foods, cover, and resting areas, and natural wetland food resources during the fall and winter season.
6. Manage Eagle Nest Lake at a lower water level to create a palustrine marsh and create additional waterfowl habitat.
7. Continue research programs on mottled ducks including brood and molter banding programs.

Objective 2 – Forest birds
Throughout the life of the CCP, protect and manage existing mature forest and restore units requiring restoration due to cattle grazing, clearing, logging, etc, to provide floral diversity and high stem density at all canopy layers to provide habitat for 80 percent of the following indicator forest breeding bird species (Swainson's, prothonatary and hooded warblers, yellow-breasted chat, acadian flycatcher, barred owl, downy woodpecker, yellow-throated vireo, northern parula, and summer tanager).

Rationale:
The Austin Woods Conservation Plan identifies the need to protect forested habitats in the Columbia Bottomlands for the preservation of migratory birds. For the past ten years, a variety of research and monitoring projects occurred in the bottomlands. These projects generally focus on continuing to gather information on species' habitat associations to aid management in decision making concerning priorities for conservation and restoration of existing units. During migration, bottomland hardwood forest are particularly valuable to a large variety of warblers, vireos, thrushes, tanagers, buntings, goatsuckers, and other forest birds that seek out forest resources after a long flight to recuperate and refuel. In Mississippi, research has demonstrated that neotropical migrants using coastal forests are found in increasing abundance with increasing density of forest trees and increasing numbers of insects in forest understories (Buler et. al. 2007).

Conservation and restoration of bottomland habitats will result in a mosaic of microhabitat types that support a variety of forest birds. For example, Swainson's warblers require high stem densities and nest in association with heavy concentrations of small trees such as rhododendron (Lanham and Miller 2006) or switchcane or beneath vine tangles with a non-vegetated leaf litter below (Graves 2002). Prothonotary warblers are cavity nesters that select snags in flooded areas and frequently forage in the forest mid-story (Petit 1999). Unlogged forests with all layers intact provide the greatest densities of Acadian flycatchers (Twedt and Somershoe 2009). For migrating songbirds, it appears that birds probably settle in response to gross habitat features such as vegetation density or stratification and then search for resources based on other factors (Moore and Aborn 2000).

Our objective to establish canopy layers to provide habitat for 80 percent of the indicator forest breeding bird species (Swainson's, prothonatary and hooded warblers, yellow-breasted chat, acadian flycatcher, barred owl, downy woodpecker, yellow-throated vireo, northern parula, summer tanager) will be measured through point count surveys in designated tracts on

an annual basis. If our studies indicate the presence of eight of these ten species, then we will be meeting our habitat management objectives of 80 percent forest breeding bird species throughout the Complex.

Strategies:

1. Within two years, publish information gathered by the Forest Bird Study Group on the site fidelity of some wintering songbirds in the bottomland habitats.
2. Within five years, evaluate the potential of reestablishing turkeys into bottomland habitats through partnering with TPWD and other organizations.
3. Continue to acquire a variety of bottomland habitats that provide corridors for wildlife movement including the migration of large numbers of songbirds along waterways.
4. Locate nesting territories of bald eagles and swallow-tailed kites. Consider these locations a priority in conservation activities.
5. Within one year, develop and implement a forest bird habitat monitoring protocol such as a modified James and Schugart vegetation sample.

***Objective 3 – Grassland and Secretive Marsh Bird*s**

Manage prairie and upper marsh habitats, which will support and maintain existing populations of LeConte's sparrows and loggerhead shrikes, seaside sparrows, black rails and yellow rails (as indicator species), and increase populations of northern bobwhite quail 30 percent over the life of the CCP through continued application of habitat disturbance and treatment of invasive species across 15,000 acres of prairie and marsh habitat annually. Continue to restore old field and pasture land to coastal prairie, enabling the acreage to support grassland dependent species.

Rationale:

Degradation and loss of habitat has occurred throughout the prairies and salt marshes along the Texas coast. Coastal marshes are expected to change in the future in conjunction with sea-level rise and climatic change, affecting species in these habitats even further (Rush et. al. 2009). The birds associated with these habitats have documented declining populations (Igl and Ballard 1999). Texas' northern bobwhite population has declined approximately 5.6 percent per year since 1980 (Brennan et. al. 2005). The refuges and other managed and conserved areas along the Gulf Coast offer a remnant of high quality habitat, essential for continued survival.

In order to provide quality habitat for the array of grassland and prairie birds, prairies and marshes will require regular disturbance. Northern bobwhites use early successional habitat in a variety of landscape settings, including prairies (Brennan 1999). LeConte's sparrows prefer tall grass, sparse to moderate litter, and little woody vegetation (Baldwin 2005). Gabrey and Afton (2000) found that abundance of male seaside sparrows decreased in burned plots during the first breeding season post-burn, but was higher than that of unburned plots during the second breeding season post-burn. The preferred habitat of loggerhead shrike in breeding season and winter is open country with scattered bushes, including pastures with hedgerows, orchards, and roadway edges (Yosef 1996).

Continue research on wintering grassland birds on two select sites annually during the management cycle (i.e. fire rotation) to ensure management practices are continuing to provide habitat for select species of concern (Henslow's and LeConte's sparrows, northern bobwhite and yellow rails). Continue black and yellow rail research annually, to aid in determining habitat requirements, impacts of management techniques, food availability, and through collaboration with other researchers, determine populations for both species across the wintering range.

Strategies:

1. Continue to acquire a variety of prairie and marsh habitats that provide corridors for wildlife movement.
2. Throughout the life of this CCP, protect coastal and saline prairie, salt marsh, and associated wetlands for resident and migratory birds including Henslow's and LeConte's sparrows, white-tailed hawk, northern bobwhite, and dickcissels in prairie; and yellow and black rails and seaside sparrow in marsh habitats.
3. Conduct habitat management activities (prescribed burning, haying, grazing etc.) in rotations to provide structural heterogeneity and promote a mosaic of habitat conditions for grassland birds, considering food and cover requirements during planning and implementation.
4. Conduct prescribed burns in such a manner as to minimize bird mortality, including using backing and flanking fires rather than head fires, burn units adjacent to quality habitat to allow movement of displaced wildlife.
5. Continue black and yellow rail research in salt marshes and expanding research within three years into the coastal prairie to evaluate secretive marsh bird habitat requirements.
6. Within two years, establish a grassland bird food and cover monitoring protocol.
7. Coordinate with Attwater Prairie Chicken NWR to monitor and evaluate habitat suitability for Attwater's prairie-chickens.
8. Monitor populations and evaluate how refuge management would better benefit northern bobwhite quail.
9. Locate and document nesting sites of white-tailed hawks.

Objective 4 – Colonial Waterbird Colonies

Maintain eight existing colonies of waterbirds and where opportunities lie, create three additional colonies (Bastrop Bayou, Cowtrap, Salt Lake) through terracing or dredge placement and improve four existing colonies through dredge placement, erosion control, predator barrier, or other means to encourage additional nesting birds. Within the term of this CCP, double the population of nesting reddish egrets in and around the Complex.

A permanent solution for erosion and growth of Dressing Point Island at Big Boggy NWR is needed to maintain this important nesting colony. Photo Credit: USFWS

Rationale:
Colonial waterbird nesting sites across the Texas Gulf coast have diminished due to development, erosion, and disturbance. Nesting sites are now at a premium and determine population levels for several species of concern. (Glass 1994). The reddish egret is among the priority species identified for habitat planning, implementation, and evaluation by the Gulf Coast Joint Venture (GCJV) partnership. Because of its relatively specialized habitat needs, this species was probably never as abundant as other egret species; however, it is believed that the population was greatly impacted by plume hunters in the early 20th century, as well as high pesticide levels, and possibly military training on nesting islands (Paul 1991). Today, major threats to the species include habitat loss and disturbance by humans (Lowther and Paul 2002). Current nesting population of reddish egrets in and around the Complex is approximately 18. The Complex needs to work with partners to expand/improve existing colonies and work with the Army Corps of Engineers on beneficial dredge projects that would establish additional nesting locations.

Strategies:
1. Continue to protect from disturbance all refuge locations and advocate protection of other local colonies.
2. Within five years, partner with other agencies (including Army Corps of Engineers) and organizations to protect the Dressing Point Island from erosion and ultimately find a means to increase the acres of the island and establish new nesting islets using dredge material.
3. In partnership with the Texas General Land Office, seek a means to protect area rookeries that are not on the Complex.
4. When necessary, control predator populations near rookeries that could have detrimental effects on the nesting success of colonial waterbirds.
5. When feasible, establish predator-proof enclosures around rookeries to protect nesting birds from predators.
6. Control invasive fauna (primarily fire ants) in accordance with approved management plans.
7. In association with terracing projects to protect eroding shorelines in Salt and Cowtrap Lakes, establish new islets for nesting birds.
8. Continue monitoring populations of birds on local rookeries through colonial waterbird count and other established censuses.

Objective 5 – Shorebirds
Provide a combination of quality habitats including 1,400 acres of shorebird foraging habitat during spring migration (April–May) and 900 acres during fall (August–September) among managed wetlands and farm fields by providing water ranging from a fraction of an inch to several inches deep.

Rationale:
Because of the geographic location of the Gulf Coastal Prairies region, and the diversity of habitats provided by rice fields, beaches, coastal marshes, and lagoons, large numbers of shorebirds migrate, winter, and breed on the Gulf Coast, making this is one of the most important regions in the U.S. for this group of birds. However, habitat along the Texas coast

has degraded and been lost due to erosion, disturbance, and development (Wilson and Esslinger 2002). The Western Hemisphere Shorebird Reserve Network recognize the refuges as a Western Hemisphere Shorebird Reserve Network site and host large populations of shorebirds. Habitats for shorebirds using maritime and estuarine habitats can be generally defined as submerged to emergent lands between seagrass beds and upland grasslands on bay sides of barrier islands and the mainland, and as the area between the low intertidal zone (forebeach) and backshore (backbeach) on Gulf of Mexico beaches (Elliot and McKnight 2000). The Complex has minimal management capability over much of this area; however, the refuges protect the habitats from disturbance and degradation. The Complex characterizes non-maritime habitats as those occurring inland from the upland grasslands on bay sides of barrier islands and the mainland, and from the backbeach inland. These habitats include coastal marsh (saline to fresh), prairie, agricultural lands (rice, crawfish), and inland ponds (including waterfowl impoundments) and depressions (Elliot and McKnight 2000). Additional shorebird habitat includes shallow wetlands, salt marsh, tidal flats, and beach. The Complex manages more than 4,000 acres of impoundments and farm fields/wetlands that it can manipulate to enhance the naturally occurring wetlands and provide feeding areas for shorebirds.

Strategies:

1. Ensure available prey for shorebirds by slowly drawing down wetlands in the spring or allowing ponds/reservoirs to dry through evaporation.
2. Begin flooding managed wetlands early August to enable feeding areas for fall migrating shorebirds.
3. Provide foraging and nesting areas associated with estuary and managed wetlands throughout the year.
4. Continue shorebird monitoring protocol that was established in 2011.
5. Continue to monitor snowy and piping plovers every five years with the International Piping Plover Survey.
6. Protect four miles of beach habitat of San Bernard NWR by restricting vehicle access above mean high tide, establishing education programs and regular law enforcement patrols.

Objective 6 – Reptiles and Amphibians

Maintain current populations by providing quality habitat for a variety of reptiles and amphibians, and where opportunities arise, increase populations of threatened, endangered, and species of concern such as sea turtles, timber rattlesnake, diamond-backed terrapin, Gulf saltmarsh snake, ornate box turtles, and Texas horned lizard through adaptive management and protection of habitat throughout the life of the CCP.

Rationale:

Reptile and amphibian populations across the refuges are not well documented; however, many populations of reptile and amphibians have declined due to habitat loss and exploitation of species throughout their range (TPWD 2005). However, the refuges provide conserved habitat, safe from specimen collection. Despite favorable habitats, some species, including the Texas horned lizards, are not recently documented. Because development is increasingly isolating the refuge units, determining reptile and amphibian populations' status

and trends will aid in establishing priorities for conservation of minimal unit size and corridors between units to sustain existing populations.

Strategies:

1. Protect four miles of San Bernard NWR beach habitat by restricting vehicular travel above mean high tide to protect nesting sea turtles and nests.
2. Within five years of the CCP's approval, develop an inventory and monitoring protocol for reptiles and amphibians across Complex habitats.
3. Locate and protect den sites for timber rattlesnakes in the bottomlands.
4. Continue sea turtle stranding and nest monitoring on area beaches, both on and off refuge.
5. Continue to support research on herptile populations in association with education and non-profit organizations.
6. Within five years, implement a monitoring protocol on American alligators across the Complex.

Objective 7 – Mammals

Maintain current populations of 45 mammal species by providing bottomlands, prairies, freshwater wetlands, and salt-marsh habitats across the Complex. Within three years of the CCP's approval, conduct baseline monitoring for river otter, deer in bottomlands, and small mammals, in an attempt to determine population trends in three to five year intervals, and assess the need to initiate adaptive management practices if trends show declining populations or overpopulations.

Rationale:

Mammal populations are difficult to monitor; therefore, populations are unknown across the ecoregion. The Complex provides habitat not found in abundance outside of each refuge due to protection and management. Monitoring the mammal populations on the refuge is essential in determining the status of populations throughout the area. River otters wander a great deal through their habitats, making them scarce and rarely seen in most localities (TPWD-WFS 2011). In order to protect refuge populations, information on population status on and around the refuges is required. White-tailed deer populations on and around the refuges are stable; approximately one deer per eight to ten acres, with a one to three buck to doe ratio (Pilchek 2011). However, development in Brazoria County continues at a high rate may push deer into less than ideal habitats (dense bottomland forests). The refuges need to begin monitoring deer populations, and/or habitat

Populations of bobcats along with other mammals will be monitored in the future to ensure management activities are not adversely affecting populations. Photo Credit: Janie Mason

conditions (browse lines), in both bottomland and prairie habitats where increases in the deer population have been observed recently. In these prairie habitats, carrying capacity should be about one deer to 15 acres (Pilchek, 2011). The refuge may manage populations through controlled hunts in the future in order to maintain healthy deer populations and habitat. The Complex has no information on small mammals. Because development increasingly isolated the refuge units, determining small mammal populations will aid in establishing priorities for conservation of minimal unit size and corridors between units to sustain existing populations. Small mammal surveys will include live trapping on various habitat types throughout the Complex. These live trapping surveys will initiate baseline data on species diversity, abundance, and eventually trend. Initial inventory and monitoring of mammals will determine the need for future best management practices.

Strategies:

1. Locate and monitor river otter populations on core refuges and along waterways adjoining the refuge units.
2. Within three years, set up an inventory and monitoring program for small mammals.
3. Control feral hog populations across the Complex in accordance with Feral Hog Management Plan to protect habitat and native wildlife populations.
4. Seek opportunities to reduce impacts of red-imported fire ants by reducing populations through biological control and pesticides in accordance with an Integrated Pest Management Plan.
5. Coordinate with education and other organizations to conduct research and monitoring of specific species.
6. Within three years, implement a deer-monitoring program in select bottomland and prairie units to ensure healthy populations.
7. Partner with other organizations to monitor bat habitat use across the Complex.
8. Work with our partners and adjacent landowners to help conserve habitat for the river otter.

4.4 Visitor Services Goal

To develop and implement quality wildlife-dependent recreation programs, which are compatible with Refuge purposes, and foster enjoyment and understanding of the Refuge's unique wildlife and plant communities.

Objective 1 – Visitation

Throughout the term of this CCP, increase annual visitation by 25 percent (current numbers are 75,000) while striving to maintain a positive and memorable experience on the refuge. The visitors' experience should be that

The Complex will strive to provide public use opportunities which will connect people with nature.
Photo Credit: USFWS

they would desire to return to the Complex, recognizing it as a national treasure and a premier destination for wildlife-dependent recreational activities.

Rationale:
Because the Complex is located close to Houston, Texas, the sixth largest metropolitan area with the largest growth (26.11 percent) over the past ten years of the top 10 metropolitan areas in the country, (2010 Census), it will likely see increased visitation during the life of this CCP. Although refuge visitation has been irregular over the past 10 years, we believe in part due to a poor economy, the refuge must continually garner public support by increasing outreach as well as providing the highest quality experiences available.

Strategies:
1. Within five years of completing of this CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Use advertising and marketing strategies, including publishing web and news/magazine articles with information about refuge activities.
3. Within two years, increase signage on incoming highways and county roads to identify public use areas.
4. Continue to offer quality public programs including the interpretive programs at the annual Migration Celebration.
5. Within two years, develop monthly interpretive programs at various refuge locations during the winter months.
6. Maintain and update the refuge web site as needed; provide relative and up-to-date information on a continuous basis.
7. Utilize the Visitor Estimation Handbook to collect visitor use information and track visitation trends on an annual or biannual basis.
8. Partner with local chambers of commerce; gaining support for refuge programs and promoting the Complex as a Great Texas Coastal Birding Trail designated site.
9. Incorporate higher customer service standards by providing periodic training for staff and volunteers ensuring compliance with Service customer service standards.
10. Increase Visitor Services personnel to accomplish priority visitor services needs. Add one full-time staff member to assist with keeping the Discovery Center open in fall, winter, and spring season. Explore innovative volunteer options such as recruitment through the Refuge Volunteer Program, SCA, interns, grants, and work study programs.
11. When funds are available, establish a Visitor Contact Station at the San Bernard NWR. This would facilitate increased awareness and understanding of the natural value of the bottomland units, and would likely attract additional volunteers from local communities.

Objective 2 – Wildlife Observation
Over the term of this CCP, provide visitors with quality wildlife observation opportunities by maintaining existing viewing areas and infrastructure across the Complex, while expanding opportunities on existing and new tracts as opportunities for development allow and are able to be maintained in a safe and operational manner with limited resources for maintenance.

Rationale:
Most visitors come to the Complex to view wildlife and enjoy nature. Approximately 32,000 visitors annually visit the refuges for wildlife observation. The refuges have received requests to expand wildlife-viewing opportunities. The Complex will balance wildlife observation opportunities with the conservation and protection of habitats and species. Most newly acquired units will not be open for wildlife observation. This ensures that the conservation of lands is meeting the purpose for which the Complex conserved them, namely migratory birds. The Comples may open units that are near communities and provide unique opportunities that enhance public awareness for conserving natural resources to the public.

Strategies:
1. Within five years of the completing of this CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Maintain all viewing areas on the Complex to including the auto tour loops, San Bernard beach, walking trails, viewing areas, decks, boardwalks, and observation platforms in a safe and usable condition. The Complex may remove facilities from service for public safety.
3. Establish scheduled programs for wildlife viewing such as the interpretive van tours and guided bird and wildflower walks.
4. Continue to evaluate existing facilities for accessibility requirements every three years and make necessary improvements to these facilities as resources allow.
5. Within five years of this CCP, expand trail system to the west side of Bastrop Bayou at the Dow Woods Unit.
6. Continue to work in partnership with local chambers of commerce, Gulf Coast Bird Observatory, Sea Center Texas, Brazosport Center for the Arts, Houston Zoo, State Parks, and TPWD's Texas Wildlife Expo. Participate in selected nature-related community events.
7. Provide social media outlets, including maintaining the refuge web sites and working with the Friends Group to provide the latest information to ensure the site has the latest information on wildlife observation opportunities such as bird sightings, optimal viewing times, and links to other important wildlife observation websites.
8. Provide a one-mile trail and boardwalk across from the Brazoria Field Office to enhance wildlife observation opportunities.

Objective 3 – Wildlife Photography
The Complex will provide safe and high quality opportunities on the Complex by maintaining existing photo blinds and viewing areas and develop new opportunities where appropriate to achieve a 10 percent annual increase in wildlife photography participants throughout the Complex.

Rationale:
The refuges are destinations for both professional and novice wildlife and nature photographers. Wildlife photography is a means of exploring and sharing the natural world. Photographers come to the refuges to get an opportunity to capture a unique expression of the

environment and nature around us, take that image home, and continuously reflect upon it promoting both wildlife and wildlife dependent recreational opportunities provided by national wildlife refuges throughout the country.

The photo blind at Hudson Woods was constructed to provide photography opportunities at the oxbow lake. Photo Credit: USFWS

The annual Migration Celebration, sponsored by the Friends of Brazoria Wildlife Refuges and hosted on San Bernard NWR, includes an annual photography contest for both youth and adults, in an attempt to encourage wildlife photography opportunities. Ten youth and thirty-six adults participated in the 2010 Migration Celebration photography contest, entering forty-nine and 194 photos respectively. Many participating photographers come back to the Complex throughout the year to continuously pursue wildlife photography opportunities. The Complex has used the amount of annual contestants as a method to determine trends and even numbers of visitors taking advantage of wildlife photography opportunities and is striving to continuously expand this opportunity by 10 percent on an annual basis throughout the life of the CCP.

In 2009, the DEEP program added a nature photography session. This mini-course educational activity allows youth to use digital cameras and capture natural images. Youth provide all images to the teacher. Expansion of this opportunity beyond the DEEP program and photography workshops will further expand photography among youth.

Recreational wildlife photography programs will promote understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System (General Guidelines for Wildlife Dependent Recreation 605 FW 1).

Strategies:

1. Within five years of completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Host children's refuge photography contests and display winning photos in the refuge Complex office or other outreach opportunities including the Brazos Mall.
3. Facilitate nature photography on the refuge in partnership with local schools or other organizations for children and adults by making cameras and portable photo blinds available for loan to the visiting public.
4. Construct two additional photo blinds on the Complex; one at Dow Woods and one on Otter Slough at Brazoria NWR.
5. Incorporate photography into the Refuge Junior Naturalist Program.

Objective 4 – Interpretation
Over the life of the CCP, the Complex will increase the effectiveness of all interpretive activities by 25 percent above current levels.

Rationale:
Surveys will measure the increasing the effectiveness of the interpretive program above current levels in annual increments with the 2010/2011 National Wildlife Refuge Visitor Surveys as the baseline. Surveys will attempt to capture a better understanding of three primary concepts: 1) the value and unique purposes of Complex, including conservation of species and habitats; 2) the Complex as a component of a national network of refuges, and; 3) the significance and mission of the Refuge System.

Many visitors do not realize the distinction between a national wildlife refuge and a park or federal or state agency lands managed for different purposes. Increased efforts are needed to help people better understand the role of national wildlife refuges, the Service mission, and to have a heightened awareness of conservation and stewardship concepts.

Strategies:
1. Within five years of the signing of the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Improve existing kiosk exhibits and add at least one new informational kiosk to be located off FM 2004 by Brazoria NWR field office.
3. Complete the interpretive trails at Dow Woods.
4. Develop and schedule high-quality interpretive programs to hold monthly during fall, winter, and spring.
5. Recruit, enlist, and train naturalists for interpretative and environmental education programs across refuge habitats.
6. Continue to offer popular, audience-specific, interpretive programs both on- and off-site, and at special events such as the Brazoria County Library Series, “Migration Celebration,” and “Wildlife Expo,” which includes activities such as interpretive van tours, guided bird and wildflower walks, and programs for school groups, libraries, and scouts.
7. Within three years, develop and interpret the San Bernard NWR Auto Tour.
8. Update all informational and interpretive materials to improve accuracy, consistency, quality, and availability. Revise and make some brochures available to local visitors in Spanish.
9. Throughout the life of this CCP, maintain and update or replace damaged and obsolete interpretive and informational panels on refuges; including entrance signs, roadway signs, wayside exhibits, trails, and viewing areas.
10. Within two years, install identification markers for native plants at the Discovery Center, Bobcat Woods, and Complex gardens.
11. Within two years of the CCP, develop an annual visitor use survey for the Complex to evaluate services and determine needs.

Objective 5 – Hunting

Over the life of the CCP, the Complex will continue to work through partnerships to increase youth hunting opportunities by 20 percent and while maintaining existing waterfowl hunts at current use levels, increase opportunities by opening additional area(s).

Rationale:

The refuges work to foster public understanding and appreciation of the natural world through wildlife-oriented recreation. This includes hunting. Hunters have supported the conservation of our nation's wildlife resources, including the Mid-coast Refuges, through the purchase of the Federal Duck Stamp. The refuges provide hunting opportunities where appropriate and compatible with refuge purposes. Although Texas has one of the largest hunting populations; estimated at 16 percent in 2001(TPWD 2001); similar to national trends, it is declining. Comparing 1991 to 2006 estimates, the number of all hunters declined by 11 percent nationwide (USFWS 2006). This decline in overall users poses a challenge for the Complex to maintain current levels. The Complex will continue to provide opportunities for waterfowl hunting, and strive to maintain hunt use at 3,400, providing compatible, safe, accessible, quality recreational hunting opportunities on the Complex while minimizing conflicts with other non-hunting visitors.

The refuge will continue to offer migratory bird hunting opportunities and expand opportunities in the future. Photo Credit: USFWS

Strategies:

1. Within five years of completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Provide waterfowl hunting opportunities within designated Public Waterfowl Hunting Areas in accordance with regulation set forth by the State of Texas.
3. In cooperation with TPWD, provide additional waterfowl hunting opportunities that foster an appreciation of refuge resources and are appropriate and compatible following appropriate NEPA processes (i.e. Eagle Nest Lake).
4. Continue to partner with TPWD and Texas Youth Hunting Program, to offer opportunities for youth deer and feral hog hunting.
5. Encourage hunting participation of under-represented segments of the public such as disadvantaged youth, persons with disabilities, and women, through various outreach.

6. Promote hunter compliance with federal and state regulations and encourage good sportsmanship, ethical hunting behavior, and understanding of the refuge and its purposes through law enforcement visibility and effective wording within informational brochures with high quality maps, signs, and posts on the refuge web site.

Objective 6 – Fishing

Over the life of the CCP, provide for a 55 percent increase of compatible, safe, accessible, and quality recreational fishing experience while minimizing conflicts with other non-fishing visitors.

Rationale:

Fishing is a traditional use of the area's salt water bays and lakes that adjoin and are within the refuges. In 2001, TPWD estimated 38 percent of Texans participate in fishing as a recreational activity. With the expected continued growth in the Houston Metropolitan Area, the number of fishing visits is likely to increase. The Complex is currently providing fishing opportunities for up to 30,000 fishing visits (70 percent accessed by boats) and with the anticipated increase, the refuges can still provide quality experience while minimizing conflicts with other Complex users. The Complex expects the anticipated increase to primarily occur from boat access fishing, rather than land access fishing in the Public Fishing Areas. Fishing provides opportunities to connect many people, particularly children, with nature. By providing safe and accessibly opportunities from designated refuge lands and access to some refuge waters, the Complex will continue to meet the need while protecting resources.

Strategies:

1. Within five years of completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Continue to provide a variety of fishing opportunities including bank fishing, canoe/kayak, and motorboat access areas.
3. Maintain facilities at the Public Fishing Areas including the accessible fishing piers.
4. Revise all brochures and fishing maps to include the San Bernard beach as a public fishing area, allowing non-motorized access along the beach to the San Bernard River.
5. Continue to encourage fishing among youth by offering fishing oriented educational activities in DEEP and at Migration Celebration.
6. Encourage fishing participation by under-represented segments of the public such as disadvantaged youth, persons with disabilities, and women, through outreach to various organizations.
7. Within three years, provide at least one educational fishing event for local youth with an emphasis on disadvantaged and minorities.
8. Throughout the life of this CCP, promote angler compliance with federal and state regulations and encourage good sportsmanship, conservation practices, and understanding of the refuge and its purposes through law enforcement visibility and effective wording within informational brochures with high quality maps, signs, and on the refuge web site.

9. Conduct all fishing activities in accordance with State of Texas regulations.

Objective 7 – Environmental Education
Over the term of the CCP, increase both on- and off-refuge structured, curriculum-based environmental education opportunities (DEEP) by 25 percent.

Rationale:
Environmental education is a critical first step in providing visitors with an awareness of the Complex and the Refuge System and will ultimately translate into support for the refuges and the Refuge System mission. Environmental education provides a way for people to connect with nature through a "hands on" approach, and provides educational experiences not easily gained in a classroom. The population of Brazoria County has grown nearly 30 percent over the past 10 years (US Census) with more than 30 percent of the population under the age of 18. In order to maintain the current opportunities to provide hands-on environmental education for area schools, DEEP will need to continue expanding from the current 3,000 students per year.
All environmental education activities both on and off refuge, will comply with Service policy (605 FW 6), which are aligned with state and national environmental educational criteria.

Strategies:
1. Within five years of the completing the CCP, develop a Visitor Services Plan that evaluates existing public use facilities, identifies additional facilities needed to provide high-quality compatible wildlife-dependent recreation, and identify sources of funding for development and maintenance of facilities.
2. Offer hands-on environmental education programs both on- and off-site, such as field trips, special educational events, and special-interest group programs.
3. Conduct annual on-site environmental education workshops that orient educators to the refuge resources and, in turn, encourage them to incorporate this into their curriculum, both in the classroom and during field trips.
4. Maintain existing and build additional partnerships with local, state, and federal agencies, nonprofit organizations, businesses, and individuals during the Migration Celebration to improve the Refuge EE Program.
5. Promote the learning trunks and resource materials for the Environmental Education Program to use on-site and take off-site for programs. These trunks include materials for topics as wetlands, wildlife, plants, conservation, endangered species, and fishing.
6. Within two years, develop and maintain a multi-faceted environmental education resource library comprised of books, videos, posters, environmental education field trip guides, specific topic packets, and pertinent written materials. These will be available for use in refuge educational programs and by educators.
7. Within 10 years, in cooperation with partners and Friends group, explore the development of environmental education areas at San Bernard NWR (including Dow Woods). At Dow Woods, construct an environmental education laboratory addition next to the pavilion, with seating and study/lab equipment for up to 50 students and teachers for the various schools, including Brazosport College.

8. Annually review and maintain the "Educator's Guide to Texas Mid-coast National Wildlife Refuge Complex" that provides orientation, guidelines, grade-level, and state learning standards information, maps, and site-specific activities that focus on one or more refuge themes.
9. Seek funding sources such as grants for refuge environmental education programs that promote understanding and appreciation of the refuge's natural and cultural resources and their management consistent with Service policy.
10. Promote the Discovery Environmental Education Program through news releases, the refuge web site, informational fliers, and other social media.

Objective 8 – Outreach

Increase refuge awareness in the local community by annually providing opportunities for approximately 15,000 people to participate in off-refuge programs and exhibits. These activities will also help recruit an additional 5 percent annually of volunteers for the Complex, and help build membership an additional 5 percent annually for the Friends of Brazoria Wildlife Refuges.

Rationale:

Accomplishing the Service's mission depends on our ability to build relationships and communicate with the American public. Strategic outreach efforts facilitate the communications and relationship building required for achieving conservation goals. It is critical to the mission of the Complex that the neighbors and citizens in the surrounding communities know about the Complex and support it as a valuable and contributing part of the community. Although currently recognized for its aesthetic and biological value by current users, by preserving wilderness (or natural environments such as refuges) and avoiding the irreversible decision of development, we may be creating and capturing option, existence, and bequest values (Manning, 1989).

Strategies:

1. Within two years, complete an Outreach Plan that will better identify the need, target audience, and means for future outreach.
2. Coordinate with partners and Friends group, continue to work off-site to promote and support refuge events like the Migration Celebration. Sponsor special on-site annual events such as Refuge Week, International Migratory Bird Day, and National Fishing and Boating Week that engage the public in wildlife-dependent activities, and increase people's knowledge and understanding of wildlife conservation and related issues.
3. Within five years, develop portable interpretive displays that highlight the Refuge System mission, refuge purposes, management, themes, and natural resource highlights to use on-site as needed for programs or special events, and for off-site displays at festivals, special events, and malls as part of the Visitors Services Plan.
4. Maintain an active volunteer program that includes recruitment and training of volunteers for assistance in all refuge programs.
5. Within eight years, develop at least two outreach tools such as posters or brochures to promote public involvement or participation in support of the refuge purposes and vision.

6. Increase outreach efforts to local schools, organizations, agencies, neighbors, and the public to enhance awareness, understanding, and support for the Complex and Refuge System.
7. Partner with local hunting and fishing organizations to develop outreach opportunities specific to those uses.
8. Support and help promote the Texas Junior Duck Stamp Program including featuring artwork in the Brazos Mall.
9. Coordinate with local chambers of commerce, birding organizations, local attractions, and other public venues such as motels to display and provide refuge information to the public.
10. Ensure consistency of media and public communication information among staff and volunteers during all outreach functions, as an important element of the Visitor Services Plan. This involves maintaining and regularly updating the Refuge and Friends web site as a "single source" for this outreach information.
11. Within eight years, develop outreach plans for important resource issues in the local area for distribution in the Discovery Center, Complex, and field offices.

Objective 9 – Law Enforcement and Visitor Safety

Throughout the life of the CCP, the Complex will double its law enforcement presence in and around the Complex by increasing cooperation with other local, county, and state public safety officers by formalizing cooperative agreements through Memorandums of Understandings (MOUs).

Rationale:

Currently, the Complex is limited to two full-time and one dual-function law enforcement officer to cover more than 100,000 acres spread out over 27 units in three counties. Building strong partnerships and liaisons with federal, state, and local law enforcement agencies improves our ability to provide a 24/7 presence or access to all parts of the Complex. The Complex currently has MOUs with Brazoria County and TPWD and one formal agreement with one city near the refuges. With populations in and around the refuges continuing to grow, Brazoria County is reporting a 20 percent increase in call outs over the past five years (Sheriff's Office, personal communication). The Complex will continue to work collaboratively to provide law enforcement coverage to protect natural resources, facilities, and people, and provide visitor safety and emergency response by building and maintaining partnerships with local law enforcement agencies over the term of this CCP.

Strategies:

1. Continue to build strong partnerships to increase law enforcement coverage, enhance visitor safety, and emergency response. Continue to work cooperatively, developing good relations and radio communications with local law enforcement offices of TPWD Law Enforcement; Brazoria, Matagorda County Sheriff's Departments; Texas Department of Public Safety; and the Service's Law Enforcement Office in Houston to enforce federal, state, and refuge-specific hunting and fishing regulations.
2. Provide for visitor safety, protect resources, and ensure compliance with federal, state, and refuge-specific regulations through law enforcement.

3. Maintain a good working relationship with Emergency Medical Services of Brazoria and Matagorda counties and local volunteer fire departments to provide immediate emergency response as needed.
4. Within three years, develop a Law Enforcement and Emergency Services Management Plan.
5. Annually review and revise refuge-specific visitor regulations for consistency and compatibility.
6. Maintain current law enforcement and emergency equipment and provide as necessary, including any patrol vehicles to meet applicable federal and state emergency vehicle standards.
7. Increase the public's knowledge of refuge regulations and the boundaries on refuge lands. Update Web pages and improve Complex signs, kiosks, and facilities to better advise the public on refuge regulations, boundaries, and safety issues.

Objective 10 – Partnerships
Continue to maintain existing partnerships (eight) with agencies, groups, neighboring landowners, and other interested parties to help achieve the vision, goals, objectives, and strategies outlined in this CCP.

Rationale:
Partnerships are an essential element in fulfilling the vision as stated in this CCP. Partners bring new and different ideas and resources to the table that supports conservation management, biological research, and a variety of public use programs.

Strategies:
1. Within two years of completing the CCP, develop and revise the "Volunteer Manual" to ensure consistency in our message to the public to include the Service mission, Refuge System mission, refuge purpose, and difference between state and federal areas.
2. Continue to partner with local schools, state and federal agencies, and local organizations to promote the refuges and conservation of habitat throughout the mid-coast area of Texas.
3. Within three years, in cooperation with Friends of the Brazoria Wildlife Refuges, offer educational materials for sale at the Discovery Center and Complex with proceeds benefitting the education and interpretation programs.
4. Coordinate with and support the Friends of Brazoria Wildlife Refuges, continuing to develop new opportunities that support the vision of this CCP.
5. Continue to coordinate with Area Leaders for Christmas Bird Counts on both San Bernard and Brazoria NWR, which are in the San Bernard, Freeport, and Brazoria Count Circles.

Objective 11 – Cultural Resources
Maintain existing interpretive, cultural, historical, and archeological resources (two) on refuge lands and interpret additional sites as new opportunities arise.

Rationale:
The Service is required to protect all cultural resources on refuge lands as mandated by federal law and Service policies and mandates. Interpretation of the history of the area is an important aspect of highlighting the refuge resources and people's connections with the land. Although people are more removed from the environment today than in times past, they are nonetheless a part of it.

Strategies:
1. Within five years, complete a step-down Cultural Resources Management Plan to fulfill requirements of the Archaeological Resources Protection Act for surveying lands and the National Historic Preservation Act for a preservation program.
2. Throughout the life of this CCP, preserve known cultural resources in place through non-disturbance. The most abundant type of cultural resource on the Complex is the numerous "shell middens" left by Karankawa Indians.
3. Continue to consult with the State Historic Preservation Office prior to all proposed construction actions.
4. Work with community and county museums to document more of the human history across what are now refuge lands, collecting historic photographs and integrating this information into refuge programs.
5. Within 10 years, develop exhibits to inform and interpret the historical connection between people and the land.

4.5 Facilities Goal

To provide administrative and public use facilities needed to carry out the Refuges' purposes and meet management objectives.

Objective 1 – Public Use Facilities
Maintain current public use facilities in a safe and accessible manner and construct additional (25 percent) facilities (i.e. trails, classrooms, hunting blinds, and wildlife observation facilities) over the life of the CCP that support a diversity of compatible wildlife-oriented public use opportunities.

Rationale:
Quality public use facilities enhance visitor experiences and encourage visitor's to return to the refuges, building a connection between the visitor and nature. However, the Complex's ability to maintain existing facilities is paramount to adding additional facilities. It is often easier through grants and partnerships to develop facilities, but much more difficult to ensure resources (time, staff (including LE), and equipment) are available for maintaining those facilities over time. The Complex will add facilities only as funds for construction and resources to maintain additional facilities become available.

Strategies:
1. Within three years, expand the trail system at Dow Woods Unit of San Bernard NWR to the west side of the Bayou; providing additional access and interpretive opportunities.

2. Within ten years and through a partnership with the Friends group, construct an educational facility at San Bernard NWR to support school and group environmental education activities, including Migration Celebration.
3. Develop accessible waterfowl hunting facilities at the Sargent Permit Hunt Area on San Bernard NWR.
4. Expand RV volunteer site at San Bernard NWR from two to five campsites.
5. Maintain all roads, trails, wildlife observation facilities, fishing piers, and other public use facilities in a safe and operable condition.

Objective 2 – Administrative, Maintenance, and Storage Facilities
Provide safe, accessible administrative facilities that support the administrative, refuge management, biological, maintenance, and law enforcement programs across the Complex and foster productive environments for staff and volunteers.

Rationale:
Throughout the refuges' history, facilities have slowly grown and today, two field headquarters—including offices, maintenance and storage facilities, and one Complex office—provide the primary infrastructure supporting administrative, maintenance, biological, and management programs. Most recently, the construction of the Brazoria Field Headquarters in 2006–2011 and the Complex Headquarters (2008) has enabled the refuge to move out of GSA leased space. Refuge administrative, maintenance, and storage facilities are critical for protecting government-owned equipment and staff essential to completing the refuges' mission.

Strategies:
1. Replace the refuge office at San Bernard NWR with an accessible facility; providing office space for 11 staff and volunteers as funds allow.
2. Replace the Quonset hut at Hudson Woods Unit with a facility at Buffalo Creek to provide storage for equipment used on the unit and during hurricanes.
3. Replace the wash station at San Bernard NWR and construct a wash station at Brazoria NWR, using "green" technology that will enable the refuges to maintain equipment in this harsh environment.
4. Construct one additional storage shop facility at Brazoria NWR for the secure storage of vehicles and equipment.
5. Construct on additional storage facility supporting the Refuge Law Enforcment Program at a central location.

Objective 3 – Habitat Management Facilities
Throughout the life of the CCP, maintain all habitat management facilities including levees, ditches, water-control structures, freshwater wells, and fire lines to effectively manage habitat across the Complex.

Rationale:
A variety of ditches, levees, and water control structures support the water management capabilities across the Complex. Staff must keep these facilities in good working condition to effectively use rainfall, run-off, and purchased water to support resident and migratory

birds. Freshwater wells may become a lifeline during extended droughts, providing a minimum amount of freshwater in some ponds. Boundary fire breaks must be maintained in order to manage effectively wildland fire and prescribed burning on refuges and protect adjacent private property.

Strategies:

1. Maintain all levees, ditches, and water control structures and pumps in serviceable condition ensuring that the Complex can move and store water to provide the optimal support of management programs.
2. Maintain freshwater wells at Sargent, Wolfweed, and Big Slough Tour Loop to provide freshwater during drought periods for wildlife.
3. Regularly maintain fire breaks on the refuges, to control the spread of wildland fires and conduct prescribed burning.

Objective 4. Oil and Gas Facilities. Continue to work closely with companies who have oil and gas interests under refuge lands and ensure that exploration and development of those interests are conducted in the most environmentally-sensitive manner possible.

***Rationale*:**

There are currently four active oil and/or gas operations (Slop Bowl, Sargent, Cocklebur Slough and Buffalo Creek) across on the Complex. A number of active pipelines cross the core refuges and many of the bottomland units as well. The refuges do not own the minerals below the surface (with the exception of a partial interest on Swaggert Tract). The refuge must allow for their exploration and development through reasonable means. Except for Dance Bayou tract there are generally no deed restrictions for O&G development. Refuge personnel work closely with those oil and gas companies during all phases of operations through the preparation of an EA and Operation Plan for seismic, and drilling activities to ensure the surface is minimally impacted to the extent possible by these operations. Although issues are rare, occasional spills and worn or abandoned equipment must be cleaned-up and removed.

***Strategies*:**

1 Coordinate with oil and gas interests on all exploration and development activities on the refuge, and administer such activities under Service policy and regulations through issuance of Special Use Permits
2. Coordinate with Regional Oil and Gas Specialist to ensure oil and gas operations are in compliance with Service regulations and policy.
3. Work with Evironmental Protection Agency and Texas Railroad Commission to ensure operators are within State compliance. Require each operator to operate under current local, state and federal regulations and policies.
4. Require each operator to prevent, to the maximum extent possible, releases of hazardous materials and substances, crude oil, and produced water.
5. Ensure that each operator has a current *Oil Discharge Prevention and Contingency Plan* outlining procedure for accidental releases.

6. On a case-by-case basis, the refuge may request that wells, roads, pipelines, and associated infrastructure and facilities not needed to support operations be removed and the sites restored to the satisfaction of the Refuge Manager.