STATEWIDE DISTRIBUTED EPHEMERAL HABITATS AND PERENNIAL TANKS

In New Mexico, many diverse aquatic habitat types occur in geographically isolated, and closed (endorheic) basins. The most prominent basins include the Tularosa, Mimbres, Estancia, San Augustine, Salt, Southwestern, and North Plains (NMDGF 2003). More than 84 mi (135 km) of perennial rivers and 3,900 mi (6,276 km) of intermittent streams exist within the state's closed basins. Associated key aquatic habitats include ephemeral natural catchments, ephemeral marsh/cienegas, ephemeral 1st and 2nd order streams, ephemeral man-made catchments, and perennial tanks (Fig. 5-8).

For reasons of similarity, ephemeral natural catchments, ephemeral marsh/cienegas, and ephemeral 1st and 2nd order streams are collectively addressed under the heading Geographically Isolated Wetlands. "Geographically Isolated Wetlands" refers to wetlands that are completely surrounded by upland at the local scale (Tiner 2003). However, for this document, we included large endorheic basins, complexes of wetlands within a single basin, and individual isolated wetlands.

Geographically isolated wetlands and waters of closed basins have designated uses for fish and wildlife indigenous to New Mexico under Sections 20.6.4.801-805, NMAC 1978 (as amended in 2005) of the State Standards for Interstate and Intrastate Surface Waters. They provide a suite of functions and services (such as valuable commodities derived by natural processes) that benefit society (Bolen *et al.* 1989, Costanza *et al.* 1997, Tiner *et al.* 2002, Mitsch and Gosselink 2000, Leibowitz 2003, Smith 2003). In New Mexico, these functions and services are inextricably linked to intrastate, interstate, and foreign commerce by providing areas valued by hunters, anglers, and recreationists (NMDGF 2003). Hydrologic and mineral resources extracted from waters and wetlands of isolated basins in New Mexico provide significant sources of revenue for the state and private industries such as oil and gas extraction, potash mining, agriculture and livestock.

Species of Greatest Conservation Need

Of the 867 species of vertebrates known to occur in New Mexico, approximately 479 (55%) rely wholly, or in part on aquatic, riparian or wetland habitat for their survival (NMDGF 1994a). Nearly 25% (30 of 118) of the species and subspecies of wildlife listed as threatened and endangered in New Mexico (NMDGF 2004a) are restricted to or occur in wetlands, riparian areas, and waters of closed basins (NMDGF 2003).

Approximately 59 Species of Greatest Conservation Need (SGCN), excluding arthropods other than crustaceans, are associated with geographically isolated wetlands, ephemeral man-made catchments, and perennial tanks (Table 5-10). Of these 59 species, 23 (39%) are considered vulnerable, imperiled, or critically imperiled both statewide and nationally. An additional 25 (42%) species are nationally secure, but are considered vulnerable, imperiled, or critically imperiled in New Mexico, and 11 species (19%) are secure both statewide and nationally. Conservation status codes (abundance estimates) for each SGCN are provided in Appendix H. Additional conservation concerns for taxa listed in Table 5-10 are addressed in the riparian habitat and/or key terrestrial habitat discussion.

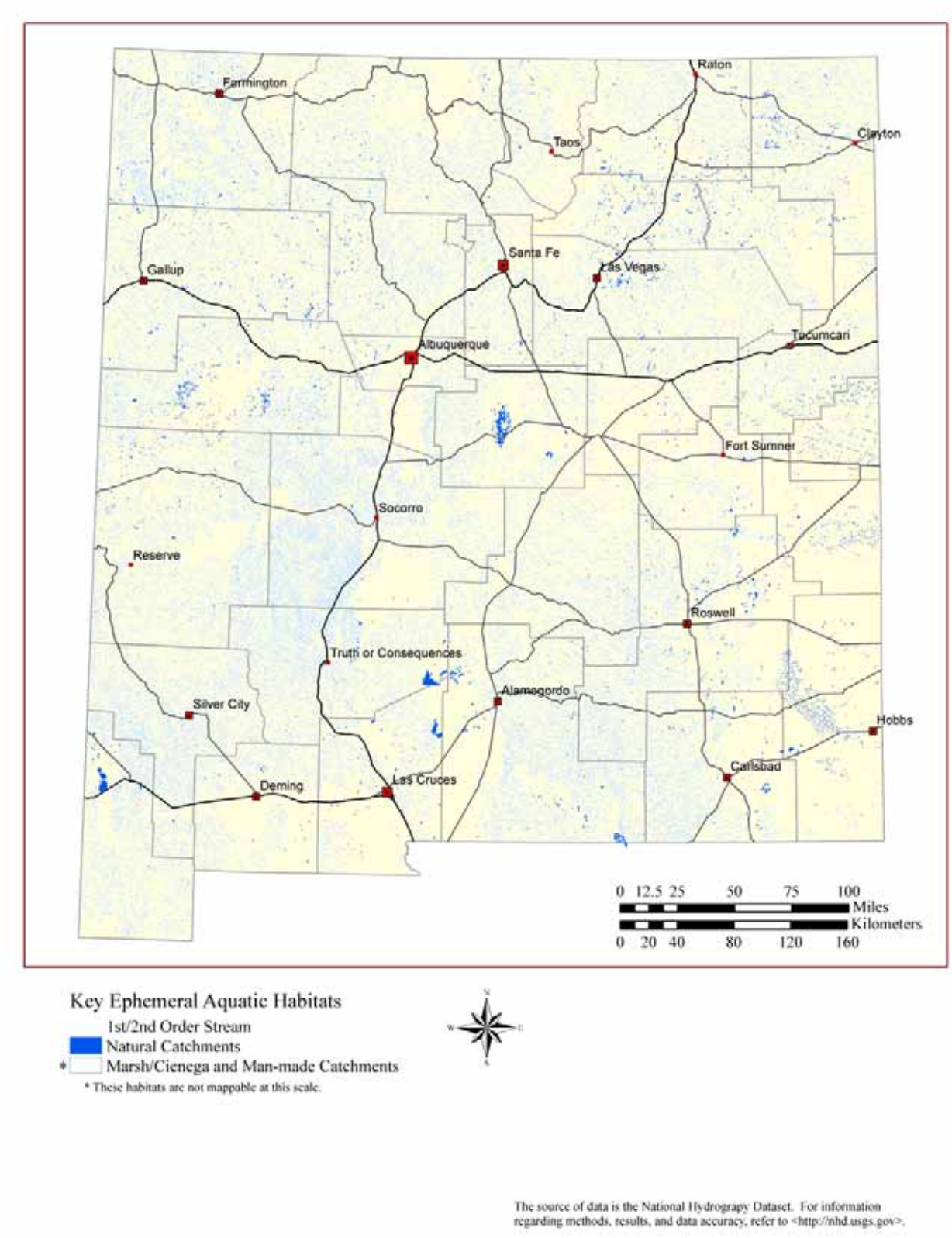

Figure 5-8. Key statewide aquatic habitats in New Mexico. Ephemeral marsh/cienega and man-made catchments are not shown.

Table 5-10. Species of Greatest Conservation Need associated with ephemeral aquatic habitats and perennial tank habitats in New Mexico.

	Perennial	*Ephemeral*			
Common Name or Scientific Name[1]	Tank	1st and 2nd Order Stream	Marsh/ Cienega	Man-made Catchments	Natural Catchments
Birds[2]					
American Bittern			X		X
Common Black-Hawk	X		X		
Sandhill Crane					X
Northern Pintail	X		X	X	X
Bald Eagle	X		X	X	X
Peregrine Falcon			X		
Southwestern Willow Flycatcher			X		
Eared Grebe	X				X
Northern Harrier			X		
White-Faced Ibis	X		X	X	X
Wilson's Phalarope	X		X	X	X
Interior Least Tern	X				
Mammals[2]					
Allen's Big-Eared Bat	X				
Pocketed Free-Tailed Bat	X				
Western Red Bat	X				
Spotted Bat	X				
NM Meadow Jumping Mouse			X		
Desert Bighorn Sheep	X		X	X	X
Prairie Vole			X		
Amphibian[2]					
Western Chorus Frog	X	X	X	X	X
Chiricahua Leopard Frog	X		X	X	X
Lowland Leopard Frog		X			
Northern Leopard Frog	X		X	X	X
Plains Leopard Frog	X			X	X
Rio Grande Leopard Frog	X				
Tiger Salamander	X		X	X	X
Arizona Toad		X		X	X
Colorado River Toad				X	X
Great Plains Narrowmouth Toad				X	X
Reptiles[2]					
Arid Land Ribbon Snake	X	X	X		X
Western Painted Turtle	X				
Big Bend Slider	X				
Mexican Garter Snake				X	
Sonoran Mud Turtle	X		X	X	X

Table 5-10 Cont.

Common Name or Scientific Name[1]	*Perennial* Tank	*Ephemeral* 1st and 2nd Order Stream	*Ephemeral* Marsh/ Cienega	*Ephemeral* Man-made Catchments	*Ephemeral* Natural Catchments
Molluscs					
Wrinkled Marshsnail			X	X	X
New Mexico Ramshorn Snail		X			X
Crustaceans					
Brine Shrimp					X
Colorado Fairy Shrimp					X
Versatile Fairy Shrimp					X
Akali Fairy Shrimp					X
Packard's Fairy Shrimp					X
Cyzicus sp. (mexicanus?)				X	X
Eocyzicus concavus					X
Eocyzicus digueti				X	X
Knobblip Fairy Shrimp					X
Eulimnadia antlei					X
Eulimnadia cylindrova				X	X
Eulimnadia diversa				X	X
Eulimnadia follismilis				X	
Eulimnadia texana				X	X
Lepidurus lemmoni					X
Sublette's Fairy Shrimp					X
Moore's Fairy Shrimp				X	X
Streptocephalus n. sp. 1				X	X
Streptocephalus n. sp. 2				X	X
Great Plains Fairy Shrimp				X	X
Mexican Beavertail Fairy Shrimp				X	X
Beavertail Fairy Shrimp				X	X
Tadpole Shrimp				X	X

[1] Scientific names are provided where common names for the species does not exist.
[2] Conservation concerns for these taxa are addressed in the Statewide Distributed Riparian Habitats and/or Ecoregion and terrestrial habitat sections.

Many upland and big game species, threatened and endangered species, and non-game species have essential aspects of their life history linked to geographically isolated wetlands (NMDGF 2003). Ephemeral natural catchments such as playas and salt basins and their associated watersheds are considered self-contained, functional ecosystems (Belk 1998, Leibotwitz and Nadeau 2003, Tiner 2003) that provide habitats for a broad spectrum of plant and wildlife species (NatureServe 2004a). They serve as important feeding, resting and breeding areas for resident and migratory water birds (Ducks Unlimited 2001, Sibbing 2004) and support a great diversity of New Mexico's SGCN.

All SGCN large branchiopod crustaceans (fairy shrimp, clam shrimp, and tadpole shrimp) are obligate aquatic species whose persistence across the landscape is wholly dependent on geographically isolated ephemeral wetlands. They do not occur in perennial waters. These crustaceans are important links in the aquatic food web of ephemeral wetlands (Proctor 1964, Silveira 1988, Thièry *et al.* 1989, Graham 1994, Woodward and Kiesecker 1994, Moorhead *et al.* 1998, Eriksen and Belk 1999, Wissinger *et al.* 1999). Branchiopod crustaceans rely on a seasonal hydrologic regime to complete their life cycle. The resting cysts (eggs) endure harsh environmental conditions during their dormant period of habitat desiccation. Under natural conditions, the diapausing (resting) cyst bank can remain dormant in sediments from 1 to 20 years or longer until the next period of inundation (Steiert 1995, Belk 1998). Because they are obligate aquatic macro-invertebrates, the presence and persistence of large branchiopods in ephemeral wetlands serves as a biological indicator of aquatic ecosystem health (Lackey 1995). Further, they indicate the integrity (Callicott 1994) and ultimately the affects of land use practices in the surrounding landscape.

The knobblip fairy shrimp (*Eubranchipus bundyi*), Colorado fairy shrimp (*Branchinecta coloradensis*), and Packard's fairy shrimp (*B. packardi*) are anostracans that are known from seasonally astatic, cool to cold-water habitats at high elevations of 7,500-9,370 ft (2,286-2,856 m). These species occur in, or near areas of mixed conifers in isolated wetlands of northern and west-central New Mexico (Lang and Rogers 2002, Lang 2005, Rogers *et al.* In Review). Several other species of fairy shrimp (*Streptocephalus dorothae*, *S. mackini*, *S. texanus*, *Thamnocephalus platyurus*), clam shrimp, and the tadpole shrimp (*Triops* sp.) occur rather ubiquitously in warm to cool water pools at low to moderate elevations in diverse ecoregions such as the Apache Highlands, Shortgrass Prairie, and Chihuahuan Desert (Sublette and Sublette 1967, Lang and Rogers 2002, Rogers *et al*. In Review). Moore's fairy shrimp (*Streptocephalus moorei*) and Mexican beavertail fairy shrimp (*Thamnocephalus mexicanus*) can be considered naturalized in the Chihuahuan Desert. They occur sporadically in warm water basins, dirt stock tanks, and pit tanks dug into alkali playas (Lang and Rogers 2002, Rogers *et al.* In Review). The brine shrimp, (*Artemia franciscana*), is common in astatic brackish to saline playas of eastern Eddy and Lea counties, e.g., Great Salt Lake, Williams Sink, Middle Lake, Laguna Walden (Davis and Hopkins 1993), Chaves County, e.g., Bitter Lake National Wildlife Refuge (Rogers *et al.* In Review), Doña Ana County, e.g., Lake Lucero and White Sands National Monument (Patrick *et al.* 1977), Grant County (Lang and Rogers 2002), and in the Laguna del Perro playa basin complex of Torrance County (Davis *et al.* 1996a).

In New Mexico unique records of large branchiopods documented by Lang and Rogers (2002) and Rogers *et al.* (In Review) include: 1) The International Union for the Conservation of Nature and Natural Resources (IUCN) (1994, 1996) endangered Moore's fairy shrimp and Sublette's fairy shrimp (*Phallocryptus sublettei*), 2) two new streptocephalid fairy shrimps; and 3) the first North American records of a Venezuelan clam shrimp tentatively identified as *Eulimnadia follisimilis*. Lang and Rogers (2002) identified specific sites that provide unique natural ephemeral wetland habitats for large branchiopod crustaceans and migratory water birds. Some of these areas are in *New Mexico Wetlands 1996* (NMEMNRD 1996) and the *New Mexico 2000 Wetlands Conservation Plan* (NMED 2000), and include the BLM Lordsburg Playa Special Management Area in Hidalgo County, BLM Alkali Lakes Area of Critical Concern in Otero County, and Laguna del Perro Salt Lakes in Torrance County.

Similar to natural catchments, ephemeral marshes and cienegas provide habitat for at risk wildlife in New Mexico. The state endangered wrinkled marshsnail (*Stagnicola caperata*) occurs in high-elevation ephemeral marsh/cienega habitats in the Valle Grande, Valles Caldera National Preserve, Sandoval County (Lang 2005). This species, like other molluscs (pulmonate aquatic and land snails, and sphaeriid clams), survive periods of inclement weather by burrowing into mesic soils. Currently, the New Mexico ramshorn snail (*Pecosorbis kansasensis*) (Taylor 1985) is known from exposed sedimentary rock (fractures, rock pools) in mesic, ephemeral drainages from 3,125 - 4,685 feet elevation in Chaves, Eddy, Guadalupe, Lincoln, Otero, and San Miguel counties (Smartt 1988). In such habitats, this species occurred commonly with aquatic insect larvae and large branchiopod crustaceans.

Ephemeral man-made catchments provide habitat suitable for a suite of SGCN that are considered ephemeral wetlands obligates (aquatic macro-invertebrates), and taxa that have requirements of both wet and dry conditions (amphibians, reptiles). Man-made catchments also provide habitat for SGCN that migrate between wetlands, such as water birds (Leibotwitz and Nadeau 2003, NMDGF 2003). Several branchiopod crustaceans occur commonly in ephemeral man-made catchments (Eng *et al.* 1990, Lang and Rogers 2002). In New Mexico, unique records of these crustaceans occurring in this habitat type include: the knobblip fairy shrimp from Clayton Corral Tank in the Valle Vidal, Carson National Forest; two new streptocephalid fairy shrimps; and the first North American records of a Venezuelan clam shrimp tentatively identified as *Eulimnadia follisimilis* (Rogers *et al.* In Review). Lang (2005) reported the state endangered wrinkled marshsnail in a roadside pool in Taos County.

Many amphibians and reptiles depend upon ephemeral man-made catchments, including the tiger salamander, Colorado river toad (*Bufo alvarius*), Arizona toad (*Bufo microscaphus*), mountain treefrog (*Hyla eximia*), western chorus frog (*Pseudacris triseriata*), Rio Grande leopard frog (*Rana berlandieri*), plains leopard frog (*R. blairi*), Chiricahua leopard frog (*R. chiricahuensis*), northern leopard frog (*Rana pipiens*), lowland leopard frog (*R. yavapaiensis*), and the Sonoran mud turtle (*Kinosternon sonoriense*) (Degenhardt *et al.* 1996). Summer monsoon rains fill catchments and stimulate breeding for these and numerous other amphibians. In southwestern New Mexico, the Sonoran mud turtle lives in these sites until seasonal drought causes drying and forces the turtle to move into the terrestrial habitats and seek other aquatic habitats or aestivate until the catchments once again fill with water. The western chorus frog and northern leopard frog also live in ephemeral marshes and cienegas, where they breed in shallow aquatic habitat formed by early spring rains or snowmelt. Tiger salamanders (*Ambystoma tigrinum*) may also breed in these habitats although suitable aquatic habitat is generally limiting.

Perennial tanks that do not support large populations of non-native predators (such as sunfish and catfish) afford important habitat stability for leopard frogs (Rio Grande, Chiricahua, and northern) western chorus frogs, and tiger salamanders. Tanks may also provide suitable habitat for the American bullfrog (*R. catesbeiana*), which is widespread in the muddy-bottomed freshwater habitats below 6,889 ft (2,100 m) in New Mexico. This voracious, non-native predator has been implicated in the decline of *Ranid* frogs in New Mexico and elsewhere (Degenhardt *et al.* 1996).

Geographically Isolated Wetlands

Ephemeral natural catchments, ephemeral marshes/cienegas, and ephemeral 1st and 2nd order streams share many similarities regarding the factors that adversely affect them, including information gaps, research, survey, and monitoring needs, desired future outcomes, and conservation actions. Thus, to avoid redundancy, we have elected to address these key habitats collectively as Geographically Isolated Wetlands.

Habitat Condition

The hydrology of ephemeral natural catchments is driven entirely by seasonal and localized precipitation patterns. Each isolated depression is filled by snowmelt or rainfall captured within the adjacent upland (watershed). The hydroperiod may vary from seasonally astatic pools that fill and desiccate one or more times during any year (or not at all during prolonged drought periods) to perennial sites that fluctuate significantly during the year (Eriksen and Belk 1999). These isolated wetlands may lack a hydrologic connection to other wetlands, or they may be connected to other waters through groundwater with occasional surface water connections (Tiner *et al.* 2002, Leibowitz and Nadeau 2003). Plants may or may not develop in ephemeral natural catchments depending on soil conditions, duration of hydroperiod, and the hydrochemical environment (Bradley *et al.* 1998, Muldavin *et al.* 2000, Smith 2003).

Ephemeral natural catchments are recognized for their importance for a variety of uses. They have biological significance as wildlife habitat (Simpson *et al.* 1981, Guthery 1981, Silveira 1988, Bolen *et al.* 1989, Cole 1996, Anderson 1997, Lang and Rogers 2002, Rogers *et al.* (In Review), NMDGF 2003, Smith 2003, Tiner *et al.* 2002, Sibbing 2004). They provide recharge points to groundwater aquifers, and positively affect water quality (Osterkamp and Wood 1987, Zartman 1987, Zartman *et al.* 1994, Gustavson *et al.* 1995, Leibowtiz and Nadeau 2003, Whigham and Jordan 2003). Ephemeral natural catchments also provide anthropogenic uses, such as seasonal water storage and surface water sources for livestock and irrigation (Branson *et al.* 1981, NMED 2000, NMDGF 2003, New 1979, Fish *et al.* 2002). This water source can increase agricultural productivity and function as catchment basins for point and non-point source discharges such as those from sediment traps, livestock feed lots, municipal waste facilities, potash production, and oil and gas field operations (Pence 1981, Irwin *et al.* 1996, Davis and Hopkins 1993, Dein *et al.* 1997, Bristol 1999, Luo *et al.* 1997, Bolen *et al.* 1989, Smith 2003).

In arid New Mexico, ephemeral marsh and cienega habitats are most common at higher elevations of inter-montane basins where wet meadows and grasslands promote prolonged periods of snowmelt and run-off. At lower elevations, rain filled depressions, often underlain by a clay or caliche hardpan, hold water for sufficient duration to promote growth of wetland plant communities. At the same time, they provide habitat for wildlife species tolerant of wet and dry periods. Intermittent streams convey run-off waters that recharge groundwater aquifers. Ephemeral 1st and 2nd order streams are also hydrologically connected to ephemeral natural and man-made catchments that retain seasonal surface water utilized wildlife and livestock.

In the wetlands and waters of isolated basins, discharge practices associated with agriculture and livestock management, municipal waste and storm water run-off management, and extractive-use industries have resulted in contamination of ground and surface water (Boyer 1986, Rail 1989, McQuillan and Parker 2000). Such practices have impaired aquatic ecosystem functions (Davis and Hopkins 1993, Davis *et al.* 1996a, 1996b), and caused wildlife mortality (Dein *et al.* 1997, Bristol 1999, Lang and Rogers 2002).

Invasive and non-native plants and animals have been identified as a concern in the ephemeral natural catchments of the Tularosa Basin. Further, the decline in leopard frog populations is likely due to chytrid fungal infections.

Problems Affecting Habitats or Species

Ephemeral natural catchments were the aquatic key habitat that was most likely to be altered by cumulative factors in New Mexico (Chapter 4; Fig. 4-6). The other geographically isolated wetland types also had high cumulative factors that are likely to alter these habitats. Factors that adversely influence geographically isolated wetlands include: 1) habitat conversion (altered hydroperiod, sediment load), 2) abiotic resource use (oil/gas exploration and development, mining, dewatering), 3) pollution (toxic and solid waste), 4) consumptive biological use (improper grazing practices), and 5) modification of natural processes (drought and fire management). See Chapter 4 for a discussion of these factors. Additional factors that influence geographically isolated wetlands are detailed below.

Habitat Conversion
Any type of habitat conversion in geographically isolated wetlands (such as filling, dredging, draining, water discharges, etc.) that alters the hydroperiod of a given isolated catchment can result in the loss of ephemeral wetland abundance, a decrease in biotic diversity, reduced beneficial use by wildlife, and ecosystem dysfunction (New 1995, Belk 1998, Lang and Rogers 2002, Smith 2003).

For example, specific factors that influence the integrity of the New Mexico ramshorn snail include land-use practices that exacerbate arroyo entrenchment, sedimentation, and prolonged drought that could result in the extirpation of local populations. Similarly, populations of western chorus frog, lowland leopard frog, and the Arizona toad are influenced by fire management, invasion by non-native wildlife, and the spread of pathogens through increased recreational and commercial use (see Chapter 4).

Military Activities
Military maneuvers and related construction activities pose threats and loss of isolated populations of aquatic fauna that occur in ephemeral natural catchments on White Sands Missile Range (WSMR) and Holloman Air Force Bases (HAFB). The *Integrated Natural Resources Management Plans* for WSMR and HAFB, co-signed by the NMDGF and USFWS, attempt to mitigate potentially adverse affects of military maneuvers on significant natural resources.

Invasive Species
Invasive and non-native plants and animals have been identified as a concern in ephemeral natural catchments. The invasion of non-native species into such ecosystems can have adverse effects (Stohlgren *et al.* 1999). Invasive species have the ability to displace native plant and animal species, disrupt nutrient and fire cycles, and alter the character of the community by enhancing susceptibility to additional invasions (Cox 1999, Deloach *et al.* 2000, Zavaleta *et al.* 2001, Osborn *et al.* 2002). The State Forest and Watershed Health Plan devotes significant planning to the management of non-native invasive phreatophytes (New Mexico Energy, Minerals, and Natural Resources Department 2004).

Legal Protection
Perhaps the most comprehensive factor affecting geographically isolated wetlands in the US is the loss of legal protection under the federal Clean Water Act (CWA). Protection was denied for "isolated, intrastate, non-navigable waters" of closed basins (such as ephemeral wetlands [catchments], streams, marsh/cienega, including perennial catchments and rivers). This followed the Supreme Court's ruling in the case of Solid Waste Agency of Northern Cook County (SWANCC) v. United States Army Corps of Engineers (Corps) (Federal Register 2003). The protection of geographically isolated wetlands under the post-SWANCC wetlands regulatory regime emerges as a significant issue in New Mexico, where closed basins cover approximately 20% of the surface area of the state (NMDGF 2003). National policy directives issued by the Corps and Environmental Protection Agency in 2003 instructed field staff to begin withholding CWA protection to some 20 million ac (8 million ha) of wetlands nationwide (Sibbing 2004). In New Mexico, the Corps has already made decisions of non-jurisdiction regarding numerous isolated basins, including ephemeral and perennial waters in the Sacramento River and its tributaries in the Tularosa Basin (Tularosa River, its tributaries, Ysletano Canyon), the Mimbres River and tributaries, San Augustine Plains, Santa Clara Creek, Estancia Basin (Bachelor Draw), and Jornado del Muerto Basin (Sibbing 2004).

Pursuant to its statutory mandates, NMDGF actively manages 17 isolated wetlands (ponds, lakes) and five intermittent streams (Mimbres and Tularosa rivers, Running Water Draw, Three Rivers, and Tajique Creek) to provide fishing opportunities for anglers (NMDGF 2003). These cold and warm water fishery programs may be adversely affected by broad interpretations of the SWANCC decision.

Under the current post-SWANCC regulatory environment, New Mexico has no state-level wetlands permitting program to protect its most vulnerable waters. Moreover, the state's definition of "waters of the state" and surface water quality standards (NMAC 2000) are modeled after similar definitions and standards set forth under the CWA. Thus, "waters of the United States" in New Mexico that are no longer protected under the CWA may also lack state protection (NMDGF 2003, Sibbing 2004).

Information Gaps

Numerous information gaps regarding geographically isolated wetlands merit the attention of wetland scientists, policy-makers, and land/resource managers (Leibowitz and Nadeau 2003, NMDGF 2003, New Mexico Environment Department 2005).

- A clear definition of Clean Water Act language of "tributary", "adjacency", and "significant nexus" as they relate to federal and state wetland policies, regulations, and laws represents a significant information gap to refine jurisdictional authority over waters of the US and of the state.

- Explicit definitions are needed for geographically isolated wetland types in New Mexico.

- Comprehensive spatial data are lacking on the location, number, and total area of geographically isolated wetlands in New Mexico.

- Data are lacking on the biotic diversity of geographically isolated wetlands and waters of the state, especially for taxa that spend a significant part of their life history cycles in such habitats.

- Data are lacking on the types of wildlife that spend a significant part of their life cycles in waters of the US and the state, but also require isolated wetlands for their persistence across the landscape. Knowing the typical home ranges of these species would be useful to establish how far these organisms would be expected to travel between jurisdictional waters and geographically isolated wetlands.

- Fundamental information is lacking regarding the role of landscape scale interactions relative to the biotic and abiotic connectedness of geographically isolated wetlands and waters of the US and the state. How does geographic isolation and connectivity contribute to landscape function? Is isolation critical to the function of geographically isolated wetlands? How do isolated wetlands contribute to regional water quality?

- Studies are lacking that compare the diversity of geographically isolated wetlands relative to each other and to other aquatic and terrestrial ecosystems.

- The interrelationships of groundwater and surface waters of ephemeral natural catchments in the Tularosa Basin are poorly known. This lack of information raises concern for this habitat type regarding plans for water development projects (such as desalinization plants or water supply for Alamogordo) within the basin.

- The existing environmental conditions or thresholds that preclude populations of SGCN are unknown.

- Information is needed about the extent to which invasive and non-native species may alter aquatic community structure and preclude populations of SGCN in Geographically Isolated Wetlands.

Research, Survey, and Monitoring Needs

Under the current post-SWANCC regulatory environment, the future condition of geographically isolated wetlands in New Mexico is contingent upon providing legal authorities and policymakers with sound scientific data to reform current interpretations of state and federal laws and policies that were originally developed to protect geographically isolated wetlands. Research or survey efforts required to make informed conservation decisions are detailed below (Semlitsch 2000, Leibowitz and Nadeau 2003, NMDGF 2003, and New Mexico Environment Department 2005).

- Comprehensive spatial data designating the location, number, total area, and functional classification of geographically isolated wetlands would provide the foundation for monitoring impacts, quantifying wetland loss/gain, and facilitating risk assessment for these waters.

- Empirical studies are needed to examine and quantify how geographically isolated wetlands, wetland complexes, and other potentially impacted waters contribute hydrologically, chemically, and biologically to waters.

- Further research is needed that describes how geographically isolated wetlands contribute to regional water quality, particularly with respect to groundwater aquifers and waters.

- Studies that use landscape-level concepts to classify geographically isolated wetland types and compare their function(s) relative to the "isolation-connectivity" continuum should be a research priority.

- Research should analyze the relationship of biodiversity of geographically isolated wetlands to size, spatial distribution, and connectedness, and how the loss of wetlands at varying spatial scales affects metapopulation processes.

- Field methods are needed for relatively inexpensive and rapid techniques (RAPIDs) to classify geographically isolated wetlands by employing abiotic and biotic functional criteria.

- Studies are needed to develop a state wetland ranking system, more protective water quality standards, and well-defined mitigation measures for wetland resources that are outside of federal, state, and tribal jurisdictions.

- Studies are needed to quantify and compare the diversity of geographically isolated wetlands relative to each other and to other ecosystems.

- GIS-based biotic surveys statewide would serve to map the distribution and areal extent of geographically isolated wetlands and their associated SGCN. These data will also serve to assess at-risk wetlands and will facilitate monitoring of wetland loss and gain.

- Field studies are recommended that focus on habitat use patterns of all SGCN that are ephemeral wetlands obligates, those taxa that have obligate requirements of both wet and dry conditions, and those SGCN that primarily utilize jurisdictional wetlands but migrate to and from geographically isolated wetlands.

- Spatially explicit data are needed on physiochemical and hydrologic conditions of geographically isolated wetlands.

- Determine the extent to which invasive and non-native species may alter aquatic community structure and preclude populations of SGCN and identify methods to minimize impacts from non-native species.

- Research is needed to determine environmental conditions or thresholds that preclude populations of SGCN.

Desired Future Outcomes

Desired future outcomes for geographically isolated wetlands include:

- Geographically isolated wetlands persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN and host a variety of land management uses with reduced resource use conflicts.

- There is no net loss of geographically isolated wetlands in New Mexico.

- An expanded database (such as maps, data, etc.) exists for the New Mexico Wetlands Inventory.

- Improved water quality standards and mitigation requirements for geographically isolated wetlands are established and implemented.

- Refined definitions of "wetlands" and "waters of the state" are developed.

- Clarification of the terms "tributary", "adjacency", and "significant nexus" relative to jurisdictional waters and wetlands of the US and New Mexico are developed.

- Proactive *ad hoc* committees comprised of federal, state, tribal, municipal, NGOs, and citizen-based watershed groups are established to facilitate the conservation of geographically isolated wetlands and to improve the use of existing data management systems (such as STORET, New Mexico Natural Heritage Program Wetlands/Riparian Assessment Database).

- Management practices are developed and implemented that protects the ecological integrity of geographically isolated wetlands.

- The identification and adoption of RAPID methods to classify, rank, and assess geographically isolated wetlands are established and implemented.

- Wetlands regulatory program is established that provides state government full regulatory authority over all wetland types in New Mexico, including geographically isolated wetlands.

Prioritized Conservation Actions

Approaches for conserving New Mexico's biological diversity at the species or site-specific level are inadequate for long-term conservation of SGCN. Conservation strategies should be ecosystem-based and include public input and support (Galeano-Popp 1996). Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Collaborate with federal and state agencies and affected publics to create public awareness and understanding afforded by geographically isolated wetlands.

2. Work with appropriate state and federal entities and potentially affected interests to strengthen or develop state laws and policies that will protect the biotic and abiotic resources of geographically isolated wetlands.

3. Collaborate with federal and state agencies and affected publics to achieve a state goal of no net loss of geographically isolated wetlands as set forth under federal policy directives for waters of the US.

4. Encourage collaboration among state, federal, tribal, NGO's, and private land stewards to form playa alliances or wetlands working groups that develop and implement management practices to protect geographically isolated wetlands. Similar ecosystem-based approaches and integrated management strategies have gained momentum, with some measure of proven success, for the conservation of migratory waterfowl in North America (such as Playa Lakes Joint Venture, Ducks Unlimited, Inc., and the Rainwater Basin Joint Venture).

5. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about SGCN and geographically isolated wetlands outlined in the Information Gaps and Research, Survey, and Monitoring Needs section.

6. Work with federal, state, and private agencies and institutions to improve and increase the use of existing data management systems for tracking information pertinent to geographically isolated wetlands statewide.

7. Adopt standardized intergovernmental monitoring and survey methods to track gains and losses of geographically isolated wetlands statewide.

8. Encourage public participation in state and federal incentive-based programs to protect, enhance, and restore geographically isolated wetlands. Such incentive-based programs include: Swampbuster, Wetlands Reserve Program, Landowner Incentive Program, among others (McKinstry *et al.* 2004).

9. Provide information to the USFWS to update the New Mexico National Wetland Inventory.

10. Collaborate with the New Mexico Environment Department's Wetland Program to improve program efficiency to protect, restore, conserve, and create geographically isolated wetlands while tracking these achievements into the future.

11. Work with the Valles Caldera National Preserve to locate and protect populations of SGCN that occur in high-elevation ephemeral marsh/cienega habitats (such as vernal grassland pools) on the preserve.

12. Establish collaborative relations among state, federal, tribal, NGO's, universities, and private landowner to leverage funding at levels adequate to protect, enhance, and restore geographically isolated wetlands.

Ephemeral Man-Made Catchments

Habitat Condition

Ephemeral man-made catchments that serve as reservoirs for run-off provide aquatic habitat suitable for exploitation by wildlife and livestock. In practical terms, it is the joint beneficial use of ephemeral man-made catchments that affords rangeland wildlife and livestock the essential elements of habitat, food, water, and shelter to meet their needs. The hydrologic regime of these man-made habitats is similar to that of ephemeral natural catchments. These areas are very dynamic environments, subject to disturbance by flash flooding, drying, sedimentation, and routine maintenance.

Problems Affecting Habitats or Species

The primary factors that adversely affect man-made catchments and their ability to sustain SGCN include: 1) habitat conversion (altered hydroperiod, sediments), 2) abiotic resource use (oil/gas exploration/development, dewatering), 3) pollution (agricultural chemicals, solid waste, and toxic waste), and 4) drought. Detailed discussions of these factors are presented in Chapter 4. An additional discussion on habitat conversion factors is provided below.

Habitat Conversion
Habitat conversion that alters the hydroperiod of a catchment can result in a loss of abundance, a decrease in biotic diversity, and reduced beneficial use by wildlife (Lang and Rogers 2002).

Since there is no regulatory authority over man-made "wetlands" in New Mexico, this aquatic habitat type is subject to any form of disturbance or alteration, except where a federally listed species may occur or an alteration may adversely impact ground or surface waters.

Information Gaps

There are numerous information gaps regarding ephemeral man-made catchments that merit the attention of biologists, policy-makers, and land/resource managers. Information gaps that impair our ability to make informed conservation decisions are described below.

- Comprehensive spatial data are lacking on the number and total area of ephemeral man-made catchments in New Mexico.

- Data are lacking on the biotic diversity of ephemeral man-made catchments.

- Data are lacking on the types of wildlife that spend a significant part of its life cycle in ephemeral man-made catchments. Knowing the typical home ranges of these species would be useful to establish how far these organisms would be expected to travel between jurisdictional waters and human-created wetlands.

- Differences and similarities between the biotic diversity of ephemeral natural catchments and ephemeral man-made catchments are unknown.

- The existing environmental conditions or thresholds that preclude populations of SGCN are unknown.

Research, Survey, and Monitoring Needs

Research or survey efforts required to make informed conservation decisions for ephemeral man-made catchments are detailed below.

- Comprehensive spatial data designating the number and total area of ephemeral man-made catchments would provide the foundation for mapping this habitat type.

- Research is needed to analyze the relationship of ephemeral man-made catchment biodiversity to size, spatial distribution, and connectedness, and how man-made catchments may affect wildlife metapopulation processes.

- Studies focused on wildlife use of ephemeral man-made catchments would provide the foundation for understanding the function of such systems across the landscape.

- Studies are needed to quantify and compare the biotic diversity of ephemeral man-made catchments relative to each other and to other wetland ecosystems.

- Research is needed to assess the feasibility of creating man-made catchments as wetland mitigation banks that conform to state and federal objectives pertaining to no net loss of natural wetlands.

- GIS-based biotic surveys statewide would serve to map the distribution and areal extent of ephemeral man-made catchments and their associated SGCN. These data will also serve to assess at-risk populations of SGCN known to utilize this aquatic habitat.

- Field studies are recommended that focus on habitat use patterns of all SGCN that are ephemeral wetlands obligates (aquatic macroinvertebrates), those taxa that have obligate requirements of both wet and dry conditions (amphibians), and those SGCN that primarily utilize jurisdictional wetlands but migrate to and from this habitat type (birds).

- Spatially explicit data are needed on physicochemical and hydrologic conditions of ephemeral man-made catchments.

- Research is needed to determine environmental conditions or thresholds that preclude populations of SGCN.

Desired Future Outcomes

Attaining the following desired future conditions will require collaboration among state, federal, tribal, NGOs, and private land stewards to foster a working environment that promotes conservation and management of this resource.

- Ephemeral man-made catchments persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN and host a variety of land management uses with reduced resource conflicts.

- A GIS-based database with spatial information on the distribution, water quality, and biotic diversity of ephemeral man-made catchments is available to state and federal agencies, NGOs, and private land stewards.

- Recommended management practices are established and implemented to protect the ecological integrity and function of ephemeral man-made catchments.

- Incentive-based programs are developed and implemented that encourage private landowners to construct, operate, and maintain catchments with assurances that protect property rights while also protecting the habitat of associated SGCN. The Safe Harbor Agreement for the Chiricahua leopard frog represents one such example (see Federal Register 2002, Malpai Borderland Group 2002).

Prioritized Conservation Actions

Ephemeral man-made catchments occur in a patchy network of government, tribal, and private ownerships across the landscape of New Mexico and will require collaborative efforts among these stakeholders. Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Collaborate with federal and state agencies and affected publics to create public awareness and understanding of the functions and values afforded by ephemeral man-made catchments.

2. Encourage collaboration among state, federal, tribal, NGO, and private land stewards to form alliances or working groups to develop and implement management practices to protect, maintain, and enhance ephemeral man-made catchments to benefit both associated SGCN and stakeholders' land-use interests.

3. Promote efforts that take advantage of man-made catchments as a form of wetland mitigation to achieve a mutual goal of no net loss of wetlands in New Mexico. Guidance for such an initiative is detailed in vernal pool wetland conservation and management strategies in California (Witham 1998).

4. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about SGCN and ephemeral man-made catchments outlined in the Information Gaps and Research, Survey, and Monitoring Needs section.

5. Collaborate with federal and state agencies and affected publics to improve and increase the use of existing data management systems for tracking information pertinent to ephemeral man-made catchments.

6. Work with federal and state agencies and affected publics to adopt standardized monitoring and iterative survey methods to track gains and losses of ephemeral man-made catchments statewide.

7. Encourage public participation in state and federal incentive-based programs with assurances to protect, enhance, and restore ephemeral man-made catchments. Such incentive-based programs may include federal programs such as Safe Harbor Agreement, Partners for Wildlife, Candidate Conservation Agreement, and state initiatives like the Landowner Incentive Program.

Perennial Tanks

Habitat Condition

Perennial tanks are uncommonly encountered in New Mexico partly due to the lack of natural springs of sufficient flow volume, and diversion and capping of natural springs for livestock operations. These tanks may vary from a few square feet of water surface to several acres and provide permanent refuge for numerous plants, invertebrates, and vertebrates. As with most riparian and wetland communities, perennial tanks continue to be rapidly destroyed by reductions of stream flows and lowered water tables (Minckley and Brown 1982).

Problems Affecting Habitats or Species

Literature review and assessment of factors that influence perennial tank habitats suggest that excessive grazing intensity, drought, pollution, and invasive plant species represent the primary factors that adversely affect them and their ability to sustain SGCN. Detailed discussions of these factors are presented in Chapter 4. An additional discussion on habitat conversion factors is provided below.

Habitat Conversion
Any habitat conversion (such as filling, dredging, draining, water discharges, etc.) that alters the hydroperiod of a perennial tank can result in a loss of abundance, a decrease in biotic diversity, and reduced beneficial use by wildlife (Lang and Rogers 2002). Since there is no regulatory authority over man-made wetlands in New Mexico, this aquatic habitat type is subject to any form of disturbance or alteration, except where a federally listed species may occur or an alteration may adversely impact ground or surface waters.

Information Gaps

There are numerous information gaps regarding perennial tanks that merit the attention of biologists, policy-makers, and land/resource managers. These information gaps are outlined below.

- Comprehensive spatial data are lacking on the number and total area of perennial tanks in New Mexico.
- Data are lacking on the biotic diversity of perennial tanks.
- Data are lacking on the types of wildlife that spend a significant part of its life cycle in perennial tanks. Knowing the typical home ranges of these species would be useful to establish how far these organisms would be expected to travel between jurisdictional waters and human-created wetlands.
- Studies are lacking that compare the biotic diversity of perennial tanks relative to that of ephemeral man-made catchments and natural catchments.

- The existing environmental conditions or thresholds that preclude populations of SGCN are unknown.

- Information is needed about the extent to which invasive and non-native species may alter aquatic community structure and preclude populations of SGCN in perennial tanks.

Research, Survey, and Monitoring Needs

Research or survey efforts required to make informed conservation decisions for perennial tanks are described below.

- Comprehensive spatial data designating the number and total area of perennial tanks would provide the foundation for mapping this habitat type.

- Studies focused on wildlife use of perennial tanks would provide the foundation for understanding the function of such systems across the landscape.

- Studies are needed to quantify and compare the biotic diversity of perennial tanks relative to each other and to other wetland ecosystems.

- Research is needed to investigate the role of perennial tanks in the persistence of the chytrid fungus pathogen compared to other ephemeral wetlands.

- Research is needed to assess the feasibility of creating perennial tanks as wetland mitigation banks that conform to state and federal objectives pertaining to no net loss of natural wetlands.

- GIS-based biotic surveys statewide would serve to map the distribution and areal extent of perennial tanks and their associated SGCN. These data will also serve to assess at-risk populations of SGCN known to utilize this aquatic habitat.

- Field studies are needed that focus on habitat use patterns of SGCN associated with perennial tanks compared to ephemeral wetlands obligates (aquatic macroinvertebrates), those taxa that have obligate requirements of both wet and dry conditions (amphibians), and those SGCN that primarily use jurisdictional wetlands but migrate to and from this habitat type (birds).

- Spatially explicit data are needed on physiochemical and hydrologic conditions of perennial tanks.

- Determine the extent to which invasive and non-native species may alter aquatic community structure and preclude populations of SGCN and identify methods to minimize impacts from non-native species.

- Research is needed to determine environmental conditions or thresholds that preclude populations of SGCN.

Desired Future Outcomes

Attaining the following desired future conditions for perennial tanks statewide will require collaboration among state, federal, tribal, NGOs, and private land stewards to foster a working environment that promotes conservation and management of this resource.

- Perennial tanks persist in the condition, connectivity, and quantity necessary to sustain viable and resilient populations of resident SGCN and host a variety of land management uses with reduced resource use conflicts.

- A GIS-based database with spatial information on the distribution, water quality, and biotic diversity of perennial tanks is available to state and federal agencies, NGOs, and private land stewards.

- Recommended management practices are developed and implemented to protect the ecological integrity and function of perennial tanks.

- Incentive-based programs are developed and implemented that encourage private landowners to construct, operate, and maintain perennial tanks with assurances that protect property rights while also protecting the habitat of SGCN. The Safe Harbor Agreement for the Chiricahua leopard frog represents one such example (see Federal Register 2002, Malpai Borderland Group 2002).

Prioritized Conservation Actions

Perennial tanks occur in a widely spaced network of government, tribal, and private ownerships across the landscape of New Mexico and will require collaborative efforts among these stakeholders. Monitoring of species and habitat will be employed to evaluate the effectiveness of the conservation actions described below. Those found to be ineffective will be modified in accordance with the principles of adaptive management. Conservation actions, in order of priority, which assist in achieving desired future outcomes, are outlined below.

1. Collaborate with federal and state agencies and affected publics to create public awareness and understanding of the functions and values afforded by perennial tanks.

2. Encourage collaboration among state, federal, tribal, NGO's, and private land stewards to form alliances or working groups that develop and implement management practices to protect, maintain, and enhance perennial tanks to the benefit of both wildlife resources and affected land-use interests.

3. Work with federal and state agencies, private landowners, research institutions, and universities to design and implement projects that will provide information about SGCN

and perennial tanks outlined in the Information Gaps and Research, Survey, and Monitoring Needs section.

4. Promote efforts that take advantage of perennial tanks as a form of wetland mitigation to achieve a mutual goal of no net loss of wetlands in New Mexico. Guidance for such an initiative is detailed in vernal pool wetland conservation and management strategies in California (Witham 1998).

5. Collaborate with federal and state agencies and affected publics to improve and increase the use of existing data management systems for tracking information pertinent to perennial tanks.

6. Work with federal and state agencies and affected publics to adopt standardized monitoring and repetitive survey methods to track gains and losses of perennial tanks statewide.

7. Encourage public participation in state and federal incentive-based programs with assurances to protect, enhance, and restore perennial tanks. Such incentive-based programs may include federal programs such as Safe Harbor Agreement, Partners for Wildlife, Candidate Conservation Agreement and state initiatives such as Landowner Incentive Program.