Appendix C-1

Status of the Species - Animals

SPECIES ACCOUNT: *Rana sevosa* (dusky gopher frog)

Species Taxonomic and Listing Information

Listing Status: Endangered; 12/4/2001; Southeast Region (R4) (USFWS, 2016)

Physical Description

The dusky gopher frog has a stubby appearance due to its short, plump body, comparatively large head, and relatively short legs (Conant and Collins 1991). The coloration of its back varies in individual frogs. It ranges from an almost uniform black to a pattern of reddish brown or dark brown spots on a ground color of dark gray or brown (Goin and Netting 1940). Warts densely cover the back. The belly is thickly covered with dark spots and dusky markings from chin to mid-body (Goin and Netting 1940, Conant and Collins 1991). Males are distinguished from females by their smaller size, nuptial pad (swollen area that assists grip during breeding) on their thumbs, and paired vocal sacs on either side of the throat (Goin and Netting 1940). Richter (1998) reported mean snout-vent lengths from three years of data from dusky gopher frogs at Glen's Pond. Measurements ranged from 2.5 to 2.8 inches (in) (63.2 to 70.2 millimeters (mm)) for males and 3.1 to 3.3 in (78.0 to 82.7 mm) for females. Dusky gopher frog tadpoles are similar to those of other gopher frogs and crawfish frogs (R. areolata) (Volpe 1957, Altig et al. 2001).

Taxonomy

Gopher frogs (Rana capito and R. sevosa) are members of the large family, Ranidae ("true frogs"), which has a worldwide distribution. The genus Rana is the only North American representative of this family.

Historical Range

Historical records exist for Alabama and Louisiana, but currently no populations are known from these two states. Historic records for the dusky gopher frog exist for sites in St. Tammany Parish, Louisiana; Forrest, Greene, Hancock, Harrison, Jackson, Pearl River, and Perry Counties in Mississippi; and Mobile County, Alabama (Allen 1932, Netting and Goin 1942, Smith and List 1955, Neill 1957, Volpe 1957, Crawford 1988, Dundee and Rossman 1989, HerpNet 2013).

Current Range

Its current distribution is restricted to the state of Mississippi, in Harrison and Jackson counties. At the time of listing, only one population of the species was known. Subsequently, two other naturally-occurring populations were discovered. One additional dusky gopher frog population has been established in Mississippi as a result of translocation experiments

Critical Habitat Designated

Yes; 6/12/2012.

Legal Description

On June 12, 2012, the U.S. Fish and Wildlife Service designated critical habitat for the dusky gopher frog under the Endangered Species Act. In previous publications, the Service used the common name ''Mississippi gopher frog'' for this species. The Service is taking this action to fulfill obligations under the Act. Land in St. Tammany Parish, Louisiana, and Forrest, Harrison, Jackson, and Perry Counties, Mississippi, was designated under a court approved settlement agreement to finalize critical habitat for the species.

Critical Habitat Designation

15 units/subunits are designated as critical habitat for the dusky gopher frog:

Unit 1: St. Tammany Parish, Louisiana Unit 1 encompasses 625 ha (1,544 ac) on private lands managed for industrial forestry in St. Tammany Parish, Louisiana. This unit is located north and south of State Hwy. 36, approximately 3.1 km (1.9 mi) west of State Hwy. 41 and the town of Hickory, Louisiana. Unit 1 is not within the geographic area occupied by the species at the time of listing. It is currently unoccupied; however, the last observation of a dusky gopher frog in Louisiana was in 1965 in one of the ponds within this unit. Unit 1 consists of five ponds (ephemeral wetland habitat) and their associated uplands. If dusky gopher frogs are translocated to the site, the five ponds are in close enough proximity to each other that adult frogs could move between them and create a metapopulation, which increases the chances of the long-term survival of the population. Although the uplands associated with the ponds do not currently contain the essential physical or biological features of critical habitat, we believe them to be restorable with reasonable effort. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species is at high risk of extirpation from stochastic events, such as disease or drought. Maintaining the five ponds within this area as suitable habitat into which dusky gopher frogs could be translocated is essential to decrease the risk of extinction of the species resulting from stochastic events and provide for the species' eventual recovery. Therefore, we have determined this unit is essential for the conservation of the species because it provides important breeding sites for recovery. It includes habitat for population expansion outside of the core population areas in Mississippi, a necessary component of recovery efforts for the dusky gopher frog.

Unit 2: Harrison County, Mississippi Unit 2 comprises two subunits encompassing 549 ha (1,356 ac) on Federal and private lands in Harrison County, Mississippi. This unit, between U.S. Hwy. 49 and Old Hwy. 67, is approximately 224 m (735 ft) northeast of the Biloxi River. It is located approximately 2.8 km (1.8 mi) east of U.S. Hwy. 49 and approximately 2.3 km (1.4 mi) west of Old Hwy. 67. Within this unit, approximately 525 ha (1,297 ac) are in the DNF and 24 ha (59 ac) are in private ownership. Subunit A Unit 2, Subunit A encompasses 121 ha (299 ac) around the only breeding pond (Glen's Pond) known for the dusky gopher frog when it was listed in 2001; as a result, it is within the geographic area of the species occupied at the time of listing. In addition, this subunit contains all elements of the essential physical or biological features of the species. The majority of this subunit (100 ha (247 ac)) is in the DNF, with the remainder (21 ha (52 ac)) in private ownership. This subunit is being designated as critical habitat because it was occupied at the time of listing, is currently occupied, and contains sufficient primary constituent elements (ephemeral wetland habitat (PCE 1), upland forested nonbreeding habitat (PCE 2), and upland connectivity habitat (PCE 3)) to support life-history functions essential to the conservation of the species. Glen's Pond and the habitat surrounding it, consisting of forested uplands used as nonbreeding habitat and upland connectivity habitat between breeding and nonbreeding habitat, support the majority of the dusky gopher frogs that currently exist in the wild. Within Unit 2, Subunit A, the dusky gopher frog and its habitat may require special management considerations or protection to address potential adverse effects caused by: Fire suppression and low fire frequencies; detrimental alterations in forestry practices that could destroy belowground soil structures, such as stump removal; hydrologic changes resulting from ditches, and/or adjacent highways and roads that could alter the ecology of the breeding pond and surrounding terrestrial habitat; wetland degradation; random effects of drought or floods; off-road vehicle use; gas, water, electrical power, and sewer easements; and agricultural and urban development. Subunit B Unit 2, Subunit B encompasses 428 ha (1,057 ac) adjacent to Subunit A and the area surrounding Glen's Pond. The majority of this subunit (425 ha (1,050 ac)) is in the DNF, with the remainder (3 ha (7 ac)) in private ownership. This subunit is not within the geographic area of the species occupied at the time of listing and is currently unoccupied. However, we believe this subunit is essential for the conservation of the dusky gopher frog because it consists of areas, within the dispersal range of the dusky gopher frog (from Subunit A), which we believe provide important breeding sites for recovery and metapopulation structure that will protect the dusky gopher frog from extinction. This unoccupied area consists of three ponds and their associated uplands in the DNF. These ponds were named Reserve Pond, Pony Ranch Pond, and New Pond during our ongoing recovery initiatives. The USFS is actively managing this area to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and the severely restricted range of the dusky gopher frog, the species is at high risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat into which dusky gopher frogs could be translocated is essential to decrease the risk of extinction of the species resulting from stochastic events and provide for the species' eventual recovery.

Unit 3: Harrison County, Mississippi Unit 3 encompasses 121 ha (299 ac) on Federal land in Harrison County, Mississippi. This unit is located in the DNF approximately 7.9 km (4.9 mi) east of the community of Success at Old Hwy. 67 and 4 km (2.5 mi) south of Bethel Road. Unit 3 is not within the geographic range of the species occupied at the time of listing and is currently unoccupied. This area surrounds a pond on the DNF that was given the name of Carr Bridge Road Pond during ongoing recovery initiatives when it was selected as a dusky gopher frog translocation site. The USFS is actively managing this area to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat into which dusky gopher frogs could be translocated is essential to decrease the potential risk of extinction of the species resulting from stochastic events and to provide for the species' eventual recovery. Therefore, this unit is being designated as critical habitat because it is essential for the conservation of the species.

Unit 4: Jackson County, Mississippi Unit 4 encompasses 278 ha (687 ac) on Federal and private land in Jackson County, Mississippi. This unit borders the north side of Interstate 10 approximately 1.1 km (0.7 mi) west of State Hwy. 57. Within this unit, approximately 48 ha (119 ac) are in the Mississippi Sandhill Crane National Wildlife Refuge and 230 ha (568 ac) are in private ownership. Subunit A Unit 4, Subunit A encompasses 121 ha (299 ac) on private land. It is currently occupied as a result of translocation efforts conducted in 2004, 2005, 2007, 2008, 2009, and 2010; however, it was not occupied at the time of listing. We believe this subunit is essential for the conservation of the dusky gopher frog because of the presence of a proven breeding pond (egg masses have been deposited here in 2007 and 2010 by gopher frogs translocated to the site) and its associated uplands (upland forested nonbreeding habitat and upland connectivity habitat). We also believe that metapopulation structure, which will further protect the dusky gopher frog from extinction, is possible when the whole area of Unit 4 is considered. The private owners of this property are actively managing this area to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at high risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat into which dusky gopher frogs can continue to be translocated is essential to decrease the risk of extinction of the species resulting from stochastic events and provide for the species' eventual recovery. Subunit B Unit 4, Subunit B encompasses 157 ha (388 ac) on Federal and private land adjacent to Subunit A. The majority of this subunit (109 ha (269 ac)) is on private land, with the remainder of the unit (48 ha (119 ac)) in the Mississippi Sandhill Crane National Wildlife Refuge. This subunit is not within the geographic area of the species occupied at the time of listing and is currently unoccupied. However, we believe this subunit is essential for the conservation of the dusky gopher frog because it consists of an area, within the dispersal range of the dusky gopher frog (from Subunit A), which provides two important breeding sites and their associated upland for recovery and metapopulation structure that will protect the dusky gopher frog from extinction. This area is actively managed to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat is essential to decrease the potential risk of extinction of the species and provide for the species' eventual recovery.

Unit 5: Jackson County, Mississippi Unit 5 encompasses 175 ha (432 ac) on private land in Jackson County, Mississippi. This unit is located approximately 10.6 km (6.6 mi) north of Interstate 10. It is 124 m (407 ft) north of Jim Ramsey Road and 5.7 km (3.6 mi) west of the community of Vancleave located near State Hwy. 57. Subunit A Unit 5, Subunit A encompasses 121 ha (299 ac) on private land. It is currently occupied, but was not known to be occupied at the time of listing. This subunit contains a breeding site where dusky gopher frogs were discovered in 2004, subsequent to the listing of the dusky gopher frog. We believe this subunit is essential for the conservation of the dusky gopher frog because of the presence of a proven breeding pond, named Mike's Pond (ephemeral wetland habitat), and its associated uplands (upland forested nonbreeding habitat and upland connectivity habitat). We also believe that metapopulation structure, which will further protect the dusky gopher frog from extinction, is possible when the whole area of Unit 5 is considered. The owners of this property are actively managing this area to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at high risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat is essential to decrease the risk of extinction of the species resulting from stochastic events and provide for the species' eventual recovery. Subunit B Unit 5, Subunit B encompasses 54 ha (133 ac) on private land adjacent to Subunit A. This subunit is not within the geographic area of the species occupied at the time of listing and is currently unoccupied. However, we believe this subunit is essential for the conservation of the dusky gopher frog because it consists of an area, within the dispersal range of the dusky gopher frog (from Subunit A), which provides an important breeding site and associated forested uplands for recovery and metapopulation structure that will protect the dusky gopher frog from extinction. This unoccupied area consists of a single pond and its associated uplands. This area is actively managed to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat is essential to decrease the potential risk of extinction of the species and provide for the species' eventual recovery.

Unit 6: Jackson County, Mississippi Unit 6 encompasses 121 ha (299 ac) on Federal land in Jackson County, Mississippi. This unit is located on the Ward Bayou Wildlife Management Area (WMA) approximately 4.8 km (3 mi) northeast of State Hwy. 57 and the community of Vancleave.

This land is owned by the U.S. Army Corps of Engineers (Corps) and managed by the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) to benefit the recovery of the dusky gopher frog. Unit 6 is not within the geographic range of the species occupied at the time of listing and is currently unoccupied. This area consists of a pond and its associated uplands on the WMA and has been given the name of Mayhaw Pond during ongoing recovery initiatives. We believe this area is essential for the conservation of the dusky gopher frog because it provides an important breeding site and associated forested uplands for recovery. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events, such as disease or drought. Maintaining this area of suitable habitat, into which dusky gopher frogs could be translocated, is essential to decrease the potential risk of extinction of the species and provide for the species' eventual recovery.

Unit 7: Jackson County, Mississippi Unit 7 encompasses 121 ha (299 ac) on State and private land in Jackson County, Mississippi. This unit is located approximately 4.2 km (2.6 mi) east of the intersection of State Hwy. 63 and State Hwy. 613; it is 3.8 km (2.4 mi) west of the Escatawpa River, and 3.2 km (2 mi) northeast of Helena, Mississippi. The portion of this unit in State ownership (107 ha (264 ac)) is 16th section land held in trust by the State of Mississippi as a local funding source for public education in Jackson County. The Jackson County School board has jurisdiction and control of the land. The balance of this unit is on private land (14 ha (35 ac)). Unit 7 is currently occupied, but was not known to be occupied at the time of listing. The area, discovered in 2004 subsequent to the listing of the dusky gopher frog, contains a breeding pond named McCoy's Pond and associated uplands. We believe this area is essential for the conservation of the species because it provides an important breeding site and associated forested uplands for recovery of the dusky gopher frog. Currently, the State-owned portion of the area is managed for timber production by the Mississippi Forestry Commission for the Jackson County School Board. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, it may be at high risk of extirpation from stochastic events, such as disease or drought. Maintaining this area of currently occupied habitat for dusky gopher frogs is essential to decrease the risk of extinction of the species and provide for the species' eventual recovery.

Unit 8: Forrest County, Mississippi Unit 8 encompasses 121 ha (299 ac) on Federal land in Forrest County, Mississippi. This unit is located in the DNF approximately 1.9 km (1.2 mi) east of U.S. Hwy. 49, approximately 1.7 km (1.1 mi) south of Black Creek, and approximately 3.1 km (1.9 mi) southeast of the community of Brooklyn, Mississippi. Unit 8 is not within the geographic range of the species occupied at the time of listing and is currently unoccupied. This area consists of a pond and associated uplands that have been selected as a future dusky gopher frog translocation site during ongoing recovery initiatives. We believe this area is essential for the conservation of the species because it provides an important breeding site and associated forested uplands for recovery of the dusky gopher frog. Unit 8 is being actively managed by the USFS to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat, into which dusky gopher frogs could be translocated, is essential to decrease the potential risk of extinction of the species and provide for the species' eventual recovery.

Unit 9: Forrest County, Mississippi Unit 9 encompasses 121 ha (299 ac) on Federal land and private land in Forrest County, Mississippi. The majority of this unit (120 ha (297 ac)) is located in the DNF and the balance (1 ha (2.5 ac)) on private land. This unit is located approximately 3.9 km (2.4 mi) east of U.S. Hwy. 49, approximately 4.3 km (2.7 mi) south of Black Creek, and approximately 6.1 km (3.8 mi) southeast of the community of Brooklyn, Mississippi, at the Perry County line. Unit 9 is not within the geographic range of the species occupied at the time of listing and is currently unoccupied. This area consists of a pond and associated uplands that have been selected as a future dusky gopher frog translocation site during ongoing recovery initiatives. We believe this area is essential for the conservation of the species because it provides an important breeding site and associated forested uplands for recovery of the dusky gopher frog. Most of Unit 9 is being actively managed by the USFS to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat, into which dusky gopher frogs could be translocated, is essential to decrease the potential risk of extinction of the species and provide for the species' eventual recovery.

Unit 10: Perry County, Mississippi Unit 10 encompasses 147 ha (363 ac) on Federal land and private land in Perry County, Mississippi. The majority of this unit (127 ha (314 ac)) is located in the DNF and the balance (20 ha (49 ac)) is located on private land. This unit is located at the intersection of Benndale Road and Mars Hill Road, approximately 2.6 km (1.6 mi) northwest of the intersection of the Perry County, Stone County, and George County lines and approximately 7.2 km (4.5 mi) north of State Hwy. 26. Unit 10 is not within the geographic range of the species occupied at the time of listing and is currently unoccupied. This area consists of two ponds and their associated uplands that have been selected as future dusky gopher frog translocation sites during ongoing recovery initiatives. It provides the habitat for establishing new breeding ponds and metapopulation structure that will protect the dusky gopher frog from extinction. We believe this area is essential for the conservation of the dusky gopher frog because it provides two important breeding sites and their associated forested uplands for recovery of the dusky gopher frog. Most of Unit 10 is being actively managed by the USFS to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at high risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat, into which dusky gopher frogs could be translocated, is essential to decrease the risk of extinction of the species and provide for the species' eventual recovery.

Unit 11: Perry County, Mississippi Unit 11 encompasses 121 ha (299 ac) on Federal land and private land in Perry County, Mississippi. The majority of this unit (119 ha (294 ac)) is located in the DNF and the balance (2 ha (5 ac)) is located on private land. This unit borders the north side of Benndale Road northeast of the intersection of the Perry County, Stone County, and George County lines, approximately 6.4 km (4 mi) north of State Hwy. 26. Unit 11 is not within the geographic range of the species occupied at the time of listing and is currently unoccupied. This area consists of a pond and associated uplands that have been selected as a future dusky gopher frog translocation site during ongoing recovery initiatives. We believe this area is essential for the conservation of the gopher dusky frog because it provides an important breeding site and associated forested uplands for recovery of the dusky gopher frog. Most of Unit 11 is being actively managed by the USFS to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events, such as disease or drought. Maintaining this area as suitable habitat, into which dusky gopher frogs could be translocated, is essential to decrease the potential risk of extinction of the species and provide for the species' eventual recovery.

Unit 12: Perry County, Mississippi Unit 12 encompasses 121 ha (299 ac) on Federal land and private land in Perry County, Mississippi. The majority of this unit (115 ha (284 ac)) is located in the DNF and the remaining balance (6 ha (15 ac)) is located on private land. This unit is located approximately 1.2 km (0.75 mi) east of Mars Hill Road, approximately 3.9 km (2.4 mi) north of the intersection of the Perry County, Stone County, and George County lines, and approximately 10.2 km (6.4 mi) north of State Hwy. 26. Unit 12 is not within the geographic range of the species occupied at the time of listing and is currently unoccupied. This area consists of a pond and its associated uplands that have been selected as a future dusky gopher frog translocation site during ongoing recovery initiatives. We believe this area is essential for the conservation of the dusky gopher frog because it provides an important breeding site and associated forested uplands for recovery of the dusky gopher frog. Most of Unit 12 is being actively managed by the USFS to benefit the recovery of the dusky gopher frog. Due to the low number of remaining populations and severely restricted range of the dusky gopher frog, the species may be at risk of extirpation from stochastic events such as disease or drought. Maintaining this area as suitable habitat into which dusky gopher frogs could be translocated is essential to decrease the potential risk of extinction of the species and provide for the species' eventual recovery.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for St. Tammany Parish, Louisiana, and Forrest, Harrison, Jackson, and Perry Counties in Mississippi. Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of the dusky gopher frog are:

(i) Ephemeral wetland habitat. Breeding ponds, geographically isolated from other waterbodies and embedded in forests historically dominated by longleaf pine communities, that are small (generally <0.4 to 4.0 hectares (<1 to 10 acres)), ephemeral, and acidic. Specific conditions necessary in breeding ponds to allow for successful reproduction of dusky gopher frogs are: (A) An open canopy with emergent herbaceous vegetation for egg attachment; (B) An absence of large, predatory fish that prey on frog larvae; (C) Water quality such that frogs, their eggs, or larvae are not exposed to pesticides or chemicals and sediment associated with road runoff; and (D) Surface water that lasts for a minimum of 195 days during the breeding season to allow a sufficient period for larvae to hatch, mature, and metamorphose.

(ii) Upland forested nonbreeding habitat. Forests historically dominated by longleaf pine, adjacent to and accessible to and from breeding ponds, that are maintained by fires frequent enough to support an open canopy and abundant herbaceous ground cover and gopher tortoise burrows, small mammal burrows, stump holes, or other underground habitat that the dusky gopher frog depends upon for food, shelter, and protection from the elements and predation.

(iii) Upland connectivity habitat. Accessible upland habitat between breeding and nonbreeding habitats to allow for dusky gopher frog movements between and among such sites. This habitat is characterized by an open canopy, abundant native herbaceous species, and a subsurface structure that provides shelter for dusky gopher frogs during seasonal movements, such as that created by deep litter cover, clumps of grass, or burrows.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on the effective date of this rule.

All areas occupied at the time of listing will require some level of management to address the current and future threats to the dusky gopher frog and to maintain or restore the PCEs. Unoccupied areas will also require management to complete restoration. The features essential to the conservation of this species may require special management considerations or protection to reduce various threats to critical habitat that may affect one or more of the PCEs. Special management of ephemeral wetland habitats ((breeding sites (PCE 1)) will be needed to ensure that these areas provide water quantity, quality, and appropriate hydroperiod; cover; and absence from levels of predation and disease that can affect population persistence. In nonbreeding upland forested habitat (PCEs 2 and 3), special management will be needed to ensure an open canopy and abundant herbaceous ground cover; underground habitat for adult and subadult frogs to occupy; and sufficient cover as frogs migrate to and from breeding sites. A detailed discussion of activities influencing the dusky gopher frog and its habitat can be found in the final listing rule (66 FR 62993; December 4, 2001). Activities that may warrant special management of the physical or biological features that define essential habitat (appropriate quantity and distribution of PCEs) for the dusky gopher frog include, but are not limited to: (1) Land use conversions, primarily urban development and conversion to agriculture and pine plantations; (2) stump removal and other soil-disturbing activities that destroy the belowground structure within forest soils; (3) fire suppression and low fire frequencies; (4) wetland destruction and degradation; (5) random effects of drought or floods; (6) off-road vehicle use; (7) maintenance of gas, water, electrical power, and sewer easements; and (8) activities that disturb underground refugia used by dusky gopher frogs for foraging, protection from predators, and shelter from the elements.

Special management considerations or protection are required within critical habitat areas to address the threats identified above. Management activities that could ameliorate these threats include (but are not limited to): (1) Maintaining critical habitat areas as forested pine habitat (preferably longleaf pine); (2) conducting forestry management using prescribed burning, avoiding the use of beds when planting trees, and reducing planting densities to create or maintain an open canopied forest with abundant herbaceous ground cover; (3) maintaining forest underground structure such as gopher tortoise burrows, small mammal burrows, and stump holes; (4) and protecting ephemeral wetland breeding sites from chemical and physical changes to the site that could occur by presence or construction of ditches or roads.

Life History

Food/Nutrient Resources

Food Source

Larvae: Periphyton, algae

Adult: Terrestrial invertebrates, fossorial invertebrates, terrestrial vertebrates

Food/Nutrient Narrative

Larvae: Dusky gopher frog larvae are likely filter-feeders in their pond's water column and also grazers on periphyton and epiphytic algae, as is typical of most tadpoles (Duellman and Trueb 1986, Alford 1999, Hoff et al. 1999).

Adult: Little information is available regarding the food habits of dusky gopher frogs. Netting and Goin (1942) provide the only published account for the diet of an adult dusky gopher frog and described finding carabid (Pasimachus sp.) and scarabaeid (generaCanthon sp. and Ligryus sp.) beetles in the gut of one specimen. Adult dusky gopher frogs are carnivorous and likely have a diet similar to that reported for other species of gopher frogs which includes frogs, toads, small mammals, beetles, hemipterans, grasshoppers, spiders, roaches, and earthworms (Deckert 1920, Carr 1940, Dickerson 1969, Blihovde, USFWS, pers. comm. 2005).

Reproductive Strategy

Adult: R-Selected, oviparity, colonial

Lifespan

Adult: 3 - 12 years

Breeding Season

Adult: Typically December - March, but may occur in late summer and fall

Key Resources Needed for Breeding

Adult: Ephemeral ponds, upland connectivity habitat, rains associated with cold fronts, aquatic herbaceous vegetation

Reproduction Narrative

Egg: Dusky gopher frog egg masses take 9 to 21 days to complete hatching; the hatching rate is driven by water temperature (Richter and Seigel, unpublished data, Baxley and Qualls 2007).

Larvae: Metamorphosis occurs from mid-May to early August at Glen's Pond (Richter et al. 2003, Sisson et al. 2008). Tadpoles develop in the pond and may metamorphose as early as 94 days after hatching (Pechmann pers. comm. 2014); however, if the breeding pond continues to hold water, tadpoles may gain mass and metamorphose after a longer period. The date that metamorphosis begins appears to be unaffected by oviposition date and over-wintering of dusky gopher frog tadpoles has been documented (Sisson 2003, Pechmann and Tupy 2010).

Adult: Breeding sites are ephemeral (seasonally flooded) ponds not connected to other water bodies (isolated) (Kirkman et al. 2007) with an open canopy (Thurgate and Pechmann 2007). During the breeding season, dusky gopher frogs leave their subterranean retreats in the uplands and migrate to their breeding sites during rains associated with passing cold fronts (Young 1997). Although breeding typically occurs from December through March, reproduction has been documented in all months except May, June and July. Late summer and autumn breeding has occurred after heavy rains from tropical depressions and hurricanes in August, September and October (Seigel and Kennedy 1999, Thurgate and Pechmann 2007, Pechmann and Tupy 2012). Male dusky gopher frogs move to breeding ponds before females and begin calling (Richter and Seigel 2002); however, males may call below water and calls may be difficult to detect (Dundee and Rossman 1989, Jensen et al. 1995). Females typically arrive at the pond, breed, deposit their eggs as a single clutch on emergent herbaceous vegetation (Goin and

Netting 1940, Dundee and Rossman 1989, Young et al. 1995, Richter and Seigel 2002, Richter et al. 2003), and leave the pond; males generally remain at the pond longer. The number of eggs per egg mass ranges from 500 to 2,800 in Mississippi (Richter and Seigel 1997, 1998; Young 1997, Richter 1998), to 3,000 to 7,000 in Louisiana (Volpe 1957, Dundee and Rossman 1989). After breeding, adult dusky gopher frogs leave pond sites during rainfall events and move to terrestrial belowground refugia.In the wild, male dusky gopher frogs attain adult size and become reproductively mature at age 1 to 5 years and females at 2 to 5 years (Richter and Seigel 2002, Pechmann et al. 2012). Results from field enclosure experiments indicate timing to maturity can take up to 5 years depending on habitat quality (J. Tupy, Western Carolina University, pers. comm. 2013). The estimated maximum longevity, based on mark-recapture data, for male dusky gopher frogs is 9 years and 12 years for females (Pechmann et al. 2012). However, only an estimated one quarter of males live longer than 3 years, and only one third of females live longer than 5 years (Richter and Seigel 2002, Pechmann et al. 2012). Frogs breed, on average, only one to two seasons during their lifetime (Richter and Seigel 2002, Pechmann et al. 2012). Studies at the Mississippi breeding site suggest that female dusky gopher frogs do not breed until at least 2 to 3 years of age and only average one to two lifetime breeding events (Richter et al. 2003, Pechmann et al. 2012). In addition, larval survival at Glen's Pond is extremely low (Richter et al. 2003, Pechmann et al. 2012).

Habitat Type

Egg: Freshwater

Larvae: Freshwater

Juvenile: Freshwater, terrestrial

Adult: Terrestrial, fossorial, freshwater

Habitat Vegetation or Surface Water Classification

Egg: Freshwater: Palustrine - wetland, riparian, ephemeral pool

Larvae: Freshwater: Palustrine - wetland, riparian, ephemeral pool

Juvenile: Terrestrial: Conifer woodland, Freshwater: Palustrine - wetland, riparian, ephemeral pool

Adult: Terrestrial: Conifer woodland, Freshwater: Palustrine - wetland, riparian, ephemeral pool

Dependencies on Specific Environmental Elements

Larvae: Acidic wetland

Juvenile: Periodic fires

Adult: Periodic fires

Geographic or Habitat Restraints or Barriers

Adult: Roads, development

Spatial Arrangements of the Population

Juvenile: Small subpopulations distributed among breeding ponds

Adult: Small subpopulations distributed among breeding ponds

Dependency on Other Individuals or Species for Habitat

Juvenile: Gopher tortoise (Gopherus polyphemus)

Adult: Gopher tortoise (Gopherus polyphemus)

Habitat Narrative

Larvae: Larval habitat consists of grassy, acidic, isolated, ephemeral, depressional wetlands that lack predaceous fish.

Juvenile: For juvenile habitat see adult narrative.

Adult: Dusky gopher frogs are amphibians with a complex life cycle that consists of aquatic eggs/larvae and terrestrial adults. Optimal post-larval dusky gopher frog habitat consists of uplands dominated by fire-maintained longleaf pine (Pinus palustris) with a grassy understory. Adult and subadult dusky gopher frogs spend the majority of their lives underground, generally in stump holes or small mammal burrows within their forested habitat (Richter et al. 2001, Tupy 2012). Historically, they were frequently found in active and abandoned gopher tortoise (Gopherus polyphemus) burrows (Allen 1932). Forested habitat consists of fire-maintained, open-canopied woodlands historically dominated by longleaf pine (Pinus palustris) with an understory of grasses such as little bluestem (Schizachyrium scoparium). Dusky gopher frog habitat includes both upland sandy and sandy loam habitats—historically forest dominated by longleaf pine—and wetland breeding sites embedded within the forested landscape.Separation barriers include busy major highway, especially at night, such that frogs rarely if ever cross successfully; urban development dominated by buildings and pavement; habitat in which site-specific data indicate the frogs virtually never occur. Published studies of population dynamics in gopher frogs (R. capito) indicate that their populations are naturally (but often only historically) distributed across the landscape among multiple breeding ponds interconnected by suitable upland habitat; they may have small local/pond subpopulation sizes, which cumulatively can form large populations (Semlitsch et al. 1995, Greenberg 2001, Richter et al. 2009).

Dispersal/Migration

Motility/Mobility

Juvenile: Moderate

Adult: Moderate

Dispersal

Juvenile: Low

Adult: Low

Dispersal/Migration Narrative

Juvenile: Metamorphic frogs leave pond sites during rainfall events and move to terrestrial belowground refugia once their development is complete.

Adult: Richter et al. (2001) used radio transmitters to track a total of 13 adult frogs from Glen's Pond to their primary upland retreats. The farthest movement recorded was 981 feet (ft) (299 meters (m)) by a frog tracked for 63 days from the time of its exit from the breeding site (Richter et al. 2001). Tupy (2012) conducted a more recent radio telemetry study of 17 dusky gopher frogs captured at Glen's Pond. The maximum distance traveled by one of these frogs to its underground refuge was 787 ft (240 m). In 2013, dusky gopher frogs from the Glen's Pond population moved 0.8 mi (1.3 km) to Pony Ranch Pond where they bred (Pechmann and Tupy 2013).Connectivity of dusky gopher frog breeding and nonbreeding habitat within the geographic area occupied by the species must be maintained to support the species' survival (Semlitsch 2002, Rothermel 2004, Harper et al. 2008, Richter et al. 2009, Richter and Nunziata 2013). This connectivity allows for gene flow among local populations within a metapopulation, which enhances the likelihood of metapopulation persistence and allows for recolonization of sites that are lost due to drought, disease, or other factors (Hanski and Gilpin 1991).

Population Information and Trends

Population Trends:
Not available

Species Trends:
Increasing (USFWS, 2015b)

Population Size:
160 (wild) (USFWS, 2015b)

Resistance to Disease:
Low in tadpoles (See Threats)

Adaptability:
Low

Population Narrative:
Presently, the USFWS estimates that a minimum of 135 individual adult frogs survive in the wild, the vast majority of which occur in the original population known at the time of listing. The Glen's Pond population, supported by the Glen's Pond and Pony Ranch Pond breeding sites, is the only population that is considered stable at this time. Only three small, isolated, naturally-occurring populations have been documented since 2001 and their distribution is limited from what was once likely a larger, connected complex of subpopulations and breeding ponds. The genetic and population ecology data available for the dusky gopher frog illustrate the consequences of geographic range collapse and geographic isolation of populations: reduced overall population sizes, increased negative effects of variation in reproductive success, inbreeding-related mortality, low genetic diversity, and elevated probability of extinction (Richter et al. 2009, Richter and Nunziata 2013).

Threats and Stressors

Stressor: Degradation and destruction of habitat
Exposure:
Response:
Consequence:
Narrative: The dusky gopher frog is an endemic of the longleaf pine ecosystem. Outside of occupied habitat and those areas managed as potential translocation sites, the remaining parts of this ecosystem within the historical range of the frog continue to decline through fragmentation and destruction, primarily as a result of urbanization from residential and commercial development. In addition, management of remaining natural areas of the longleaf pine ecosystem is inadequate (e.g., limited use of prescribed fire as a management tool). Optimal terrestrial microhabitat, within burrows of the threatened gopher tortoise, continues to decline as gopher tortoise populations are diminished (Hinderliter 2015) (USFWS, 2015).

Stressor: Habitat fragmentation
Exposure:
Response:
Consequence:
Narrative: Habitat fragmentation of the longleaf pine ecosystem, resulting from habitat conversion, threatens the survival of the remaining dusky gopher frog populations. Even large tracts of intact longleaf pine habitat are fragmented by roads and pine plantations. Roads contribute to habitat fragmentation by isolating blocks of remaining contiguous habitat. This fragmentation may disrupt migration routes and dispersal of individuals to and from breeding sites and result in the death of dusky gopher frogs when they are attempting to cross roads. Extant dusky gopher frog populations are widely separated from each other by unsuitable habitat. Studies have shown that the loss of small, fragmented populations is common, and recolonization is critical for their regional survival (Fahrig and Merriam 1994, Burkey 1995, Marsh and Trenham 2001). As patches of available habitat become separated beyond the dispersal range of a species, disruption of metapopulation dynamics occurs and populations become more sensitive to genetic, demographic, and environmental variability and may be unable to sustain themselves (Gilpin 1987, Sjogren 1991, Blaustein et al. 1994). Dusky gopher frogs, not existing as part of a metapopulation, may be unable to recolonize areas after local extinctions due to their physiological constraints, relatively low mobility, and site fidelity (Blaustein et al. 1994). The isolation of dusky gopher frog populations eliminates the possibility of reestablishment occurring naturally and brings into question the long-term viability of the species (USFWS, 2015).

Stressor: Alteration of hydrological patterns due to urbanization and climate change
Exposure:
Response:
Consequence:
Narrative: Breeding events can be unpredictable (and may become more so with climate change), and the likelihood that recruitment will occur in a given year cannot be predicted. Higher temperatures that may result from climate change could reduce the hydroperiod of breeding ponds (USFWS, 2015).

Stressor: Small number of populations
Exposure:
Response:

Consequence:
Narrative: Small populations are at increased threat from natural processes and random events (genetic isolation, inbreeding, and drought) as well as the threats listed above. Inbreeding depression and loss of genetic diversity may also occur in small populations and reduce the fitness of individuals and the ability of the population to adapt to change (Frankel and Soule 1981), as well as increase their vulnerability to environmental stressors (Weyrauch and Grubb 2006).

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: A lethal disease killed most gopher frog tadpoles at the Glen's Pond site in 2003 (Overstreet and Lotz 2004). Recent monitoring indicates this disease, an unnamed protist (Dermomycoides sp., also known as “Perkinsus-like” disease (Green et al. 2003, Jones et al. 2012)) is still present at the site, but mortality is sporadic and has never been as high as that which occurred during the first episode. The disease has also recently caused mortality of dusky gopher frog tadpoles at Pony Ranch Pond (Pechmann and Tupy 2014), the site where the disease was originally observed in Mississippi in 2001. Fortunately, this disease does not appear to negatively affect adult dusky gopher frogs (USFWS, 2015).

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Predation may be a threat to the dusky gopher frog. Predation is expected to be high as survivorship from the egg stage to adulthood is typically low for ranid frogs (reviewed in Richter et al. 2003). No published records of predation on adults or juvenile dusky gopher frogs exist, but predators would be similar to those of other gopher frog and ranid species (e.g., snakes, birds, and mammals; Jensen and Richter 2005, Pechmann and Tupy 2010). Richter (2000) reported an undetermined amount of the egg mortality due to predation by caddisfly larvae (Order Trichoptera, Family Phryganeidae) on the egg masses. Caddisfly infestations of dusky gopher frog egg masses have been variable since the time of listing (Baxley and Qualls 2007); however, they do not currently pose a threat to the species. No other direct documentation of egg or larval predation on dusky gopher frogs exists, but potential predators include those observed feeding on southern leopard frog eggs (Rana sphenocephala) and larvae in Glen's Pond and those of other gopher frog species. These potential predators include dragonfly naiads (Odonata), backswimmers (Hemiptera), giant water bugs (Hemiptera), predaceous diving beetles (Coleoptera), fish, salamanders, snakes, turtles, and birds (Jensen and Richter 2005, Richter pers. comm. 2013). Predation from fishes likely contributed to the loss of historic populations. Predation on amphibians by the red imported fire ant (Solenopsis invicta) has been reported in the literature (Allen et al. 2004) and these ants have been observed at Glen's Pond and caused the death of at least one gopher frog (Pechmann and Thurgate 2001) (USFWS, 2015).

Stressor: Fire suppression
Exposure:
Response:
Consequence:

Narrative: Fire is the preferred habitat management tool used to maintain the natural longleaf pine community. Fire suppression of naturally-occurring fire and low fire frequencies have the potential of reducing the quality of terrestrial and aquatic habitat for the dusky gopher frog. Urban areas are being developed around dusky gopher frog habitat and, as a result, it is becoming more challenging to conduct prescribed burns. Drought has also contributed to a reduction in the number of days available to conduct prescribed burns (See discussion of annual variability of rainfall below, under this factor). Although prescribed burning is an important management tool, timing of introducing fire into dusky gopher frog habitat should be carefully assessed in order to prevent mortality to the species during its migrations to and from breeding sites (Humphries and Sisson 2012) (USFWS, 2015).

Stressor: Pesticides and herbicides
Exposure:
Response:
Consequence:
Narrative: Pesticides and herbicides commonly used in habitat management pose a threat to amphibians such as the dusky gopher frog, because their permeable eggs and skin readily absorb substances from the surrounding aquatic or terrestrial environment (Duellman and Trueb 1986). Negative effects of commonly used pesticides and herbicides on amphibian larvae include delayed metamorphosis, paralysis, reduced growth rates, and mortality (Bishop 1992, Berrill et al. 1997, Bridges 1999). Sublethal levels of chemical contamination can alter juvenile recruitment in amphibian populations (Bridges and Semlitsch 2000, Rohr et al. 2013). Herbicides may alter the density and species composition of vegetation surrounding a breeding site and reduce the number of potential sites for egg deposition, larval development, or shelter for migrating frogs (USFWS, 2015).

Recovery

Reclassification Criteria:
1. Six viable metapopulations are documented within blocks of recovery focus areas (described in Section II of this recovery plan) and are widely distributed across the range of the species. The six metapopulations would include a minimum of 12 breeding ponds distributed within the species historic range.

2. Long-term monitoring (at least 10 years) of each metapopulation documents population viability (viability standard to be defined through a recovery task). The 10-year timeframe will allow monitoring recruitment events and other population attributes in a species that has been characterized by highly variable reproductive and survival rates. In each of at least two annual breeding events within a three-year period, a total of 30 egg masses per metapopulation must be documented and natural recruitment must be verified.

3. Breeding and adjacent upland habitats within the six metapopulations are protected longterm through management agreements, public ownership, or other means, in sufficient quantity and quality (to be determined by recovery task) to support growing populations.

4. Studies of the dusky gopher frog’s biological and ecological requirements have been completed and measures necessary for recovery discovered during these studies are being implemented and are showing progress.

Delisting Criteria:
1. Four additional metapopulations (beyond those required for downlisting) are established that exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes. Each of these 4 meta-populations is supported by a minimum of 2 breeding ponds (Addresses Factor A and E) (USFWS, 2019)

2. Spatial distribution of the four meta-populations (as defined in Criteria 1) includes one metapopulation in each of the focus area blocks 1, 2 and 3. Additionally, one metapopuation occurs in either Focus Block 4 or 5 (USFWS, 2019).

3. Breeding and adjacent upland habitats within the four additional metapopulations are protected by a conservation mechanism (addresses Factor A, D and E) (USFWS, 2019).

4. The threat of disease is ameliorated to the extent that the species will remain viable into the foreseeable future (addresses Factor C) (USFWS, 2019).

Recovery Actions:
- 1. Protect existing wild dusky gopher frog populations through habitat restoration, management and other conservation techniques.
- 2. Monitor dusky gopher frog populations and their habitat.
- 3. Continue searches for additional dusky gopher frog populations
- 4. Conduct a population and habitat viability analysis (PHVA) and develop the necessary supporting research.
- 5. Formulate and implement guidelines for using translocations to establish dusky gopher frog populations.
- 6. Revise and implement a controlled propagation and reintroduction plan to facilitate use of captive dusky gopher frogs in translocation efforts.
- 7. Develop and distribute public educational and informational materials/programs to solicit and promote voluntary stewardship.
- 8. Review and evaluate recovery progress using the SSA framework (see http://sites.google.com/a/fws.gov/ssa/?pli=1).
- Since 2004, eggs have been removed from the Glen’s Pond population, and tadpoles and metamorphic dusky gopher frogs have been raised in cattle tanks and released in Jackson County, Mississippi, at a pond (TNC Pond 1) on a site managed by TNC (Old Fort Bayou Mitigation Bank).
- Silviculture, including timber sales with associated longleaf pine restoration and pine thinnings, is the primary activity on the DNF, the location of Glen’s Pond. DNF continues to work with the USFWS, and our state and non-governmental partners, to improve habitat for the frog in the area of Glen’s Pond and elsewhere on the Forest.
- In 2002, a pond (New Pond) was constructed at a site on the DNF where one had not previously existed. The Harrison County Soil Conservation Service and the Natural Resources Conservation Service (NRCS) worked with USFWS, MDWFP, DNF, and gopher frog researchers to develop a plan for creating a pond that would provide an additional breeding site near Glen’s Pond. In 2012, 10 years after the pond was first completed, it achieved the point where it was considered appropriate dusky gopher frog breeding habitat, and the first dusky gopher frog tadpoles were released there.

- The USFWS, DNF, and our non-governmental partners began working with the developers of a site immediately adjacent to Glen's Pond and the DNF property boundary to restore and protect habitat, even prior to the listing of the species. Coordinated management efforts have included control of invasive vegetation; removal of beds used to plant off-site pine species; and revegetation with longleaf pine trees. Representatives of the development have also permitted DNF to burn this area as a part of the adjacent forest burn unit surrounding Glen's Pond. By burning the whole area as a single unit, the need for a permanent firebreak was avoided, along with potential threats to the frog and its belowground habitat.
- The Nature Conservancy has worked with the USFWS and NRCS to develop a management plan that will improve the longleaf pine habitat at the naturally-occurring dusky gopher frog population supported by Mike's Pond. TNC received funding from NRCS through the Healthy Forest Reserve Program to implement the management plan which includes prescribed burning, restoring an additional pond for potential gopher frog breeding, and planting longleaf pine on the site.
- Due to the paucity of available suitable habitat for the dusky gopher frog, the USFWS worked with our state, Federal, and nongovernmental partners to identify and restore additional upland and wetland habitats to create appropriate translocation sites for the species, in close proximity to each other when possible. After restoration efforts were completed, suitable sites were included in the designation of critical habitat for the dusky gopher frog. After completing habitat assessments of available restored habitat, a site on TNC property, managed as Old Fort Bayou Mitigation Bank, was considered to be in the best condition to support an initial translocation attempt. Tadpoles and metamorphic frogs were released at the site and two breeding events have been verified there.
- For a decade, numerous unsuccessful efforts in captive reproduction were made and the potential founder population was periodically augmented from Glen's Pond. A breakthrough using in vitro fertilization was achieved in 2008, and captive breeding efforts have subsequently occurred at two facilities. Results from the most recent census of dusky gopher frogs in captivity (March, 2014) indicate there are 554 individuals distributed among 16 AZA institutions. The maintenance of initial founder genetic diversity is being achieved through selected pairings to avoid inbreeding.
- The COE owns the Ward Bayou Wildlife Management Area (WBWMA) in Jackson County, Mississippi, a property managed by the MDWFP. The COE, MDWFP, USFWS, and our nongovernmental partners are cooperating on efforts to establish two potential dusky gopher frog breeding ponds on WBWMA. Beginning in 2006, efforts were begun to restore one pond and create an additional pond nearby. Over time, alterations to both ponds have been necessary to improve their hydrology. Monitoring of the two ponds will continue until such time that the wetlands are determined to be appropriate breeding habitat for dusky gopher frogs and translocations can begin. In conjunction with the work on the two ponds, improvements have been made to the uplands surrounding them.
- The MDWFP has used Section 6 funding provided under the Act in collaboration with the USFWS to benefit the dusky gopher frog by conducting surveys; monitoring the Glen's Pond and Mike's Pond population, as well as other sites; and head-starting tadpoles for, and monitoring, translocation efforts.
- In 2012, through a partnership between Ecological Services and Refuges, the USFWS acquired funding through our own Cooperative Recovery Initiative to work towards

establishing dusky gopher frogs on the Mississippi Sandhill Crane National Wildlife Refuge (MSCNWR).

- Gopher tortoises, whose burrows are frequently occupied by gopher frogs of other species, are absent from most of the areas currently occupied by the dusky gopher frogs. As a result, efforts to reestablish gopher tortoises to these areas have been made to improve available belowground habitat for the frogs.
- The Glen's Pond dusky gopher frog breeding site was discovered during surveys conducted in 1988. Ever since that time, searches for additional populations of the frog have been on-going.
- Glen's Pond was discovered to be a gopher frog breeding site on February 3, 1988 (Young et al. 1995). Egg mass and breeding call surveys were conducted at the pond from 1987 through 1996 as the primary means of monitoring the population (Young et al. 1995). Currently, metamorphic dusky gopher frogs captured at the drift fence are marked below the knee with fluorescent VIA tags and all adult gopher frogs are implanted with a Passive Integrated Transponder (PIT) tag (Sisson et al. 2008). Egg mass and call surveys are used in addition to the data collected at the drift fence to monitor the population and collect demographic information. Maintaining the pond water level after a dusky gopher frog breeding event was achieved in 2001 by supplementing the pond with 96,899 gal (366,805 L) of water from water tanker trucks and = 7,133 gal/day (27,000 L/day) of water pumped from underground for 23 days (Seigel et al. 2006). This was attempted again in 2005 for 8 days of 5,831 gal/day (22,073 L/day) using only pumped ground water. Both events resulted in the maintenance of the pond level and allowed larval dusky gopher frogs to reach metamorphosis. The practice of supplementing Glen's Pond with ground water was discontinued following a die-off of dusky gopher frog tadpoles due to disease.
- One-third of the egg masses were collected and hatched in a nearby laboratory. Tadpoles from the eggs were either released back into Mike's Pond (295 tadpoles/approximately 80 days post-hatching) or raised in cattle watering tanks and then released at Mike's Pond (138 metamorphs) or Glen's Pond (389 metamorphs) after metamorphosis (Lee 2010, Pechmann and Tupy 2010). Additionally, progeny were also sent to the Memphis Zoo and the Audubon Zoo (Pechmann and Tupy 2010).
- When breeding has occurred at Glen's Pond and/or Mike's Pond, eggs have been collected from individual clutches for genetic sampling.
- Sawdust Pond is located on the MSCNWR where we have begun a translocation project using funding from the Cooperative Recovery Initiative (See discussion above: Management through Partnerships). In 2015, cattle tanks were setup on the refuge and dusky gopher frog tadpoles from the Glen's Pond population where raised to metamorphosis. By mid-May 2015, more than 250 metamorphic frogs were released at the pond with hundreds more likely to follow.

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SPECIES ACCOUNT: *Tympanuchus cupido attwateri* (Attwater's greater prairie-chicken)

Species Taxonomic and Listing Information

Commonly-used Acronym: APC

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Attwater's prairie chicken is a brownish, chunky, hen-like bird with dark bars above and below. Males have short rounded black tails and female's tails are barred. Males have yellow-orange eye combs and both sexes have elongated dark neck feathers, which in males are longer and erected during courtship. Males have large orange air sacs on the sides of their necks and during mating season, they make a "booming" sound, amplified by inflating the air sacs on their necks that can be heard 1/2 mile away.

Current Range

The Attwater's prairie chicken was formerly found throughout Gulf Coast prairies of southwestern Louisiana and Texas, south to the Rio Grande. Presently, less than 200,000 fragmented acres of coastal prairie habitat remain and it is restricted to a narrow band along the Texas coast, some offshore islands, and remnant inland populations (NatureServe website 2007). Currently only two APC populations exist in the wild, one at the Attwater Prairie Chicken National Wildlife Refuge in Colorado/Austin County and one on private lands in Goliad County, Texas. There are no known populations of APCs in Aransas, Calhoun, Refugio, and Victoria counties (personal communication, T. Rossignol, Attwater Prairie Chicken National Wildlife Refuge, August 2015).

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The APC diet consists mostly of insects, especially grasshoppers during the summer and at other times eats fruit, leaves, flowers, shoots, seeds, or grain (Campbell 1995).

Reproduction Narrative

Adult: Males gather for communal courtship (10-30 birds) called leks. Breeding begins early April. Clutch size averages about 12. Incubation lasts 23-24 days. Young leave the nest a few hours after hatching; tended by female. Nests are usually located on average 1.6 km from the booming grounds and more than 60% are lost to predation.

Habitat Narrative

Adult: The Attwater's prairie chicken uses different areas of coastal prairie grassland, preferring a variety of short, mid and tall grass prairie. The habitat is usually dominated by tall dropseed (Sporobolus asper), little bluestem (Schizachyrium scoparium), sumpweed (Iva frutescens), broomweed (Xanthocephalum texanum), ragweed (Ambrosia psilostachya) and big bluestem (Andropogon gerardii) (Service 1983). They may use grass areas less than 10 inches in height for courtship, feeding, and to avoid moisture. Grass up to 10-16 inches tall is used for roosting and feeding, whereas 16-24 inches of grass (maximum height) are used for nesting, loafing, feeding, and escape. Interspaces between grass clumps should be relatively open to facilitate movement. Densely vegetated areas over 24 inches in height are generally avoided, but may be used occasionally for protection from inclement weather and predators, and as fall feeding grounds (Service 1983).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Population Information and Trends

Number of Populations:

Two

Population Size:

104

Population Narrative:

In Goliad County, the population peaked in 1974 at 486 birds and declined to 62 by 1982. The 1980 estimate for Refugio County was 726 individuals; declined to 438 by 1982 (Service 1983). The 1982 populations in Austin and Colorado counties were 250 and 200, respectively. Aransas County population in 1982 was estimated at 20. As of 1991, over 2/3 of the wild population (318 birds) occurred in a contiguous area of primarily private land (O'Conner Ranch) in Aransas, Goliad, and Refugio counties. Birds previously occurring on the Tatton Unit of Aransas National Wildlife Refuge have since disappeared. About 1/4 (126 birds) of the remaining population occurred in Austin and Colorado counties, mostly on Attwater Prairie Chicken National Wildlife Refuge. About 30 birds survived on a 120-ha island of prairie habitat in Galveston County, and another 18 birds occurred in Victoria County. In 1999, fewer than 50 birds remained in the wild despite the introduction of 167 birds from a captive breeding program in 1995-1998 on the Attwater Prairie-Chicken National Wildlife Refuge, Colorado County and The Nature Conservancy of Texas' Galveston Bay Prairie Preserve, Galveston County (NatureServe website 2007). Currently, a total of 104 birds are estimated at the last two remaining wild populations, Attwater Prairie Chicken National Wildlife Refuge (2015 estimate of 100 birds) and on private lands in Goliad County, Texas (2015 estimate of 4 birds) (personal communication, T. Rossignol, Attwater Prairie Chicken National Wildlife Refuge, August 2015).

Threats and Stressors

Stressor: Habitat loss
Exposure:

Response:
Consequence:
Narrative: Threats to the Attwater's prairie chicken include habitat loss, fragmentation, and degradation of coastal prairie habitat due to agricultural practices, development, brush invasion, overgrazing; and competition with introduced exotic species (pheasants) (Phasianus colchicus). Losses may also be attributed to fire ants (Solenopsis invicta), wild and feral mammals, and raptors. Areas that are no longer suitable due to overgrazing or habitat succession potentially can be restored by reducing livestock numbers or by instituting a program of prescribed burning (Service 1983).

Recovery

Conservation Measures and Best Management Practices:

- Conservation measures to benefit the Attwater's prairie chicken include creating, restoring, and/or enhancing habitat on private lands in an effort to increase their numbers and distribution. Good range management could produce good patchy, open cover and a diversity of forbes that provide the bulk of adult Attwater's prairie chickens diet. Prescribed burning, which should be completed by late February keeps woody plant invasion under control, reduces growth of vegetation that is too dense for Attwater's prairie chickens, improves plant diversity, improves availability of food, and provides nesting sites and booming grounds for Attwater's prairie chickens. Mechanical or chemical management techniques (dozing, roller chopping, or shredding followed by prescribed burn or herbicide application) helps control of large, dense brush and provide feeding areas and brood habitat and control undesirable plant growth. Shredding during the nesting and brooding season (March through June 15) could result in the destruction of nests and incidental take of young chicks unable to fly. Habitat improvements may result in occupancy by Attwater's prairie chickens. If such occupancy does occur, the landowner can return the restored habitat to baseline conditions and incidental take of the species may occur in the future. Improvements of currently unsuitable habitat adjacent to habitat occupied by Attwater's prairie chickens could also cause the movement of Attwater's prairie chickens from the occupied habitat to the improved habitat. Lack of management may result in the loss of Attwater's prairie. However, if newly created habitat functions as successful nesting habitat for the Attwater's prairie chicken it will provide a source for dispersing young to occupy other nearby suitable habitats.

References

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SPECIES ACCOUNT: *Procambarus econfinae* (Panama City crayfish)

Species Taxonomic and Listing Information

Commonly-used Acronym: PCC

Listing Status: Proposed Threatened

Physical Description

The PCC is a small crayfish, growing to about two inches (body length minus claws). Detailed morphological descriptions of the PCC are provided by Hobbs (1942), Keppner and Keppner (2001), and Breinholt and Moler (2016)(Figure 2.6). The color pattern consists of a medium-dark brown background color, lighter brown mid-dorsal stripe, and darker brown dorsolateral stripes (Figure 2.1). The lower lateral carapacial surfaces are lighter brown with reddish-brown spots (USFWS, 2017).

Taxonomy

The currently accepted classification is (Integrated Taxonomic Information System 2017): Phylum: Arthropoda Subphylum: Crustacea Class: Malacostraca Order: Decapoda Family: Cambaridae Subfamily: Cambarinae Genus: Procambarus Subgenus: Procambarus (Leconticambarus) Species: Procambarus econfinae (Hobbs 1942) (USFWS, 2017)

Historical Range

The PCC's historic range is located in south-central Bay County, Florida and is estimated to cover a 56 square mile area (FWS GIS 2017). It's range, on a peninsula, is bounded by Callaway Bayou to the southeast, Callaway Creek to the east, Bayou George Creek and the headwaters of Callaway Creek to the northeast, North Bay to the north, West Bay to the west, and St. Andrew Bay and East Bay to the south (Figure3.1).The PCC range overlaps jurisdictional boundaries of four cities (Panama City, Lynn Haven, Callaway, Springfield) and Bay County proper (Figure 3.2) (USFWS, 2017).

Current Range

FL; Using November 2016 Bay County, Florida Department of Revenue (DOR) parcel layers, we estimated undeveloped acres remaining in core and secondary soils (Table 3.1). "Undeveloped" parcels include lands labeled cropland, improved agriculture, vacant industrial, vacant commercial, vacant residential, grazing, urban, utilities rights-of-way, and timberland (FWS GIS 2017). Sixty-one (61%) or 9,180 acres of historic core soils remain undeveloped and 46% or 5,646 acres or secondary soils remain undeveloped (Figure 3.4)(Table 3.1). Averaging the losses of both core and secondary soils, we estimate that 54% of the original lands historically available to the PCC remains potentially available for use by the PCC. If we remove hardwood swamps from the core and secondary soils, then 6,287 acres (42%) of core, and 5,325 acres (43%) remain undeveloped from historic levels, or 43% overall. A 2013 aerial photo shows the undeveloped areas remaining within the PCC's range (Figure 3.5) (USFWS, 2017).

Critical Habitat Designated

Yes;

Life History

Food/Nutrient Resources

Food Source

Adult: Herbaceous vegetation

Reproductive Strategy

Adult: Oviparous

Lifespan

Adult: 1.5 - 3.5 years (USFWS, 2017)

Breeding Season

Adult: April-August (USFWS, 2017)

Reproduction Narrative

Adult: The life history of this species is not well known. Surveys conducted to date were focused on finding locations where the PCC currently survives and attempting to characterize those habitats and to begin management on easements when possible. Quantitative studies of population densities and the life history were not part of the surveys, although abundance records were captured during certain years. As a result, there are only fragments of information regarding breeding seasons, seasonal occurrence of juveniles, fecundity, and population density. Butler et al. (2003) provides an overview of crayfish of North America and generalities obtained from the study of a few of the many species of cambarid crayfishes: 1) Generally in the southern United States, crayfish mate in the spring and the fertilized eggs adhere to the female's swimmerets while she sequesters herself in a safe place while "in berry" (her egg mass resembles berries). Upon hatching, the young remain with the female for the first three molts before leaving for an independent existence. Brown and Gunderson (1997) stated crayfish are ectothermic, meaning their body temperature is the same as the environmental temperature. Reproduction is cued by seasonal changes (particularly temperature) and growth of juveniles tends to be during the period of maximum availability of food and optimum temperature. This is in response to seasonal changes, also. Optimum temperature for crayfish, regardless of species, is generally thought to be in the range of 68-79o F (20- 26o C). 2) Molting or shedding of the exoskeleton provides a period for growth before the new exoskeleton hardens. This is a critical time for crayfish due to increased vulnerability to predation and pollutants. 3) Many crayfish species have a maximum life span of 1.5 to 3.5 years. According to Hobbs (2001), cambarid crayfishes live about 2.5-3 years. The majority breed more than once, with mating among mature yearlings frequent; however, many individuals do not become sexually active until late summer or fall. 4) Crayfish can be keystone predators in some situations. Some species of crayfish are omnivorous and feed on a wide variety of food items, including plant material, detritus, carrion, and live prey (Smith et al. 2011). Information summarized below is more specific to the PCC and depicted in a life cycle in Figure 2.8: 1) Males alternate between reproductively mature forms (Form I) and nonreproductive forms (Form II) through a continuous series of molts (Taylor et al. 1996, p. 27). Most breed more than once, with mating among mature yearlings frequent. PCC Form I males have been captured in April and June (Hobbs 1942, Keppner and Keppner 2014) 2) There are multiple instances of females captured from burrows with eggs or young and even adult males in the presence of females with young (Hobbs 1942, Keppner and Keppner 2002, FWC 2017 dataset) (Table 2.2). Female PCC have been found with eggs and/or young from March through September. Juveniles are most frequently found in the summer and have been observed through December, so young appear to be produced from at least March to December. Juveniles can be carried overland by sheet flow during rainy periods, which aids in dispersal (Keppner and Keppner 2002) (Table 2.2). Juveniles about the size that just detached from the females (from 15-25 mm in length) were netted a number of times in December 2003 (Keppner and Keppner 2004). However, the number of juveniles encountered decreased from September through December (seasonal dry period)(Table 2.2). During the normal, seasonal dry conditions experienced from April through May, captures are challenging due to limited surface water. We developed a conceptualized life cycle diagram for the PCC based on available life history information but when information was lacking we relied on data available regarding another semi-terrestrial crayfish, Procambarus hayi (Figure 2.8) and general crayfish life history information (Butler et al. 2003; Longshaw and Stebbing 2016). 3) Adult and juvenile PCC crayfish held in captivity have often died during molting phases where neither predation nor pollutants were issues, but perhaps they lacked certain minerals to successfully complete the process (Patty Kelly pers. comm. 2017). Almost all specimens held in aquaria molted at least once during their captivity if captivity was of sufficient duration (Keppner and Keppner 2014). One juvenile molted twice within a span of two months in captivity (Patty Kelly, USFWS, pers. comm. May 2017) (USFWS, 2017).

Dependencies on Specific Environmental Elements

Adult: The Panama City crayfish needs freshwater wetlands that support herbaceous vegetation, which is important to the Panama City crayfish for food, shelter, and detritus formation. The species needs core or secondary soils to provide the proper sediment structure for burrow construction and to support the herbaceous vegetation. The Panama City crayfish needs access to groundwater (through burrowing) or surface water to prevent desiccation of individuals and populations. The species needs both adequate water quality and quantity to fulfill its life history (USFWS, 2018).

Habitat Narrative

Adult: Historically, the PCC inhabited natural and often temporary bodies of shallow fresh water within open pine flatwoods and prairie-marsh communities (Hobbs 1942). However, most of these communities have been cleared for residential or commercial development or replaced with slash pine plantations. Thus, the PCC currently is known to inhabit the waters of grassy, gently-sloped ditches and swales, slash pine plantations, and utility rights-of-way (Keppner and Keppner 2001). Several conservation easements within their range are under management for the PCC. These easements are largely wet pine flatwoods and wet prairie habitats. Other private lands are inaccessible to surveyors although, lacking significant disturbance, are likely occupied by PCC given the appropriate soil types discussed further below (USFWS, 2017).

Dispersal/Migration

Population Information and Trends

Resiliency:

High for 4 populations, moderate for 5 populations and low for 4 populations (USFWS, 2017)

Representation:

It is likely the PCC was formerly one metapopulation connected through core and secondary soils (Duncan et al. 2017). When urban growth came to Panama City (incorporated in 1909) the processes of fragmentation and genetic isolation began in the known 13 remaining localized populations. Genetic analysis of population differentiation and clustering methods to assess population structure suggests that the 13 locations across the PCC's range are strongly differentiated, with the largest differences occurring between the eastern and western portions of the range (Duncan et al. 2017). The differences between the east and the west likely correspond to patterns of fragmentation from urban development and not necessarily from selective pressures maintaining adaptive differences. Because of the lack of studies using genome wide loci analyses of population structure and genetic diversity, particularly in crayfish, we do not have comparisons for values we would expect to see for estimates of heterozygosity, inbreeding coefficients, and effective population sizes in the PCC (Tables 3.2 and 3.3). However, population genetic measures estimated across the range from 13 primary sampling locations (Figure 3.6) give us insight into current conditions and how strongly these locations will be affected by future environmental change. Generally, genetic variation is low and inbreeding is high across the range, which indicate a high degree of current population isolation. This pattern is generally more pronounced in sampling locations in the west (heavily urbanized areas). Additionally, the St Joe and Star Avenue populations are positioned in the core of the least cost paths corridor identified by the landscape genetic analyses and these core locations could be particularly important for maintaining gene flow and, thus, genetic variation. These two populations also had the highest effective population sizes (Duncan et al. 2017) which indicates some levels of stability compared to the other populations (USFWS, 2017)

Redundancy:

Based on the recent genetic work of Duncan et al. (2017), PCC historically lacked redundancy in that its historic range consisted of one metapopulation based on interconnected habitats positioned on suitable soils throughout the 56 sq. mi. range. Currently, we see the range fragmented, and existing populations are broken into an eastern group of five populations and a western group of eight populations based on the genetics of PCC and its geographic distribution. Currently, only 9 resilient populations exist rangewide; 4 in the western group and 5 in the eastern group. Of these populations, only 1 highly resilient population persists in the west and 3 highly resilient populations in the east (USFWS, 2017).

Threats and Stressors

Stressor: The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range
Exposure:
Response:
Consequence:
Narrative: Development projects and land conversion can result in direct loss of habitat, as well as fragmentation and isolation of populations. The effects of development may also include alterations to water quality and quantity. Historically, the Panama City crayfish inhabited natural and often temporary bodies of shallow fresh water within open pine flatwoods and wet prairie-marsh communities (Hobbs 1942). The Panama City crayfish's natural habitat (wet pine flatwoods) has been lost or degraded through residential, commercial, and industrial development, as well as conversion to intensive pine silviculture and for ranching and farming uses. It is likely that no unaltered natural pine flatwoods remain within the Panama City crayfish's

current range. Most known Panama City crayfish occurrences are in human-altered habitats and are vulnerable to further loss or alteration. Although artificial habitats such as roadside ditches and rights-of-way have allowed the Panama City crayfish to persist in areas from which they would otherwise likely have been extirpated, human activities can alter the hydrology and configuration of these sites, making them unsuitable for long-term Panama City crayfish persistence. For example, roadside ditch maintenance and construction activities have resulted in the destruction of several crayfish sites. While ditch maintenance activities may have temporary negative impacts on the species, if conducted using conservation management principles, they may provide long-term habitat improvements that support Panama City crayfish presence. For example, the design of the ditch helps determine whether it can support Panama City crayfish. Swales and ditches with herbaceous vegetation and a 3:1 or shallower slope are more likely to support Panama City crayfish than ditches with a steeper slope (FWC 2017, p. 22). Infrastructure development has impacted, or is anticipated to impact, several crayfish sites (Keppner and Keppner 2001, pp. 13–14, 2004, p. 9). For example, several proposed road construction or expansion projects, such as the widening of Star Avenue and Kern Avenue and the widening and hardening of Tram Road, may impact Panama City crayfish habitat in the future. Infrastructure development can eliminate suitable Panama City crayfish habitat by removing the required herbaceous vegetation and digging up the surrounding soils. Silvicultural practices such as ditching and bedding, roller chopping, installing fire breaks, and constructing roads can alter the hydrology of Panama City crayfish sites, create physical barriers to crayfish movement, and destroy underground burrows (Hobbs 2001, p. 988; Keppner and Keppner 2001, p. 13, 2004, p. 10; FWC 2006, p. 10). These activities may contribute to the isolation of Panama City crayfish populations. Fire suppression and high tree density on silvicultural sites can reduce herbaceous groundcover necessary for suitable crayfish habitat (Keppner and Keppner 2001, p. 13, 2004, p. 10; FWC 2006, p. 27). Similarly, removal of tree canopy cover, changes in ground cover vegetation, and associated changes in water quality and surface water availability are all possible changes associated with the effects of conversion to farming and ranching practices, such as cattle grazing (e.g., Jansen and Robertson 2001, pp. 71–73). These activities negatively impact the habitat of the Panama City crayfish. Although minimal changes are expected to occur due to farming and ranching practices, conversion from silviculture to grazing use has occurred on lands adjacent the crayfish's range (USFWS, 2018).

Stressor: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes
Exposure:
Response:
Consequence:
Narrative: Crayfish may be recreationally harvested for fish bait. Within the range of the Panama City crayfish, several of the areas where the species occurs are known to be utilized by locals collecting fish bait (FWC 2016, p.11; Keppner and Keppner 2001, 2005). However, although harvesting individual crayfish at these sites has been documented, the actual species collected are unknown. Therefore, while harvesting crayfish may be impacting individual Panama City crayfish, we find that it is not having a species-wide impact (USFWS, 2018).

Recovery

Conservation Measures and Best Management Practices:

- Several private lands within the Panama City crayfish's range are being managed under conservation easements for the species. These easements largely cover wet pine flatwoods and wet prairie habitats. Other private lands are inaccessible to surveyors, but if they lack significant disturbance and have suitable habitat for the species, they are likely occupied by Panama City crayfish. Areas in silviculture adjacent to human-altered habitats may serve as refuges for Panama City crayfish, and silvicultural BMPs require operators to minimize impacts to Panama City crayfish. Use of BMPs for agriculture and grazing can also help minimize impacts to aquatic species (e.g., Florida Department of Agriculture and Consumer Services 2008, p. 1). Gulf Power Company manages rights-of-way along approximately 114 acres of land that is populated by the Panama City crayfish. The Service and FWC have a management agreement that provides recommended BMPs to Gulf Power Company; the management practices through this agreement have proven effective as the crayfish continue to thrive within the easement areas (USFWS, 2018).

References

U.S. Fish and Wildlife Service. 2017. Species status assessment report for the Panama City crayfish, Version 1.1, November, 2017, Atlanta, GA.

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Threatened Species Status for the Panama City Crayfish. Proposed Rule. FR Vol. 83, No. 2. Pages 330-341.

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SPECIES ACCOUNT: *Hesperia dacotae* (Dakota Skipper)

Species Taxonomic and Listing Information

Listing Status: Threatened

Physical Description

Small to medium-sized butterfly with a wingspan of 2.4–3.2 centimeters (cm) (0.9–1.3 inches (in)) and hooked antennae (Royer and Marrone 1992a, p. 3). Like other Hesperiidae species, Dakota skippers have a faster and more powerful flight than most butterflies because of a thick, well-muscled thorax (Scott 1986, p. 415). Adult Dakota skippers have variable markings. The dorsal surface of adult male wings ranges in color from tawny orange to brown and has a prominent mark on the forewing; the ventral surface is dusty yellow-orange (Royer and Marrone 1992a, p. 3). The dorsal surface of adult females is darker brown with diffused tawny orange spots and a few diffused white spots restricted to the margin of the forewing; the ventral surfaces are dusty gray-brown with a faint white spotband across the middle of the wing (Royer and Marrone 1992a, p. 3). Dakota skipper pupae are reddish-brown, and the larvae are light brown with a black collar and dark brown head (McCabe 1981, p. 181).

Taxonomy

Family Hesperiidae; Adult Dakota skippers may be confused with the Ottoe skipper (H. ottoe), which is somewhat larger with slightly longer wings (Royer and Marrone 1992a, p. 3).

Historical Range

The historical distribution of Dakota skippers may never be precisely known because ‘‘much of tallgrass prairie was extirpated prior to extensive ecological study’’ (Steinauer and Collins 1994, p. 42), such as butterfly surveys. Britten and Glasford’s (2002, pp. 363, 372) genetic analyses support the presumption that this species formerly had a relatively continuous distribution; the small genetic divergence (genetic distance) among seven sites in Minnesota and South Dakota indicate that populations there were once connected. Dakota skipper dispersal is very limited due in part to its short adult life span and single annual flight. Therefore, the species’ extirpation from a site is likely permanent unless it is within about 1 km (0.62 mi) of a site that generates a sufficient number of emigrants or is artificially reintroduced to a site. The Dakota skipper’s range once comprised native prairie in five States and Canada, extending from Illinois to Saskatchewan.

Current Range

The Dakota skipper currently occurs in Minnesota, North Dakota, South Dakota, Manitoba, and Saskatchewan.

Distinct Population Segments Defined

Not applicable

Critical Habitat Designated

Yes; 10/1/2015.

Legal Description

On October 1, 2015, the U.S. Fish and Wildlife Service (Service), designated critical habitat for the Dakota skipper (Hesperia dacotae) under the Endangered Species Act (Act). In total, approximately 19,903 acres (8,054 hectares) in Chippewa, Clay, Kittson, Lincoln, Murray, Norman, Pipestone, Polk, Pope, and Swift Counties, Minnesota; McHenry, McKenzie, Ransom, Richland, and Rolette Counties, North Dakota; and Brookings, Day, Deuel, Grant, Marshall, and Roberts Counties, South Dakota, fall within the boundaries of the critical habitat designation for Dakota skipper.

Critical Habitat Designation

The critical habitat designation for Hesperia dacotae includes 38 units in Chippewa, Clay, Kittson, Lincoln, Murray, Norman, Pipestone, Polk, Pope, and Swift Counties in Minnesota; McHenry, McKenzie, Ransom, Richland, and Rolette Counties in North Dakota; and Brookings, Day, Deuel, Grant, Marshall, and Roberts Counties in South Dakota. The units are (1) DS Minnesota Units 1–14; (2) DS North Dakota Units 1–3, 5–9, and 11–13; and (3) DS South Dakota Units 1–8, 15–18, and 22.

Unit descriptions not available.

Primary Constituent Elements/Physical or Biological Features

Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of the Dakota skipper consist of three components:

(i) Primary Constituent Element 1— Wet-mesic tallgrass or mixed-grass remnant untilled prairie that occurs on near-shore glacial lake soil deposits or high-quality dry-mesic remnant untilled prairie on rolling terrain consisting of gravelly glacial moraine soil deposits, containing: (A) A predominance of native grasses and native flowering forbs; (B) Glacial soils that provide the soil surface or near surface (between soil surface and 2 cm depth) micro-climate conditions conducive to Dakota skipper larval survival and native-prairie vegetation; (C) If present, trees or large shrub cover of less than 5 percent of area in dry prairies and less than 25 percent in wet-mesic prairies; and (D) If present, nonnative invasive plant species occurring in less than 5 percent of area.

(ii) Primary Constituent Element 2— Native grasses and native flowering forbs for larval and adult food and shelter, specifically: (A) At least one of the following native grasses to provide food and shelter sources during Dakota skipper larval stages: prairie dropseed (Sporobolus heterolepis) or little bluestem (Schizachyrium scoparium); and (B) One or more of the following forbs in bloom to provide nectar and water sources during the Dakota skipper flight period: purple coneflower (Echinacea angustifolia), bluebell bellflower (Campanula rotundifolia), white prairie clover (Dalea candida), upright prairie coneflower (Ratibida columnifera), fleabane (Erigeron spp.), blanketflower (Gaillardia spp.), black-eyed Susan (Rudbeckia hirta), yellow sundrops (Calylophus serrulatus), prairie milkvetch (Astragalus adsurgens), or common gaillardia (Gaillardia aristata) .

(iii) Primary Constituent Element 3— Dispersal grassland habitat that is within 1 km (0.6 mi) of native highquality remnant prairie (as defined in Primary Constituent Element 1) that connects high-quality wet-mesic to dry tallgrass prairies or moist meadow habitats. Dispersal grassland habitat consists of undeveloped open areas dominated by perennial grassland with limited or no barriers to dispersal including tree or shrub cover less than 25 percent of the area and no row crops such as corn, beans, potatoes, or sunflowers.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on November 2, 2015.

The greatest, overarching threats to the Dakota skipper and Poweshiek skipperling are habitat curtailment, destruction, and fragmentation. The aforementioned activities will require special management consideration not only for the direct effects of the activities on the species and their habitat, but also for their indirect effects and how they are cumulatively and individually increasing habitat curtailment, destruction, and fragmentation. Based on our analysis of threats to Dakota skipper and Poweshiek skipperling, special management activities that could ameliorate these threats include, but are not limited to, habitat maintenance or restoration activities that occur at an intensity, duration, spatial arrangement, or timing that is not detrimental to the species. These activities include, but are not limited to, the following: Late-season haying (after the adult flight period), brush or tree removal, prescribed low intensity rotational grazing, invasive species control, habitat preservation, and prescribed fire.

Life History

Feeding Narrative

<u>Larvae:</u> Dakota skipper larvae feed on several native grass species; little bluestem (Schizachyrium scoparium) is a frequent food source of the larvae (Dana 1991, p. 17; Royer and Marrone 1992a, p. 25), although they have been found on Dichanthelium spp., and other native grasses (Royer and Marrone 1992a, p. 25). When presented with no other choice, Dakota skipper larvae may feed on a variety of native and nonnative grasses (e.g., Kentucky bluegrass (Poa pratensis)) at least until diapause (Dana 1991, p. 17). The timing of growth and development of grasses relative to the larval period of Dakota skippers are likely important in determining the suitability of grass species as larval host plants. Large leaf blades, leaf hairs, and the distance from larval ground shelters to palatable leaf parts preclude the value of big bluestem and Indian grass as larval food plants, particularly at younger larval stages (Dana 1991, p. 46). In captivity, Dakota skipper larvae ate big bluestem (Andropogon gerardii), at older larval stages, and prairie dropseed (Sporobolus heterolepis) (Runquist 2014, pers. comm.). Captive larvae also fed on smooth brome (Bromus inermis) (Dana 1991, p 17), but this was not tested in a natural setting and the structural features of this grass would hinder or prevent larval survival (Dana 2013, pers. comm.). The larvae emerge from their shelters at night to forage (McCabe 1979, p. 6; McCabe 1981, p. 181; Royer and Marrone 1992a, p. 25) and appear to clip blades of grass and bring them back to their shelters to consume (Dana 2012a, pers. comm.).

<u>Adult:</u> Nectar and water sources for adult Dakota skippers vary regionally and include purple coneflower (Echinacea angustifolia), blanketflower (Gaillardia aristata), black-eyed Susan (Rudbeckia hirta), purple locoweed (Oxytropis lambertii), bluebell bellflower (Campanula rotundifolia), prairie milkvetch (Astragalus adsurgens) (syn. A. laxmannii), and yellow sundrops (Calylophus serrulatus) (Dana 1991; McCabe and Post 1977, pp. 36–38; Royer and Marrone 1992a, p. 21; Rigney 2013a, p. 142). Plant species likely vary in their value as nectar sources due to the amount of nectar available during the adult flight period (Dana 1991, p.48). Nectar source preferences are typically indicated as the relative proportion of plants selected for nectaring among all the available species in a particular area. Swengel and Swengel (1999, pp. 280–281)

observed nectaring at 25 plant species, however, most of the nectaring was at purple coneflower and blanketflower. In Manitoba, nectar sources include: White sweetclover (Melilotus alba), purple prairie clover (Petalostemon purpureus), yellow evening-primrose (Oenothera biennis), palespike lobelia (Lobelia spicata), fiddleleaf hawksbeard (Crepis runcinata), and upland white aster (Solidago ptarmicoides) (Rigney 2013a, pp. 4, 57). In addition to nutrition, the nectar of flowering forbs provides water for Dakota skipper, which is necessary to avoid desiccation during flight activity (Dana 1991, p. 47; Dana 2013, pers. comm.). The flight of the adult female typically extends beyond that of males (Dana 2014, pers. comm.; Dana 1991, pp. 1,15; Rigney 2013a, p. 138); therefore the two sexes can visit the same nectar plant species at different rates (e.g., if the flowering period is more coincident with either the male or the female flight period).

Reproduction Narrative

Larvae: Dakota skippers overwinter as larvae and complete one generation per year. Dakota skipper eggs hatch after incubating for 7–20 days; therefore, hatching is likely completed before the end of July. Recent research at the Minnesota Zoo demonstrated that, under controlled conditions in the laboratory, Dakota skippers eggs hatched after 11 to 16 days, and the majority of the caterpillars hatched on the 13th and 14th days (Runquist 2014, pers. comm.). After hatching, Dakota skipper larvae crawl to the bases of grass plants where they form shelters at or below the ground surface with silk, fastened together with plant tissue (Dana 1991, p. 16).

Adult: Dakota skippers lay eggs on broadleaf plants (McCabe 1981, p. 180) and grasses (Dana 1991, p. 17), although larvae feed only on grasses. Potential lifetime fecundity is between 180 and 250 eggs per female Dakota skipper; realized fecundity depends upon longevity (Dana 1991, p. 26). Female Dakota skippers lay eggs daily in diminishing numbers as they age (Dana 1991, pp. 25–26). Dana (1991, p. 32) estimated the potential adult life span of Dakota skipper to be 3 weeks and the average life span (or residence on site before death or emigration) to be 3 to 10 days on one Minnesota prairie (USFWS, 2014). Adults are dependent on Native grass species, Native flowering forbs and a water source for reproduction. The habitat structure must be mid-height grasses; If present, trees or large shrub cover less than 5% and 25% of area in dry and wet mesic prairies, respectively. Note: Mid-height grasses provide perches for males, which need unobstructed flight path from perches to chase rivals, search for mates (USFWS, 2018).

Spatial Arrangements of the Population

Larvae: Clumped according to suitable microhabitat characteristics

Adult: Clumped according to suitable microhabitat characteristics

Environmental Specificity

Larvae: specialist; requires host plant

Adult: specialist; requires host plant

Tolerance Ranges/Thresholds

Larvae: Low tolerance; Hypersensitive to fires

Adult: Low tolerance; Hypersensitive to fires

Site Fidelity

Larvae: high

Adult: high

Dependency on Other Individuals or Species for Habitat

Larvae: native prairie species

Adult: native prairie species

Habitat Narrative

Egg: Eggs are dependent on Native grasses, broadleaf plants and dry-mesic habitat for sheltering. Habitat must not be subject to intense herbivory or fire when eggs are present (USFWS, 2018).

Larvae: Larvae and Pupa are dependent on Native grass species and a soil surface (0-2cm) microclimate for feeding and sheltering. Note: Little bluestem (S. scoparium) is frequent larval food source. Temperature and relative humidity near soil surface may be important for larval survival (USFWS, 2018).

Adult: Dakota skippers are obligate residents of undisturbed (remnant, untilled) high quality prairie, ranging from wet-mesic tallgrass prairie to dry-mesic mixedgrass prairie (Royer and Marrone 1992a, pp. 8, 21). High-quality prairie contains a high diversity of native plant species, including flowering herbaceous plants (forbs). Royer and Marrone (1992a, p. 21) categorized Dakota skipper habitat into two main types that were once intermixed on a landscape scale, but are now mostly segregated. The first, referred to as ‘‘Type A’’ by Royer et al. (2008, pp. 14–16), is low wet-mesic prairie that occurs on near-shore glacial lake deposits. Type A Dakota skipper habitat is dominated by bluestem grasses, with three other plant species almost always present and blooming during Dakota skipper’s flight period: Wood lily (Lilium philadelphicum), bluebell bellflower, and mountain deathcamas (smooth camas; Zigadenus elegans) (McCabe 1981, p. 190). This habitat type has a high water table and is subject to intermittent flooding in the spring, but provides ‘‘sufficient relief to provide segments of non-inundated habitat during the spring larval growth period within any single season’’ (Royer et al. 2008, p. 15). Common forbs in bloom during the late season in Type A habitat include Rocky Mountain blazing star (Liatris ligulistylis), Canada goldenrod (Solidago canadensis), strict blue-eyed grass (Sisyrinchium montanum), common goldstar (Hypoxis hirsuta), and black-eyed Susan (Lenz 1999, p. 6). Type A habitats also contain small patches of dry-mesic prairie inhabited by Dakota skippers. Common forb species in these dry-mesic areas include stiff sunflower (Helianthus pauciflorus Nutt. ssp. pauciflorus) and candle anenome (Anemone cylindrica), although purple coneflower was rare in these habitats (Lenz 1999, pp. 6–11). The second Dakota skipper habitat type, referred to as ‘‘Type B’’ by Royer et al. (2008, p. 14), occurs on rolling terrain over gravelly glacial moraine deposits and is dominated by bluestems and needle grasses (Heterostipa spp.).As with Type A habitat, bluebell bellflower and wood lily are also present in Type B habitats, but Type B habitats also support more extensive stands of purple coneflower, upright prairie coneflower, and common gaillardia (Royer and Marrone 1992a, p. 22). Both Type A and Type B prairies may contain slightly depressional (low topographical areas that allow for the collection of surface water) wetlands with extensive flat areas and slightly convex hummocks, which are dryer than the wet areas (Lenz 1999, pp. 4, 8). Two key factors, soils unsuitable for agriculture and steep topography, have allowed remnant native-prairie habitats inhabited by Dakota skippers to persist(Royer and Marrone 1992a, p. 22). McCabe (1979, pp. 17–18; 1981, p. 192) and Royer et al. (2008, p. 16) have linked the historical distribution ofDakota skippers to surface geological features and soils that are glacial in origin and, possibly, regional precipitation-evaporation ratios.Soil types typical of Dakota skipper sites were described as sandy loams, loamy sand, or loams (Lord 1988 in Royer et al. 2008, pp. 3, 10). Additional edaphic(soil) features, such as soil moisture, compaction, surface temperature, pH, and humidity, may be contributing factors in larval survival and, thus, important limiting factors for Dakota skipper populations (Royer et al. 2008, p. 2). For example, edaphic parameters measured in sites throughout the range of Dakota skipper and occupied by the species included a bulk density (an indicator of soil compaction) that ranged from 0.9g/cm3 to 1.3 g/cm3 and mean soil pH that ranged from 6.3 to 6.7 with high micro-scale variation (variation on a small scale) (Royer et al. 2008, p. 10). Soil texture ranged from 4 to 12 percent clay, 53 to 74 percent sand, and 14 to 39 percent silt (Royer et al. 2008, p. 12). Seasonal soil temperatures, measured at three depths (20, 40, and 60 cm (8, 16, and 24 in))were the same at all depths within a site; occupied Minnesota sites generally had higher soil temperatures at all depths than occupied sites in NorthDakota or South Dakota (Royer et al. 2008, p. 11). Royer did not measure these parameters in unoccupied sites. Rigney (2013a, pp. 108–109) measured edaphic features at 8 sites in Manitoba occupied by the species and broadly characterized the soil compaction (at 10 cm) as 570 to 990 kPA, bulk density ranging from 0.75 to 1.30 kg/L, mean soil surface air temperature at 18 °C during Julian weeks 28–39 (continuous count of weeks since the beginning of the calendar year), and mean relative humidity at 85 percent during the same time period. Soils were classified as clay loams and sandy loams, with generally low to moderate compaction (<1375 kPA) and bulk densities, which is indicative of little or no compacting forces from cattle grazing, tilling, or agricultural vehicles (Rigney 2013a, pp. 104, 119). Royer (2008, pp. 2, 16) hypothesized that Dakota skipper larvae are particularly vulnerable to desiccation (drying out) during dry summer monthsand require ‘‘vertical water distribution’’ (movement of shallow groundwater to the soil surface) in the soils or wet low areas to provide relief from highsummer temperatures. Humidity may also be essential for larval survival during winter months since the larvae cannot take in water during that timeand depend on humid air to minimize water loss through respiration (Dana 2013, pers. comm.). Royer (2008, pp. 14–15) measured microclimalogicallevels (climate in a small space, such as at or near the soil surface) within ‘‘primary larval nesting zones’’ (0 to 2 cm (0 to 0.8 inches) above the soilsurface) throughout the range of Dakota skippers, and found an acceptable rangewide seasonal (summer) mean temperature range of 18 to 21 °C (64 to70 °F), rangewide seasonal mean dew point ranging from 14 to 17 °C (57 to 63 °F), and rangewide seasonal mean relative humidity between 73 and 85percent. Royer (2008) only examined occupied areas for these parameters; therefore, the statistical and biological significance of these edaphic variablescannot be determined from his study. After hatching, Dakota skipper larvae crawl to the bases of grass plants where they form shelters at or below the ground surface with silk, fastened together with plant tissue (Dana 1991, p. 16). They construct 2–3 successively larger shelters as they grow (Dana 1991, p. 16). Dakota skippers have six or seven larval stages (instars) (Dana 1991, pp. 14–15) and overwinter (diapause) in ground-level or subsurface shelters during either the fourth or fifth instar (McCabe 1979, p. 6; McCabe 1981, pp. 180, 189; Dana 1991, p. 15; Royer and Marrone 1992a, pp. 25–26). In the spring, larvae resume feeding and undergo two additional molts before they pupate. During the last two instars, larvae shift from buried shelters to horizontal shelters at the soil surface (Dana 1991, p. 16).

Dispersal/Migration

Motility/Mobility

Larvae: Extremely low. Adult more mobile.

Adult: Low; 3.5

Migratory vs Non-migratory vs Seasonal Movements

Larvae: Non-migratory.

Adult: Flight period that may occur from the middle of June through the end of July

Dispersal

Larvae: A lot less than a km

Adult: 1 km

Immigration/Emigration

Larvae: Does not migrate or emmigrate

Adult: Not likely; Butterflies capable of dispersing approximately 1 km. Sites are isolated, not likely that butterflies are migrating to new sites.

Dependency on Other Individuals or Species for Dispersal

Larvae: Not applicable

Adult: Not applicable

Dispersal/Migration Narrative

Larvae: Dakota skipper are not known to disperse widely; the species was evaluated among 291 butterfly species in Canada as having relatively low mobility. Experts estimated Dakota skipper to have a mean mobility of 3.5 (standard deviation = 0.7) on a scale of 0 (sedentary) to 10 (highly mobile) (Burke et al. 2011, p. 2279; Fitzsimmons 2012, pers. comm.). Dakota skippers may be incapable of moving greater than 1 kilometer (km) (0.6 miles (mi)) between patches of prairie habitat separated by structurally similar habitats (e.g., crop fields, grassdominated fields or pasture, but not necessarily native prairie) (Cochrane and Delphey 2002, p. 6). Royer and Marrone (1992a, p. 25) concluded that Dakota skippers are not inclined to disperse, although they did not describe individual ranges or dispersal distances. McCabe (1979, p. 9; 1981, p. 186) found that concentrated activity areas for Dakota skippers shift annually in response to local nectar sources and disturbance. In a mark–recapture study, average adult movements of Dakota skipper were less than 300 meters (m) (984 feet (ft)) over 3–7 days; marked adults crossed less than 200 m (656 ft) of unsuitable habitat between two prairie patches and moved along ridges more frequently than across valleys (Dana 1991, pp. 38–40). Dana (1997, p. 5) later observed reduced movement rates across a small valley dominated by exotic grasses compared with movements in adjacent widespread prairie habitat. Roads and crop fields were suspected as impediments for movement among prairie patches along two sites of the main valley (Dana 1997, p. 5), although movements beyond the study area were beyond the scope of the 1997 mark–recapture study (Dana 2013, pers. comm.). Skadsen (1999, p. 2) reported possible movement of Dakota skippers in 1998 from a known population at least 800 m (2625 ft) away to a site with an unusually heavy growth of purple coneflower; he had not found Dakota skippers in three previous years when coneflower production was sparse. The two sites were connected by native vegetation of varying quality, interspersed by a few asphalt and gravel roads (Skadsen 2001, pers. comm.). In summary, the best information we have suggests that dispersal of Dakota skipper is very limited due in part to its short adult life span and single annual flight. Therefore, the species' extirpation from a site is likely permanent unless it is within about 1 km (0.6 mi) of a site that generates a sufficient number of emigrants or is artificially reintroduced to a site; however, the capability to propagate the Dakota skipper is currently lacking.

Adult: Dakota skippers are univoltine (having a single flight per year), with an adult flight period that may occur from the middle of June through the end of July (McCabe 1979, p. 6; McCabe 1981, p. 180; Dana 1991, p. 1; Royer and Marrone 1992a, p. 26; Skadsen 1997, p. 3; Swengel and Swengel 1999, p. 282). The actual flight period varies somewhat across the range of each species and can also vary significantly from year to year (e.g., Rigney 2013a, p. 138), depending on temperature patterns (Bink and Bik 2009, Koda and Nakamura 2012). Females emerge slightly later than males (Dana 1991, p. 15, Rigney 2013a, p. 138), and the observed sex ratio of Dakota skippers was roughly equal during peak flight periods (Dana 1991, p. 15; Swengel and Swengel 1999, pp. 274, 283). The Dakota skipper flight period in a locality lasts 2 to 4 weeks, and mating occurs throughout this period (Braker 1985, p. 46; McCabe and Post 1977, pp. 36–38; McCabe 1979, p. 6; McCabe 1981, p. 180; Dana 1991, p. 15; Swengel and Swengel 1999, p. 282; Rigney 2013a, p. 138). Adult male Dakota skippers exhibit perching behavior (perch on tall plants to search for females), but occasionally appear to patrol in search of mating opportunities (Royer and Marrone 1992a, p. 25).

Population Information and Trends

Population Trends:
Declining

Species Trends:
Declining

Resiliency:
low

Representation:
low

Redundancy:
moderately low

Population Growth Rate:
unknown

Number of Populations:
83 sites (USFWS, 2014). 75 metapopulations consisting of 157 subpopulations persist across 5 states (USFWS, 2018).

Population Size:
unknown

Minimum Viable Population Size:
unknown

Adaptability:
low

Population Narrative:
Once found in native prairies in five States and two Canadian provinces, the Dakota skipper and its habitat have undergone dramatic declines; the species is now limited to native prairie remnants in three States and two Canadian provinces.

Threats and Stressors

Stressor: Habitat Destruction and conversion of habitat
Exposure: No shelter or food source
Response: Starve; Cannot reproduce
Consequence:
Narrative: Conversion of prairie for agriculture may have been the most influential factor in the decline of the Dakota skipper since Euro-American settlement, but the impacts of such conversion on extant populations is not well known. By 1994, tallgrass prairie had declined by 99.9 percent in Illinois, Iowa, Indiana, North Dakota, Wisconsin, and Manitoba; and by 99.6 percent in Minnesota; and 85 percent in South Dakota (Samson and Knof 1994, p. 419). Conversion for agriculture on lands suitable for such purposes is a current, ongoing stressor of high level of impact to the Dakota skipper populations in areas where such lands still remain. Advances in technology may also increase the potential of conversions in areas that are currently unsuitable for agriculture.

Stressor: Energy development
Exposure: Spills; Road, facility, and other infrastructure construction
Response: Mortality; Reproductive problems; Destroys habitat; Introduces invasive vegetation that outcompetes food source leads to starvation
Consequence:
Narrative: Energy development (oil, gas, and wind) and associated roads and facilities result in the loss or fragmentation of suitable prairie habitat (Reuber 2011, pers. comm.). Major areas of recent oil and gas development, such as that occurring in the Bakken formation, overlaps with parts of the Dakota skipper's range in North Dakota. Catastrophic events, such as oil and brine spills, could cause direct mortality of Dakota skipper larvae that are in shelters at or below the soil surface. Such spills may also cause the loss of larval host and nectar plants in the spill path. Additional plants may be lost during spill response, particularly if the response involves burning. Wind energy turbines and associated infrastructure (e.g., maintenance roads) are likely stressors to Dakota skipper populations, particularly on private land in South Dakota (Skadsen 2002, p. 39; Skadsen 2003, p. 47; Skadsen 2012d, pers. comm.). Similar to oil and gas development, wind development would destroy native-prairie habitat in the footprint of the structure, add access roads and other infrastructure that may further fragment prairies, and could be catalysts for the spread of invasive species. Further, it is unknown if the noise and flicker effects associated with

wind turbines may impact Dakota skipper populations beyond direct impacts from the turbines and/or infrastructure.

Stressor: Flooding/Hydrology
Exposure: Destroy food source and habitat; Introduce invasives; Increase predation
Response: Mortality (drown, larvae desicate, starve)
Consequence:
Narrative: Flooding is a stressor to Dakota skippers at sites where too much of the species' habitat is flooded or where patches are flooded too frequently. Dakota skippers must either survive flooding events in numbers sufficient to rebuild populations after the flood or recolonize the area from nearby areas that had not flooded. In addition, the return interval of floods must be infrequent enough to allow for recovery of the populations between floods. Changes in hydrology resulting from wetland draining and development may permanently alter the plant community and, therefore, pose a threat to Dakota skipper due to loss of larval food and nectar sources. The Dakota skipper are presumed extirpated from several sites due to flooding or draining. Fluctuating water levels are a current stressor to populations across both species' ranges. Loss of habitat or direct mortality due to fluctuating water levels, such as permanent flooding or wetland draining, is a current stressor to populations in at least 14 Dakota skipper sites with present or unknown status. Interrupted groundwater flow-through fens can reduce water levels and facilitate woody vegetation establishment and growth (Michigan Natural Features Inventory 2012, p. 4). Agricultural and residential drains and wells can lower the groundwater table, thereby reducing the supply of calcareous seepage, which is an essential underlying component of prairie fen hydrology (Michigan Natural Features Inventory 2012, p. 4). Furthermore, nutrient additions associated with drain fields can contribute to invasive species encroachment. For instance, if groundwater flow to prairie wetlands is severed, fen habitats may convert from native grasses and flowering forbs to habitats dominated by invasive species or woody vegetation (Fiedler and Landis 2012, p. 51, Michigan Natural Features Inventory 2012, p. 4).

Stressor: Invasive species
Exposure: Destroy food source and habitat; alter hydrology
Response: Mortality
Consequence:
Narrative: Dakota skippers typically occur at sites embedded in agricultural or developed landscapes, which make them more susceptible to nonnative or woody plant invasion. Nonnative species including leafy spurge, Kentucky bluegrass, alfalfa, glossy buckthorn, smooth brome, purple loosestrife (Lythrum salicaria), Canada thistle (Cirsium arvense), reed canary grass, and others, have invaded Dakota skipper habitat throughout their ranges (Orwig 1997, pp. 4, 8; Michigan Natural Features Inventory 2011, unpubl. data; Skadsen 2002, p. 52; Royer and Royer 2012b, pp. 15–16, 22–23). Once these plants invade a site, they replace or reduce the coverage of native forbs and grasses used by adults and larvae of both butterflies. Thus, a prevalence of these grasses reduces food availability for the larvae. The stressor from nonnative invasive herbaceous species is compounded by the encroachment of woody species into native-prairie habitat. Invasion of tallgrass prairie and prairie fens by woody vegetation such as glossy buckthorn reduces light availability, total plant cover, and the coverage of grasses and sedges (Fiedler and Landis 2012, pp. 44, 50–51). This in turn reduces the availability of both nectar and larval host plants for Dakota skippers. If groundwater flow to prairie wetlands is disrupted (e.g., by development) or intercepted (e.g., digging a pond in adjacent uplands or installing wells for

irrigation or drinking water), it can quickly convert to shrubs or other invasive species (Fiedler and Landis 2012, p. 51; Michigan Natural Features Inventory 2012, p. 4). When prairie is converted to shrubland, forest, or semi-forested habitat types and facilitates invasion of adjacent native prairie by exotic, cool-season grasses, such as smooth brome. Moreover, the trees and shrubs provide perches for birds that may prey on the butterflies (Royer and Marrone 1992b, p. 15; 1992a, p. 25).

Stressor: Fire
Exposure: Burns caterpillar or butterflies; Temporily removes shelter, food, and breeding areas.
Response: Mortality
Consequence:
Narrative: Dakota skipper populations existed historically in a vast ecosystem maintained in part by fire. Due to the great extent of tallgrass prairie in the past, fire and other intense disturbances (e.g., locally intensive bison grazing) likely affected only a small proportion of the habitat each year, allowing for recolonization from unaffected areas during the subsequent flight period (Swengel 1998, p. 83). Fire can improve Dakota skipper habitat (e.g., by helping to control woody vegetation encroachment), but it may also kill most or all of the individuals in the burned units and alter entire remnant prairie patches, if not properly managed (e.g., depends on the timing, intensity, etc.). Accidental wildfires also may burn entire prairie tracts (Dana 1997, p. 15). Intentional fires, without careful planning, may also have significant adverse effects on populations of Dakota skippers, especially after repeated events (McCabe 1981, pp. 190–191; Dana 1991, pp. 41– 45, 54–55; Swengel 1998, p. 83; Orwig and Schlicht 1999, pp. 6, 8). The effects of fire on prairie butterfly populations are difficult to ascertain (Dana 2008, p. 18), but the apparent hypersensitivity of Dakota skippers indicates that it is a stressor to both species in habitats burned too frequently or too broadly. The Dakota skipper is not known to disperse widely (Swengel 1996, p. 81; Burke et al. 2011, p. 2279); therefore, in order to reap the benefits of fire to habitat quality, Dakota skippers must either survive in numbers sufficient to rebuild populations after the fire or recolonize the area from a nearby unburned area. In addition, the return interval of fires needs to be infrequent enough to allow for recovery of the populations between burns. Therefore, fire is a stressor to Dakota skippers at any site where too little of the species' habitat is left unburned or where patches are burned too frequently. When all or large portions of prairie remnants are burned, many or all prairie butterflies may be eliminated at once. Complete extirpation of a population, however, may not occur after a single burn event (Panzer 2002, p. 1306), and the extent of effects would vary depending on time of year and fuel load. As the spring progresses, the vulnerability of Dakota skippers to fire increases as larvae shift from buried shelters to horizontal shelters at the soil surface (Dana 1991, p. 16).

Stressor: Grazing
Exposure: Trampled; Alters adult behavior; Destroys habitat; Destroys food source; Introduces invasives; Increases predation; Larvae desicate
Response: Mortality; Reproductive problems; Destroys habitat; Introduces invasive vegetation that outcompetes food source leads to starvation
Consequence:
Narrative: Grazing may maintain habitat for the Dakota skipper, but as with any management practice, appropriate timing, frequency, and intensity are important. The level of impact of grazing on Dakota skipper populations also depends on the type of habitat that is being grazed. In addition, grazing may be a valuable tool for controlling smooth brome invasion and maintaining native diversity in prairies, especially where circumstances make the use of fire

difficult or undesirable (Service 2006, p. 2; Smart et al. 2013, pp. 685–686). Conversely, grazing may stimulate brome growth and reduce native plant diversity. Bison (Bison bison) grazed at least some Dakota skipper habitats historically (McCabe 1981, p. 190; Bragg 1995, p. 68; Schlicht and Orwig 1998, pp. 4, 8; Trager et al. 2004, pp. 237–238), but cattle (Bos taurus) are now the principal grazing ungulate in both species' ranges. Bison and cattle both feed primarily on grass, but have some dissimilar effects on prairie habitats (Damhoureyeh and Hartnett 1997, pp. 1721–1725; Matlack et al. 2001, pp. 366–367). Cattle consume proportionally more grass and grasslike plants than bison, whereas bison consume more browse and forbs (flowering herbaceous plants) (Damhoureyeh and Hartnett 1997, p. 1719). Grasslands grazed by bison may also have greater plant species richness and spatial heterogeneity than those grazed by cattle (Towne et al. 2005, pp. 1553–1555). Both species remove forage for larvae (palatable grass tissue) and adults (nectar-bearing plant parts), change vegetation structure, trample larvae, and alter larval microhabitats. Grazing reduces Dakota skipper numbers in direct proportion to its intensity, due to the reduction in flowers that provide nectar and perhaps by influencing adult behavior (Dana 1997, p. 4). Proximity of nearby populations or contiguous habitat may alleviate some of the negative impacts of grazing. Grazing also causes direct mortality of larvae due to trampling and altering larval microhabitats (Royer et al. 2008, pp. 10–15). Grazing can compact soils in wet-mesic prairie inhabited by Dakota skippers and Poweshiek skipperlings, altering vertical water movement in the soil, which may lead to larval desiccation (Royer et al. 2008, p. 16) and may inhibit subsurface shelter construction, potentially increasing larval vulnerability to predators, parasites, and other environmental stressors (Dana 2013, pers. comm.). Cattle may also kill larvae by trampling them (McCabe 1981, p. 189).

Stressor: Haying and Mowing
Exposure: Removes food source; crush or smash butterflies/caterpillars
Response: Mortality; Emigration
Consequence:
Narrative: Haying (mowing grasslands and removing the cuttings) may maintain habitat for the Dakota skipper, but as with any management practice, appropriate timing, frequency, and intensity are important. Haying generally maintains prairie vegetation structure, but it may favor expansion of invasive species such as Kentucky bluegrass. If done during the adult flight period, haying may kill the adult butterflies or cause them to emigrate, and if done before or during the adult flight period, it may reduce nectar availability (McCabe 1979, pp. 19–20; McCabe 1981, p. 190; Dana 1983, p. 33; Royer and Marrone 1992a, p. 28; Royer and Marrone 1992b. p. 14; Swengel 1996, p. 79; Webster 2003, p. 10). In summary, haying is a current and ongoing stressor of moderate to high level of impacts to Dakota skippers at the few sites where the site is normally hayed before August and where annual haying is reducing availability of larval food and adult nectar plants. However, fall haying is beneficial to both species, specifically if it is conducted after the flight period (after August 1), no more than every other year, and there is no indication that native plant species diversity is declining due to timing or frequency of haying. Haying is a current stressor at a small number of sites for both species.

Stressor: Lack of Management/Disturbance
Exposure: Increases invasive vegation; Reduces available shelters and food sources
Response: Mortality; reproductive problems
Consequence:
Narrative: Prairies that lack periodic disturbance become unsuitable for Dakota skippers due to expansion of woody plant species (secondary succession), litter accumulation, reduced densities

of adult nectar and larval food plants, or invasion by nonnative plant species (e.g., smooth brome) (McCabe 1981, p. 191; Dana 1983, p. 33; Dana 1997, p. 5; Higgins et al. 2000, p. 21; Skadsen 2003, p. 52).

Stressor: Size/Isolation
Exposure: Extirpated sites remain extirpated; Inbreeding; Unadaptable
Response: Mortality; Extirpation
Consequence:
Narrative: Small, isolated populations face a current and ongoing stressor of moderate to high severity. The stressor has a high impact to populations when isolation is combined with small habitat fragments or small populations; for example, where the population is too small to supplement nearby populations without adverse genetic consequences to the source population. Isolated populations occur throughout the entire range; about 40 percent (64–69 of 171 sites) of Dakota skipper sites with present or unknown occupancy. The small populations are subject to erosion of genetic variability leading to inbreeding, which lowers the ability of the species to adapt to environmental change.

Stressor: Herbicide and/or Pesticide Use
Exposure:
Response: Mortality or kills food source/shelter; Reproductive issues
Consequence:
Narrative: Neonicotinyl pesticides, such as the imidacloprid compound, for example, are a commonly used seed dressing that spreads to nectar and pollen of flowering crops (Whitehorn 2012, p. 1). The use of neonicotinoids on agricultural crops has dramatically increased in the last ten years and they are now the most widely used group of insecticides in the world (Jeschke et al. 2011, pp. 2897–2898; Main et al. 2014, p. 2; Goulson 2013, pp. 1–2). Neonicotinoids persist in the environment (Goulson 2013, p. 1) and are thought to accumulate in the soil from repeated applications over time (Hopwood et al. 2013, p. 4). Insects can be exposed through multiple routes— neonicotinoids are used in seed dressings, foliar spray, soil irrigation water, soil drench, granular in pastures, tree injections, and topical applications to pets. Similarly, soybean aphid spraying occurs during the adult flight period, is widespread, and applied aerially—this spray can drift to nearby Dakota skipper habitat. A study has recently begun, investigating the levels of neonicotinoids, aphid pesticides, and other insecticides that may be present at several skipper sites in Minnesota and South Dakota. Insecticides used in the gypsy moth suppression programs sometimes include Foray, a formulation of the bacterial insecticide Bacillus thuringiensis kurstakii, which is lethal to butterfly larvae (e.g., Karner blue butterfly) (Carnes 2011, p. 1). Some efforts to manage woody encroachment and invasive species, such as herbicide use, can be a stressor to both Dakota skipper populations. Invasive species management is a current and ongoing stressor of low to high impact to populations, depending on the intensity and extent of the use, types of techniques, and the compounding effects that may occur from varying management. Medium- to high-level impacts of herbicide or pesticide use to Dakota skipper populations have been documented in North and South Dakota. This stressor has a high impact to populations when it is combined with other stressors, such as management, that reduces or eliminates nectar food sources, or small habitat fragments that are isolated from other source populations that may replenish individuals killed by pesticides. Herbicide and pesticide use may have direct or indirect effects on Dakota skipper. Although such activities occur, there is no evidence that these activities alone have significant impacts on either species, since their effects are often localized. However, these factors may have a cumulative effect on the Dakota skipper

when added to habitat curtailment and destruction because dramatic population declines have occurred i. Invasive species and woody vegetation management helps to maintain prairie habitats and can also be beneficial to populations of both species, for example, when concentrated on affected areas through spot spraying. Ivermectin, a widely used and persistent veterinary pharmaceutical used to treat cattle, is a chemical of emerging concern to the Dakota skipper. Ivermectin is an anthelmintic (drugs that are used to treat infections with parasitic worms) that is spread to prairie environments via the dung of grazing cattle (Lange et al. 2009, p. 2238). Lange et al. (2009, pp. 2234, 2238) found that skipper butterflies are particularly vulnerable to ivermectin, due to their low dispersive capacities and habitat preferences for soil.

Stressor: Prairie Conversion
Exposure:
Response:
Consequence:
Narrative: Prairie conversion has had a devastating impact on the distribution and abundance of the Dakota skipper historically and, if the rate of prairie conversion increases, it could further exacerbate the threat to the Dakota skipper posed by habitat fragmentation. Conversion of native prairie to cropland and non-agricultural land uses, such as energy development, gravel mining, transportation, and housing, and the degradation of remnant prairie, have reduced the historical abundance and distribution of the Dakota skipper and pose continuing threats to the species' persistence. Prairie conversion is the act of replacing native prairie plants with non-native grasses or legumes for hay or pasture, crops, or other developments. This conversion increased dramatically in the U.S. with the invention of the steel plow, making it easier to cut through heavy sod grasses. The historical loss of tallgrass prairie over the range of the Dakota skipper varies from about 85% in South Dakota to nearly 100% in Iowa, Minnesota, and North Dakota (Samson and Knopf 1994). Similarly, though not as drastic, about 60% of mixed grass prairies in South and North Dakota and Montana have been converted to cropland (Higgins et al. 2002). Following the rapid and extensive conversion of native prairie that began in the 1800s, conversion of remnant native grasslands continues today and threatens to further deplete Dakota skipper habitat. It is unclear how much is converted annually due to differences in the geographic area or time period studied. Earlier studies estimate an annual conversion rate of 0.004% in the Missouri Coteau region of central North Dakota and north-central South Dakota, from 1989-2003 (Stephens et al. 2008) and 1% in the Northern Great Plains from 1997-2007 (Classen et al. 2011). Conversion rates documented in more recent studies reflect the increase in corn prices that occurred in 2007. Wright and Wimberly (2013) estimated the annual rate of conversion in the Western Corn Belt was between 1%-5.4% and Gage et al. (2016) reported a 2% annual loss from 2009-2015 in the Great Plains. Although corn prices have decreased in recent years, conversion most likely will continue at a significant rate due to ethanol fuel standards, crop insurance subsidies or other governmental disaster or loan programs, as well as technological advances in equipment, seed, and herbicides (Classen et al. 2011, Wright 2015, Higgins et al. 2002). The region with the greatest grassland conversion currently occurring is the area covered by the Prairie Habitat Joint Venture2 , which covers portions of the Canadian provinces of Manitoba, Saskatchewan, and Alberta (Gage et al. 2016). From 2011-2015, cumulative losses in this region alone totaled 16.44% with an average of over 4% per year. This area contains important Dakota skipper populations in southeastern Saskatchewan and southwestern Manitoba. Similarly, the Prairie Pothole Joint Venture region3 , which contains all the remaining Dakota skipper populations in the United States, is experiencing sustained grassland conversion. During the same period (2011-2015), more than 10% of this region's

grasslands had been converted to cropland with an average annual loss of 2.7% (Gage et al. 2016). The proportion of these grasslands that were Dakota skipper habitat is unknown. Dakota skippers inhabit only high quality native prairies; when converted they are essentially lost as habitat for the species, even if they are later replanted to grassland. This has been documented by looking at the survey data over time and from expert observation at prairie sites bordered by a completely re-established prairie. Additional conversion and fragmentation of native prairie may result from the ongoing development of wind energy in the Dakota skipper range. There are currently seventeen wind farms located in the eastern half of South Dakota with 34 more proposed (SDWEA 2015). Although wind towers probably do not cause direct mortality (e.g. through collision) of butterflies (Grealey and Stephenson 2007), the area affected by the development of a wind energy farm can be significant. For example, a 200+ turbine proposed wind farm in Clark County South Dakota would be spread across 43,000 acres of land (C. Mueller, U.S. Fish and Wildlife Service, Waubay National Wildlife Refuge, pers. comm. 2017). Not all the area will be directly affected, but development of pads, access roads, and collection lines will occur in grasslands, some of which are native prairie. This will not only result in a direct loss of native prairie, but it will also increase grassland fragmentation and can exacerbate the invasion of nonnative species (Jones et al. 2015). In the Draft Environmental Assessment of the Crocker Wind Farm, a desktop review of appropriate Dakota skipper habitat identified 65 potential areas for surveys. Ground based assessments found 34 sites with suitable habitat. These 34 sites were surveyed from 29 June to 13 July 2017 for presence of Dakota skippers and Poweshiek skipperlings with negative results for either species (Crocker Wind Farm, LLC 2018). The Peckham Ranch metapopulation is within 6.5 miles of the Crocker Wind Farm and currently six SD metapopulations occur within the boundaries of proposed wind farms and three more are within 5 miles, including Scarlet Fawn and Oak Island/Wike metapopulations. North Dakota, South Dakota and Minnesota all occur in high wind areas (USDOE 2018) and will likely continue to develop wind energy resources (USFWS, 2018).

Stressor: Climate Change
Exposure:
Response:
Consequence:
Narrative: Climate change may currently or into the future pose a threat to the Dakota Skipper. Although experts believe climate change effects could—currently or over time--influence Dakota skipper survival or reproductive success, data are lacking. Given that climate, along with fire and herbivory, were major drivers in maintaining the native plant cover prior to Euro-American settlement (Anderson 2006), we explored the effects of climate change via changes to habitat. Specifically, we evaluated how length of growing season and annual precipitation are predicted to change over time (1950-2100) under two IPCC Representative Concentration Pathways (RCP) scenarios, RCP 4.5 and RCP 8.5 (USFWS, 2018).

Stressor: Catastrophic Drought
Exposure:
Response:
Consequence:
Narrative: Drought is a natural ecosystem process of prairies, and prairie-dependent species are generally very drought tolerant. Through expert input, we defined catastrophic drought as a Palmer Drought Severity Index of -4.0 or lower, persisting for one year or more (i.e., one full generation). The primary effects of this level and extent of drought include direct mortality

through larval desiccation, as well indirect mortality (e.g., starvation) resulting from impacts to larval plant food resources. Extreme drought would cause above-ground plant tissues to desiccate, resulting in lower quality and availability of larval food and water resources (R. Dana, Minnesota Dept. of Natural Resources, pers. comm. 2016; R. Westwood, University of Winnipeg, pers. comm. 2016). Larvae are most susceptible to drought mortality during late summer and winter (R. Royer, retired, Minot State University, pers. comm. 2016). Adults in captivity require the provision of a water source, such as freshly cut flowers or misting of cages (R. Dana, Minnesota Dept. of Natural Resources, pers comm., 2017; E. Runquist, Minnesota Zoo, pers comm. 2017), indicating that severe droughts during mid-summer (i.e., the flight period) could result in direct adult mortality. The negative effects of drought would be particularly strong in dry prairies (Royer et al. 2008 referred to these as Type B Habitats), though a catastrophic drought could cause metapopulation collapse in any prairie type. A milder or shorter-lived drought may have any one of the above effects (e.g., reduced larval food quality) without leading to population collapse. The species experts agreed that the duration and extent of the drought would need to be extreme in order to cause extirpation of this prairiedependent (i.e., drought tolerant) species (USFWS, 2018).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
Not available

Recovery Actions:
- Not available

Conservation Measures and Best Management Practices:
- Supportive Factors: Supportive factors specifically focused on the Dakota skipper are few. In 2014, the Dakota skipper was listed as Threatened under the ESA. In Canada, Dakota skipper is listed as threatened on the SARA List of Wildlife Species at Risk. States that recognize Dakota skipper in their State Wildlife Action Plans as Endangered, Threatened or Greatest Conservation Need include Minnesota, North Dakota, South Dakota, and Iowa. The Dakota skipper was listed in 2014 and thus is protected under the ESA; federal agencies are required under section 7(a)(2) of the ESA to consult with the Service and ensure their activities (including those they conduct themselves as well as those they may fund, authorize or permit) do not jeopardize the continued existence of the species. The conservation focus in the section 7(a)(2) consultation process is often limited to avoidance and minimization of impacts of activities subject to federal purview, not necessarily on actions to broadly improve the status of the species. However, most of the extant Dakota skipper populations are located on private land (about 70%); about 13% are on State or county owned land, and about 17% are on Federal or Tribal lands in the U.S. and over 90% of the populations are located on private land in Canada. Most conservation for Dakota skipper will take place on private lands; conservation actions by Non-governmental organizations, County and State governments, and private landowners are occurring, but not in a coordinated manner. We anticipate recovery of the species will be predicated on a comprehensive, coordinated strategy that we will be designing together with our Federal, Tribal, State and local partners. Below we describe some of the ongoing conservation efforts. Maintenance of High Quality Habitats: Recovery of the Dakota skipper will be closely tied to

the extent and condition of its native grassland habitat. The species is endemic to North American tallgrass and mixed grass prairie and does not inhabit non-native grasslands, weedy roadsides, tame hayland, or other habitats that are not remnant native prairie. In addition, Dakota skippers have not been recorded in reconstructed prairie, e.g., former cropland that has been replanted to native prairie. Therefore, Dakota skipper needs native prairie habitats that are diverse in flowering herbaceous plants and native grasses. Land management actions that affect Dakota skipper habitat will also play a critical role in the species' survival. Haying, grazing, and fire are essential management tools to maintain native prairie and the essential features of the Dakota skipper's grassland habitats. In the absence of grazing, fire, or haying, Dakota skipper habitat is likely to become too brushy or wooded to support the species (e.g., Rigney 2013, p. 151) or can succumb to invasion by cool season exotic grasses, especially Kentucky bluegrass and smooth brome. Increasingly, conservation land managers are considering Dakota skipper and other invertebrates in setting their management regimes (timing, intensity and duration of the management practices). 56 Research and Captive Rearing: The captive rearing program at Minnesota Zoo is now capable of producing significant numbers of the Dakota skipper ex situ, such that reintroduction of the species is feasible. The Minnesota Zoo, U.S. Fish and Wildlife Service and its partner agencies have finalized a plan to guide ex situ management of the species. Under that plan, ex situ management would be used to facilitate important research, but also to produce animals for reintroduction. In May 2017, a formal plan for the reintroduction of Dakota skipper at Hole-in-the-Mountain Prairie was prepared and the first year of introduction was conducted during the 2017 flight season. There were 196 individuals released at Hole-in-the-Mountain Prairie and 111 were observed post-release. Mating, oviposition in the wild, and egg viability have all been confirmed and two additional years of Dakota skipper release are planned at this site followed by extensive monitoring to determine if the population is self-supporting (Runquist and Nordmeyer 2018). Perpetual Protection of Dakota Skipper Habitats: Acquisition of perpetually protected lands throughout the Dakota skipper's range has been ongoing for many decades. Grasslands are protected both through fee title and easements, by many agencies and organizations. In recent years, native prairie protection and management has become a high priority for many of those agencies. For example, several conservation agencies in Minnesota are committed to a unified, 25-year statewide prairie conservation plan, which includes goals for perpetual protection of over 850,000 acres of grasslands in targeted landscapes (Minnesota Prairie Plan Working Group 2011). Although the condition of these protected grasslands is not fully known, it is likely that at least some of these conservation lands and easements include good to high quality native prairie and could provide habitat for Dakota skippers. At the least, these acres may provide areas for dispersal and connectivity between populations (USFWS, 2018).

References

2014 USFWS. Endangered and Threatened Wildlife and Plants

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U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants

Designation of Critical Habitat for the Dakota Skipper and Poweshiek Skipperling. Final rule. 80 FR 59247 - 59384 (October 1, 2015).

Threatened Species Status for Dakota Skipper and Endangered Species Status for Poweshiek Skipperling. FR 79 (206), 63672. October 24, 2014. Final Rule. U.S. Fish and Wildlife Service. 2018. Species status assessment report for the Dakota skipper (Hesperia dacotae). 97 pp.

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Threatened Species Status for Dakota Skipper and Endangered Species Status for Poweshiek Skipperling. FR 79 (206), 63672. October 24, 2014. Final Rule.

SPECIES ACCOUNT: *Oarisma poweshiek* (Poweshiek skipperling)

Species Taxonomic and Listing Information

Listing Status: Endangered; 11-24-2014

Physical Description

Poweshiek skipperlings are small and slender-bodied, with a wingspan generally ranging from 2.3 to 3.0 cm (0.9 to 1.2 in). The upper wing surface is dark brown with a band of orange along the leading edge of the forewing. Ground color of the lower surface is also dark brown, but the veins of all but the anal third of the hindwing are outlined in hoary white, giving an overall white appearance to the undersurface.

Taxonomy

The Poweshiek skipperling (Oarisma poweshiek) is a member of the skipper family, Hesperiidae. The Poweshiek skipperling is most easily confused with the Garita skipperling (Oarisma garita), which can be distinguished from Poweshiek skipperling by their smaller size, quicker flight, and overall goldenbronze color (Royer and Marrone 1992b, p. 3). Another distinguishing feature is the color of the anal area of the ventral hindwing (orange in Garita; dark brown in Poweshiek).

Historical Range

The Poweshiek skipperling is historically known from eight States, ranging widely over the native wetmesic to dry tallgrass prairies from eastern North and South Dakota (Royer and Marrone 1992b, pp. 4–5) through Iowa (Nekola and Schlicht 2007, p. 7) and Minnesota (Minnesota DNR, Division of Ecological Resources, unpubl. data), with occurrences also documented in northern Illinois (Dodge 1872, p. 218), Indiana (Blatchley 1891, p. 898), Michigan (Holzman 1972, p. 111; McAlpine 1972, p. 83), and Wisconsin (Borkin 2011, in litt.; Selby 2010, p. 22). The relatively recent discovery of Poweshiek skipperling populations in the Canadian province of Manitoba further extends its known historical northern distribution (Westwood 2010, pp. 7–22; Dupont 2010, pers. comm.).

Current Range

Currently, the Poweshiek skipperling is found in Michigan, Minnesota, Wisconsin, and Manitoba. Once common and abundant throughout native prairies in eight States and at least one Canadian province, the Poweshiek skipperling and its habitat have experienced significant declines. The species is considered to be present at a few native prairie remnants in two States and one location in Manitoba, Canada. The species is presumed extirpated from Illinois and Indiana, and the status of the species is uncertain in four of the six States with relatively recent records (within the last 20 years). The historical distribution of Poweshiek skipperling may never be precisely known because ‘‘much of tallgrass prairie was extirpated prior to extensive ecological study’’ (Steinauer and Collins 1994, p. 42), such as butterfly surveys.

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 10/1/2015.

Legal Description

On October 1, 2015, the U.S. Fish and Wildlife Service designated critical habitat for the Poweshiek skipperling (Oarisma poweshiek). In total, approximately 25,888 acres (10,477 hectares) in Cerro Gordo, Dickinson, Emmet, Howard, Kossuth, and Osceola Counties, Iowa; Hilsdale, Jackson, Lenawee, Livingston, Oakland, and Washtenaw Counties, Michigan; Chippewa, Clay, Cottonwood, Douglas, Kittson, Lac Qui Parle, Lincoln, Lyon, Mahnomen, Murray, Norman, Pipestone, Polk, Pope, Swift, and Wilkin Counties, Minnesota; Richland County, North Dakota; Brookings, Day, Deuel, Grant, Marshall, Moody, and Roberts Counties, South Dakota; and Green Lake and Waukesha Counties, Wisconsin, fall within the boundaries of the critical habitat designation for Poweshiek skipperling. The effect of this regulation is to designate critical habitat for the Dakota skipper (Hesperia dacotae) and the Poweshiek skipperling (Oarisma poweshiek) under the Endangered Species Act.

Critical Habitat Designation

56 units are designated as critical habitat for Poweshiek skipperling. Those 56 units are: (1) PS Iowa Units 1–11; (2) PS Michigan Units 1–9; (3) PS Minnesota Units 1–20; (4) PS North Dakota Units 1 and 2; (5) PS South Dakota Units 1–8, 15–18; and (6) PS Wisconsin Units 1 and 2.

Individual unit descriptions not available.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Cerro Gordo, Dickinson, Emmet, Howard, Kossuth, and Osceola Counties in Iowa; in Hilsdale, Jackson, Lenawee, Livingston, Oakland, and Washtenaw Counties in Michigan; Chippewa, Clay, Cottonwood, Douglas, Kittson, Lac Qui Parle, Lincoln, Lyon, Mahnomen, Murray, Norman, Pipestone, Polk, Pope, Swift, and Wilkin Counties in Minnesota; Richland County in North Dakota; Brookings, Day, Deuel, Grant, Marshall, Moody, and Roberts Counties in South Dakota; and Green Lake and Waukesha Counties in Wisconsin. Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of Poweshiek skipperling consist of four components:

(i) Primary Constituent Element 1— Wet-mesic to dry tallgrass remnant untilled prairies or remnant moist meadows containing: (A) A predominance of native grasses and native flowering forbs; (B) Undisturbed (untilled) glacial soil types including, but not limited to, loam, sandy loam, loamy sand, gravel, organic soils (peat), or marl that provide the edaphic features conducive to Poweshiek skipperling larval survival and native-prairie vegetation; (C) If present, depressional wetlands or low wet areas, within or adjacent to prairies that provide shelter from high summer temperatures and fire; (D) If present, trees or large shrub cover less than 5 percent of area in dry prairies and less than 25 percent in wetmesic prairies and prairie fens; and (E) If present, nonnative invasive plant species occurring in less than 5 percent of area.

(ii) Primary Constituent Element 2— Prairie fen habitats containing: (A) A predominance of native grasses and native flowering forbs; (B) Undisturbed (untilled) glacial soil types including, but not limited to, organic soils (peat), or marl that provide the edaphic features conducive to Poweshiek skipperling larval survival and native-prairie vegetation; (C) Depressional wetlands or low wet areas, within or adjacent to prairies that provide shelter from high summer temperatures and fire; (D) Hydraulic features necessary to maintain prairie fen groundwater flow and prairie fen plant communities; (E) If present, trees or large shrub cover less than 25 percent of the unit; and (F) If present, nonnative invasive plant species occurring in less than 5 percent of area.

(iii) Primary Constituent Element 3— Native grasses and native flowering forbs for larval and adult food and shelter, specifically: (A) At least one of the following native grasses available to provide larval food and shelter sources during Poweshiek skipperling larval stages: Prairie dropseed (Sporobolus heterolepis), little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), or mat muhly (Muhlenbergia richardsonis); and (B) At least one of the following forbs in bloom to provide nectar and water sources during the Poweshiek skipperling flight period: Purple coneflower (Echinacea angustifolia), black-eyed Susan (Rudbeckia hirta), smooth ox-eye (Heliopsis helianthoides), stiff tickseed (Coreopsis palmata), palespike lobelia (Lobelia spicata), sticky tofieldia (Triantha glutinosa), or shrubby cinquefoil (Dasiphora fruticosa ssp. floribunda).

(iv) Primary Constituent Element 4— Dispersal grassland habitat that is within 1 km (0.6 mi) of native highquality remnant prairie (as defined in Primary Constituent Element 1) that connects high-quality wet-mesic to dry tallgrass prairies, moist meadows, or prairie fen habitats. Dispersal grassland habitat consists of the following physical characteristics appropriate for supporting Poweshiek skipperling dispersal: Undeveloped open areas dominated by perennial grassland with limited or no barriers to dispersal including tree or shrub cover less than 25 percent of the area and no row crops such as corn, beans, potatoes, or sunflowers.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on November 2, 2015.

Management activities should be of the appropriate timing, intensity, and extent to be protective of Dakota skipper and Poweshiek skipperling during all life stages (e.g., eggs, larvae, pupae, and adults) and to maximize habitat quality and quantity. Some management activities, depending on how they are implemented, can have intensive impacts to the species, its habitat, or both. Depending on site-specific conditions, management that includes prescribed fire and some low-intensity grazing must affect no more than onequarter to one-third of the occupied habitat at a site in any single year to ensure that the resulting mortality or effects to reproduction do not have undue impacts on population viability. Management activities should protect the primary constituent elements for the species by conserving the extent of the habitat patches, the quality of habitat within the patches, and connectivity among occupied patches (e.g., see Schmitt, 2003). Appropriate management helps increase the number of individuals reproducing each year by minimizing the activities that may harm Dakota skippers or Poweshiek skipperling during adult, larval, or pupal stages. Such special management activities may be required to protect the physical or biological features and support the conservation of Dakota skipper and Poweshiek skipperling by preventing or reducing the loss, degradation, and fragmentation of native prairie landscapes. Additionally, management of critical habitat lands can increase the amount of suitable habitat and enhance connectivity among Dakota skipper and Poweshiek skipperling populations through the restoration of areas that were previously composed of native tallgrass and mixed-grass prairie communities. The limited extent of native tallgrass and mixed-grass prairie habitats, particularly the eastern portion of the Poweshiek skipperling range, emphasizes the need for additional habitat into which the Poweshiek skipperling could expand to survive and recover as well as to allow for adjustment to changes in habitat availability that may result from climate change.

Life History

Feeding Narrative

Adult: The preferred larval food plant for some populations of Poweshiek skipperling is prairie dropseed (Borkin 1995, p. 6); larvae have also been observed feeding on little bluestem (Schizachyrium scoparium) (Borkin 1995, pp. 5–6) and sideoats grama (Bouteloua curtipendula) (Dana 2005a, pers. comm.). Poweshiek skipperling larvae have been observed feeding on Carex sp. (Borkin 1994, p. 6; Borkin 1996, p. 2), although not through the entire larval development (Borkin 2014, pers. comm.). Poweshiek skipperling have been observed laying eggs (ovipositing) on mat muhly (Muhlenbergia richardsonis) (Cuthrell 2012a, pers. comm.), a grass in Michigan's prairie fens (Penskar and Higman 1999, p. 1). Captive-reared caterpillars fed most successfully on prairie dropseed, and older caterpillars (late 2-day instar and older) successfully fed on little bluestem, big bluestem, and side-oats gramma (Runquist 2013, pers. comm.). One post-diapause Poweshiek skipperling was successfully reared to adulthood on Pennsylvania sedge (Carex pensylvanica) (Runquist 2013, pers. comm.).

Reproduction Narrative

Adult: Poweshiek skipperlings lay their eggs near the tips of leaf blades and overwinter as larvae on the host plants (Bureau of Endangered Resources in Swengel and Swengel 1999, p. 285, Borkin 2000, p. 7). Poweshiek skipperlings have also been documented laying eggs on the entire length of grass leaf blades and on low-growing deciduous foliage (Dupont 2013, p. 133). McAlpine (1972, pp. 85–93) observed hatching of larval Poweshiek skipperling after about 9 days. McAlpine's records were incomplete, and he did not have any observations past the 7th instar, but he believed that there should have been one or two additional instars, followed by the chrysalis (pupa) and then the imago (adult) stages (McAlpine 1972, pp. 85–93). Captive Poweshiek skipperling eggs hatched 8 to 9 days after oviposition (Runquist 2013, pers. comm.). After hatching, Poweshiek skipperling larvae crawl out near the tip of grasses and may remain stationary, with their head usually pointing downward (McAlpine 1972, pp. 88–92). Unlike Dakota skippers, Poweshiek skipperling do not form shelters underground (McAlpine 1972, pp. 88– 92; Borkin 1995, p. 9; Borkin 2008, pers. comm.), instead the larvae overwinter up on the blades of grasses and on the stem near the base of the plant (Borkin 2008, pers. comm.; Dana 2008, pers. comm.). Borkin (2008, pers. comm.) observed larvae moving to the tips of grass blades to feed on the outer and thinner edges of the blades, with later movement down and among blades.

Geographic or Habitat Restraints or Barriers

Adult: Roads and crop fields

Spatial Arrangements of the Population

Adult: Clumped according to suitable microhabitat

Environmental Specificity

Adult: High

Tolerance Ranges/Thresholds

Adult: Sensitive

Site Fidelity

Adult: High

Habitat Narrative

Larvae: After hatching, Poweshiek skipperling larvae crawl out near the tip of grasses and may remain stationary, with their head usually pointing downward (McAlpine 1972, pp. 88–92). Unlike Dakota skippers, Poweshiek skipperling do not form shelters underground (McAlpine 1972, pp. 88– 92; Borkin 1995, p. 9; Borkin 2008, pers. comm.), instead the larvae overwinter up on the blades of grasses and on the stem near the base of the plant (Borkin 2008, pers. comm.; Dana 2008, pers. comm.). Borkin (2008, pers. comm.) observed larvae moving to the tips of grass blades to feed on the outer and thinner edges of the blades, with later movement down and among blades.

Adult: Poweshiek skipperling habitats include prairie fens, grassy lake and stream margins, moist meadows, sedge meadow, and wet-to-dry prairie. McCabe and Post (McCabe and Post 1977, pp. 36–38) describe the species' habitat in North Dakota as ''. . . high dry prairie and low, moist prairie stretches as well as old fields and meadows.'' Royer and Marrone (1992b, p. 12) describe Poweshiek skipperling habitat in North Dakota and South Dakota as moist ground in undisturbed native tallgrass prairies. Poweshiek skipperling habitat throughout Iowa and Minnesota is described as both ''high dry'' and ''low wet'' prairie (McCabe and Post 1977, pp. 36–38). The only documented Illinois record was associated with high rolling prairie (Dodge 1872, p. 218); the only documented Indiana record was from marshy lakeshores and wetlands (Blatchley 1891, p. 398; Shull 1987, p. 29). Southern dry prairies in Minnesota are described as having sparse shrub cover (less than 5 percent) composed primarily of leadplant, with prairie rose, wormwood sage, or smooth sumac present and few, if any, trees (Minnesota DNR 2012a, p. 1). Southern mesic prairies also have sparse shrubs (5–25 percent cover) consisting of leadplant and prairie rose with occasional wolfberry (Symphoricarpos occidentalis) and few, if any, trees (Minnesota DNR 2012b, p. 1). The disjunct populations of Poweshiek skipperlings in Michigan have more narrowly defined habitat preferences, variously described as wet marshy meadows (Holzman 1972, p. 114), bog fen meadows or carrs (Shuey 1985, p. 181), sedge fens (Bess 1988, p. 13), and prairie fens (Michigan Natural Features Inventory 011, unpubl. data; Michigan Natural Features Inventory 2012, unpubl. data). Bess (1988, p. 13) found the species primarily in the drier ortions of Liberty Fen, Jackson County, dominated by ''low sedges'' and an abundance of nectar sources. Summerville and Clampitt (1999, p. 231) noted that the population was concentrated in areas dominated by spikerush and that only 10–15 percent of the fen area was occupied despite the abundance of nectar sources throughout. Poweshiek skipperling have been described as occupying peat domes within larger prairie fen complexes in areas either dominated by mat muhly or prairie dropseed (Cuthrell 2013a, pers. comm.). Poweshiek skipperling populations in Wisconsin are also disjunct from the population to the west and are associated with areas that contain intermixed wet prairie, wet-mesic, and dry-mesic prairie habitats (Borkin 1995, p. 6; Swengel 2013, pers. comm.). The dry-mesic habitats in the Scuppernong Prairie contain ''extensive patches of prairie dropseed and little bluestem grasses'' (Borkin 1995, p. 7). Survival in wetter areas, which tend to burn cooler and less completely, coupled with low recolonization rates, or the disproportionate loss of wet versus dry prairie could give the false impression that the wet areas were their preferred habitat (Borkin 1995, p. 7). Puchyan Prairie consists of wet-mesic prairie that grades lower into sedge meadow (WI DNR Web site http://dnr.wi.gov/topic/ Lands/naturalareas/ index.asp?SNA=172; Swengel 2013, pers. comm.) and adult Poweshiek Skipperlings have been observed in wet prairie there, although it is not known if these areas function as successful larval habitat (Swengel 2013, pers. comm.). Like the Dakota skipper, it has been hypothesized that Poweshiek skipperling larvae may be vulnerable to desiccation during dry summer months (Borkin 2012a, pers. comm.) and require movement of shallow groundwater to the soil surface or wet low areas to provide relief from high summer temperatures or dry conditions (Royer et al. 2008, pp. 2, 16; Borkin 2012a, pers. comm.). Humidity may also be an essential factor to larval survival during winter months since the larvae cannot take in water during that time and depend on humid air to minimize water loss through respiration (Dana 2013, pers. comm.). Royer (2008, pp. 14–15) measured microclimatological (climate in a small space, such as at or near the soil surface) levels within ‘‘larval nesting zones’’ (0 to 2 cm above the soil surface) at six known Poweshiek skipperling sites, and found an acceptable rangewide seasonal (summer) mean temperature range of 18 to 21 °C (64 to 70 °F), rangewide seasonal mean dew point ranging from 14 to 17 °C (57 to 63 °F), and rangewide seasonal mean relative humidity between 73 and 85 percent. Plant species generally associated with upland, drier portions of the mesic tallgrass prairies in Manitoba include: Big bluestem, pale-spike lobelia, prairie dropseed, mountain death camas, stiff goldenrod, black-eyed Susan, and meadow blazing-star (Environment Canada 2012, p. 6). In lower, wetter prairies with Poweshiek skipperlings, the following species are listed as often seen: Willow (Salix spp.), sedges (Carex spp.), rushes (Juncus spp.), groundsels (Pakera spp.), tufted hairgrass, creeping bentgrass (Agrostis stolonifera), mat muhly, elliptic spike-rush, fourflowered yellow loosestrife (Lysimachia quadriflora), and common self-heal (Environment Canada 2012, p. 6). The soils where the Poweshiek skipperling occurs in Manitoba are described as shallow, rocky, and highly calcareous (Westwood and Borkowsky 2004 in Dupont 2013, p. 19). Prairie fen habitat soils in Michigan are described as saturated organic soils (sedge peat and wood peat) and marl, a calcium carbonate (CaCO3) precipitate (MINFI Web site accessed August 3, 2012). In other States, soil textures in Poweshiek skipperling habitats are classified as loam, sandy loam, or loamy sand (Royer et al. 2008, pp. 3, 10); soils in moraine deposits are described as gravelly, except the deposits associated with glacial lakes. The Poweshiek larvae overwinter up on the blades of grasses and on the stem near the base of the plant (Borkin 2008, pers. comm.; Dana 2008, pers. comm.)

Dispersal/Migration

Motility/Mobility

Larvae: Larvae are very sedentary.

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal

Adult: Very limited

Immigration/Emigration

Adult: Not likely

Dispersal/Migration Narrative

Adult: Poweshiek skipperlings have low mobility and are non-migratory. Their dispersal is very limited and they are unlikely to immigrate. Larvae are very sedentary.

Additional Life History Information

Adult: Larvae are very sedentary.

Population Information and Trends

Population Trends:

Not available

Resiliency:

Very low

Representation:

Low

Redundancy:

Unknown

Population Growth Rate:

Steep negative

Number of Populations:

1 to 12

Population Size:

Unknown; small

Resistance to Disease:

Unknown

Population Narrative:

Recent survey data indicate that Poweshiek skipperling has declined to zero or to undetectable levels at 96 percent of sites where it has ever been recorded. Until about 2003, Poweshiek skipperling was regarded as the most frequently and reliably encountered prairie-obligate skipper butterfly in Minnesota, which contains approximately 48 percent of all known Poweshiek skipperling locations rangewide. Numbers and distribution dropped dramatically in subsequent years, however, and the species was not seen in Minnesota from 2007 through 2012. Two individuals were observed at one site in 2013 (Weber 2014, in litt.; Dana 2014, pers. comm.). In Iowa, the Poweshiek skipperling was found at 2 of 33 sites with previous records surveyed in 2007; the species was last observed at one site in 2008. Iowa contains about 14 percent of documented sites rangewide. Unidentified threats to the species have acted to extirpate or sharply diminish populations at all or the vast majority of sites in Iowa and Minnesota (Dana 2008, p. 16; Selby 2010, p. 7). South Dakota historically contained about 23 percent of the rangewide sites with documented presence of Poweshiek skipperling, although recent surveys in that State also suggest an emergent and mysterious decline. The species was last observed in South Dakota in 2008, at three sites. Surveys conducted in 2009–2013 flight seasons in South Dakota resulted in zero detections of the species. North Dakota historically contained about six percent of the rangewide sites with documented presence of Poweshiek skipperling; the species was last observed in North Dakota in 2001. Survey efforts in North Dakota have been minimal between 1998 and 2011, but surveys conducted in 1997 documented more than 10 Poweshiek skipperlings at 1 site; 6 individuals were counted at 1 site, and 0 were detected at 6 other sites. Surveys conducted during the 2012 and 2013 flight seasons in North Dakota resulted in zero detections of the species. Seven Michigan sites were recently ranked as having good or better ‘‘viability,’’ a habitat-based element occurrence rank assigned by the Michigan Natural Features Inventory (2011); however, the number of individuals observed at a few of those sites has declined in recent years, and the species is presumed extirpated from one of those sites. Currently, four of the ten extant occurrences of Poweshiek skipperling in Michigan are considered to have good or better viability (Michigan Natural Features Inventory (2011, unpubl. data). Each of those faces threats of at least low to moderate magnitude, and the State contains only about 6 percent of all known historical Poweshiek skipperling records. One population of Poweshiek skipperlings in Wisconsin had fairly consistent numbers observed over the last 5 years (17 to 63 individuals counted using modified Pollard transect covering 15 ac (6 ha) in approximately 40 minutes), but the species was not observed in 2013 surveys. One population in Manitoba has fairly consistent numbers (typically hundreds of individuals observed each year). To summarize, of the 298 documented sites, there are 12 sites where we consider the Poweshiek skipperling to be present, 111 sites with unknown status, 96 possibly extirpated sites, and 79 where we consider the species to be extirpated.

Threats and Stressors

Stressor: Habitat destruction and conversion
Exposure:
Response:
Consequence:
Narrative: Conversion of prairie for agriculture may have been the most influential factor in the decline of the Poweshiek skipperling since Euro-American settlement, but the impacts of such conversion on extant populations is not well known. By 1994, tallgrass prairie had declined by 99.9 percent in Illinois, Iowa, Indiana, North Dakota, Wisconsin, and Manitoba; and by 99.6 percent in Minnesota; and 85 percent in South Dakota (Samson and Knof 1994, p. 419). Conversion for agriculture on lands suitable for such purposes is a current, ongoing stressor of high level of impact to the Poweshiek skipperling populations in areas where such lands still remain. Advances in technology may also increase the potential of conversions in areas that are currently unsuitable for agriculture.

Stressor: Energy development
Exposure:
Response:
Consequence:
Narrative: Energy development (oil, gas, and wind) and associated roads and facilities result in the loss or fragmentation of suitable prairie habitat (Reuber 2011, pers. comm.). Catastrophic events, such as oil and brine spills, could cause direct mortality of Poweshiek skipperling larvae that are in shelters at the soil surface. Such spills may also cause the loss of larval host and nectar plants in the spill path. Additional plants may be lost during spill response, particularly if the response involves burning. Wind energy turbines and associated infrastructure (e.g., maintenance roads) are likely stressors to Poweshiek skipperling populations, particularly on private land in South Dakota (Skadsen 2002, p. 39; Skadsen 2003, p. 47; Skadsen 2012d, pers.

comm.). Similar to oil and gas development, wind development would destroy native-prairie habitat in the footprint of the structure, add access roads and other infrastructure that may further fragment prairies, and could be catalysts for the spread of invasive species. Further, it is unknown if the noise and flicker effects associated with wind turbines may impact Poweshiek skipperling populations beyond direct impacts from the turbines and/or infrastructure.

Stressor: Invasive species
Exposure:
Response:
Consequence:
Narrative: Poweshiek skipperlings typically occur at sites embedded in agricultural or developed landscapes, which make them more susceptible to nonnative or woody plant invasion. Nonnative species including leafy spurge, Kentucky bluegrass, alfalfa, glossy buckthorn, smooth brome, purple loosestrife (Lythrum salicaria), Canada thistle (Cirsium arvense), reed canary grass, and others, have invaded Poweshiek skipperling habitat throughout their ranges (Orwig 1997, pp. 4, 8; Michigan Natural Features Inventory 2011, unpubl. data; Skadsen 2002, p. 52; Royer and Royer 2012b, pp. 15–16, 22–23). Once these plants invade a site, they replace or reduce the coverage of native forbs and grasses used by adults and larvae of both butterflies. Thus, a prevalence of these grasses reduces food availability for the larvae. The stressor from nonnative invasive herbaceous species is compounded by the encroachment of woody species into native-prairie habitat. Glossy buckthorn and gray dogwood encroachment, for example, is a major stressor to Poweshiek skipperling populations. Invasion of tallgrass prairie and prairie fens by woody vegetation such as glossy buckthorn reduces light availability, total plant cover, and the coverage of grasses and sedges (Fiedler and Landis 2012, pp. 44, 50–51). This in turn reduces the availability of both nectar and larval host plants for Poweshiek skipperlings. If groundwater flow to prairie wetlands is disrupted (e.g., by development) or intercepted (e.g., digging a pond in adjacent uplands or installing wells for irrigation or drinking water), it can quickly convert to shrubs or other invasive species (Fiedler and Landis 2012, p. 51; Michigan Natural Features Inventory 2012, p. 4). For example, roads and residential development likely disrupted the hydrology of a prairie fen where the Poweshiek skipperling was last observed in 2007 and where 2008 and 2009 surveys for Poweshiek skipperlings were negative (Michigan Natural Features Inventory 2011, unpubl. data). When prairie is converted to shrubland, forest, or semi-forested habitat types and facilitates invasion of adjacent native prairie by exotic, cool-season grasses, such as smooth brome. Moreover, the trees and shrubs provide perches for birds that may prey on the butterflies (Royer and Marrone 1992b, p. 15; 1992a, p. 25).

Stressor: Fire
Exposure:
Response:
Consequence:
Narrative: Poweshiek skipperling populations existed historically in a vast ecosystem maintained in part by fire. Due to the great extent of tallgrass prairie in the past, fire and other intense disturbances (e.g., locally intensive bison grazing) likely affected only a small proportion of the habitat each year, allowing for recolonization from unaffected areas during the subsequent flight period (Swengel 1998, p. 83). Fire can improve Poweshiek skipperling (Cuthrell 2009, pers. comm.) (e.g., by helping to control woody vegetation encroachment), but it may also kill most or all of the individuals in the burned units and alter entire remnant prairie patches, if not properly managed (e.g., depends on the timing, intensity, etc.). Accidental wildfires also may burn entire

prairie tracts (Dana 1997, p. 15). Intentional fires, without careful planning, may also have significant adverse effects on populations of Poweshiek skipperlings, especially after repeated events (McCabe 1981, pp. 190–191; Dana 1991, pp. 41– 45, 54–55; Swengel 1998, p. 83; Orwig and Schlicht 1999, pp. 6, 8). The effects of fire on prairie butterfly populations are difficult to ascertain (Dana 2008, p. 18), but the apparent hypersensitivity of Poweshiek skipperlings indicates that it is a stressor in habitats burned too frequently or too broadly. The Poweshiek skipperling are not known to disperse widely (Swengel 1996, p. 81; Burke et al. 2011, p. 2279); therefore, in order to reap the benefits of fire to habitat quality, Poweshiek skipperlings must either survive in numbers sufficient to rebuild populations after the fire or recolonize the area from a nearby unburned area. In addition, the return interval of fires needs to be infrequent enough to allow for recovery of the populations between burns. Therefore, fire is a stressor to Poweshiek skipperlings at any site where too little of the species' habitat is left unburned or where patches are burned too frequently. When all or large portions of prairie remnants are burned, many or all prairie butterflies may be eliminated at once. Complete extirpation of a population, however, may not occur after a single burn event (Panzer 2002, p. 1306), and the extent of effects would vary depending on time of year and fuel load. Poweshiek skipperlings lay their eggs near the tips of leaf blades, and they overwinter as larvae on the host plants (Borkin 200, p. 2), where they are exposed to fires during their larvalstages. Poweshiek skipperlings have also been documented laying eggs on the entire length of grass leaf blades and on low-growing deciduous foliage (Dupont 2013, p. 133). Poweshiek skipperlings do not burrow into the soil surface (McAlpine 1972, pp. 88–92; Borkin 1995, p. 9), which makes them more vulnerable to fire (and likely more vulnerable to chemicals such as herbicides and pesticides) throughout their larval stages.

Stressor: Grazing
Exposure:
Response:
Consequence:
Narrative: Grazing may maintain habitat for the Poweshiek skipperling, but as with any management practice, appropriate timing, frequency, and intensity are important. The level of impact of grazing on Poweshiek skipperling populations also depends on the type of habitat that is being grazed. In addition, grazing may be a valuable tool for controlling smooth brome invasion and maintaining native diversity in prairies, especially where circumstances make the use of fire difficult or undesirable (Service 2006, p. 2; Smart et al. 2013, pp. 685–686). Conversely, grazing may stimulate brome growth and reduce native plant diversity. Bison (Bison bison) grazed at least some Poweshiek skipperling habitats historically (McCabe 1981, p. 190; Bragg 1995, p. 68; Schlicht and Orwig 1998, pp. 4, 8; Trager et al. 2004, pp. 237–238), but cattle (Bos taurus) are now the principal grazing ungulate in both species' ranges. Bison and cattle both feed primarily on grass, but have some dissimilar effects on prairie habitats (Damhoureyeh and Hartnett 1997, pp. 1721–1725; Matlack et al. 2001, pp. 366–367). Cattle consume proportionally more grass and grasslike plants than bison, whereas bison consume more browse and forbs (flowering herbaceous plants) (Damhoureyeh and Hartnett 1997, p. 1719). Grasslands grazed by bison may also have greater plant species richness and spatial heterogeneity than those grazed by cattle (Towne et al. 2005, pp. 1553–1555). Both species remove forage for larvae (palatable grass tissue) and adults (nectar-bearing plant parts), change vegetation structure, trample larvae, and alter larval microhabitats.

Stressor: Haying and mowing

Exposure:
Response:
Consequence:
Narrative: Haying (mowing grasslands and removing the cuttings) may maintain habitat for the Poweshiek skipperling , but as with any management practice, appropriate timing, frequency, and intensity are important. Haying generally maintains prairie vegetation structure, but it may favor expansion of invasive species such as Kentucky bluegrass. If done during the adult flight period, haying may kill the adult butterflies or cause them to emigrate, and if done before or during the adult flight period, it may reduce nectar availability (McCabe 1979, pp. 19–20; McCabe 1981, p. 190; Dana 1983, p. 33; Royer and Marrone 1992a, p. 28; Royer and Marrone 1992b. p. 14; Swengel 1996, p. 79; Webster 2003, p. 10). Haying is a current and ongoing stressor of moderate to high level of impacts to Poweshiek skipperlings at the few sites where the site is normally hayed before August and where annual haying is reducing availability of larval food and adult nectar plants. However, fall haying is beneficial, specifically if it is conducted after the flight period (after August 1), no more than every other year, and there is no indication that native plant species diversity is declining due to timing or frequency of haying. Haying is a current stressor at a small number of sites.

Stressor: Lack of management/disturbance
Exposure:
Response:
Consequence:
Narrative: Prairies that lack periodic disturbance become unsuitable for Poweshiek skipperlings due to expansion of woody plant species (secondary succession), litter accumulation, reduced densities of adult nectar and larval food plants, or invasion by nonnative plant species (e.g., smooth brome) (McCabe 1981, p. 191; Dana 1983, p. 33; Dana 1997, p. 5; Higgins et al. 2000, p. 21; Skadsen 2003, p. 52).

Stressor: Demographics (population size and isolation)
Exposure:
Response:
Consequence:
Narrative: Small, isolated populations face a current and ongoing stressor of moderate to high severity. The stressor has a high impact to populations when isolation is combined with small habitat fragments or small populations; for example, where the population is too small to supplement nearby populations without adverse genetic consequences to the source population. Isolated populations occur throughout both species' entire ranges; only 4 of the 12 Poweshiek sites with present status are within the estimated maximum dispersal distance from one another. The small populations are subject to erosion of genetic variability leading to inbreeding, which lowers the ability of the species to adapt to environmental change. Small populations occur rangewide; for example, surveyors have counted fewer than 100 individuals in all but 4 Poweshiek skipperling sites in 2011, all but one site surveyed in 2012, and all sites surveyed in 2013.

Stressor: Herbicide and/or pesticide use
Exposure:
Response:
Consequence:

Narrative: Herbicide and pesticide use may have direct or indirect effects on Poweshiek skipperling. Although such activities occur, there is no evidence that these activities alone have significant impacts on either species, since their effects are often localized. However, these factors may have a cumulative effect on the Poweshiek skipperling when added to habitat curtailment and destruction because dramatic population declines have occurred.Invasive species and woody vegetation management helps to maintain prairie habitats and can also be beneficial to populations of both species, for example, when concentrated on affected areas through spot spraying. Ivermectin, a widely used and persistent veterinary pharmaceutical used to treat cattle, is a chemical of emerging concern to the Poweshiek skipperling. Ivermectin is an anthelmintic (drugs that are used to treat infections with parasitic worms) that is spread to prairie environments via the dung of grazing cattle (Lange et al. 2009, p. 2238). Lange et al. (2009, pp. 2234, 2238) found that skipper butterflies are particularly vulnerable to ivermectin, due to their low dispersive capacities and habitat preferences for soil.

Recovery

Reclassification Criteria:
Not addressed

Delisting Criteria:
Not addressed

Recovery Actions:
- Not addressed (see conservation measures)

Conservation Measures and Best Management Practices:
- Habitat protection: Protection or restoration of habitat quality at these isolated sites is critical to the survival of this species, although stochastic events still pose some risk, especially for smaller populations and at small sites.
- Grazing BMPs: The level of impact of grazing to populations would be low if the dry/mesic slopes were grazed only before June 1 with at least one year of rest between rotations and if the pasture were only spot-sprayed with herbicides when and where necessary. Dakota skippers and Poweshiek skipperlings may benefit when prairie habitat is rested from grazing for at least a part of each growing season, if livestock are precluded from removing too much plant material (e.g., are moved when stubble heights are 6–8 in (15–20 cm) (Skadsen 2007, pers. comm.), and if the timing of grazing for each field varies from year to year (Skadsen 2007, pers. comm.). Britten and Glasford (2002, p. 373) recommended minimizing disturbance habitat during the flight period (late June to early July) to maximize genetically effective population sizes (the number of adults reproducing) to offset the effects of genetic drift of small populations (change in gene frequency over time due to random sampling or chance, rather than natural selection).
- Fire management: Burn habitat in early spring instead of late spring. An increase in purple coneflower, an important nectar source for Dakota skippers and Poweshiek skipperlings, may last for 1– 2 years after early spring fires, and females may preferentially oviposit near concentrations of this nectar source (Dana 2008, p. 20). Rotational burning may benefit prairie butterflies by increasing nectar plant density and by positively affecting soil temperature and near-surface humidity levels due to reductions in litter (Dana 1991, pp. 53–55; Murphy et al. 2005, p. 208; Dana 2008, p. 20). Fire presents a low level of impact to populations at sites where the species' habitat is divided into at least four burn units and no unit is burned more frequently than once every 4 years;

or, the species' habitat is divided into three or more burn units, at least three units are burned no more frequently than once every 4 years, and the site contains more than 140 ha (346 ac) of native prairie or where the site is separated from another occupied site by less than 1 km (1.6 mi).

- Enforce regulations: Enforce Endangered Species Act protections; Lacey Act
- Perform research: Research on pesticides to determine significance as a threat; research on Wolbachia (disease) to determine significance as a threat

References

USFWS 2014. Threatened Species Status for Dakota Skipper and Endangered Species Status for Poweshiek Skipperling (79 FR 63671 63748)

November 24, 2014.

U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants

Designation of Critical Habitat for the Dakota Skipper and Poweshiek Skipperling. Final rule. 80 FR 59247 - 59384 (October 1, 2015).

USFWS. 2014. Threatened Species Status for Dakota Skipper and Endangered Species Status for Poweshiek Skipperling (79 FR 63671 63748)

SPECIES ACCOUNT: *Clemmys muhlenbergii* (Bog (=Muhlenberg) turtle (Glyptemys))

Species Taxonomic and Listing Information

Listing Status: Threatened; Northeast Region (R5) (USFWS, 2015)

Physical Description

A small turtle.Carapace is light brown to black (may have yellowish or reddish areas on large scutes), strongly sculptured with growth lines, and has an inconspicuous keel; plastron is mainly dark brown to black; head is brown, with a large yellow or orange (sometimes red) blotch above and behind the tympanum (blotch may be divided); adult carapace length usually is 7.5-9 cm (up to 11.5 cm); hatchling carapace is 2.5-3.2 cm; male vent is posterior to the rear edge of the carapace and the plastron is concave (flat in female) (Ernst and Barbour 1989, Conant and Collins 1991). LENGTH:9 (NatureServe, 2015)

Taxonomy

The bog turtle was described as Testudo muhlenbergii by Schoepff (1801), from a specimen collected by Reverend Gotthilf Heinrich Ernst Muhlenberg. The type locality was “Pennsylvaniae”; the holotype was not designated and its location is unknown (Ernst and Bury 1977). Stejneger and Barbour (19 17) restricted the type locality to “Lancaster, Pennsylvania.” Fitzinger (1835) was the first to use the combination CIemmys muhlenbergii. Included in the synonymy ofC1emmy.s muhlenbergii are Emys biguttata (Say 1825), lacking a designated holotype, type locality “United States,” and restricted to the “vicinity of Philadelphia” by Schmidt (1953), and Clemmys nuchalis (Dunn 1917). The type specimen (American Museum of Natural History No. 8430) was collected by Dunn on August 17, 1916, on the “side of Yonahlossee Road, about 3 miles from Linville, North Carolina,” at an altitude of 4,200 feet (USFWS, 2001).

Current Range

Discontinuous, spotty distribution; New York (including remnant population at two sites in the Finger Lakes region), western Massachusetts, and western Connecticut southward to Pennsylvania, New Jersey, Maryland, and northern Delaware; southeastern Virginia through western and central North Carolina and extreme eastern Tennessee to western South Carolina and Georgia (Herpetol. Rev. 14:55). Large hiatus of about 250 miles between the northern populations and the southern populations. In the north, Maryland has the largest number of occurrences and turtles; only about 20 populations thought to be viable exist outside Maryland and New Jersey. In the south, most occurrences and turtles are in North Carolina and Virginia (only a few viable populations elsewhere). Sea level to 1280 m in the Appalachians; usually below 245 m in the north. Most populations occur on private property. Extirpated in western Pennsylvania and in the Lake George region of New York.

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Feeds opportunistically on insects, worms, slugs, crayfish, snails, and other small invertebrates; also amphibian larvae and fruits. Diet generally is dominated by insects. Apparently forages on land and in water (Bury 1979).; Food Habits: Invertivore (Adult, Immature)Most activity occurs from mid-April to late September in New Jersey and Pennsylvania. In some areas, including Pennsylvania and Delaware, there is an apparent peak in activity in May (see Bury 1979). Reportedly may estivate or at least reduce activity to a small area during hot summer periods (especially July-August). In North Carolina, radiotelemetry showed that turtles remained active through summer and fall whereas hand captures indicated primarily vernal activity (Herman and Fahey 1992). In Maryland, movement into and out of retreats was noted from November through March (Chase et al. 1989). Active during daylight hours, mostly from mid-morning to late afternoon or early evening. More active on cloudy days than on bright sunny days (Mitchell 1991). In early spring, activity occurs mainly at midday and in the afternoon; most active in the morning in late spring and summer (Mitchell 1991).; (NatureServe, 2015)

Adult: Feeds opportunistically on insects, worms, slugs, crayfish, snails, and other small invertebrates; also amphibian larvae and fruits. Diet generally is dominated by insects. Apparently forages on land and in water (Bury 1979).; Food Habits: Invertivore (Adult, Immature)Most activity occurs from mid-April to late September in New Jersey and Pennsylvania. In some areas, including Pennsylvania and Delaware, there is an apparent peak in activity in May (see Bury 1979). Reportedly may estivate or at least reduce activity to a small area during hot summer periods (especially July-August). In North Carolina, radiotelemetry showed that turtles remained active through summer and fall whereas hand captures indicated primarily vernal activity (Herman and Fahey 1992). In Maryland, movement into and out of retreats was noted from November through March (Chase et al. 1989). Active during daylight hours, mostly from mid-morning to late afternoon or early evening. More active on cloudy days than on bright sunny days (Mitchell 1991). In early spring, activity occurs mainly at midday and in the afternoon; most active in the morning in late spring and summer (Mitchell 1991).; (NatureServe, 2015)

Reproduction Narrative

Adult: Most researchers have reported a fairly even sex ratio. Although Klemens (1990, 1993a) found significantly more adult females than males at two of his Massachusetts study sites, subsequent fieldwork by A. Whitlock (pers. comm.) at these sites has produced more even sex ratios. J. L. Behler (pers. comm.) observed a I:2 male to female ratio at his southeastern New York study site (USFWS, 2001). Mating occurs from late April to early June. Lays clutch of 1-6 (usually 3-5) eggs in May, June, or July (occasionally August). Eggs hatch in about 6-9 weeks, late July to early September. In the north, hatchlings may not emerge from the nest until October or they may overwinter in the nest. Sexually mature in 5-8 years. Not all adult females produce clutches annually. No evidence of multiple clutches wihtin a single season.; Home range size averaged 1.3 ha in Pennsylvania, where the longest distance moved by any individual was 225 m (see Bury 1979). Home range was 0.04-ha to 0.24 ha in Maryland (Chase et al. 1989). Home range size averaged 0.52 ha (median 0.35 ha, range 0.02-2.26 ha, minimum convex polygon) in Virginia (Carter et al. 1999). Long-distance movements between wetlands were infrequently observed in southwestern Virginia (Carter et al. 2000). In North Carolina over somewhat less than 1 year, distances between relocations of radio-tagged turtles was 0-87 m (mean 24 m) for males, 0-62 m (mean 16 m) for females (Herman and Fahey 1992). Population density may exceed 110/ha in some areas (see Ernst and Barbour 1972). In Maryland, population density was 7-213/ha of wetland habitat; average was 44 individuals per site at 9 sites (Chase et al. 1989). Searches of suitable habitat in North Carolina and Delaware yielded 1 bog turtle per 1.8 to 4.2 hours of search (see Bury 1979). In Pennsylvania, patches of suitable habitat had 3 to 300 individuals, mostly around 30 (see Mitchell 1991). In the northern half of the range, other turtles most likely to occur in bog turtle habitat include the spotted turtle, painted turtle, and wood turtle. Eggs, young, and adults are preyed on by various Carnivora, opossums, and some wading birds. Juveniles are very secretive.; (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: Clumped (NatureServe, 2015)

Environmental Specificity

Adult: Narrow/specialist (NatureServe, 2015)

Habitat Narrative

Adult: Bog turtles inhabit slow, shallow, muck-bottomed rivulets of sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamps; the habitat usually contains an abundance of sedges or mossy cover. The turtles depend on a mosaic of microhabitats for foraging, nesting, basking, hibernation, and shelter (USFWS 2000). "Unfragmented riparian systems that are sufficiently dynamic to allow the natural creation of open habitat are needed to compensate for ecological succession" (USFWS 2000). Beaver, deer, and cattle may be instrumental in maintaining the essential open-canopy wetlands (USFWS 2000). Bog turtles commonly bask on tussocks in the morning in spring and early summer. They burrow into soft substrate of waterways, crawls under sedge tussocks, or enter muskrat burrows during periods of inactivity in summer (see Bury 1979). In Pennsylvania, bog turtles hibernated mainly in water and mud in muskrat burrows, and in mud bottom of marsh rivulets under 5-15 cm of water. In New Jersey, hibernacula were in subterranean rivulets or seepage areas where water flowed continuously from underground springs; turtles were under 5-55 cm of water and mud (see Ernst et al. [1989] for further details). In Maryland, larger population sizes were associated with sites with the following characteristics: circular basin with spring-fed pockets of shallow water, bottom substrate of soft mud and rock, dominant vegetation of low grasses and sedges, and interspersed wet and dry pockets; winter retreats were shallow, just below upper surface of frozen mud and/or ice (Chase et al. 1989). Studies in Maryland and Pennsylvania noted use of the lower portion of wetlands for overwintering. In Virginia, selected habitats included wet meadow, smooth alder edge, and bulrush; dry meadow and streams were avoided (Carter et al. 1999). Nests are in open and elevated ground in areas of moss, sedges, or moist earth (see Bury 1979). The turtles dig a shallow nest or lay eggs in the top of a sedge tussock.SPRING/SPRING BROOKBog/fen; HERBACEOUS WETLAND; Riparian; SCRUB-SHRUB WETLANDBurrowing in or using soil (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: Moderate (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: Low (natureServe, 2015)

Immigration/Emigration

Adult: Emigrates (USFWS, 2001)

Dispersal/Migration Narrative

Adult: May migrate about 200 m between winter hibernation site and upstream summer range in some areas (Ernst and Barbour 1972). Hibernating juveniles were found in a nesting area in New Jersey (Ernst et al. 1989).; Nonmigrant: Y; Local migrant: Y; Distant migrant: N; (NatureServe, 2015). Occasionally, individual bog turtles are found crossing roads a considerable distance from any apparently suitable habitat. These apparent long distance movements may result from emigration out of habitats declining in quality through disturbances or succession (USFWS< 2001).

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:

Low (NatureServe, 2015)

Representation:

Low (NatureServe, 2015)

Redundancy:

Low (NatureServe, 2015)

Number of Populations:

81 to >300 (NatureServe, 2015)

Population Size:

2500 - 100,000 individuals (NatureServe, 2015)

Population Narrative:

Low fecundity and high mortality rate of young make populations slow to recover from population losses. Decline of 30-70% Southern population, based on known sites, has been estimated at about 2500-4000; inclusion of potential occurrences in apparently suitable habitat brings the estimate up to about 4000-6000. Most populations are small. Cryptic, hard to find even when present in good numbers; easily overlooked (Collins 1990). In the northern segment of the range, currently known from 360 sites (5 in Connecticut, 4 in Delaware, 71 in Maryland, 3 in Massachusetts, 165 in New Jersey, 37 in New York, and 75 in Pennsylvania). Some of these are parts of larger occurrences, so the number of distinct occurrences is less than the number of sites. See USFWS (1997, 2000) for information on status in each state in the northern part of the range. (NatureServe, 2015)

Threats and Stressors

Stressor: Development (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Development occurring in groundwater recharge areas results in increases in impervious surfaces and the number of wells, which can, in turn, lower water tables, affecting groundwater discharges into bog turtle habitats (in terms of both quantity and quality) and accelerating succession (Lowenstein in litt. 2000). Patterns of subsurface water flow can be altered by infrastructure construction and other development projects. Drilling under wetlands (e.g., to install utility lines or fiber optic cable) has the potential to disrupt the flow of water and even fracture bedrock and significantly impact a small wetland system (USFWS, 2001).

Stressor: Grazing (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Although light grazing may be beneficial in controlling succession, intensive pasturing adds excessive nutrient loading from fecal material, results in significant soil disturbance, (which may accelerate exotic plant invasion), destroys the unique plant community by overgrazing, and will result in bog turtles being crushed. The type and density of grazers determines the effect on the habitat. For example, horses appear to cause more damage to a pasture than cows, animal for animal. Smith (in litt. 2000) has observed that horses “graze lower to the soil, like sheep, and this coupled with their hoofs somehow appear to damage the substrate more - areas become mud holes with only a few horses whereas it would take many more cows to inflict the same amount of damage.” (USFWS, 2001)

Stressor: Succession (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Some of the most persistent and widespread problems associated with maintaining bog turtle habitat are succession of open meadows to wooded swamps, drainage and flooding of habitats through diversion or damming of feeder streams, chemical and heavy metal pollution, nutrient enrichment from fertilizer and septic runoff, and the establishment of alien plants. Disturbance of surface soils and degraded water quality may result in the establishment and spread of invasive wetland plant species such as the alien purple loosestrife (Lythrum salicaria) or native giant reed (Phrugmites australis). These aggressive species rapidly invade wetlands when areas of disturbance and/or impaired water quality are created. Favored colonization sites are the piles of excavated soil placed alongside ponds and ditches. After taking root in a disturbed microhabitat, these plants quickly spread into the adjacent wetlands, replacing a diverse botanical community with a dense monoculture. This monoculture is unsuitable for many wetland species, including bog turtles (Klemens, 1990, 1993a). Other invasive species implicated in reducing the value of bog turtle habitats include reed canary grass (Phaluris arundinucea) and multiflora rose (Rosa multiflora) (USFWS, 2001).

Stressor: Inadequacy of Existing Regulatory Mechanisms (USFWS, 2001)

Exposure:
Response:
Consequence: Loss of habitat
Narrative: Although some states have been successful in avoiding or minimizing encroachments (e.g., filling, ditching, draining, development) into bog turtle habitat, significant habitat degradation and fragmentation has resulted from indirect effects to wetlands caused by activities in the adjacent uplands. Despite the recognition of regulated upland buffers around wetlands (in all northern range states except Pennsylvania), activities that contribute to habitat loss, including development, farming, and placement of detention or storm water basins, are often allowed to proceed within the buffer. These activities can degrade water quality, accelerate succession, encourage the invasion and spread of exotic plants, and change wetland hydrology (USFWS, 2001).

Stressor: Illegal trade and collection (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Exploitation of bog turtles for commercial or private use ranks second in threats to this species, after habitat loss. Their small size, attractive shell and coloration, and rarity make the bog turtle a prize eagerly pursued by unscrupulous collectors, both in the United States and overseas, resulting in illegal collecting for an illicit pet trade. Tryon (1989), Strong (1989), and Herman (1989b) described one incident where a series of southern Appalachian study sites was decimated by a group of collectors who had specifically traveled south to capture bog turtles. Apart from removing large numbers of adults, these collectors seriously compromised at least one long-term mark and recapture study site by removing marked turtles (Herman 1989b). Klemens (1991) reviewed reports of illegal collecting activities from Delaware, Massachusetts, Maryland, New Jersey, New York, North Carolina, and Pennsylvania. In 1975, the bog turtle was added to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in order to monitor trade in the species. In 1992, the bog turtle was transferred from Appendix II to Appendix I due to the increased number of bog turtles being advertised for sale, the increased price being paid for individuals and pairs, and illegal trade not being reported under CITES (57 FR 7722, March 4, 1992). Both import and export permits are required from the importing and exporting countries before an Appendix I species can be transported, and an Appendix I species cannot be exported for primarily commercial purposes (USFWS, 2001)

Stressor: Disease and predation (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Many of the primary predators on bog turtles and their nests are human commensals, i.e., they flourish in the presence of humans and the landscapes that they alter. This is particularly acute for species such as the bog turtle, which occurs primarily in agricultural landscapes where the presence of raccoons, skunks, opossums, and crows can pose a significant threat. How significant a threat these subsidized species pose to bog turtles is hard to determine, although in certain populations it is speculated that predation of adults and eggs is a serious problem. At present, there are no substantiated reports of disease affecting a wild population of bog turtles, although at one site in Columbia County, New York (J.L. Behler, pers. comm) the

number of dead turtles is cause for concern; eight dead bog turtles were collected during three visits to the site in 1988 and 1989 (A. Breisch, in Mt. 2000). A sick turtle removed from that population and held for several years in captivity tested positive for upper respiratory distress syndrome (URDS) upon necropsy (J. L. Behler, pers. comm.). Although this could indicate a health problem within that population, it is also possible that the turtle contracted this disease while in captivity. Disease issues have the potential to become a much larger threat to wild bog turtle populations as they are subjected to more handling by researchers or if manipulation of turtle populations is undertaken through the deliberate release into the wild of bog turtles from other areas, zoological collections, or those seized by law enforcement activities. It should be noted that thorough health screening of wild-caught bog turtles has not been a standard practice of researchers, although it may be warranted (Smith in iitt. 2001) (USFWS, 2001).

Recovery

Delisting Criteria:

Long range protection is secured for at least 185 populations distributed among five recovery units: Prairie Peninsula/Lake Plain Recovery Unit (I 0), Outer Coastal Plain Recovery Unit (S), HudsoniHousatonic Recovery Unit (40), SusquehannaA'otomac Recovery Unit (50), and Delaware Recovery Unit (80) (USFWS, 2001).

Monitoring at five-year intervals over a 25-year period shows that these 185 populations are stable or increasing (USFWS, 2001).

Illicit collection and trade no longer constitute a threat to this species' survival (USFWS, 2001).

Long-term habitat dynamics, at all relevant scales, are sufficiently understood to monitor and manage threats to both habitats and turtles, including succession, invasive wetland plants, hydrology, and predation (USFWS, 2001).

References

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