STATUS OF THE SPECIES – Key Largo cotton mouse (*Peromyscus gossypinus allapaticola*)

Legal status – Federal: *endangered*, 1984; State: *endangered*.

The U.S. Fish and Wildlife Service (Service) emergency listed the Key Largo cotton mice (KLCM) under the Endangered Species Act of 1973, as amended in 1998 (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) as endangered for 240 days on September 21, 1983 (Service 1983). The emergency listing was necessary to provide full consideration of the welfare of this species during a section 7 consultation with the Rural Electrification Administration. The Rural Electrification Administration's action was a loan to the Florida Keys Electric Cooperative for construction of a project that would accelerate loss of KLCM habitat. The KLCM was proposed as endangered with critical habitat on February 9, 1984 (Service 1984a) and was listed as endangered on August 31, 1984 (Service 1984b). The proposed critical habitat was withdrawn on February 18, 1986 (Service 1986; 1999).

Species description

Appearance/morphology

The KLCM are larger with a more reddish color than other subspecies of cotton mice from peninsular Florida. Its pelage is red dorsally, with dusky brown sides and white underparts. Its bicolored tail is darker brown on top and whiter underneath. Body length is 6.7 to 7.4 inches [170 to 189 millimeter (mm)] and tail length is 2.8 to 3.4 inches (72 to 87 mm).

Taxonomy

The KLCM is an island subspecies of the cotton mouse (*P. gossypinus*), a widespread species in the southeastern United States. It is distinguished as a separate subspecies because of its overall larger size (*e.g.*, total length, tail length, skull measurements) and more reddish-colored fur (Schwartz 1952). Its name originates from the Seminole Indian term 'allapattah' which stands for the tropical dry deciduous hammocks of South Florida (Humphrey 1992).

Life history

The KLCM is an herbivore, its diet consisting of leaves, buds, seeds, and fruits. The KLCM builds leaf-lined shelters in logs, tree hollows, rock crevices, or within or near Key Largo woodrat (*Neotoma floridana smalli*) nests. The shelter entrances measures 1.2 to 3.5 inches (3 to 9 centimeters) in diameter, and is often partially covered with leaves or bark. Cotton mice breed throughout the year, and produce two to three litters annually with a mean litter size of four. The KLCM's life expectancy ranges from about 5 months to 3 years (Service 2009).

Habitat

The Key Largo cotton mouse uses a variety of tropical hardwood habitats including recently burned, early successional, and mature hammock forests, and Salicornia coastal strands adjacent to these forests (Humphrey 1992). Hardwood hammocks are highly productive forests with a tall canopy and an open understory. Canopy trees include black ironwood (*Krugiodendron ferreum*), gumbo limbo (*Bursera simaruba*) Jamaican dogwood (*Piscidia piscipula*), mahogany (*Swietenia mahagani*), pigeon plum (*Coccoloba diversifolia*), poisonwood (*Metopium toxiferum*), strangler fig (*Ficus aurea*), and wild tamarind (*Lysiloma latisiliquum*). Hammock understory contains torchwood (*Amyris elemifera*), milkbark (*Drypetes diversifolia*), wild coffee (*Psychotria nervosa*), marlberry (*Aroisia escallonioides*), stoppers (*Eugenia* spp.), soldierwood (*Colubrina elliptica*), crabwood (*Gymnanthes lucida*), and velvetseed (*Guettarda scabra*). Ground cover contains cheese shrub (*Morinda royoc*) and snowberry (*Chicocoea alba*). Cotton mice have also been trapped in recently burned areas where bracken fern (*Pteridium aquilinum*) predominates (Goodyear 1985).

Distribution

From the early 1950s to the present, the KLCM has lost much of its hammock habitat due to land clearing for commercial and residential development. The KLCM historically inhabited all of the hammock forests from the northern end of Key Largo southward to Tavernier in Plantation Key. The distribution of the KLCM is now restricted to Key Largo north of the intersection of U.S. Highway 1 and County Road (CR) 905, known locally as North Key Largo (Frank et al. 1997). The Service introduced the KLCM to Lignumvitae Key in 1970. However, the last recorded sighting was in 1977 (Service 2009). The KLCM was not observed during a trapping study on Lignumvitae Key in 2007 (Greene 2007) and it appears that this population no longer exists.

The KLCM was formerly distributed throughout Key Largo, but is now restricted to hammocks on North Key Largo. The majority of high quality hammock habitat available on North Key Largo has been protected through acquisition and is being managed for conservation by the Service and State of Florida. Because of these efforts and current land use regulations in place by Monroe County, the threat of occupied habitat loss from development on North Key Largo is low. There is currently a total of 2,498 acres (1011 hectares) of suitable KLCM habitat in North Key Largo. About 88 percent of this acreage [2,188 acres (885.5 hectares)] is protected under public ownership.

Population dynamics

Efforts to monitor the KLCM population over the last 30 years have been meager, consequently, trends in the population are difficult to ascertain. Surveys of different areas of tropical hardwood hammock habitat in northern Key Largo, and using similar methods, Barbour and Humphrey

(1982) reported a density of 4.7 KLCM per acre (11.5 KLCM per hectare), Humphrey (1988) reported a density of 8.6 KLCM per acre (21.2 KLCM per hectare), and Frank et al. (1997) reported a density of 2.5 KLCM per acre (6.2 KLCM per hectare). Castleberry et al. (2008) conducted relatively recent monitoring efforts of the KLCM population in North Key Largo in 2007 and estimated a KLCM population of about 17,000 individuals with an increasing trend in the population based on live trapping conducted from November to December.

Critical habitat

Critical habitat is not currently designated for the KLCM. When the species was proposed for listing in 1984, critical habitat was also proposed. However, the proposed critical habitat was withdrawn on February 18, 1986 (Service 1986; 1999).

Threats

Present or threatened destruction, modification or curtailment of its habitat or range

Habitat loss and degradation have adversely affected the KLCM. Significant commercial and residential development in the Florida Keys during the 1960s and 1970s has reduced the extent of habitat available to the KLCM, and degraded the condition of remaining habitat. However, the Federal government and State of Florida have protected the majority of the remaining high quality hammock available for KLCMs on North Key Largo through acquisition and management. A total of about 65 million dollars has been spent to acquire 2,147 acres (868.9 hectares) of habitat on North Key Largo. The threat of loss and degradation of remaining KLCM habitat has been significantly diminished with the establishment of the Monroe County's *Rate of Growth Ordinance* (ROGO) in the 1990s. Due to these efforts, the threat of significant loss of remaining KLCM habitat is low.

Nonnative and invasive species

The presence of exotic animal species on Key Largo also may represent a threat to the KLWR. Feral and free-roaming domestic cats are known to occur within the Crocodile Lake National Wildlife Refuge (CLNWR) and the Key Largo Hammocks State Botanical Site. Densities of domestic cats appear to be greater near the residential areas of North Key Largo such as the Ocean Reef, Garden Cove, and the Ocean Shores developments. Cats are known to prey upon a variety of wildlife species, and studies indicate that small mammals often compose a large proportion of the diet (Churcher and Lawton 1989). Moreover, domestic cats may hunt even when fed daily by humans (Liberg 1985). In addition to direct mortality, predators may also have indirect effects on prey species. The risk of predation may alter the behavior of prey species resulting in reduced growth rates and reproductive output (Arthur et al. 2004). Consequently, it is likely feral and free-roaming domestic cats are affecting the KLCM

population, but in the absence of specific studies their effects are difficult to quantify. The Service is attempting to address the problem of cats on North Key Largo and contracted the U.S. Department of Agriculture's Wildlife Services in 2005 to remove the cats from the CLNWR. However, because humans continue to release cats in this area, ongoing efforts to remove cats will be necessary.

Other non-native species occurring on Key Largo that may pose a threat to the KLCM include the fire ant (*Solenopsis invicta*), the Burmese python (*Python bivittatus*), and the black rat (*Rattus rattus*) (Service 2008). The role of fire ants in the ecology of the North Key Largo hammocks is not specifically known, but predation by fire ants has substantially affected wildlife populations in other areas (Killion and Grant 1993). Because the KLCM is a ground nester, it may be vulnerable to predation by fire ants. With respect to Burmese pythons, U.S. Geological Survey (USGS) spent three years using visual surveys and experimental traps to detect and control Burmese pythons on Key Largo (Service 2008). Seven Burmese pythons have been captured in Key Largo since April 2007 (Snow 2008). Finally, black rats have also been established on Key Largo, and competition from this species may adversely affect the KLCM. The full extent of the threat from these exotic species is not yet known.

Climate change and sea level rise

Information for the United States at national and regional levels is summarized in the National Climate Assessment (Melillo et al. 2014). Because observed and projected changes in climate at regional and local levels vary from global average conditions, rather than using global scale projections, we use "downscaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species and the conditions influencing it. In our analysis, the Service used our expert judgment to weigh the best scientific and commercial data available in our consideration of relevant aspects of climate change and related effects (*i.e.*, changes in air temperature, rainfall, storms, and sea level).

Current models predict changes in mean global temperature in the range of 4 degrees Fahrenheit (F) to 8 degrees F by 2100. How this manifests at the regional and local scale is uncertain, but model estimates for Monroe County are approximately 4.1 degrees F (National Climate Change Viewer (NCCV; USGS). A change of just a couple degrees can have profound effects, particularly at temperature extremes. For example, in Florida, winter frost, a 2-degree transition from 33^{o}F to 31^{o}F, greatly affects vegetation. While predicted changes in average annual temperature appear small, local and seasonal temperature variation may be greater, and an increase in the temperature of the global atmosphere may manifest as an increase or a decrease in local means and extremes. These temperature changes may alter KLCM activity patterns, reproductive behaviors and other life cycle activities that may be triggered by temperature. Food and nest site availability may be increased or reduced due to changes in soil moisture.

Ecosystems in Florida are sensitive to variation in rainfall. Despite a high average rainfall, much of Florida experiences seasonal drought that profoundly affects fish and wildlife resources. Florida's rain depends on both global and regional climate factors (*e.g.*, jet stream, El Niño, frontal progression, storms and hurricanes) and local weather (*e.g.*, thunderstorms, sea breezes, lake effects and local circulation) that are likely affected by climate change. Changes in rainfall intensity, distribution, and amount are possible. Monroe County may see changes of 0.4 inches (1 centimeter) per day (NCCV; USGS). Rainfall changes would influence the vegetative community within the project area and like temperature, would change soil moisture levels, possibly increasing or reducing burrow site availability.

Another predicted effect of climate change is to increase the frequency and intensity of severe storms, particularly tropical cyclones (hurricanes). Higher sea temperatures and high atmosphere conditions generate energy and conditions suitable for storms. Hurricanes may directly cause wildlife mortality, and have significant secondary effects, reshaping coastal habitat structure (barrier islands, beaches, salt/freshwater intrusion to marshes, and estuaries), replenishing water bodies and aquifers and renewing plant succession, which are not completely negative for wildlife. Hurricane effects will interact with rainfall and sea level changes, possibly exacerbating coastal flooding and severe erosion of these systems. Overwashes, blowouts, and water table changes may be common in the Florida Keys. Hurricanes and other storms can result in the direct loss of KLCM, either by washing individuals out to sea or by wave action and inundation or "drowning".

Sea level rise (SLR) also impacts coastal erosion, changes tidal flows, results in more frequent flooding from higher storm surges, the fragmentation of islands, and the landward migration of shorelines (Melillo et al. 2014). Prior to these effects, habitat loss due to hydrology and vegetative community changes is likely to occur. Modeling tools are available that provide location-specific information related to SLR in Florida. These spatial models estimate areas of inundation under various climate change scenarios. Regardless of scenario, these tools identify relatively vulnerable areas on the landscape.

For the KLCM, increased soil moisture and vegetative community changes are of particular concern. Hammocks characteristic of the upper Florida Keys will ultimately be replaced by mangrove communities (Sternberg et al. 2007; Su Yean Teh et al. 2008). Worst-case models forecast an 88 percent loss in hammock vegetation within Key Largo by 2100 (Bergh 2009). Consequently, survival of the KLCM may require resource management intervention or translocation to suitable habitat outside of North Key Largo.

Overall, climatic changes in south Florida could also exacerbate current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be

affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

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