Supplemental Information for the Florida Keys Mole Skink

Biological Status Review Report

The following pages contain peer reviews received from selected peer reviewers, comments received during the public comment period, and the draft report that was reviewed before the final report was completed

March 31, 2011

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Peer review #1 from Lou Somma

Biological Status Review
For the
Florida Keys Mole Skink
(*Plestiodon egregius egregius*)

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of 1 September 2010. Public information on the status of the Florida Keys mole skink was sought from September 17 through November 1, 2010. The 3-member biological review group (BRG) met on November 19, 2010. Group members were Kevin Enge (FWC lead), Steve Johnson (University of Florida), and Paul Moler (independent consultant) (Appendix 1). In accordance with rule 68A-27.0012 F.A.C, the BRG was charged with evaluating the biological status of the Florida Keys mole skink using criteria included in definitions in 68A-1.004 and following protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. Please visit http://myfwc.com/docs/WildlifeHabitats/Imperiled_EndangeredThreatened_FinalRules.pdf to view the listing process rule and the criteria found in the definitions. The BRG concluded from the biological assessment that the Florida Keys mole skink met 1 sub-criterion for designation as a Threatened species. FWC staff recommends that the Florida Keys mole skink continue to be listed as a ~~threatened~~Threatened species.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Taxonomic Classification – The Florida Keys ~~mole skink~~ Mole Skink (*P. e. egregius*)is 1 of 5 subspecies of Mole Skink, although Branch et al. (2003) found that the 3 mainland subspecies in Florida exhibit intermixing of mtDNA haplotypes and considering them to be separate subspecies may not be valid. Crother (2008) recommended further taxonomic study and assessment of gene flow between the mainland and 2 island subspecies. The genus was formerly *Eumeces*, but Brandley et al. (2005) resurrected the name *Plestiodon* for a clade containing all of the North American species north of Mexico, plus East Asian species. Specimens from the Upper Keys usually show characteristics intermediate between this race and the peninsula mole skink (*P. e. onocrepis*), whereas typical specimens from the Lower Keys most closely resemble the northern mole skink (*P. e. similis*) in having light dorsolateral stripes extending the length of the body and 2 rows of enlarged middorsal scales (Duellman and Schwartz 1958, Mount 1965).

Life History and Habitat Requirements – Information on the taxon has been summarized by Lazell (1989) and Christman (1992). The Florida Keys ~~mole skink~~Mole Skink is found in sandy areas, usually near the shoreline under rocks, leaf litter, anthropogenic debris,

driftwood, or tidal wrack (Carr 1940, Duellman and Schwartz 1958, Christman 1992). On Key Largo, skinks have been found in leaf litter on rock (Paul Moler, pers. comm~~un~~. 2010). Carr (1940) indicated that they were partly fossorial but often seen running on the surface, and he found them numerous among rocks a few feet above the water on railroad embankments in the Upper Keys. Specimens have been found in rockland hammocks in the Upper Keys (Florida Natural Areas Inventory [FNAI] records), but the taxon was rare in a former hammock on Middle Torch Key that was an old lime grove undergoing ecological succession (Lazell 1989). Charles Hilsenbeck (1993) found abundant populations at sites in the Lower Keys in the buttonwood (*Conocarpus erectus*) ecotonal communities of coastal rock barrens, where they were most common on open, bare marl soils among dense, but patchy cordgrass (*Spartina* spp.), salt grass (*Distichlis spicata*), and fringe-rush (*Fimbristylis* spp.) (FNAI records). According to Hilsenbeck (1993), the fast-moving skinks were conspicuous when flushed and usually darted into surrounding vegetation for cover. The island-dwelling Cedar Key Mole Skink (*P. e. insularis*) can be found buried among root systems of beach vegetation (L. Somma, pers. comm. 2011).

Mole ~~skinks~~Skinks ~~may~~"swim" through loose sand and prey on a variety of small arthropods, particularly roaches, spiders, and crickets (Mount 1963). Prey records from the island-dwelling Cedar Key subspecies (*P. e. insularis*) include earwigs, beetle larvae, spiders, and many small crustaceans, primarily amphipods (Mount 1963; L. Somma, pers. comm. 2011). The insular Florida Keys Mole Skink ~~mole skink~~ may also feed on crustaceans. Typically, a single clutch of 3–5 (range 2–11) eggs is laid annually in April–June in an underground nest that the female attends (Mount 1963, Bartlett and Bartlett 1999). Age at maturity is unknown for the Florida Keys Mole Skink ~~mole skink~~, but Blue-Tailed ~~blue-tailed~~ Mole Skinks ~~mole skink~~(*P. e. lividus*) on the Lake Wales Ridge apparently mature in their first year, mating during the first fall or winter after hatching (Mount 1963).

Population Status and Trend – Carr (1940) found this taxon to be locally common, whereas Lazell (1989) considered it to be genuinely rare and probably endangered. Christman (1992) concluded it did not seem to be very abundant anywhere in the Keys, which was Mount's (1963) conclusion during visits in February and June 1960. However, ~~C.~~Hilsenbeck (1993) considered populations ~~to be~~ locally abundant on naval properties in the Lower Keys in 1993, observing >80 skinks at a site on Key West (FNAI Element Occurrence Record 4186) and >65 skinks at a site on the Saddlebunch Keys (FNAI Element Occurrence Record 15827). Populations have probably declined because of development of coastal habitats and rockland hammocks, but the present status is unknown. There are no records since 2000 in museum collections or FNAI's database, but the Threatened status of the taxon precludes its collection. In the 1990s, there are records from Key West and Boot, East Rockland, Long, Plantation, and Saddlebunch keys. In the 1980s, there are records from Key Largo (intergrades), Bahia Honda, Grassy, Middle Torch, Vaca, and West Summerland keys. The last record from Big Pine Key was in 1947 and from the Dry Tortugas was in 1862; it may no longer occur on Indian Key, the type locality (Lazell 1989).

Comment [s3]: Unnecessary infinitive.

Geographic Range and Distribution –The Florida Keys Mole Skink ~~mole skink~~ has been found in the Dry Tortugas (1862 record) and in the Lower Keys on Key West, Stock Island, and East Rockland, Middle Torch, Big Pine, Bahia Honda, West Summerland, and Saddlebunch

keys. It has been found in the Middle Keys on Key Vaca, and Boot and Grassy keys. In the Upper Keys, it has been found on Key Largo and Indian, Long, Plantation, and Upper Matecumbe keys. Mole skinks probably occur on many other keys (Duellman and Schwartz 1958), particularly ones with undeveloped shorelines.

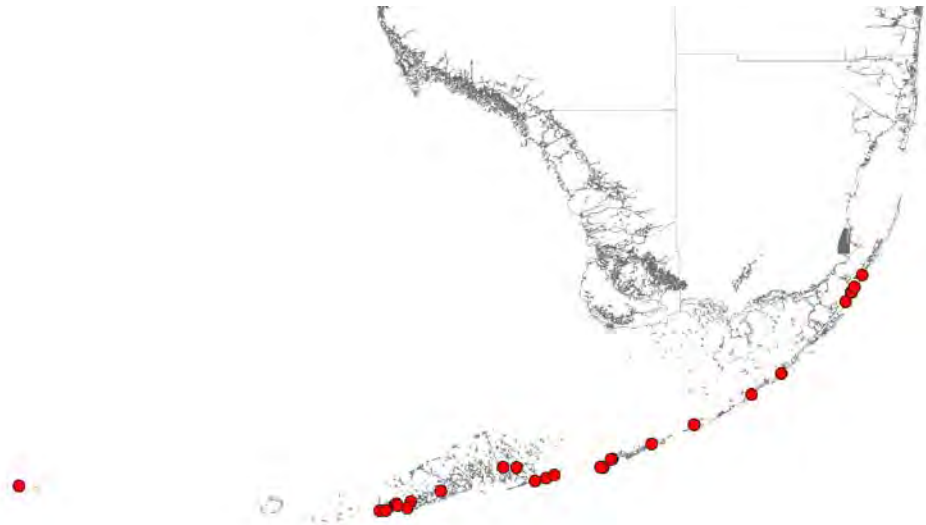

Fig. 1. Locality records from museums and FNAI for the Florida Keys Mole Skink ~~mole skink~~ (many specimens from the Upper Keys show intergradation with the Peninsula Mole Skink ~~mole skink~~).

Quantitative Analyses – Two population viability analysis models have been run for the Florida Keys Mole Skink ~~mole skink~~. One model considered all potential habitat identified in the Keys and the other model only potential habitat occurring on conservation lands. Under the baseline parameters, there was 0% risk of extinction or decline over the next 100 years for both models, assuming no catastrophe or loss of habitat (Endries et al. 2009). A sea level rise due to climate change would be such a catastrophe. Florida Keys Mole Skinks ~~mole skink~~ often inhabit the transitional zone 50–80 cm (20–31 in~~ches~~) above sea level that is dominated by salt-tolerant vegetation in woodlands, shrublands and salt marshes; it is frequently very dry but periodically is submerged in salt water. In the best-case scenario, a sea level rise of 18 cm (7 in~~ches~~) by Year 2100 would inundate ca. 23,800 ha (58,800 acres) in the Florida Keys (http://frrp.org/SLR%20documents/FINAL%20-%20Aug%2021%20-WITH%20COVER.pdf). In the worst-case scenario, a sea level rise of 140 cm (4.6 feet) by Year 2100 would inundate 57,500 ha (142,000 acres) in the Florida Keys. Climate change is also expected to increase the severity of hurricanes, which could result in increased mortality of skinks from storm surges.

Comment [s4]: Abbreviate units.

BIOLOGICAL STATUS ASSESSMENT

Threats – Enge et al. (2003) provide descriptions of the coastal habitats and rockland habitats of South Florida, their threats, and their wildlife communities. Development along shorelines and clearing of pine rockland and rockland hammock habitats have undoubtedly eliminated Florida Keys Mole Skinks ~~mole skinks~~ from some areas. This taxon is somewhat tolerant of habitat alteration, and specimens have been found in cemeteries, vacant lots, and backyards in Key West and on a golf course on Stock Island (FNAI records). Hurricanes strike South Florida about every 3 years (Gentry 1974), and approximately 80% of the Florida Keys is subject to storm surge impact from a Category 1 hurricane (Monroe County 1999). Mount (1963) thought it doubtful that populations of Mole Skinks ~~mole skinks~~ on the smaller keys would survive complete inundation by severe hurricanes. However, many lizard species in the Keys appear adapted to periodic flooding (Bartlett and Bartlett 1999). Although the Keys are generally <1.5 m (5 f~~ee~~t) above mean sea level (MSL), portions on Key West and Windley Key are over 3 times as high (Monroe County 1999). In 2005, Hurricane Wilma (Category 3) passed just north of the Florida Keys, causing 2 storm surges. The second surge caused maximum storm tides 1.5–2.4 m (5–8 f~~ee~~t) above MSL in most of the Lower Keys and Middle Keys and 1.4 m (4.5 f~~ee~~t) above MSL in the Upper Keys, overwashing many of the keys (Kasper n.d.). The Florida Keys have been hit with more intense hurricanes, such as the Labor Day Hurricane of 1935 (Category 5) and Hurricane Donna (Category 4) in 1960. The 1935 hurricane, which was small in size, made landfall at Islamorada and devastated the Middle Keys. The much larger Hurricane Donna caused a 4-m (13-f~~ee~~t) storm surge in Marathon on Vaca Key. A sea level rise due to climate change could significantly impact this taxon, particularly populations living along shorelines and other low-lying habitats. In the best-case scenario, a sea level rise of 18 cm (7 in~~ches~~) by Year 2100 would inundate 34% of Big Pine Key, resulting in the loss of 11% of the island's upland habitat (http://frrp.org/SLR%20documents/FINAL%20-%20Aug%2021%20-WITH%20COVER.pdf). In the worst-case scenario, a sea level rise of 140 cm (4.6 f~~ee~~t) by Year 2100 would inundate 96% of Big Pine Key.

The Red Imported Fire Ant ~~red imported fire ant~~(*Solenopsis invicta*) has invaded the Lower Keys, and predation by this ~~nonnative~~ nonindigenous species has been suggested as a reason for declines in some oviparous snake populations in the southeastern Coastal Plain (Mount 1981). Because of its terrestrial nature and small size, the Mole Skink ~~mole skink~~ would appear to be susceptible to fire ants. In a study conducted in the Lower Keys, transects with the highest probability of the presence of fire ants were those closest to roads and with the largest amount of development within a 150-m radius (Forys et al. 2002). Mole Skinks are occasionally preyed upon by snakes (Hamilton and Pollack 1958, Mount 1963), but the impact of indigenous species on the Florida Keys Mole Skink ~~mole skink~~ has probably remained unchanged and presents no current threat..

Statewide Population Assessment – Findings from the BRG are included in Biological Status Review Information tables.

LISTING RECOMMENDATION

The BRG found the Florida Keys Mole Skink ~~mole skink~~ met the sub-criterion D2 for listing as a Threatened species. The taxon has a very small or restricted population with an area of occupancy of ca. 20 km^2 (8 mi^2). Staff recommends that the Florida Keys mole skink continue to be listed as a Threatened species.

SUMMARY OF THE INDEPENDENT REVIEW

The authors of this report have carefully reviewed both the published and unpublished data on the Florida Keys Mole Skink (*P. e. egregius*), exhibiting a thorough, complete, and sophisticated knowledge of this taxon. In doing so, they have correctly, and with certainty, identified *P. e. egregius* as clearly meeting sub-criterion D2 for maintaining its listing as Threatened. As such, my only criticisms are minor and involve editorial changes which will enhance the professionalism of this report and its conclusions. Particular attention should be paid to the Hilsenbeck (1993) reference as there is no indication what kind of publication it is. (Unpublished report? Article? Dissertation? etc.?) This is crucial as much is made of citing (often not clearly) Hilsenbeck's data, and I am certain others would like to have access to it and read it.

LITERATURE CITED

Bartlett, R. D., and P. P. Bartlett. 1999. A field guide to Florida reptiles and amphibians. Gulf Publishing, Houston, Texas, USA. 280pp.

Branch, L. C., A. M. Clark, P. E. Moler, and B. W. Bowen. 2003. Fragmented landscapes, habitat specificity, and conservation genetics of three lizards in Florida scrub. Conservation Genetics 4:199–212.

Brandley, M. C., A. Schmitz, and T. W. Reeder. 2005. Partitioned Bayesian analyses, partition choice, and the phylogenetic relationships of scincid lizards. Systematic Biology 54:373–390.

Carr, A. F., Jr. 1940. A contribution to the herpetology of Florida. University of Florida Publications, Biological Sciences 3:1–118.

Christman, S. P. 1992. Florida Keys mole skink, *Eumeces egregius egregius* (Baird). Pages 178–180 *in* P. E. Moler, editor. Rare and endangered biota of Florida. Volume III. Amphibians and reptiles. University Press of Florida, Gainesville, Florida, USA.

Christman, S. P. 2005. Densities of *Neoseps reynoldsi* on the Lake Wales Ridge. Final Report, Part 1 Surveys for *Neoseps reynoldsi* and *Eumeces egregius lividus*. Cooperative Agreement No. 401813J035, U.S. Fish and Wildlife Service,Vero Beach, Florida, USA. 62pp.

Crother, B. I., Committee Chair. 2008. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. Sixth edition. Society for the Study of Amphibians and Reptiles Herpetological Circular No. 37~~, 84pp~~:1-84.

Duellman, W. E., and A. Schwartz. 1958. Amphibians and reptiles of southern Florida. Bulletin of the Florida State Museum, Biological Sciences 3:181–324.

Endries, M., B. Stys, G. Mohr, G. Kratimenos, S. Langley, K. Root, and R. Kautz. 2009. Wildlife habitat conservation needs in Florida. Fish and Wildlife Research Institute Technical Report TR-15. x + 178pp.

Enge, K. M., B. A. Millsap, T. J. Doonan, J. A Gore, N. J. Douglass, and G. L. Sprandel. 2003. Conservation plans for biotic regions in Florida containing multiple rare or declining wildlife taxa. Florida Fish and Wildlife Conservation Commission, Bureau of Wildlife Diversity Conservation. Final Report, Tallahassee, Florida, USA. 146pp.

Forys, E. A., C. R. Allen, and D. P. Wojcik. 2002. Influence of the proximity and amount of human development and roads on the occurrence of the Red Imported Fire Ant~~ red imported fire ant~~ in the lower Florida Keys. Biological Conservation 108:27–33.

Gentry, R. C. 1974. Hurricanes in South Florida. Pages 73–81 *in* P. J. Gleason, editor. Environments of South Florida: Present ~~present~~ and past. Miami Geological Society Memoirs No. 2, Miami, Florida, USA.

Hamilton, W. J., Jr., and J. A. Pollack. 1958. Notes on the life history of the Red-Tailed Skink ~~red-tailed skink~~. Herpetologica 14:25–28.

Hilsenbeck, C. E. 1993. Ecological Sruvey of Lower Keys Naval Properties, Monroe County, FL.??????

Kasper, K. n.d. Hurricane Wilma in the Florida Keys. NOAA/National Weather Service Forecast Office, Key West, Florida, USA. 20pp. (http://www.srh.noaa.gov/media/key/Research/wilma.pdf)

Lazell, J. D., Jr. 1989. Wildlife of the Florida Keys: A ~~a~~ natural history. Island Press, Covelo, California, USA. 254pp.

Meneken, B. M., A. C. S. Knipps, J. N. Layne, and K. G. Ashton. 2005. *Neoseps reynoldsi* (Sand Skink ~~sand skink~~). Longevity. Herpetological Review 36:180–181.

Monroe County. 1999. Future land use element. Pages 2-1–2-147 *in* Technical document – Monroe County Year 2010 Comprehensive Plan. (http://www.monroecounty-fl.gov/pages/MonroeCoFL_Growth/CompPlan2010/technical/02.0%20Future%20Land%20Use%20Element.pdf)

Morgenstern, C. S. 1997. Managing Monroe County's unbridled growth. Florida Naturalist 70(2):18.

Mount, R. H. 1963. The natural history of the Red-Tailed Skink ~~red-tailed skink~~, *Eumeces egregius* Baird. American Midland Naturalist 70:356–385.

Mount, R. H. 1965. Variation and systematics of the scincoid lizard, *Eumeces egregius* (Baird). Bulletin of the Florida State Museum, Biological Sciences 9:183–213.

Mount, R. H. 1981**.** The Red Imported Fire Ant ~~red imported fire ant~~, *Solenopsis invicta* (Hymenoptera: Formicidae), as a possible serious predator on some native southeastern vertebrates: Direct ~~direct~~ observations and subjective impressions. Journal of the Alabama Academy of Science 52:71–78.

Sutton, P. E. 1996. A mark and recapture study of the Florida Sand Skink ~~sand skink~~, *Neoseps reynoldsi*, and a comparison of sand skink sampling methods. M.S. Thesis, University of South Florida, Tampa, Florida, USA. 45pp.

Zwick, P. D., and M. H. Carr. 2006. Florida 2060: A ~~a~~ population distribution scenario for the State of Florida. A research project prepared for 1000 Friends of Florida. GeoPlan Center, University of Florida, Gainesville, Florida, USA. 25pp.

Biological Status Review Information
Findings

Species/taxon: Florida Keys Mole Skink
Date: 11/19/10
Assessors: Enge, Johnson, Moler

Generation length: 4 years

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	Causes of reduction (habitat loss) have not ceased	S	N	
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	<30% population size reduction because of 8.1% decline in human population in Keys since 2000 and limits on development	S	N	Monroe County (1999)
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	<30% population size reduction because of projected 2.2% human population increase in Keys in next 10 years and limits on development	S	N	Monroe County (1999), Zwick and Carr (2006)
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	<30% population size reduction (see A2 and A3)	S	N	Monroe County (1999), Zwick and Carr (2006)
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	Total land area of the keys is 356 km^2	E	Y	Wikipedia
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	20.3 km^2, excluding high impact urban and mangrove swamp landcover classes	E	Y	GIS analysis of potential habitat by B. Stys (FWC)
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Taxon rafts well and there is probably some genetic interchange among islands; probably tolerant of storm surges from hurricanes so cannot be assigned locations.	S	N	

b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	Continuing decline in iii	P	Y	Monroe County (1999)
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No evidence of extreme fluctuations	S	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	likely >10,000 mature individuals	S	N	Mount (1963), C. Hilsenbeck's (1993) observations in FNAI database, GIS analysis of potential habitat by B. Stys (FWC)
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR		S	N	
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	Continuing decline in quality and extent of habitat.	P	Y	
a. Population structure in the form of EITHER	Suspect subpopulations on Big Pine Key and Key Largo have >1,000 individuals	S	N	
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation	Subpopulations on multiple islands	E	N	
b. Extreme fluctuations in number of mature individuals	No evidence of extreme fluctuations	S	N	
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	likely >10,000 mature individuals	S	N	See Criterion C
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	20.3 km^2, excluding high impact urban and mangrove swamp landcover classes	S	Y	GIS analysis of potential habitat by B. Stys (FWC)
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	0% probability from PVA	E	N	Endries et al. (2009)

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	D2
Is species/taxon endemic to Florida? (Y/N)	Y
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	

Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	D2

Additional notes - Generation length is defined as the average age of parents of the current cohort, which is greater than the age at first breeding and less than the age of the oldest breeding individual. On the Lake Wales Ridge, Blue-Tailed Mole Skinks ~~blue-tailed mole skinks~~ become sexually mature in their first year, but information on longevity is unavailable (Mount 1963). However, skinks are generally long lived, and the fossorial Sand Skink ~~sand skink~~ (*Plestiodon reynoldsi*) can live to be at least 10 years old (Meneken et al. 2005). We infer a mean generation length of 4 years.

Sub-criterion A2. – Habitat destruction, particularly shoreline development, has probably resulted in a reduction in the Florida mole skink's area of occupancy. Actual estimates of Florida Keys Mole Skink ~~mole skink~~ populations do not exist, but we suspect that loss and degradation of habitat would not have resulted in a reduction of >30% in the population size of this taxon within the past 12 years, particularly considering efforts to preserve remaining coastal areas and parcels of rockland habitat in the Keys. Enactment of federal and state laws, such as the Florida Coastal Management Program that was approved by NOAA in 1981, has restricted further development in coastal habitats. In 1980, the State of Florida designated the unincorporated portions and incorporated municipalities of the Keys as "Areas of Critical State Concern" in order to protect the unique environment, vegetation, and natural resources by regulating land development and other activities regarded as detrimental to the environment. In conjunction with the designation, the legislature enacted the "Principles for Guiding Development," which provides for State oversight of development and changes to land-use regulations, a function carried out by the Department of Community Affairs. Residential and commercial property comprises 17.6% and 3.7% of the land area of the 38 main keys connected by U.S. 1 (Monroe County 1999). Approximately 33.7% of the Florida Keys is in conservation land. Another 34.4% of the 38 main keys consists of vacant land, but in Monroe County's Comprehensive Plan, future development of vacant, developable land is directed away from beach/berm habitats (95 ha; 235 acres; 9% of developable land), ~~and~~ high-quality rockland hammock (1,354 ha; 3,346 acres; 59% of developable land) and pine rocklands (141 ha; 349 acres; 6% of developable land), and towards lands with disturbed vegetation (692 ha; 1,711 acres; 30% of developable land) (Monroe County 1999). This does not include the 73% of vacant land that is not developable because it consists of mangrove swamps or other wetland habitats, or the more than 200 offshore islands, including the Dry Tortugas (Monroe County 1999). Urbanization resulted in extensive destruction of occupied habitats in the past, but vigorous litigation has slowed the previous uncontrolled rate of growth in the Keys (Morgenstern 1997), and according to the U.S. Census Bureau, the human population of Monroe County decreased by 8.1% from 2000 through 2009. It is possible that some introduced lizard species, such as the Brown Anole ~~brown anole~~ (*Anolis sagrei*) and Ashy Gecko ~~ashy gecko~~ (*Sphaerodacylus elegans*) compete with the Florida Keys Mole Skink ~~mole skink~~.

Sub-criterion A3. – Three generations from 2010 would be 2022. Future development in the Keys is controlled, and because of the high cost of living and limited land availability in the Keys, population growth is projected to be slow. Monroe County's population is only projected to increase by 2.2% from 82,414 people in 2010 to 84,233 people in 2020 (Zwick and Carr 2006). However, according to the U.S. Census Bureau, the population in 2009 was only 73,165 people. The number of dwelling units (permanent and seasonal) that can be permitted in Monroe County has been controlled by the Rate of Growth Ordinance adopted by Monroe County in 1992, which was developed as a response to the inability of the road network to accommodate a timely, large-scale hurricane evacuation (http://www.monroecounty-fl.gov/pages/MonroeCoFL_Emergency/LMSplan/ch02.pdf). Of 7,683 ha (18,984 acres) of potential habitat identified for the Florida Keys Mole Skink ~~mole skink~~, 27% is

in conservation lands (B. Stys, FWC, pers. comm~~un~~. 2010). Based on the above information, we suspect that a >30% population size reduction in the next 3 generations will not occur.

Sub-criterion B1. – The extent of occurrence is the Florida Keys, which consists of ca. 1,700 islands. The total land area of the Florida Keys is ca. 356 km^2 (137.3 mi^2) (http://en.wikipedia.org/wiki/Florida_Keys). The land area of unincorporated portions of the Keys, excluding offshore islands, is ca. 264 km^2 (102 mi^2) (Monroe County 1999).

Sub-criterion B2. –A GIS analysis of potential habitat for the subspecies identified 76.8 km^2 (29.7 mi^2) of potential habitat (B. Stys, FWC, pers. comm~~un~~. 2010), which we will assume is approximately equivalent to the area of occupancy. The potential-habitat areas for the Florida Keys mole skink were identified using the FWC 2003 landcover image and the SSURGO database. The SSURGO database was used to identify all upland soils for the Florida Keys not classified as open water in the 2003 land cover, and then all areas classified as sand/beach (54 ha; 134 acres) from the FWC 2003 land-cover image were included to complete the model (Endries et al. 2009). The other land-cover classes that comprised most of the potential habitat were high impact urban (47.5 km^2; 18.3 mi^2), mangrove swamp (9.0 km^2; 3.5 mi^2), tropical hardwood hammock (5.5 km^2; 2.1 mi^2), pinelands (5.3 km^2; 2.1 mi^2), low impact urban (5.2 km^2; 2.0 mi^2), and salt marsh (4.0 km^2; 1.5 mi^2), and scrub mangrove (0.7 km^2; 0.3 mi^2). We feel that high impact urban areas and mangrove swamps should be excluded as skink habitat, which leaves 20.3 km^2 (7.8 mi^2) of potential habitat. The Florida Keys mole skink is known from 17 keys but probably occurs on additional keys. A population is considered severely fragmented if more than half of the individuals or the occupied habitat area is in small and isolated patches. A subpopulation is defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual per year or less). Some subpopulations on islands may not be isolated, because gene flow may occur between nearby islands; many islands were probably initially colonized by rafting animals. Many of the inhabited islands can be considered small, but several islands have substantial habitat and may contain >50% of the population. We do not know the dispersal capability of this coastal-adapted taxon, which either colonized islands during lower sea levels or by rafting. Currently, there is probably no gene flow between the Upper, Middle, and Lower keys, but many of the Lower Keys are separated by water channels only 1 km wide. In contrast, ca. 140 km (57 miles) separates the subpopulation on the Dry Tortugas from that on Key West. Most bridges connecting islands are probably unsuitable dispersal corridors for individuals, unless they have earthen causeways. In addition, skink subpopulations that once had a continuous distribution in coastal habitats might have been fragmented into smaller subpopulations by coastal development on some keys. We do not feel that the population meets the definition of severely fragmented nor that it occurs in >10 locations. A “location” is a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. A storm surge of salt water from a severe hurricane could completely overwash islands, and depending upon the size and path of the hurricane, the entire Florida Keys could be considered a single location susceptible to overwash (see Threats section), except for those keys with high enough elevations (e.g., Key West and Windley Key). Most keys are generally <1.5 m (5 f~~ee~~t) above sea level and prone to overwash. Approximately 80% of the land area of the Keys is subject to storm surge impact from a Category 1 hurricane, and many skinks live in coastal habitats. However, Florida Keys mole skinks have been subjected to hurricanes in the past, and they still occur on many islands. We suspect that this coastal taxon is adapted to periodic flooding of its habitat, and its prey base includes amphipods that would survive saltwater inundation. In the absence of any plausible threat for the taxon, the term "location" cannot be used. An oil spill in the Gulf of Mexico in conjunction with a storm surge that overwashed islands, affecting both the habitat and prey of skinks, could be such a threat, but the likelihood of both events occurring can be debated. Proposed oil drilling off the northern coast of Cuba (http://www.nytimes.com/2010/09/30/world/americas/30cuba.html) might make this a more plausible threat in the future. Based upon future development of privately owned vacant lands, which comprise 34.4% of the area on the 38 main keys along U.S. 1 (Monroe County 1999), we project a continuing decline in area of occupancy, extent of habitat, and number of mature individuals. It is possible that periodic hurricanes that overwash the smaller keys and flood coastal and some upland habitats on the larger keys result in extreme fluctuations in number of mature individuals, but we have no evidence of this.

Criterion C. – No information exists on population density or size for the Florida Keys mole skink, but during extensive fieldwork in ecotonal communities of coastal rock barrens, ~~C.~~ Hilsenbeck (1993) observed over 80 skinks at the Key West Naval Air Station and over 65 skinks at the Saddlebunch Navy Transmitter Site (FNAI records). At a site on East Rockland Key, ~~C.~~ Hilsenbeck (1993) estimated a population size >25 individuals, but this was based upon an initial field impression and not on a mark-recapture study (FNAI Element Occurrence Record 14171). The entire site was 12 ha (29 acres) in size, consisting mostly of rockland hammock vegetation, but skinks were observed along edges of roads through the hammock and along hammock edges in coastal rock barren habitat (Hilsenbeck 1993), so occupancy of the interior of the hammock was not determined. If we assume that skinks occupying these edge habitats constituted the entire population, then the density would be 2 skinks/ha or ca. 1 skink/acre, which is probably too low. In sandhill habitat in Alachua County, the highest density of Peninsula Mole Skinks ~~peninsula mole skinks~~ was a minimum of 62 mature individuals/ha (25/acre) (Mount 1963). Two studies of the fossorial Sand Skink ~~sand skink~~ found mean densities of 160–385 animals/ha (65–156) animals/acre (Sutton 1996, Christman 2005). However, no more than 1 Blue-Tailed Mole Skink ~~blue-tailed mole skink~~ was found in any 0.04-ha (0.1-acre) enclosure, which would represent a maximum density of only 25 animals/ha (10/acre) (Christman 2005). These density estimates include both mature and juvenile animals. If Florida Keys Mole Skinks ~~mole~~ skink~~s~~ primarily inhabit shoreline areas and hammock edges, their distribution would be more linear than in habitats where skinks were studied on the mainland. Mainland Mole Skinks ~~mole skinks~~ tend to be gregarious, exhibiting a clumped distribution in the habitat (Mount 1963), but Florida Key Mole Skinks ~~mole skinks~~ apparently are not gregarious and are seldom found together (Lazell 1989, Christman 1992). However, ~~C.~~ Hilsenbeck (1993) found the taxon to be locally abundant on 3 keys, and P. Moler (pers. comm. 2010) found densities to be fairly high on Upper Matecumbe and Boot keys. Based upon the amount of potential habitat in the Keys, excluding high impact urban areas and mangrove swamps (71.6% of the total potential habitat), then there would have to be an average of <4.8 mature skinks/ha (1.85/acre) in order for there to be <10,000 mature Mole Skinks ~~mole skinks~~ in the Florida Keys. Based on population densities of Mole Skinks elsewhere in Florida, we suspect that this density estimate is too low and that there are >10,000 Florida Keys Mole Skinks ~~mole skinks~~. However, because of uncertainty regarding population density and occupancy of potential habitat, we cannot determine whether the population size is >10,000 mature individuals. Subpopulations on islands with substantial habitat, such as Key Largo and Big Pine Key, probably have >1,000 mature individuals.

Sub-criterion D2. – Excluding high impact urban areas and mangrove swamps, a GIS analysis identified 20.3 km^2 (7.8 mi^2) of potential habitat. Some of the potential habitat identified, such as low impact urban areas, is probably not occupied, which would make the area of occupancy <20 km^2. However, there also has to be a plausible natural or anthropogenic threat within a very short time period (e.g., within 1 or 2 generations) in an uncertain future. A hurricane coupled with an oil spill or sea level rise due to climate change is not likely to occur in the next 4–8 years.

Peer review #2 from Dr. David Pike

From: David Pike
To: Imperiled
Subject: Re: Florida Keys mole skink Draft BSR Report
Date: Wednesday, January 12, 2011 6:58:11 PM

Dear Caly,

I have now reviewed the Biological Status Report (BSR) of the Florida Keys Mole Skink (*Plestiodon egregius egregius*) in great detail, and have been tasked with ensuring the quality of the science contained in this report. I am familiar with most of the literature upon which the Report is based, and have firsthand experience with related taxa on the mainland (*Plestiodon reynoldsi*). I found the biological information on the Florida Keys Mole Skink and data analyses contained in the BSR to be complete and accurate. One crucial limiting factor to assessing the status of this species is that relatively little is known about its population biology. However, the BSR accurately portrays this limitation and uses known information combined with expert opinion where needed to infer the species' status. Based on what is currently known about Florida Keys Mole Skinks, the assumptions made in the BSR are reasonable and justified, as are interpretations of the data. Ultimately, then, the conclusions are justified and represent the current status of the species, which has been listed as Threatened.

Please let me know if you need any further information.

Regards,
David Pike

_____
David A. Pike, PhD
School of Marine and Tropical Biology
James Cook University
Queensland, Australia

Peer review #3 from Kenneth Wray

From: Ken Wray
To: Imperiled
Subject: Re: Deadline reminder for peer reviews of BSR reports
Date: Monday, January 31, 2011 7:41:43 PM
Attachments: BSR Florida Keys Mole Skink.docx
BSR Key Ringneck Snake
BSR Lower Keys Population of the Florida Brown Snake.docx
BSR Lower Keys Population of the Peninsula Ribbon Snake.docx
BSR Lower Keys Population of the Red Rat Snake.docx
BSR Rim Rock Crowned Snake.docx
BSR Short-tailed Snake.docx

Greetings Dr. Haubold-

Attached you will find seven BSR reviews for species/populations I was asked to review. Please let me know if there is anything else you need from me.

Best regards,

Ken Wray

Independent Review of the Biological Status Review for the Florida Keys Mole Skink (*Plestiodon egregious egregious*)

Kenneth P. Wray

1. Completeness and accuracy of the biological information and data analyses:

This review is thorough, particularly when considering the lack of natural history information for this subspecies. Comparisons with other subspecies seem reasonable and justified. Data analyses are appropriate.

2. Reasonableness and justifiability of the assumptions, interpretations of the data, and conclusions:

Any assumptions made are conservative and reasonably grounded in the available data for this, and closely related, subspecies. Data interpretation is fair and sound. Conclusions are valid given the results of this review. A status of threatened seems warranted for this taxon based on this review.

Copy of the Florida Keys mole skink BSR draft report that was sent out for peer review

Biological Status Review
For the
Florida Keys Mole Skink
(*Plestiodon egregius egregius*)

EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) directed staff to evaluate all species listed as Threatened or Species of Special Concern as of 1 September 2010. Public information on the status of the Florida Keys mole skink was sought from September 17 through November 1, 2010. The 3-member biological review group (BRG) met on November 19, 2010. Group members were Kevin Enge (FWC lead), Steve Johnson (University of Florida), and Paul Moler (independent consultant) (Appendix 1). In accordance with rule 68A-27.0012 F.A.C, the BRG was charged with evaluating the biological status of the Florida Keys mole skink using criteria included in definitions in 68A-1.004 and following protocols in the *Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0)* and *Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1)*. Please visit http://myfwc.com/docs/WildlifeHabitats/Imperiled_EndangeredThreatened_FinalRules.pdf to view the listing process rule and the criteria found in the definitions. The BRG concluded from the biological assessment that the Florida Keys mole skink met 1 sub-criterion for designation as a Threatened species. FWC staff recommends that the Florida Keys mole skink continue to be listed as a threatened species.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida.

BIOLOGICAL INFORMATION

Taxonomic Classification – The Florida Keys mole skink is 1 of 5 subspecies of Mole Skink, although Branch et al. (2003) found that the 3 mainland subspecies in Florida exhibit intermixing of mtDNA haplotypes and considering them to be separate subspecies may not be valid. Crother (2008) recommended further taxonomic study and assessment of gene flow between the mainland and 2 island subspecies. The genus was formerly *Eumeces*, but Brandley et al. (2005) resurrected the name *Plestiodon* for a clade containing all of the North American species north of Mexico, plus East Asian species. Specimens from the Upper Keys usually show characteristics intermediate between this race and the peninsula mole skink (*P. e. onocrepis*), whereas typical specimens from the Lower Keys most closely resemble the northern mole skink (*P. e. similis*) in having light dorsolateral stripes extending the length of the body and 2 rows of enlarged middorsal scales (Duellman and Schwartz 1958, Mount 1965).

Life History and Habitat Requirements – Information on the taxon has been summarized by Lazell (1989) and Christman (1992). The Florida Keys mole skink is found in sandy areas, usually near the shoreline under rocks, leaf litter, anthropogenic debris, driftwood, or tidal wrack (Carr 1940, Duellman and Schwartz 1958, Christman 1992). On Key Largo, skinks have been found in leaf litter on rock (Paul Moler, pers. commun. 2010). Carr (1940) indicated that they were partly fossorial but often seen running on the surface, and he found them numerous among rocks a few feet above the water on railroad embankments in the Upper Keys. Specimens have been found in rockland hammocks in the Upper Keys (Florida Natural Areas Inventory [FNAI] records), but the taxon was rare in a former hammock on Middle Torch Key that was an old lime grove undergoing ecological succession (Lazell 1989). Charles Hilsenbeck found abundant populations at sites in the Lower Keys in the buttonwood (*Conocarpus erectus*) ecotonal communities of coastal rock barrens, where they were most common on open, bare marl soils among dense, but patchy cordgrass (*Spartina* spp.), salt grass (*Distichlis spicata*), and fringe-rush (*Fimbristylis* spp.) (FNAI records). According to Hilsenbeck, the fast-moving skinks were conspicuous when flushed and usually darted into surrounding vegetation for cover.

Mole skinks may "swim" through loose sand and prey on a variety of small arthropods, particularly roaches, spiders, and crickets (Mount 1963). Prey records from the island-dwelling Cedar Key subspecies (*P. e. insularis*) include earwigs, beetle larvae, and many small crustaceans, primarily amphipods (Mount 1963). The insular Florida Keys mole skink may also feed on crustaceans. Typically, a single clutch of 3–5 (range 2–11) eggs is laid annually in April–June in an underground nest that the female attends (Mount 1963, Bartlett and Bartlett 1999). Age at maturity is unknown for the Florida Keys mole skink, but blue-tailed mole skinks (*P. e. lividus*) on the Lake Wales Ridge apparently mature in their first year, mating during the first fall or winter after hatching (Mount 1963).

Population Status and Trend – Carr (1940) found this taxon to be locally common, whereas Lazell (1989) considered it to be genuinely rare and probably endangered. Christman (1992) concluded it did not seem to be very abundant anywhere in the Keys, which was Mount's (1963) conclusion during visits in February and June 1960. However, C. Hilsenbeck considered populations to be locally abundant on naval properties in the Lower Keys in 1993, observing >80 skinks at a site on Key West (FNAI Element Occurrence Record 4186) and >65 skinks at a site on the Saddlebunch Keys (FNAI Element Occurrence Record 15827). Populations have probably declined because of development of coastal habitats and rockland hammocks, but the present status is unknown. There are no records since 2000 in museum collections or FNAI's database, but the Threatened status of the taxon precludes its collection. In the 1990s, there are records from Key West and Boot, East Rockland, Long, Plantation, and Saddlebunch keys. In the 1980s, there are records from Key Largo (intergrades), Bahia Honda, Grassy, Middle Torch, Vaca, and West Summerland keys. The last record from Big Pine Key was in 1947 and from the Dry Tortugas was in 1862; it may no longer occur on Indian Key, the type locality (Lazell 1989).

Geographic Range and Distribution –The Florida Keys mole skink has been found in the Dry Tortugas (1862 record) and in the Lower Keys on Key West, Stock Island, and East Rockland, Middle Torch, Big Pine, Bahia Honda, West Summerland, and Saddlebunch keys. It has been found in the Middle Keys on Key Vaca and Boot and Grassy keys. In the Upper Keys, it has been found on Key Largo and Indian, Long, Plantation, and Upper Matecumbe keys. Mole

skinks probably occur on many other keys (Duellman and Schwartz 1958), particularly ones with undeveloped shorelines.

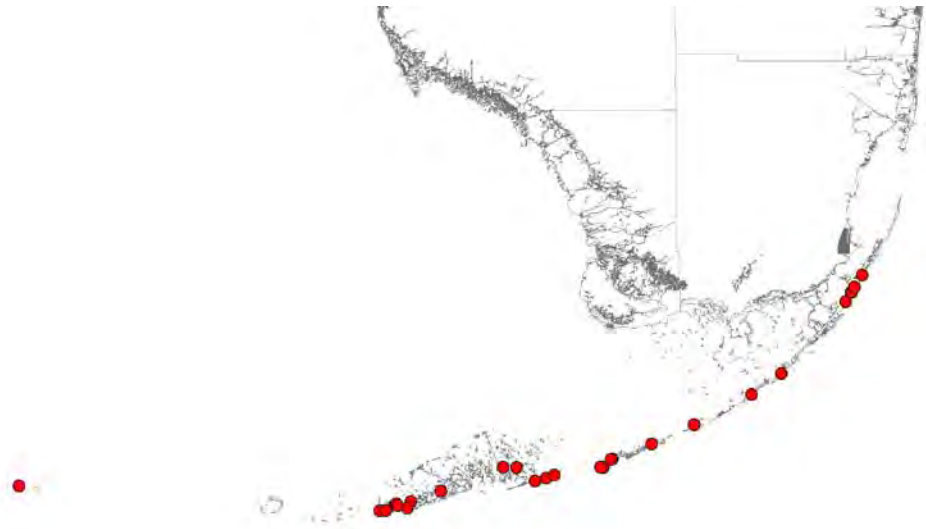

Fig. 1. Locality records from museums and FNAI for the Florida Keys mole skink (many specimens from the Upper Keys show intergradation with the peninsula mole skink).

Quantitative Analyses – Two population viability analysis models have been run for the Florida Keys mole skink. One model considered all potential habitat identified in the Keys and the other model only potential habitat occurring on conservation lands. Under the baseline parameters, there was 0% risk of extinction or decline over the next 100 years for both models, assuming no catastrophe or loss of habitat (Endries et al. 2009). A sea level rise due to climate change would be such a catastrophe. Florida Keys mole skinks often inhabit the transitional zone 50–80 cm (20–31 inches) above sea level that is dominated by salt-tolerant vegetation in woodlands, shrublands and salt marshes; it is frequently very dry but periodically is submerged in salt water. In the best-case scenario, a sea level rise of 18 cm (7 inches) by Year 2100 would inundate ca. 23,800 ha (58,800 acres) in the Florida Keys (http://frrp.org/SLR%20documents/FINAL%20-%20Aug%2021%20-WITH%20COVER.pdf). In the worst-case scenario, a sea level rise of 140 cm (4.6 feet) by Year 2100 would inundate 57,500 ha (142,000 acres) in the Florida Keys. Climate change is also expected to increase the severity of hurricanes, which could result in increased mortality of skinks from storm surges.

BIOLOGICAL STATUS ASSESSMENT

Threats – Enge et al. (2003) provide descriptions of the coastal habitats and rockland habitats of South Florida, their threats, and their wildlife communities. Development along shorelines and clearing of pine rockland and rockland hammock habitats have undoubtedly eliminated Florida Keys mole skinks from some areas. This taxon is somewhat tolerant of habitat alteration, and specimens have been found in cemeteries, vacant lots, and backyards in Key West and on a golf course on Stock Island (FNAI records). Hurricanes strike South Florida about every 3 years (Gentry 1974), and approximately 80% of the Florida Keys is subject to storm surge impact from a Category 1 hurricane (Monroe County 1999). Mount (1963) thought it doubtful that populations of mole skinks on the smaller keys would survive complete inundation by severe hurricanes. However, many lizard species in the Keys appear adapted to periodic flooding (Bartlett 1999). Although the Keys are generally <1.5 m (5 feet) above mean sea level (MSL), portions on Key West and Windley Key are over 3 times as high (Monroe County 1999). In 2005, Hurricane Wilma (Category 3) passed just north of the Florida Keys, causing 2 storm surges. The second surge caused maximum storm tides 1.5–2.4 m (5–8 feet) above MSL in most of the Lower Keys and Middle Keys and 1.4 m (4.5 feet) above MSL in the Upper Keys, overwashing many of the keys (Kasper n.d.). The Florida Keys have been hit with more intense hurricanes, such as the Labor Day Hurricane of 1935 (Category 5) and Hurricane Donna (Category 4) in 1960. The 1935 hurricane, which was small in size, made landfall at Islamorada and devastated the Middle Keys. The much larger Hurricane Donna caused a 4-m (13-foot) storm surge in Marathon on Vaca Key. A sea level rise due to climate change could significantly impact this taxon, particularly populations living along shorelines and other low-lying habitats. In the best-case scenario, a sea level rise of 18 cm (7 inches) by Year 2100 would inundate 34% of Big Pine Key, resulting in the loss of 11% of the island's upland habitat (http://frrp.org/SLR%20documents/FINAL%20-%20Aug%2021%20-WITH%20COVER.pdf). In the worst-case scenario, a sea level rise of 140 cm (4.6 feet) by Year 2100 would inundate 96% of Big Pine Key.

The red imported fire ant (*Solenopsis invicta*) has invaded the Lower Keys, and predation by this nonnative species has been suggested as a reason for declines in some oviparous snake populations in the southeastern Coastal Plain (Mount 1981). Because of its terrestrial nature and small size, the mole skink would appear to be susceptible to fire ants. In a study conducted in the Lower Keys, transects with the highest probability of the presence of fire ants were those closest to roads and with the largest amount of development within a 150-m radius (Forys et al. 2002). Mole skinks are occasionally preyed upon by snakes (Hamilton and Pollack 1958, Mount 1963).

Statewide Population Assessment – Findings from the BRG are included in Biological Status Review Information tables.

LISTING RECOMMENDATION

The BRG found the Florida Keys mole skink met the sub-criterion D2 for listing as a Threatened species. The taxon has a very small or restricted population with an area of occupancy of ca. 20 km^2 (8 mi^2). Staff recommends that the Florida Keys mole skink continue to be listed as a Threatened species.

SUMMARY OF THE INDEPENDENT REVIEW

DRAFT

LITERATURE CITED

Bartlett, R. D., and P. P. Bartlett. 1999. A field guide to Florida reptiles and amphibians. Gulf, Houston, Texas, USA. 280pp.

Branch, L. C., A. M. Clark, P. E. Moler, and B. W. Bowen. 2003. Fragmented landscapes, habitat specificity, and conservation genetics of three lizards in Florida scrub. Conservation Genetics 4:199–212.

Brandley, M. C., A. Schmitz, and T. W. Reeder. 2005. Partitioned Bayesian analyses, partition choice, and the phylogenetic relationships of scincid lizards. Systematic Biology 54:373–390.

Carr, A. F., Jr. 1940. A contribution to the herpetology of Florida. University of Florida Publications, Biological Sciences 3:1–118.

Christman, S. P. 1992. Florida Keys mole skink, *Eumeces egregius egregius* (Baird). Pages 178–180 *in* P. E. Moler, editor. Rare and endangered biota of Florida. Volume III. Amphibians and reptiles. University Press of Florida, Gainesville, Florida, USA.

Christman, S. P. 2005. Densities of *Neoseps reynoldsi* on the Lake Wales Ridge. Final Report, Part 1 Surveys for *Neoseps reynoldsi* and *Eumeces egregius lividus*. Cooperative Agreement No. 401813J035, U.S. Fish and Wildlife Service,Vero Beach, Florida, USA. 62pp.

Crother, B. I., Committee Chair. 2008. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. Sixth edition. Society for the Study of Amphibians and Reptiles Herpetological Circular No. 37. 84pp.

Duellman, W. E., and A. Schwartz. 1958. Amphibians and reptiles of southern Florida. Bulletin of the Florida State Museum, Biological Sciences 3:181–324.

Endries, M., B. Stys, G. Mohr, G. Kratimenos, S. Langley, K. Root, and R. Kautz. 2009. Wildlife habitat conservation needs in Florida. Fish and Wildlife Research Institute Technical Report TR-15. x + 178pp.

Enge, K. M., B. A. Millsap, T. J. Doonan, J. A Gore, N. J. Douglass, and G. L. Sprandel. 2003. Conservation plans for biotic regions in Florida containing multiple rare or declining wildlife taxa. Florida Fish and Wildlife Conservation Commission, Bureau of Wildlife Diversity Conservation. Final Report, Tallahassee, Florida, USA. 146pp.

Forys, E. A., C. R. Allen, and D. P. Wojcik. 2002. Influence of the proximity and amount of human development and roads on the occurrence of the red imported fire ant in the lower Florida Keys. Biological Conservation 108:27–33.

DRAFT

Gentry, R. C. 1974. Hurricanes in South Florida. Pages 73–81 *in* P. J. Gleason, editor. Environments of South Florida: present and past. Miami Geological Society Memoirs No. 2, Miami, Florida, USA.

Hamilton, W. J., Jr., and J. A. Pollack. 1958. Notes on the life history of the red-tailed skink. Herpetologica 14:25–28.
Hilsenbeck, C. E. 1993. Ecological Sruvey of Lower Keys Naval Properties, Monroe County, FL.

Kasper, K. n.d. Hurricane Wilma in the Florida Keys. NOAA/National Weather Service Forecast Office, Key West, Florida, USA. 20pp. (http://www.srh.noaa.gov/media/key/Research/wilma.pdf)

Lazell, J. D., Jr. 1989. Wildlife of the Florida Keys: a natural history. Island Press, Covelo, California, USA. 254pp.

Meneken, B. M., A. C. S. Knipps, J. N. Layne, and K. G. Ashton. 2005. *Neoseps reynoldsi* (sand skink). Longevity. Herpetological Review 36:180–181.

Monroe County. 1999. Future land use element. Pages 2-1–2-147 *in* Technical document – Monroe County Year 2010 Comprehensive Plan. (http://www.monroecounty-fl.gov/pages/MonroeCoFL_Growth/CompPlan2010/technical/02.0%20Future%20Land%20Use%20Element.pdf)

Morgenstern, C. S. 1997. Managing Monroe County's unbridled growth. Florida Naturalist 70(2):18.

Mount, R. H. 1963. The natural history of the red-tailed skink, *Eumeces egregius* Baird. American Midland Naturalist 70:356–385.

Mount, R. H. 1965. Variation and systematics of the scincoid lizard, *Eumeces egregius* (Baird). Bulletin of the Florida State Museum, Biological Sciences 9:183–213.

Mount, R. H. 1981**.** The red imported fire ant, *Solenopsis invicta* (Hymenoptera: Formicidae), as a possible serious predator on some native southeastern vertebrates: direct observations and subjective impressions. Journal of the Alabama Academy of Science 52:71–78.

Sutton, P. E. 1996. A mark and recapture study of the Florida sand skink, *Neoseps reynoldsi*, and a comparison of sand skink sampling methods. M.S. Thesis, University of South Florida, Tampa, Florida, USA. 45pp.
Zwick, P. D., and M. H. Carr. 2006. Florida 2060: a population distribution scenario for the State of Florida. A research project prepared for 1000 Friends of Florida. GeoPlan Center, University of Florida, Gainesville, Florida, USA. 25pp.

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Biological Status Review Information Findings	Species/taxon: Date: Assessors: Generation length:	Florida Keys Mole Skink 11/19/10 Enge, Johnson, Moler 4 years

Criterion/Listing Measure	Data/Information	Data Type*	Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Criterion met - yes (Y) or no (N).				
(A) Population Size Reduction, ANY of				
(a)1. An observed, estimated, inferred or suspected population size reduction of at least 50% over the last 10 years or 3 generations, whichever is longer, where the causes of the reduction are clearly reversible and understood and ceased[1]	Causes of reduction (habitat loss) have not ceased	S	N	
(a)2. An observed, estimated, inferred or suspected population size reduction of at least 30% over the last 10 years or 3 generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible[1]	<30% population size reduction because of 8.1% decline in human population in Keys since 2000 and limits on development	S	N	Monroe County (1999)
(a)3. A population size reduction of at least 30% projected or suspected to be met within the next 10 years or 3 generations, whichever is longer (up to a maximum of 100 years) [1]	<30% population size reduction because of projected 2.2% human population increase in Keys in next 10 years and limits on development	S	N	Monroe County (1999), Zwick and Carr (2006)
(a)4. An observed, estimated, inferred, projected or suspected population size reduction of at least 30% over any 10 year or 3 generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased or may not be understood or may not be reversible.[1]	<30% population size reduction (see A2 and A3)	S	N	Monroe County (1999), Zwick and Carr (2006)
[1] based on (and specifying) any of the following: (a) direct observation; (b) an index of abundance appropriate to the taxon; (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat; (d) actual or potential levels of exploitation; (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.				
(B) Geographic Range, EITHER				
(b)1. Extent of occurrence < 20,000 km^2 (7,722 mi^2) OR	Total land area of the keys is 356 km^2	E	Y	Wikipedia
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	20.3 km^2, excluding high impact urban and mangrove swamp landcover classes	E	Y	GIS analysis of potential habitat by B. Stys (FWC)
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Taxon rafts well and there is probably some genetic interchange among islands; probably tolerant of storm surges from hurricanes so cannot be assigned locations.	S	N	

b. Continuing decline, observed, inferred or projected in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent, and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals	Continuing decline in iii	P	Y	Monroe County (1999)
c. Extreme fluctuations in any of the following: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals	No evidence of extreme fluctuations	S	N	
(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	likely >10,000 mature individuals	S	N	Mount (1963), C. Hilsenbeck's observations in FNAI database, GIS analysis of potential habitat by B. Stys (FWC)
(c)1. An estimated continuing decline of at least 10% in 10 years or 3 generations, whichever is longer (up to a maximum of 100 years in the future) OR		S	N	
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	Continuing decline in quality and extent of habitat.	P	Y	
a. Population structure in the form of EITHER (i) No subpopulation estimated to contain more than 1000 mature individuals; OR	Suspect subpopulations on Big Pine Key and Key Largo have >1,000 individuals	S	N	
(ii) All mature individuals are in one subpopulation	Subpopulations on multiple islands	E	N	
b. Extreme fluctuations in number of mature individuals	No evidence of extreme fluctuations	S	N	
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	likely >10,000 mature individuals	S	N	See Criterion C
(d)2. Population with a very restricted area of occupancy (typically less than 20 km^2 [8 mi^2]) or number of locations (typically 5 or fewer) such that it is prone to the effects of human activities or stochastic events within a short time period in an uncertain future	20.3 km^2, excluding high impact urban and mangrove swamp landcover classes	S	Y	GIS analysis of potential habitat by B. Stys (FWC)
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	0% probability from PVA	E	N	Endries et al. (2009)

Initial Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	D2
Is species/taxon endemic to Florida? (Y/N)	Y
If Yes, your initial finding is your final finding. Copy the initial finding and reason to the final finding space below. If No, complete the regional assessment sheet and copy the final finding from that sheet to the space below.	

Final Finding (Meets at least one of the criteria OR Does not meet any of the criteria)	Reason (which criteria are met)
Threatened	D2

Additional notes - Generation length is defined as the average age of parents of the current cohort, which is greater than the age at first breeding and less than the age of the oldest breeding individual. On the Lake Wales Ridge, blue-tailed mole skinks become sexually mature in their first year, but information on longevity is unavailable (Mount 1963). However, skinks are generally long lived, and the fossorial sand skink (*Plestiodon reynoldsi*) can live to be at least 10 years old (Meneken et al. 2005). We infer a mean generation length of 4 years.

Sub-criterion A2. – Habitat destruction, particularly shoreline development, has probably resulted in a reduction in the Florida mole skink's area of occupancy. Actual estimates of Florida Keys mole skink populations do not exist, but we suspect that loss and degradation of habitat would not have resulted in a reduction of >30% in the population size of this taxon within the past 12 years, particularly considering efforts to preserve remaining coastal areas and parcels of rockland habitat in the Keys. Enactment of federal and state laws, such as the Florida Coastal Management Program that was approved by NOAA in 1981, has restricted further development in coastal habitats. In 1980, the State of Florida designated the unincorporated portions and incorporated municipalities of the Keys as "Areas of Critical State Concern" in order to protect the unique environment, vegetation, and natural resources by regulating land development and other activities regarded as detrimental to the environment. In conjunction with the designation, the legislature enacted the "Principles for Guiding Development," which provides for State oversight of development and changes to land-use regulations, a function carried out by the Department of Community Affairs. Residential and commercial property comprises 17.6% and 3.7% of the land area of the 38 main keys connected by U.S. 1 (Monroe County 1999). Approximately 33.7% of the Florida Keys is in conservation land. Another 34.4% of the 38 main keys consists of vacant land, but in Monroe County's Comprehensive Plan, future development of vacant, developable land is directed away from beach/berm habitats (95 ha; 235 acres; 9% of developable land) and high-quality rockland hammock (1,354 ha; 3,346 acres; 59% of developable land) and pine rocklands (141 ha; 349 acres; 6% of developable land) and towards lands with disturbed vegetation (692 ha; 1,711 acres; 30% of developable land) (Monroe County 1999). This does not include the 73% of vacant land that is not developable because it consists of mangrove swamps or other wetland habitats, or the more than 200 offshore islands, including the Dry Tortugas (Monroe County 1999). Urbanization resulted in extensive destruction of occupied habitats in the past, but vigorous litigation has slowed the previous uncontrolled rate of growth in the Keys (Morgenstern 1997), and according to the U.S. Census Bureau, the human population of Monroe County decreased by 8.1% from 2000 through 2009. It is possible that some introduced lizard species, such as the brown anole (*Anolis sagrei*) and ashy gecko (*Sphaerodacylus elegans*) compete with the Florida Keys mole skink.

Sub-criterion A3. – Three generations from 2010 would be 2022. Future development in the Keys is controlled, and because of the high cost of living and limited land availability in the Keys, population growth is projected to be slow. Monroe County's population is only projected to increase by 2.2% from 82,414 people in 2010 to 84,233 people in 2020 (Zwick and Carr 2006). However, according to the U.S. Census Bureau, the population in 2009 was only 73,165 people. The number of dwelling units (permanent and seasonal) that can be permitted in Monroe County has been controlled by the Rate of Growth Ordinance adopted by Monroe County in 1992, which was developed as a response to the inability of the road network to accommodate a timely, large-scale hurricane evacuation (http://www.monroecounty-fl.gov/pages/MonroeCoFL_Emergency/LMSplan/ch02.pdf). Of 7,683 ha (18,984 acres) of potential habitat identified for the Florida Keys mole skink, 27% is in conservation lands (B. Stys, FWC, pers. commun. 2010). Based on the above information, we suspect that a >30% population size reduction in the next 3 generations will not occur.

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Sub-criterion B1. – The extent of occurrence is the Florida Keys, which consists of ca. 1,700 islands. The total land area of the Florida Keys is ca. 356 km^2 (137.3 mi^2) (http://en.wikipedia.org/wiki/Florida_Keys). The land area of unincorporated portions of the Keys, excluding offshore islands, is ca. 264 km^2 (102 mi^2) (Monroe County 1999).

Sub-criterion B2. –A GIS analysis of potential habitat for the subspecies identified 76.8 km^2 (29.7 mi^2) of potential habitat (B. Stys, FWC, pers. commun. 2010), which we will assume is approximately equivalent to the area of occupancy. The potential-habitat areas for the Florida Keys mole skink were identified using the FWC 2003 landcover image and the SSURGO database. The SSURGO database was used to identify all upland soils for the Florida Keys not classified as open water in the 2003 land cover, and then all areas classified as sand/beach (54 ha; 134 acres) from the FWC 2003 land-cover image were included to complete the model (Endries et al. 2009). The other land-cover classes that comprised most of the potential habitat were high impact urban (47.5 km^2; 18.3 mi^2), mangrove swamp (9.0 km^2; 3.5 mi^2), tropical hardwood hammock (5.5 km^2; 2.1 mi^2), pinelands (5.3 km^2; 2.1 mi^2), low impact urban (5.2 km^2; 2.0 mi^2), and salt marsh (4.0 km^2; 1.5 mi^2), and scrub mangrove (0.7 km^2; 0.3 mi^2). We feel that high impact urban areas and mangrove swamps should be excluded as skink habitat, which leaves 20.3 km^2 (7.8 mi^2) of potential habitat. The Florida Keys mole skink is known from 17 keys but probably occurs on additional keys. A population is considered severely fragmented if more than half of the individuals or the occupied habitat area is in small and isolated patches. A subpopulation is defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual per year or less). Some subpopulations on islands may not be isolated, because gene flow may occur between nearby islands; many islands were probably initially colonized by rafting animals. Many of the inhabited islands can be considered small, but several islands have substantial habitat and may contain >50% of the population. We do not know the dispersal capability of this coastal-adapted taxon, which either colonized islands during lower sea levels or by rafting. Currently, there is probably no gene flow between the Upper, Middle, and Lower keys, but many of the Lower Keys are separated by water channels only 1 km wide. In contrast, ca. 140 km (57 miles) separates the subpopulation on the Dry Tortugas from that on Key West. Most bridges connecting islands are probably unsuitable dispersal corridors for individuals, unless they have earthen causeways. In addition, skink subpopulations that once had a continuous distribution in coastal habitats might have been fragmented into smaller subpopulations by coastal development on some keys. We do not feel that the population meets the definition of severely fragmented nor that it occurs in >10 locations. A "location" is a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. A storm surge of salt water from a severe hurricane could completely overwash islands, and depending upon the size and path of the hurricane, the entire Florida Keys could be considered a single location susceptible to overwash (see Threats section), except for those keys with high enough elevations (e.g., Key West and Windley Key). Most keys are generally <1.5 m (5 feet) above sea level and prone to overwash. Approximately 80% of the land area of the Keys is subject to storm surge impact from a Category 1 hurricane, and many skinks live in coastal habitats. However, Florida Keys mole skinks have been subjected to hurricanes in the past, and they still occur on many islands. We suspect that this coastal taxon is adapted to periodic flooding of its habitat, and its prey base includes amphipods that would survive saltwater inundation. In the absence of any plausible threat for the taxon, the term "location" cannot be used. An oil spill in the Gulf of Mexico in conjunction with a storm surge that overwashed islands, affecting both the habitat and prey of skinks, could be such a threat, but the likelihood of both events occurring can be debated. Proposed oil drilling off the northern coast of Cuba (http://www.nytimes.com/2010/09/30/world/americas/30cuba.html) might make this a more plausible threat in the future. Based upon future development of privately owned vacant lands, which comprise 34.4% of the area on the 38 main keys along U.S. 1 (Monroe County 1999), we project a continuing decline in area of occupancy, extent of habitat, and number of mature individuals. It is possible that periodic hurricanes that overwash the smaller keys and flood coastal and some upland habitats on the larger keys result in extreme fluctuations in number of mature individuals, but we have no evidence of this.

Criterion C. – No information exists on population density or size for the Florida Keys mole skink, but during extensive fieldwork in ecotonal communities of coastal rock barrens, C. Hilsenbeck observed over 80 skinks at the Key West Naval Air Station and over 65 skinks at the Saddlebunch Navy Transmitter Site (FNAI records). At a site on East Rockland Key, C. Hilsenbeck estimated a population size >25 individuals, but this was based upon an initial field impression and not on a mark-recapture study

(FNAI Element Occurrence Record 14171). The entire site was 12 ha (29 acres) in size, consisting mostly of rockland hammock vegetation, but skinks were observed along edges of roads through the hammock and along hammock edges in coastal rock barren habitat (Hilsenbeck 1993), so occupancy of the interior of the hammock was not determined. If we assume that skinks occupying these edge habitats constituted the entire population, then the density would be 2 skinks/ha or ca. 1 skink/acre, which is probably too low. In sandhill habitat in Alachua County, the highest density of peninsula mole skinks was a minimum of 62 mature individuals/ha (25/acre) (Mount 1963). Two studies of the fossorial sand Skink found mean densities of 160–385 animals/ha (65–156) animals/acre (Sutton 1996, Christman 2005). However, no more than 1 blue-tailed mole skink was found in any 0.04-ha (0.1-acre) enclosure, which would represent a maximum density of only 25 animals/ha (10/acre) (Christman 2005). These density estimates include both mature and juvenile animals. If Florida Keys mole skinks primarily inhabit shoreline areas and hammock edges, their distribution would be more linear than in habitats where skinks were studied on the mainland. Mainland mole skinks tend to be gregarious, exhibiting a clumped distribution in the habitat (Mount 1963), but Florida Key mole skinks apparently are not gregarious and are seldom found together (Lazell 1989, Christman 1992). However, C. Hilsenbeck found the taxon to be locally abundant on 3 keys, and P. Moler (pers. commun. 2010) found densities to be fairly high on Upper Matecumbe and Boot keys. Based upon the amount of potential habitat in the Keys, excluding high impact urban areas and mangrove swamps (71.6% of the total potential habitat), then there would have to be an average of <4.8 mature skinks/ha (1.85/acre) in order for there to be <10,000 mature mole skinks in the Florida Keys. Based on population densities of mole skinks elsewhere in Florida, we suspect that this density estimate is too low and that there are >10,000 Florida Keys mole skinks. However, because of uncertainty regarding population density and occupancy of potential habitat, we cannot determine whether the population size is >10,000 mature individuals. Subpopulations on islands with substantial habitat, such as Key Largo and Big Pine Key, probably have >1,000 mature individuals.

Sub-criterion D2. – Excluding high impact urban areas and mangrove swamps, a GIS analysis identified 20.3 km^2 (7.8 mi^2) of potential habitat. Some of the potential habitat identified, such as low impact urban areas, is probably not occupied, which would make the area of occupancy <20 km^2. However, there also has to be a plausible natural or anthropogenic threat within a very short time period (e.g., within 1 or 2 generations) in an uncertain future. A hurricane coupled with an oil spill or sea level rise due to climate change is not likely to occur in the next 4–8 years.

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APPENDIX 1. Biological Review Group Members Biographies

Kevin M. Enge received his M.S. in Wildlife Ecology and Conservation from the University of Florida and B.S. degrees in Wildlife and Biology from the University of Wisconsin–Stevens Point. He is currently an Associate Research Scientist in the Reptile and Amphibian Subsection of the Wildlife Research Section, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission (FWC). He has worked for FWC since 1989, serving as a nongame survey and monitoring biologist and the Herp Taxa Coordinator. He has conducted numerous surveys of both native and exotic amphibians and reptiles, and he has published >60 scientific papers and 25 reports.

Steve A. Johnson received his Ph.D. from the University of Florida and M.S. and B.S. degrees from the University of Central Florida. He is an Assistant Professor of Urban Wildlife Ecology at the University of Florida, and he holds a teaching and extension position in the Department of Wildlife Ecology and Conservation, Gulf Coast Research and Education Center. His area of expertise is natural history and conservation of amphibians and reptiles, especially those using isolated wetlands, and he has >60 publications.

Paul E. Moler received his M.S. in Zoology from the University of Florida in 1970 and his B.A. in Biology from Emory University in 1967. He retired in 2006 after working for 29 years as a herpetologist with FWC, including serving as administrator of the Reptile and Amphibian Subsection of the Wildlife Research Section. He has conducted research on the systematics, ecology, reproduction, genetics, and conservation biology of a variety of herpetofaunal species in Florida, with primary emphasis on the biology and management of endangered and threatened species. He served as Chair for the Florida Committee on Rare and Endangered Plants and Animals in 1992–94, Chair of the Committee on Amphibians and Reptiles since 1986, and editor of the 1992 volume on amphibians and reptiles. Paul has >90 publications on amphibians and reptiles.

APPENDIX 2. **Summary of letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010.**

No information about this species was received during the public information request period.

Appendix 3. Information and comments received from the independent reviewers.