

Rim Rock Crowned Snake Biological Status Review Report

March 31, 2011



**FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
620 South Meridian Street
Tallahassee, Florida 32399-1600**

**Biological Status Review Report
for the
Rim Rock Crowned Snake
(*Tantilla oolitica*)
March 31, 2011**

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 November 8, 2010 that had not undergone a status review in the past decade. Public information on the status of the rim rock crowned snake 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, Florida Administrative Code (F.A.C.), the BRG was charged with evaluating the biological status of the rim rock crowned snake using criteria included in definitions in 68A-27.001, F.A.C., 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/wildlifehabitats/imperiled/listing-action-petitions/> to view the listing process rule and the criteria found in the definitions.

In late 2010, staff developed the initial draft of this report which included BRG findings and a preliminary listing recommendation from staff. The draft was sent out for peer review and the reviewer's input has been incorporated to create this final report. The draft report, peer reviews, and information received from the public are available as supplemental materials at <http://myfwc.com/wildlifehabitats/imperiled/biological-status/>.

The BRG concluded from the biological assessment that the rim rock crowned snake met a listing criterion, limited geographic range. Based on the BRG findings, literature review, and information received from the public (*see* Appendix 2), staff recommends listing the rim rock crowned snake as a Threatened species.

This work was supported by a Conserve Wildlife Tag grant from the Wildlife Foundation of Florida. FWC staff gratefully acknowledges the assistance of the biological review group members and peer reviewers.

BIOLOGICAL INFORMATION

Taxonomic Classification – The rim rock crowned snake (*Tantilla oolitica* Telford, 1966) was described from an adult male collected in April 1955. This species was elevated from a subspecies of the southeastern crowned snake (*T. coronata wagneri*). The closest taxonomic relative to the rim rock crowned snake is the southeastern crowned snake (*T. coronata*) (Ernst and Ernst 2003), although geographically the Florida crowned snake (*T. relictus*) is closer.

Life History and Habitat Requirements – The natural habitats of the rim rock crowned snake are pine rockland and rockland hammock (also called tropical hammock) in the Miami area and Florida Keys, but there are records from human-altered habitats such as roadsides,

vacant lots, and pastures with shrubby growth and slash pines (*Pinus elliottii*) (Duellman and Schwarz 1958, Campbell and Moler 1992, Hines and Bradley 2009). Rockland hammock is a hardwood forest that represents an advanced successional stage of pine rockland that results from the absence of fire. Pine rocklands have sparse soils; refugia are provided by holes and crevices in the limestone, piles of rock rubble, and pockets of organic matter accumulating in solution holes and shallow depressions in the oolitic limestone (Enge et al. 2003). In the Lower Keys, however, the surface is mostly limestone, and a fine sandy loam exists only in scattered shallow depressions. The Upper Keys (Soldier to Big Pine Key) are composed of Key Largo limestone, a coral reef that apparently grew in the Pamlico Sea (Neill 1957), whereas the Lower Keys are Miami limestone; these limestone outcroppings have apparently been continuously exposed during rising sea levels over the last 14,000 years (Robbin 1984). The largest outcrop is of oolitic Miami limestone along the Miami Rock Ridge, which extends from Miami through Homestead to the Long Pine Key area of Everglades National Park (ENP), but this species has only been documented from the eastern rim of Miami oolite. The rim rock crowned snake is a fossorial species that inhabits shallow soil over oolitic limestone formations, and it can sometimes be found in rotten stumps and under anthropogenic surface detritus (including a pile of damp clothing and rotten boards), fallen logs, and rocks (Duellman and Schwarz 1958, Bartlett 2002, Hines and Bradley 2009, Rochford et al. 2010, Yirka et al. 2010). Eroded cavities in the limestone may provide underground refugia (Porrás and Wilson 1979). It apparently comes to the surface after rains (Porrás and Wilson 1979; J. Decker, pers. commun.), possibly because of flooding of its underground refugia.

Nothing is known regarding its reproduction, longevity, or diet, but if it is similar to the closely related southeastern crowned snake, then the rim rock crowned snake probably matures at 2 years old and may live to be at least 5 years old in the wild (Todd et al. 2008). Because of warmer temperatures and the longer growing season in South Florida, sexual maturity may be attained earlier in the rim rock crowned snake. There may be 3 eggs in a clutch, and 2 clutches could be produced annually (*see* Ernst and Ernst 2003). Prey probably consists of centipedes, insects, and other small invertebrates (Ernst and Ernst 2003). Two rim rock crowned snakes were found inside a road-killed eastern coral snake (*Micrurus fulvius*) (Hines and Bradley 2009). It may be preyed upon by the slender brown scorpion (*Centruroides gracilis*), which is abundant in the same habitats (Porrás and Wilson 1979).

Population Status and Trend – There is no information, but the population has undoubtedly declined as sites previously occupied by the species have been developed. The vacant lot in Marathon where several rim rock crowned snakes have been found under trash was cleared in the past decade and turned into a ball park (Florida Museum of Natural History records), and the lot with an abandoned house in Miami where 1–10 snakes could consistently be found each visit has been developed (Hines and Bradley 2009). The most recent mainland records are from The Barnacle Historic State Park in 2007 (Hines and Bradley 2009) and Zoo Miami (formerly Miami Metrozoo) property in 2009 (*see* Appendix 2). The Barnacle Historic State Park supports a population despite containing only 1.6 ha (4 acres) of hammock (Hines and Bradley 2009). The most recent records from the Keys are 1988 on Upper and Lower Matecumbe keys, 1998 on Grassy Key, 2002 on Vaca Key (Marathon), and 2007 on Big Pine Key and Key Largo (Hines and Bradley 2009, museum and Florida Natural Areas Inventory [FNAI] records). Records compiled by Hines and Bradley (2009) show 6 observations in 1930–50, 6 in 1951–70, 18 in 1971–90, and 12 since 1991 (does not include the Zoo Miami record).

Geographic Range and Distribution – On the mainland, the rim rock crowned snake is known from various localities in Miami, including Brownsville, Coconut Grove, Coral Gables, Cutler, Cutler Ridge, Kendall, Leisure City, North Miami, and Perrine (Duellman and Schwartz 1958, museum and FNAI records) (Fig. 1). The species also occurs in the Upper and Middle Keys (Fig. 1), but the only record from the Lower Keys (Key West in 1938), has been considered questionable (Telford 1966, Campbell and Moler 1992). However, the discovery of a specimen on Big Pine Key in 2007 (Yirka et al. 2010) confirms the occurrence of the species in the Lower Keys.

Quantitative Analyses – Endries et al. (2009) ran a population viability analysis (PVA) model on all potential habitat and a PVA model on potential habitat occurring on managed areas only (56.9% of the habitat identified). Assuming no changes, the probability that the rim rock crowned snake would become extinct during the next 100 years was 0% in both models. However, a sea level rise due to climate change could significantly impact this species, particularly in the Florida Keys. Most of the land that is 80 cm (31 inches) above sea level in the Keys was once vegetated by pine rockland or rockland hammock habitat (the preferred habitats for the rim rock crowned snake), which are flooded by salt water only during significant storm surges.

BIOLOGICAL STATUS ASSESSMENT

Threats – Enge et al. (2003) provided descriptions of the rockland habitats of South Florida, their threats, and their wildlife communities. Human development and clearing of these 2 habitats, particularly in the Miami area, has severely fragmented populations of the rim rock crowned snake; these rockland habitats are now embedded in a matrix of agricultural and residential landscapes (O'Brien 1998). Approximately 98% of the original Miami Rock Ridge pinelands outside of ENP has been lost (Snyder et al. 1990). Many of the rockland hammocks on the Keys and mainland were cleared for agriculture, firewood, and charcoal in the 1800s, and almost all pinelands were clear cut by 1950 (Snyder et al. 1990).

Seawater surges from hurricanes and tropical storms in the relatively xeric Keys, whose rockland habitats may become flooded with salt water for 1–3 days following hurricanes (Enge et al. 2003), may impact rim rock crowned snake populations in the short term. Hurricanes strike South Florida about every 3 years (Gentry 1974), and there is a 1 in 7 chance of Dade or Monroe County being struck in any given year (Fernald and Purdum 1992). In 2005, Hurricane Wilma (Category 3) passed just north of the Florida Keys, causing 2 storm surges. The second storm surge caused maximum storm tides 1.5–1.8 m (5–6 feet) above mean sea level in Key West (60% of the city was flooded) and 1.5–2.4 m (5–8 feet) between Boca Chica and Big Pine 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. In 1965, Hurricane Betsy passed over the Upper Keys as a Category 3 hurricane, and a 1.8-m (6-foot) storm surge flooded much of Miami. If climate change results in rising sea levels, much of the habitat of the rim rock crowned snake could become inundated, particularly in the Keys. 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://frp.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.

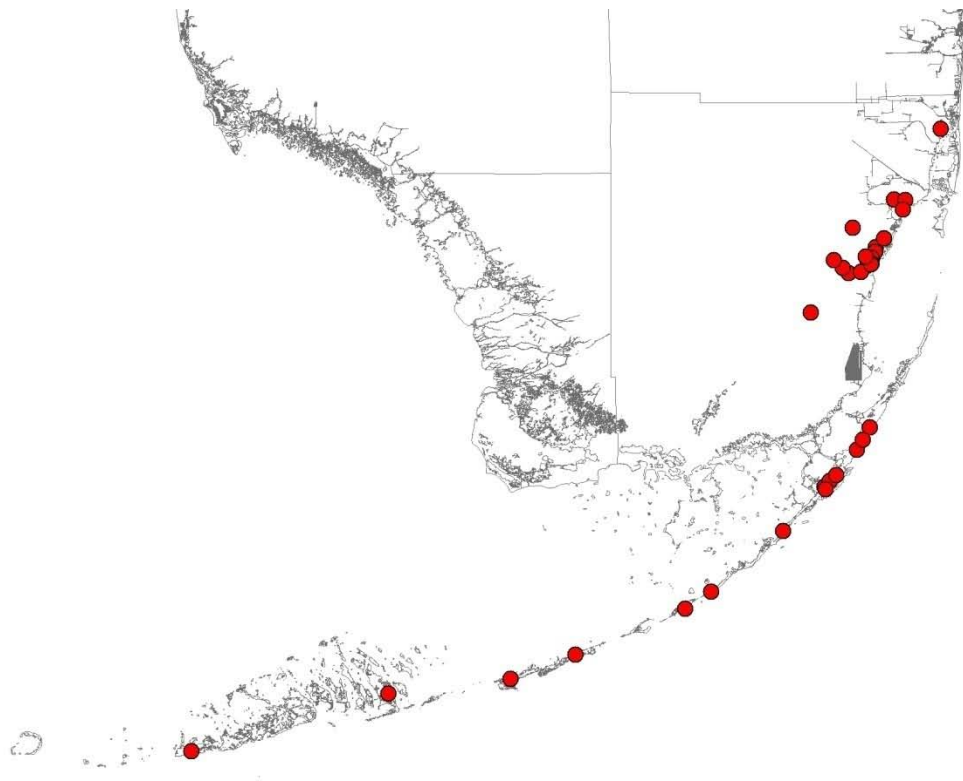


Fig. 1. Locality records from museums, FNAI, and the literature for the rim rock crowned snake.

The red imported fire ant (*Solenopsis invicta*) has invaded South Florida and the 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 fossorial nature and small size, the rim rock crowned snake would appear to be particularly 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). The increasing numbers of introduced lizard species in the Miami area and on some of the Keys (Meshaka et al. 2004) might have some impact. The Cuban treefrog (*Osteopilus septentrionalis*), cane toad (*Rhinella marina*), and several of the introduced lizard species are capable of preying on small snakes (Meshaka et al. 2004). Some introduced lizard species, especially the litter dwellers, might compete for food with the rim rock crowned snake.

Population Assessment – Findings from the BRG are included in Biological Status Review Information Findings tables. The BRG found that the rim rock crowned snake met a listing criterion.

LISTING RECOMMENDATION

The BRG concluded from the biological assessment that the rim rock crowned snake met a listing criterion, limited geographic range. Based on the BRG findings, literature review, and information received from the public (*see* Appendix 2), staff recommends listing the rim rock crowned snake as a Threatened species.

SUMMARY OF THE INDEPENDENT REVIEW

Comments were received from 4 reviewers: Dr. Sam R. Telford, Jr. (Florida Museum of Natural History); Mr. Louis W. Porras (Eagle Mountain Publishing, LC); Ms. Kirsten Hines (independent consultant); and Mr. Kenneth P. Wray (Florida State University). Appropriate editorial changes recommended by the reviewers were made to the report. All reviewers concurred with the staff recommendation to list the species as Threatened. Two reviewers cautioned against using life history or ecology information for other species of *Tantilla*, when information was lacking for the rim rock crowned snake. One reviewer thought that the species does not adapt well to disturbed areas, whereas another reviewer thought it could subsist in small patches of human-altered habitat. Because of this apparent ability to utilize disturbed habitats, the latter reviewer thought that making a numerical link between human population increase and rim rock crowned snake population decline was unwarranted. This reviewer thought that the species has always been rare and that the low number of observations over time suggested some level of population stability, although the reviewer agreed that urban expansion and ongoing habitat fragmentation have likely reduced numbers. This same reviewer thought that the population estimate of 35,000 was in excess of any empirical or calculable figure and cautioned against using G. Fried's observed numbers at a site in Miami or population densities of other *Tantilla* species. The BRG had calculated this population estimate based upon acreage of potential habitat from GIS analysis and a conservative assumption of 0.4 snakes/ha (1 snake/acre). The intent of this population estimate was solely to determine whether the species had a population size less than or greater than 10,000 adults (Criterion C). Staff and the BRG concurs that population size cannot be approximated because population density, amount of potential habitat, and occupancy of potential habitat are unknown. Criterion C of the findings table now reflects that the population size is unknown, which does not affect staff's recommendation to list the species as Threatened.

One reviewer thought that more accurate estimates of extent of occurrence and area of occupancy should be determined, although she agreed that the areas were small enough to meet the geographic range requirements (Criterion B). Staff deleted one-half the land area of Miami-Dade County, including unsuitable areas in Everglades National Park and the water conservation areas, from the extent of occurrence estimate, which did not affect the findings. For the area of occupancy estimate, the reviewer wanted Long Pine Key in Everglades National Park omitted and residential areas near natural areas in Miami included. Staff felt that deciding which residential areas to include as potential habitat would be difficult, and increasing the accuracy of the estimate of area of occupancy is unnecessary because the current estimate (140.4 km²) would have to be 5.5 times as large to not meet the area requirement for Sub-criterion B2. Peer reviews are available at MyFWC.com.

LITERATURE CITED

- Bancroft, G. T., A. M. Strong, and M. Carrington. 1995. Deforestation and its effects on forest-nesting birds in the Florida Keys. *Conservation Biology* 9:835–844.
- Bartlett, D. 2002. Notes from the field. Krazy for the Keys: to see uncommon herps, take a trip way down south. *Reptiles Magazine* 10(4):22–26.
- Campbell, H. W., and P. E. Moler. 1992. Rim rock crowned snake, *Tantilla oolítica* Telford. Pages 158–161 in P. E. Moler, editor. Rare and endangered biota of Florida. Volume III. Amphibians and reptiles. University Press of Florida, Gainesville, Florida, USA.
- Cox, J. A., and R. S. Kautz. 2000. Habitat conservation needs of rare and imperiled wildlife in Florida. Office of Environmental Services, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida, USA. 156pp.
- Cox, J., R. Kautz, M. MacLaughlin, and T. Gilbert. 1994. Closing the gaps in Florida's wildlife habitat conservation system. Florida Game and Fresh Water Fish Commission Office of Environmental Services, Tallahassee, Florida, USA.
- 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. 1997. A standardized protocol for drift-fence surveys. Florida Game and Fresh Water Fish Commission Technical Report No. 14, Tallahassee, Florida, USA. 68pp.
- Enge, K. M., and K. N. Wood. 2002. A pedestrian road survey of an upland snake community in Florida. *Southeastern Naturalist* 1:365–380.
- 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.
- Enge, K. M., M. S. Robson, and K. L. Krysko. 2004. Reptile surveys of pine rockland habitat in six Miami-Dade County parks. *Florida Scientist* 67:194–204.
- Ernst, C. H., and E. M. Ernst. 2003. Snakes of the United States and Canada. Smithsonian Books, Washington, D.C., USA. 668pp.
- Fernald, E. A., and E. D. Purdum, editors. 1992. Atlas of Florida. University Press of Florida, Gainesville, Florida, USA.

- 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.
- Franz, R., R. E. Ashton, and W. W. Timmerman. 1995. Behavior and movements of certain small sandhill amphibians and reptiles in response to drift fences. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Project Report, Tallahassee, Florida, USA. 92pp.
- 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.
- Hines, K. N., and K. A. Bradley. 2009. Assessment of the status and distribution of the endemic rim rock crowned snake (*Tantilla oolitica*) in Miami-Dade and Monroe counties, Florida. Final Report Grant Agreement No. 401817G006. The Institute for Regional Conservation, Miami, Florida, USA. 22pp.
- 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>)
- Meshaka, W. E., Jr., B. P. Butterfield, and J. B. Hauge. 2004. The exotic amphibians and reptiles of Florida. Krieger, Melbourne, Florida, USA. 166pp.
- 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. 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.
- Mushinsky, H. R., and B. W. Witz. 1993. Notes on the peninsula crowned snake, *Tantilla relicta*, in periodically burned habitat. *Journal of Herpetology* 27:468–472.
- Neill, W. T. 1957. Historical biogeography of present-day Florida. *Bulletin of the Florida State Museum, Biological Sciences Series* 2:175–220.
- O'Brien, J. J. 1998. The distribution and habitat preferences of rare *Galactia* species (Fabaceae) and *Chamaesyce deltoidea* subspecies (Euphorbiaceae) native to southern Florida pine rockland. *Natural Areas Journal* 18:208–222.

- Porras, L., and L. D. Wilson. 1979. New distributional records for *Tantilla oolitica* Telford (Reptilia, Serpentes, Colubridae) from the Florida Keys. *Journal of Herpetology* 13:218–220.
- Robbin, D. M. 1984. A new Holocene sea level curve for the upper Florida Keys and Florida reef tract. Pages 437–458 in P. J. Gleason, editor. *Environments of South Florida: present and past*. Miami Geological Society Memoirs No. 2, Miami, Florida, USA.
- Rochford, M., K. Hines, and F. J. Mazzotti. 2010. *Tantilla oolitica* (rim rock crowned snake). Defensive behavior. *Herpetological Review* 41:99.
- Semlitsch, R. D., K. L. Brown, and L. P. Caldwell. 1981. Habitat utilization, seasonal activity, and population size structure of the southeastern crowned snake *Tantilla coronata*. *Herpetologica* 37:40–46.
- Snyder, J. R., A. Herndon, and W. B. Robertson, Jr. 1990. South Florida rockland. Pages 230–277 in R. L. Myers and J. J. Ewel, editors. *Ecosystems of Florida*. University of Central Florida Press, Orlando, Florida, USA.
- Strong, A. M., and G. T. Bancroft. 1994. Patterns of deforestation and fragmentation of mangrove and deciduous seasonal forests in the upper Florida Keys. *Bulletin of Marine Science* 54:795–804.
- Telford, S. R., Jr. 1966. Variation among the southeastern crowned snakes, genus *Tantilla*. *Bulletin of the Florida State Museum, Biological Sciences* 10:261–304.
- Todd, B. D., J. D. Willson, C. T. Winne, R. D. Semlitsch, and J. W. Gibbons. 2008. Ecology of the southeastern crowned snake, *Tantilla coronata*. *Copeia* 2008:388–394.
- Yirka, M. A., J. N. Flowers, M. D. Martin, K. R. Messenger, and N. A. Shepard. 2010. Geographic distribution: *Tantilla oolitica* (rim rock crowned snake). *Herpetological Review* 41:382.
- 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.

Biological Status Review Information
Findings

Species/taxon: Rim Rock Crowned Snake

Date: 11/19/10

Assessors: Enge, Johnson, Moler

Generation length: 4 years

Criterion/Listing Measure	Data/Information	Data Type *	Sub-Criterion Met?	References
*Data Types - observed (O), estimated (E), inferred (I), suspected (S), or projected (P). Sub-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 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 and 11.0% increase in Miami-Dade County since 2000 and limits on development of rockland habitats	S	N	Monroe County (1999), U.S. Census Bureau
(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% and 10.4% human population increase in Monroe and Miami-Dade counties, respectively, in next 10 years and limits on development or rockland habitats	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	ca. 3,160 km ² (1,220 mi ²)	E	Y	Florida Keys' estimate from GIS analysis based on FWC landcover data (B. Stys, FWC, pers.

				commun.)
(b)2. Area of occupancy < 2,000 km ² (772 mi ²)	140.4 km ² (54.2 mi ²), including Long Pine Key in Everglades National Park	E	Y	GIS analysis of potential habitat (B. Stys, FWC, pers. commun.)
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Severely fragmented	S	Y	Snyder et al. (1990), Cox et al. (1994), Strong and Bancroft (1994), Bancroft et al. (1995), O'Brien (1998)
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), Zwick and Carr (2006)
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	Unknown	S	U	Too little information is available on population density and amount of occupied habitat to estimate population size
(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	Y	Monroe County (1999)
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:		P	Y	
a. Population structure in the form of EITHER	The Key Largo subpopulation and a few subpopulations in the Miami area might each contain >1,000 mature individuals	S	N	
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation				
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	>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	140.4 km ² , including Long Pine Key in Everglades National Park	E	N	

(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/sub-criteria are met)			
Threatened	B1 + 2ab(iii)			
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/sub-criteria are met)			
Threatened	B1 + 2ab(iii)			

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. No demographic data or longevity records are available for the species, but data are available from South Carolina for the closely related southeastern crowned snake. Assuming demographics of these 2 species are similar, sexual maturity is attained in 2 years, and the species may live to be 5 years old in the wild (Todd et al. 2008). However, the rim rock crowned snake lives in a subtropical climate, so sexual maturity may occur earlier. We infer a mean generation length of 4 years.

Sub-criterion A2. – We assume that the rim rock crowned snake population has declined as the human population has increased, resulting in habitat loss and degradation from residential and commercial development, but the exact relationship is unknown. According to the U.S. Census Bureau, Miami-Dade County's human population increased by 11.0% from 2000 through 2009, whereas Monroe County's population decreased by 8.1% during the same time period. Urbanization resulted in extensive destruction of rockland habitats in the past, but vigorous litigation has slowed the previous uncontrolled rate of growth in the Keys (Morgenstern 1997), and most of the remaining hammocks on the Miami Rock Ridge are not in danger of being cleared because they are now Miami-Dade County parks. The largest hammock on the Miami Rock Ridge, Brickell Hammock, was cleared in the early 1900s to build Miami, but >50% of the county's hammocks still remain (Snyder et al. 1990). Cox et al. (1994) identified about 375 pine rockland stands totaling nearly 1,780 ha outside of ENP in 1990, and about 50% of these stands were in public ownership. In the Keys, however, most hammocks are privately owned and are in demand for commercial and residential development. 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 large-scale hurricane evacuation in a timely fashion (http://www.monroecounty-fl.gov/pages/MonroeCoFL_Emergency/LMSplan/ch02.pdf). In 1991, 34.4% of the land area in the unincorporated portion of the Keys, excluding offshore islands, consisted of privately owned vacant land, whereas 33.7% was in conservation land (Monroe County 1999). The amount of habitat necessary to sustain a population of this species is unknown, but small rockland habitat fragments surrounded by unsuitable habitat may no longer support populations. However, many of the larger rockland fragments are now in public ownership or protected from development. It is difficult to determine reductions in area of occupancy resulting from declines in habitat quality, because rim rock crowned snakes have been found in altered habitat, such as partially cleared vacant lots. Because of the small size of many of these rockland fragments and their location in an urban setting, management by prescribed fire is often not an option, but there is no evidence that the resulting community is unfavorable for the species; in fact, most records of this species from natural habitats have come from rockland hammocks or the edges of hammocks and pinelands (Cox and Kautz 2000, Hines and Bradley 2009). Collection for pets is not a significant threat because of its small size, specialized diet, and fossorial habits. Populations might be affected by introduced taxa and competitors.

Sub-criterion A3. – Three generations from 2010 would be 2022. By the Year 2020, Miami-Dade County's population is projected to increase by 10.4%, whereas Monroe County's population is projected to increase by 2.2% (Zwick and Carr 2006). However, Monroe County's population has been decreasing, and according to the U.S. Census Bureau, the population in 2009

was only 73,165, not the 82,414 that was projected by Zwick and Carr (2006). Of the potential habitat identified using GIS analysis, 61.3% is protected in conservation lands, preserves, or easements (B. Stys, FWC, pers. commun. 2010), and there are restrictions on clearing rockland habitat on private lands. Even in highly urbanized Miami, rim rock crowned snake populations are likely to persist. The species has been found on the following protected tracts of land in Miami: Arch Creek Memorial Park, Bill Sadowski Park, Charles Deering Estate at Cutler, Ludlam Pineland, Miami Zoo, and Ned Glenn Pineland.

Sub-criterion B1. – A GIS estimate using 2003 FWC landcover classes of the total land area of the Florida Keys, which consists of ca. 1,700 islands, is 642 km² (248 mi²) (B. Stys, FWC, pers. commun.). The land area of Miami-Dade County, is 5,038 km² (1,945 mi²). However, at least the western one-half of Miami-Dade County, including Everglades National Park and the water conservation areas, should be excluded, making the extent of occurrence ca. 3,160 km² (1,220 mi²).

Sub-criterion B2. – A GIS analysis of potential habitat for the species identified 140.4 km² (54.2 mi²) of potential habitat (B. Stys, FWC, pers. commun. 2010), which we will assume is equivalent to the area of occupancy. However, this analysis included Long Pine Key in Everglades National Park, where rim rock crowned snakes have never been recorded. The predominant FWC 2003 land-cover classes that comprised most of the potential habitat were tropical hardwood hammock (48.2 km²; 18.6 mi²), pinelands (42.1 km²; 16.3 mi²), exotic plants (38.5 km²; 14.9 mi²), hardwood hammocks and forest (7.1 km²; 2.7 mi²), and dry prairie (3.2 km²; 1.2 mi²). 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. Of the potential identified for the species, 5,429 ha (13,414 acres) are privately owned. A severely fragmented population has to have more than half of the individuals or the occupied habitat area in small and isolated patches incapable of sustaining viable populations. On the mainland, sites where snakes have been found are widely scattered, and several sites have been lost to development. In the Keys, the species inhabits islands all the way from Key Largo to at least Big Pine Key and possibly Key West. Many of the islands are now connected by bridges, but these bridges are unsuitable dispersal corridors for individuals, and we assume that their dispersal capability across water is minimal. Animals had to colonize these islands at some time, but the colonization probably occurred during lower sea levels when many islands were connected. The greatest distances between nearest known subpopulations in the Keys would be from Big Pine to Key West (40 km), Upper Matecumbe Key to Grassy Key (30 km), and Vaca Key to Big Pine Key (23 km). On the mainland, some subpopulations are much closer, but there can be no dispersal between them because the intervening habitat is completely developed. *Tantilla* will attempt to cross paved roads (Enge and Wood 2002), so minor roads may not be barriers to movement between habitat fragments. In a study of 5 radioactive-tagged peninsula crowned snakes (*Tantilla relicta neilli*) in Putnam County, the maximum home range size was 626 m², and the average distance traveled daily by the most active snake was 4.3 m (Franz et al. 1995). Clearing for agriculture and residential development has resulted in the loss of 98% of the original Miami Rock Ridge pinelands outside of ENP (Snyder et al. 1990). O'Brien (1998) identified 420 pine rockland fragments totaling 1,524 ha, and only 14% were in public ownership, although 6 of the 7 largest sites were owned by Miami-Dade County. Private lands

in the Keys contain 453 patches of rockland hammock; the average size is 4.7 ha, with 52.5% of them being <1 ha in size (Cox et al. 1994). The Upper Keys lost 41.2% of its original 4,816 ha of forest, and the acreage in large fragments (>100 ha) decreased by 84% (Bancroft et al. 1995). The area from central Key Largo through Long Key lost 65.8% of its forests, and the original 35 large forest fragments had increased to 850 small fragments in 1991 (Strong and Bancroft 1994). Much of the northern half of Key Largo is protected within state and federal preserves, so it has lost only 29.7% of its forests, but the original 11 forest fragments increased to 165 in 1991 (Strong and Bancroft 1994). We infer that the population is severely fragmented, consisting of subpopulations on various islands and rockland fragments in Miami-Dade County that are separated by inhospitable habitat. However, the BRG discussed whether >50% of the population occurs in large subpopulations on Key Largo, Big Pine Key, Miami Zoo and adjacent lands, Charles Deering Estate at Cutler, and possibly a few other large tracts of land. If so, the population cannot be considered severely fragmented. However, the existence of large subpopulations is unknown, as are the number of small patches of habitat inhabited by the species and the minimum patch size that can support a viable population. We suspect that 8 ha (20 acres) of habitat might be enough to support a viable population, but we did not know how many habitat fragments were this large and their total combined acreage (assuming all these fragments had snake populations).

Criterion C. – No data on population densities exist for the rim rock crowned snake. Other *Tantilla* species attain high population densities (Semlitsch et al. 1981, Mushinsky and Witz 1993, Franz et al. 1995, Enge 1997, Todd et al. 2008), but the ecology, climate, and habitats of the rim rock crowned snake are sufficiently different from other *Tantilla* species to make any comparisons unreliable. We are uncertain if the relatively few records that exist for the species means that it is uncommon, occurring at low population densities, or that it is secretive and usually inaccessible in oolitic substrate. It is probably both uncommon and secretive (L. Porras, pers. commun.). Surveys for the species have been unsuccessful or found ≤ 2 individuals (e.g., Enge et al. 2004, Hines and Bradley 2009, Appendix 2). However, G. Freid, a former Miami-Dade County naturalist, reported finding up to 8 individuals under a single plywood board in an abandoned lot in Miami (see Hines and Bradley 2009).

APPENDIX 1. Brief biographies of the Rim rock crowned snake Biological Review Group members.

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 through November 1, 2010.

Letter and comments submitted by Dustin Smith:

Pine Rockland Herp Surveys:

Zoo Miami has been conducting herp surveys on property for approximately 5 years, and our surveys have yielded 1 rim rock crowned snake, (*Tantilla oolitica*). Our lone *oolitica* was found in 2009 and was the first specimen ever found in a pitfall trap. This find was the most southern and western within Dade County, according to vouchered specimens at FLMNH.

Prior to our current herp surveys, there was 1 Indigo snake found in 1996 on zoo property, but there have been none seen since. We began conducting herp surveys in December 2004, using visual surveys as the only technique. This was done throughout zoo property and inside pine rocklands.

After 1 year of visual surveys, the zoo constructed two drift fences, each containing 6 funnel traps. These funnel traps have been checked 2 times each day, since July 2005, with an 11 month break following hurricane damage from multiple hurricanes. There has been approximately 1,200 hours spent checking these 2 traps from December 2004 to present. In January 2009, staff added 2 more drift fences with funnel traps and pitfall traps to zoo property. The 4 drift fences are placed on 4 different sections of pine rockland habitat within the 750 acres of zoo grounds.

There has been approximately 440 hours spent checking the new traps from Jan 2009 to present. In addition to the 1,640 hours spent checking traps since 2004, there has been over 50 hours spent conducting visual surveys within the pine rocklands and surrounding habitat. We will continue to conduct herp surveys on property and focus on finding more *Tantilla oolitica*. I am hoping that our surveys provide you with some additional information on this species.

Dustin Smith, Assistant Curator – Ectotherms
Zoo Miami
Miami, FL 33177