Key Ringneck 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
Key Ringneck Snake
(*Diadophis punctatus acricus*)
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 Key ringneck 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 Key ringneck 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 reviewers' 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 Key ringneck snake met 2 listing criteria. FWC staff recommends that the Key ringneck snake be listed 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. Staff would also like to thank Dr. Joseph Mitchell who served as a data compiler for the species.

BIOLOGICAL INFORMATION

Taxonomic Classification – The Key ringneck snake (*Diadophis punctatus acricus* Paulson, 1968) was described as a subspecies based upon snakes from Big Pine Key having a pale grayish-brown head, chin and labial scales obscurely spotted with little contrast, and an almost absent neck ring.

Life History and Habitat Requirements – Information on the species has been summarized by Lazell (1989), Weaver et al. (1992), and Ernst and Ernst (2003). The Key

ringneck snake inhabits pine rockland habitat and the edges or disturbed portions of rockland hammocks (i.e., tropical hammocks) (Lazell 1989, Weaver et al. 1992). It seems to be restricted to areas in the vicinity of permanent fresh water, which often occur as small holes in the limestone (Lazell 1989). All *Diadophis* apparently require moist microhabitats to balance evaporative water loss from the body (Myers 1965, Clark 1967). Snakes have been found crossing roads at night and under flat rocks and boards (Paulson 1968, Lazell 1989, Weaver et al. 1992). The diet of *Diadophis* elsewhere consists of small amphibians, lizards, snakes, insects, slugs, and earthworms (*see* Ernst and Ernst 2003). A captive specimen from the Lower Keys fed on greenhouse frogs (*Eleutherodactylus planirostris*) and reef geckos (*Sphaerodactylus notatus*) (Lazell 1989). There is no information on reproduction in this subspecies, but *Diadophis* typically lay clutches of 1–10 eggs and may produce more than 1 clutch annually (*see* Ernst and Ernst 2003). Snakes in northern Florida had a mean clutch size of approximately 4 eggs (Myers 1965).

Population Status and Trend – There is no information on this topic, but the Key ringneck snake probably still occurs on all 5 keys within its historic range, plus additional keys. It was first documented in 2003 on Key West from the grounds of The Banyan Resort in a highly developed portion of the City of Key West; a total of 4 snakes were found at this site as of 2007 (Florida Museum of Natural History records). The most recent records from other keys are 1980 on Middle Torch Key, 1984 on Little Torch Key, 1995 on No Name Key, and 2007 on Big Pine Key (museum and Florida Natural Areas Inventory [FNAI] records). These records represent incidental observations; no surveys have been conducted for the taxon since the 1980s (*see* Lazell 1989). Habitat destruction and alteration have probably resulted in population declines, but populations are able to persist in some disturbed habitats with suitable cover.

Geographic Range and Distribution – The Key ringneck snake is restricted to the Lower Keys and has been found on Key West and Big Pine, Little Torch, Middle Torch, and No Name keys (Weaver et al. 1992, Auth and Scott 1996, museum records) (Fig. 1). It has been speculated that, based upon suitable habitat, it might also occur on Ramrod, Cudjoe, Summerland and Sugarloaf keys (Paulson 1968, Weaver et al. 1992). Southern ringneck snakes (*Diadophis p. punctatus*) have been found on Key Largo and Upper Matecumbe Key in the Upper Keys, but the identity of the snake found on Duck Key in the Middle Keys has not been determined (museum records) (Fig 1).

Quantitative Analyses – We are not aware of a population viability analysis for the Key ringneck snake.

BIOLOGICAL STATUS ASSESSMENT

Threats – Enge et al. (2003) provide descriptions of the rockland habitats of South Florida, their threats, and their wildlife communities. Clearing of pine rockland and rockland hammock habitats has probably eliminated Key ringneck snakes from some areas, particularly if snakes are restricted to habitats in proximity to sources of fresh water. However, populations may persist in areas where rockland hammock has been cleared and left vacant to undergo ecological succession (Lazell 1989). Snakes are found on roads, and road mortality may be a factor, particularly in areas on Big Pine Key with a dense network of roads. Hurricanes strike

South Florida about every 3 years (Gentry 1974), and associated seawater surges and short-term flooding of upland habitats in the Keys probably kill some snakes and their prey. A sea level rise due to climate change could significantly impact this taxon. 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.

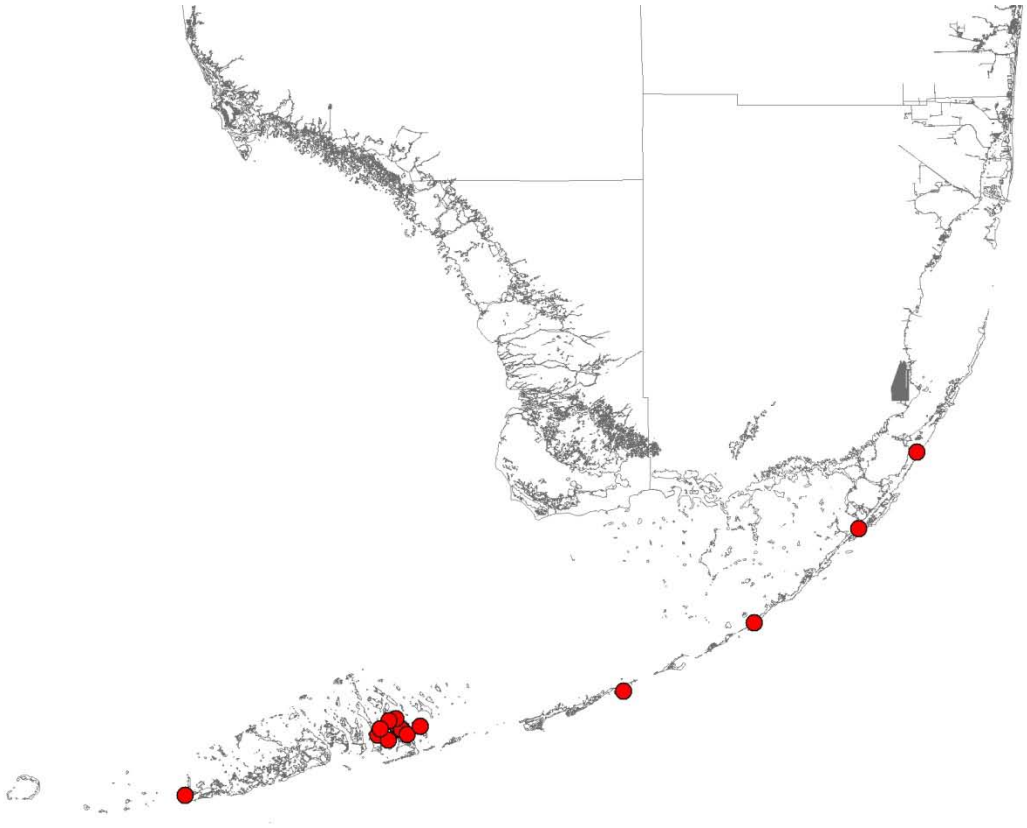

Fig. 1. Locality records from museums and FNAI for ringneck snakes in the Keys; the 3 records from the Upper Keys are southern ringneck snakes, but the identity of the 1 snake found in the Middle Keys has not been determined.

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 ringneck snake and its prey 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 most development within a 150-m radius (Forys et al. 2002). Snakes, birds, and mammals prey upon ringneck snakes (Ernst and Ernst 2003), and nonnative predators include the cane toad (*Rhinella marina*) and Cuban treefrog (*Osteopilus septentrionalis*) (Meshaka et al. 2004, Krysko and Halvorsen 2010).

Population Assessment – Findings from the BRG are included in Biological Status Review Information tables. The BRG found the Key ringneck snake met listing sub-criteria B1, B2, and D2. The taxon has a restricted geographic distribution in both extent of occurrence and area of occupancy, and it meets 2 of the other 3 requirements. It occurs in only 1 or 2 locations where subpopulations and their prey could be rapidly affected by the storm surge of an intense hurricane, and a continuing decline in extent of habitat is projected because of development of vacant lots. The 1 museum specimen from the Middle Keys should be examined to determine whether it is a Key ringneck snake. The taxon also meets the criterion for a very small or restricted population by having only a few locations.

LISTING RECOMMENDATION

Staff recommends that the Key ringneck snake be listed as a Threatened species.

SUMMARY OF THE INDEPENDENT REVIEW

Comments were received from 3 reviewers: Dr. Richard A. Seigel (Towson University), Mr. Kenneth P. Wray (Florida State University), and Mr. E. Pierson Hill (Florida State University). Appropriate editorial changes recommended by the reviewers were made to the report. No changes were recommended that would affect the findings or staff recommendations. All reviewers concurred with the staff recommendation. The reviews can be found at MyFWC.com.

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Biological Status Review Information
Findings

Species/taxon: Key Ringneck Snake
Date: 11/19/10
Assessors: Enge, Johnson, Moler

Generation length: 5 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 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 3.3% human population increase in Keys in next 15 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	137.3 km^2	E	Y	Monroe County (1999)
(b)2. Area of occupancy < 2,000 km^2 (772 mi^2)	25.0 km^2	E	Y	GIS analysis of potential habitat by B. Stys (FWC), excluding Key West
AND at least 2 of the following:				
a. Severely fragmented or exist in ≤ 10 locations	Found on 5 islands that can be considered 1 or 2 locations.	S	Y	
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 due to habitat loss from development (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		S	N	

(C) Population Size and Trend				
Population size estimate to number fewer than 10,000 mature individuals AND EITHER	Probably >10,000 mature individuals, but little data exist.	E	N	Fitch (1975), Lazell (1989), 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	Unlikely a 10% decline	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 due to habitat loss from development	P	Y	
a. Population structure in the form of EITHER	Likely the population on Big Pine Key exceeds 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	Subpopulations occur on 5 islands	I	N	
b. Extreme fluctuations in number of mature individuals	Extreme fluctuations unlikely	S	N	
(D) Population Very Small or Restricted, EITHER				
(d)1. Population estimated to number fewer than 1,000 mature individuals; OR	>1,000 individuals	E	N	
(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	Found on 5 islands that can be considered 1 or 2 locations	S	Y	
(E) Quantitative Analyses				
e1. Showing the probability of extinction in the wild is at least 10% within 100 years	No PVA		N	

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	B1ab(iii)+B2ab(iii), 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/sub-criteria are met)
Threatened	B1ab(iii)+B2ab(iii), 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. In northern Florida, males became sexually mature in 1 year and females in about 18 months (their second year) (Myers 1965). Some individuals lived more than 10 years in studies in Kansas and Michigan (Fitch 1975, Blanchard et al. 1979). Northern populations of some snake species often mature later and live longer than southern populations (e.g., Blouin-Demers et al. 2003), and this might be true of ringneck snakes. We infer a mean generation length of 5 years for the Key ringneck snake. If the mean generation length is actually 6 or 7 years, it would not affect the findings for the listing criteria.

Sub-criterion A2. – There are no data on population trends for the Key ringneck snake, which can persist in disturbed habitats, such as some yards. An increase in human population would be expected to result in a reduction in population size of the Key ringneck snake because of habitat loss and degradation, but the exact relationship is unknown. Rates of human population growth and land development in the Keys have declined in the past 15 years. From 1970 to 2000, the human population on Big Pine Key and No Name Key increased nearly 10-fold, with the largest land conversion (clearing for large subdivisions) occurring prior to 1985 and most home construction occurring later (Lopez et al. 2004). However, according to the U.S. Census Bureau, the population of Monroe County declined by 8.1% from 2000 through 2009. 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). Vigorous litigation has slowed the previous uncontrolled rate of growth in the Keys (Morgenstern 1997). Big Pine Key has 2,919 vacant, buildable lots, which represent 43% of the vacant lots in the Lower Keys (Monroe County 1999). Introduced species potentially provide additional food for Key ringneck snakes, particularly populations in urban areas. The very abundant, nonnative greenhouse frog has been reported as prey for the species (Wilson and Porras 1983, Lazell 1989), and small, nonnative lizard species and the Brahminy blind snake (*Ramphotyphlops braminus*) are other potential prey items.

Sub-criterion A3. – Three generations from 2010 would be 2025. Future development in the Keys is controlled. 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 projected to increase by 3.3% by 2025 (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, 68.9% 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. Big Pine Key has 20% of the vacant, buildable lots in the Florida Keys (Monroe County 1999).

Sub-criterion B1. – The land area of the Lower Keys, not including offshore islands, is ca. 137.3 km^2 (53.0 mi^2) (Monroe County 1999). The total land area of the Florida Keys, which

consists of ca. 1,700 islands, is ca. 225 km^2 (87 mi^2) according to 2003 Florida Vegetation and Land Cover Data (B. Stys, FWC, pers. commun. 2010).

Sub-criterion B2. – A GIS analysis of potential habitat for the Key ringneck snake identified 25.0 km^2 (9.6 mi^2) of potential habitat on 18 of the Lower Keys (B. Stys, FWC, pers. commun. 2010), which we will assume is equivalent to the area of occupancy. Key West, which has ringneck snakes, was not included in this analysis, however. The 2 FWC 2003 land-cover classes that comprised the potential habitat were tropical hardwood hammock (1,570 ha; 3,879 acres) and pinelands (928 ha; 2,294 acres). The taxon is only known from 5 islands, which we consider to be 2 locations. A "location" is a geographically or ecologically distinct area in which a single threatening event could rapidly affect all individuals of the taxon present. The Key ringneck snake is known to occur on 4 adjacent islands (Big Pine, Middle Torch, Little Torch, and No Name keys) that are separated by at least 37 km (23 miles) from Key West. A storm surge of salt water from a severe hurricane (Category 3 or higher) could completely overwash the location consisting of 4 islands; the highest natural elevation on Big Pine Key is 2.44 m (8 ft), which is higher than the other 3 islands. The same hurricane could impact Key West, but its highest elevation is ca. 6 m (18 feet). We project a continuing decline in extent of habitat and number of mature individuals as vacant lots are built upon and additional habitat is cleared. The population of Monroe County is projected to increase by an average of 212 persons annually until the Year 2060 (Zwick and Carr 2006). A future rise in sea level can be expected to decrease the amount of available habitat. We have no evidence that the taxon experiences extreme fluctuations.

Criterion C. – Actual estimates of Key ringneck snake populations do not exist. Lazell (1989) studied a population of Key ringneck snakes on a 2-ha plot on Middle Torch Key that was an abandoned lime grove in former tropical hammock and buttonwood (*Conocarpus erectus*) transition. In 1980-85, he conducted a mark-recapture study of snakes using 33 pieces of artificial cover that were checked 22 times in January-February. Only 2 of 18 marked snakes were recaptured. The density estimate was 5 snakes/ha, but the 95% confidence limits were 0.5–18 snakes/ha. At a site in Kansas, the density of ringneck snakes was estimated at 775–1,800 snakes/ha (Fitch 1975). Although the habitats and other biotic and abiotic factors in Kansas and the Keys are not comparable, we suspect that a density estimate of 5 snakes/ha is too low, and most of the snakes found were probably transient. The longest interval between captures in the Keys was only 12 days, and 1 snake had moved 47 m (Lazell 1989); the average home range in Kansas had an axis 140 m long (Fitch 1975). The total potential habitat (pine rockland and rockland hammock) identified on Big Pine, Little Torch, Middle Torch, and No Name keys is 1,376 ha (3,399 acres) (B. Stys, FWC, pers. commun. 2010). No potential habitat was identified on Key West because the occurrence of the taxon on this island was unknown at the time of the analysis. If we assume that all potential habitat on the 4 keys is occupied by snakes and the density is only 5 snakes/ha, then we estimate a population size of ca. 6,900 Key ringneck snakes. However, we suspect that the population size is >10,000 because Key West is not included, the taxon probably occurs on additional keys, and the density estimate is 2 orders of magnitude less than was found in a population study in Kansas. If we assume a density of only 5 snakes/ha and all the potential habitat identified in the Lower Keys (excluding Key West) is occupied (2,498 ha; 6,173 acres), then the population estimate would be 12,490 snakes.

APPENDIX 1. Brief biographies of the Key ringneck 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, 2010 through November 1, 2010.

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