Supplemental Information for the Red Rat Snake (Lower Keys Population) 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 Joe Burgess

From: Burgess, Joseph [mailto:Joseph.Burgess@dep.state.fl.us]
Sent: Friday, February 18, 2011 9:33 AM
To: Enge, Kevin
Subject: RE: Lower Keys red rat snake review

Kevin,

I agree with the findings of the BRG using the IUCN guidelines and tables. I am a little concerned
with the lack of current data in determining a status of this species.

Looking at the IUCN guidelines, taking into consideration geographic area (size) and the unknown variable of population size. I would think that it may fall into the Data Deficient category. Maybe (for now) that they should continued to be listed as SSC until a proper assessment of actual population size and or trends.

I have found this species crossing the street near the "Southern Most Point" marker in Key West and would probably consider them abundant in Key West, but unsure of populations on other islands in the lower keys. This information is just anecdotal of course.

~Joe

Peer review #2 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 Lower Keys Population of the Red Rat Snake (*Pantherophis guttatus*)

Kenneth P. Wray

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

This is a thorough review. 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 and agree with my own observations of this population. A status of threatened ***does not*** seem warranted for this taxon based on this review.

Peer review #3 from Dr. Robert Zappalorti

From: RZappalort@aol.com
To: Imperiled; molerp@fwc.state.fl.uss; tadpole@wec.ufl.edu
Cc: Enge, Kevin; tadpole@ufl.edu; mmccort@herpetologicalassociates.com; dschneider@herpetologicalassociates.com; hreinert@tcnj.edu
Subject: Re: Lower Florida Keys Population of the Red Rat Snake
Date: Friday, February 04, 2011 5:00:51 PM
Attachments: RTZ"s Red Rat Snake Review Comments for the FWC 2011.pdf
RTZ"s Red Rat Snake Review Comments for the FWC 2011.wpd

Elsa M. Haubold, Ph.D.
Leader, Species Conservation Planning Section
and Caly Murphy, Assistant Listed Species Coordinator
Florida Fish and Wildlife Conservation Commission
620 S. Meridian Street, MS:2A,
Tallahassee, Florida 32399-1600

Dear Dr. Haubold and Ms. Murphy:

Attached please find my comments and suggestion for the Biological Status Review of the Red Rat
Snake. It is in Word Perfect and PDF format. I do not use Word, but the Word Perfect file will open as
a Word document. I hope the FWC finds my suggestions and recommendations informative and useful.
Thanks for the opportunity to comment on this important issue.

Sincerely,

Robert T. Zappalorti
Executive Director/President
HERPETOLOGICAL ASSOCIATES, INC.
575 Toms River Road, Route 571
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Herpetological Associates, Inc. - Environmental Consultants
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February 4, 2011

Elsa M. Haubold, Ph.D.
Leader, Species Conservation Planning Section
and **Caly Murphy**, Assistant Listed Species Coordinator
Florida Fish and Wildlife Conservation Commission620 S. Meridian Street, MS:2A, Tallahassee, Florida 32399-1600

Re: Lower Keys Population of the Red Rat Snake - Should it be listed as "Threatened?"

Dear Dr. Haubold and Ms. Murphy:

I'm writing this letter in response to the recommendation made by the Biological Review Group members: Kevin Enge, Steve Johnson and Paul Moler, who suggested not to list the red rat snake (*Pantherophis guttatus*), as a "threatened species." I basically agree with there assessment, because it appears that the Lower Keys population may be well represented in the geographic area in question. Additionally, there is just not enough evidence to list the red rat snake as a threatened species. There are several reasons for my recommendation which are detailed below.

My Background and Qualifications

While most of my research deals with northern herpetological species, I have 20-years of experience observing Florida's herpetofauna as well. I, along with several colleagues such as, Howard K. Reinert, PhD, College of New Jersey, Otto Heck, College of New Jersey, Dave Schneider, Southern NJ Regional Manager, Herpetological Associates, Inc. (hereafter HA), Matthew McCort, Northern NJ Regional Manager, HA have studied the ecology and behavior of the red rat snake (which is listed as "Endangered" in New Jersey), northern pine snake (*Pituophis melanoleucus*), and timber rattlesnake (*Crotalus horridus*).

Additionally, I have studied red rat snakes from throughout their range in eastern United States for the past 45-years (**Figure 1**). I lived in Marion County, Florida between 2004 - 2010, and have personally observed red rat snakes, Florida pine snakes (*Pituophis melanoleucus mugitus*) and eastern indigo snakes *(Drymarchon couperi*), both live and road killed, in several Florida counties, including the "Rosy" Rat snake from the lower Florida

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Keys.
Between 1974 and 1977, I served as Associate Curator of Herpetology and Education, at the Staten Island Zoological Society in New York. The responsibilities of this position included curatorial administration, in-house lecturing, teaching, scientific and popular writing, herpetological research, inventory of zoo specimens, zoo exhibit planning, assist zoo veterinarian with animal care, scientific collection, public relations, education programs, film-making and wildlife photography. Between 1964 and 1974, I was a Reptile Keeper at the Staten Island Zoo and reported directly to my mentor, the late Carl F. Kauffeld, Zoo Director and Curator of Reptiles.

In 1977, I founded Herpetological Associates, Inc. (HA), an environmental consulting company that specializes in the conservation biology of threatened and endangered plants and wildlife species. HA also conducts environmental monitoring, wildlife assessments, habitat evaluations and designs management plans for plants and wildlife. We also conduct adverse impact analysis, assess development projects and design mitigation plans. I and my staff have conducted over 350 herpetological surveys for a variety of clients and sometimes provided expert testimony.

I have authored or co-authored 36 peer reviewed publications. I'm also a published wildlife photographer. Many of my photographs have appeared in books and magazines, including Florida Wildlife Magazine and National Geographic. I have served as a consultant to the Endangered and Nongame Species Program, Division of Fish and Wildlife (NJDEP), the Division of Coastal Resources, the New Jersey Pinelands Commission, the Trust for Public Land, the Pinelands Preservation Alliance, the NJ Conservation Foundation and The Nature Conservancy.

I have been invited to lecture and be a guest speaker at numerous museums, zoos and universities from 1964 to 2010 such as: All Florida HERP Conference, Gainesville, Florida, Taiwan Normal University - Republic of China, New York University, Trenton State College, University of Western North Carolina, Rutgers University, Trenton State Museum, Morris Museum, Staten Island Museum, Staten Island Zoo, Philadelphia Zoo, Atlanta Zoo, Taipei Zoo, Taiwan, Republic of China, New Jersey Audubon Society, National Audubon Society, New York Herpetological Society, Connecticut Herpetological Society, Florida Herpetological Society, Georgia Herpetological Society, North Carolina Herpetological Society, All Florida Herpetological Conference, The Nature Conservancy, the Society for the Study of Amphibians and Reptiles (SSAR), the University of Georgia - Savanna River Ecology Laboratory Site (SREL) and the National Zoo, Washington, D.C.

I am a "Life Member" of the New Jersey Academy of Science, the SSAR and the Gopher Tortoise Council. I'm also listed as a "Qualified Bog Turtle Surveyor and Trapper" by the US Fish and Wildlife Service.

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Specific Corn Snake Research

While working at the Staten Island Zoo, my colleagues and I began studies on the corn snake in the Pine Barrens of southern New Jersey. I also co-authored a preliminary management plan for corn snakes for the NJDEP, Division of Fish and Wildlife (Frier and Zappalorti 1983, Zappalorti and Johnson 1986, Brown 1993, Bailey et al 2006). Additionally, I have observed corn snakes throughout their range in the eastern United States, which includes Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia and Florida.

In 1985 I began collaborating with Dr. Otto Heck (the College of New Jersey), and together we have studied corn snake distribution in New Jersey, their breeding behavior, nest site selection, diet and winter den and hibernation habits. Our studies were conducted both in the laboratory and the field, which included a two-year captive breeding and release program for the NJDEP, Division of Fish and Wildlife. This effort resulted in releasing 150 marked hatchling corn snakes, of which two gravid adult females were recaptured 5-years later (**Figure 2**). We also initiated a radio-tracking study of corn snakes to learn about their home-range size, behavior and habitat use (**Table 1**).

We've studied their behavior and ecology on private non-profit wildlife sanctuaries and on state protected lands. The research work and data collection with corn snakes in the Pine Barrens was instrumental in having the NJDEP upgrade it from a threatened species to an endangered species in the state of New Jersey (NJDEP 1987). Therefore, I feel qualified to comment upon and make recommendations to the FWC on the status of the Lower Keys red rat snake.

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Introduction and Background

The Florida Fish and Wildlife Conservation Commission directed its staff to evaluate all species listed as "Threatened" and/or "Species of Special Concern" as of 1 September 2010. A 3-member biological review group (BRG) met on November 19, 2010. Group members were Kevin Enge (FWC lead), Steve Johnson and Paul Moler. In accordance with rule 68A-27.0012 F.A.C, the BRG was charged with evaluating the biological status of the Lower Keys population of the red rat snake (*Pantherophis guttatus*), 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).*

The BRG concluded from the biological assessment that the Lower Keys population of the red rat snake did not meet any of the criteria for designation as a threatened species. Therefore the FWC staff recommended that the Lower Keys population of the red rat snake should not be listed as threatened. I agree with your assessment not to list it as a threatened species, but with the stipulation that FWC continue to recognize the Lower Florida Keys population of red rat snakes as a "Species of Special Concern." The red rat snake's status should be monitored in the future.

The Ecology of Red Rat Snakes

Red rat snakes are fossorial, spending much of their time in underground retreats, primarily in coral rock fissures, concealed under leaf litter, hidden under discarded human debris, and when available in small mammal tunnels and/or burrows of moles, shrews, voles and pocket gophers. Additionally, red rat snakes often use old pine or oak tree stump holes and hollow fallen logs as refugia. Hatchlings and sub-adults seek shelter hidden under the loose bark of fallen pine trees or standing pine stumps (**Figure 3**), especially on the side receiving sun exposure, where they find skinks, fence and anole lizards upon which they prey (Zappalorti, personal observations). There have been very few studies done on the survival rate of hatchling snakes. The one that is available on Japanese Rat Snakes shows a 60% loss of hatchling within their first year of life (Fukada 1978 and 1960).

Corn snakes can thrive in and around abandoned buildings or barns which are surrounded by grassy fields where they find mole tunnels for cover and can crawl under the grasses to capture ample small mammal and bird prey. They also eat several species of skinks, lizards, geckos, birds and bird eggs. One adult male corn snake from Cumberland County, New Jersey was captured in a Bobwhite quail nest with four eggs in its stomach (Zappalorti, personal observation). Red rat snakes may be more common than observational data suggest, because they spend about 55% of their time hidden underground (Zappalorti, personal observations). This important survival behavior demonstrates how corn snakes hunt for prey, avoid excessive heat and/or predators.

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In order to gain information on natural life history behavior, seasonal movements and home-range size of corn snakes, 11 adult individuals were radio-tracked in the New Jersey Pine Barrens over a four-year period (**Table 1**).

The snakes were generally relocated every 72-hours between mid-April and the end of October. Of the 500 relocations, the corn snakes were observed concealed under surface objects (e.g., hollow logs, leaf litter and human debris), 26% of the time, were visible on the surface 19% of the time (e.g., in the process of foraging, eating, drinking, basking, mating, shedding and/or resting), and/or were completely hidden underground 55% of the relocations (Zappalorti and Heck, personal observations).

Based upon data collected from a 1990 to 1995 radio-tracking study of 11 adult red rat snakes, home ranges in the New Jersey Pine Barrens varied from 16.86-acres to 145.96-acres (6.82-hectares to 59.07-hectares). Most red rat snakes tended to avoid unsuitable, highly developed land, especially if they had to cross paved roads. Two of our radio-tracked corn snakes were killed crossing sand or paved roads (Zappalorti and Mitchell 2009). Of the 11 radio-tracked corn snakes, only one had a home range greater than 145.0-acres (50-hectares - see **Table 1**). Three of the radio-tracked females were gravid during June of 1992, and deposited their eggs while being monitored. One female laid 9 eggs in a mole tunnel, one laid 10 eggs in a hollow railroad tie, and the third snake deposited 10 eggs in a rotten pitch pine stump. All nesting sites were in open, sunny areas with no canopy trees (Zappalorti and Heck, personal observations). All 29 eggs hatched by September 4, 1992.

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Frequency Numbers, Sex and Activity Ranges in Acres and Hectares for Red Rat Snakes (*Pantherophis [Elaphe] guttatus*) at the Davenport Basin (Berkeley Triangle), Ocean County between 1990 and 1992, and The Nature Conservancy's Manumuskin River Preserve in Cumberland County, New Jersey between 1993 and 1995.

Snake's Frequency Number	Sex of Corn Snakes	Activity Range in Acres	Activity Range in Hectares
874	Female	25.92	10.49
377	Male	19.24	7.70
141	Male	52.55	21.26
852	Male	28.64	11.59
548	Female	44.18	17.88
499	*Female	1.80	0.73
227	*Female	1.47	0.59
684	Male	23.99	9.71
240	Male	145.96	59.07
077	Female	16.86	6.82
265	Female	37.87	15.32
N = 11	**Sex Ratio = 5 _: 6 _**	**Mean: 43.91**	**Mean : 15.77**

Note: * = These females were not included in the mean because they were killed by predators and had less than 5 relocation points in their activity range. Source: Herpetological Associates, Inc.

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Reasons for Red Rat Snake Declines

Among the threats to red rat snakes in Florida are habitat loss and fragmentation from commercial and residential development, including silviculture, agriculture, mining and collection for the pet trade. Another major contributing cause of red rat snake declines in Florida is highway and road mortality (e.g., Alligator Alley I-75, State Route 1, State Route 41 Tamiami Trail, State Route 29, along with other state and county roads which inadvertently kill snakes and other wildlife. I have personally found 5 dead on road (DOR) red rat snakes on State Route 1, between Key West and Marathon Key. Some drivers go out of their way to run over snakes. There are many new roads being built to accommodate new residential and commercial developments throughout the Florida Keys. Moreover, there are more cars and trucks on older existing paved roads.

There is also a movement in many rural Florida counties to pave old railroad right-of-ways (Rails to Trails Program), sand roads and/or horse trails, which would only serve to increase DOR snakes as they attempt to cross these new roads, while moving about within their seasonal home range. Paved roads also cause fragmentation of important red rat snake habitat and tend to isolate their meta-populations (Fitch 1949; Kauffeld 1957; Rudolph and Burgdorf 1997; Rudolph et al. 1998; and Andrews et al., 2006, 2007 and 2009).

Stumpwood removal may affect red rat snake populations by decreasing underground habitat structure (Means 2005). While some red rat snake populations can coexist with crop agricultural, they do not do well in slash pine tree farm plantations, because of the lack of prey, monotypic habitat conditions and removal of tree stumps. Nevertheless, in the Florida Keys there are many reasons for red rat snake population declines.

Some corn snake populations can survive, and at times persist in certain portions of their range if suitable habitat, shelter and ample prey animals are available. On the contrary, other populations may be highly stressed at the extreme limits of their range, such as the New Jersey population in the Pine Barrens and the Lower Keys population in south Florida.

Red rat snakes in New Jersey have a limited distribution with only three major populations in the Pine Barrens. These are in Burlington, Cumberland and Ocean Counties (the late Roger Conant, personal communication, Zappalorti and Merli 1980, Zappalorti and Johnson 1982). There is one historic record of red rat snake (with a voucher specimen from Hammonton, Atlantic

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County, New Jersey, found in 1938). The identification was verified by the late Carl F. Kauffeld. The specimen is now stored at the American Museum of Natural History (Don Johnson and Hyde, American Museum of Natural History; Specimen Number R-28947). However, no other records of corn snakes exist from Atlantic County, and none have been found by intensive field surveys over a 10-year period between 1995 to 2005 (Zappalorti, personal observations).

In the Florida Keys, most federal and state lands such as the National Key Deer Refuge, are multi-human use habitats. Likewise, in other portions of Florida the Wildlife Management Areas are crisscrossed with paved and sand roads for a variety of commercial and public uses (e.g., tree farming and harvesting, stump removal, camping, horse-back riding, cattle grazing, hunting, fishing and off road vehicle use). These many land use activities inadvertently kill red rat snakes (and many other reptiles and amphibians). While these multi-human commercial and recreational activities are all necessary and legitimate uses of public lands, the direct and secondary adverse impacts upon snakes and other wildlife is often ignored by fish and game, and forest timber managers (Gibbons et al 2000). These combined human use impacts, in conjunction with natural predators, directly effect red rat snake populations along with many other species of reptiles and amphibians (Cox and Kautz 2000, Golden et al 2009, Burger and Zappalorti 2011).

There is a combined increase of some mammalian predators that eat adults and eggs of corn snakes, such as black bear, coyote, fox, skunk, nine-banded armadillo, feral hogs, dogs and cats. Additionally, indigo snakes, king snakes, black racers, coachwhips and scarlet snakes are all predators to red rat snakes (or their eggs), especially hatchlings in their natural habitat (Burger and Zappalorti 2011, Zappalorti, personal observations). Then add the increasing problem of fire ants to the list of predators upon egg-laying snakes and other reptiles. Fire ants attack and kill snakes or other egg-laying reptiles and birds when they are hatching.

The Lower Florida Keys has drastically changed in the past 30-years. Housing and commercial development has removed much of the natural, forested habitat. Red rat snakes and other wildlife have been forced to survive in people's backyards, along vegetated hedgerows and in vacant lots (Zappalorti, personal observations). Enge et al. (2003) provided detailed descriptions of the South Florida habitats, their threats and their wildlife communities. The adaptable red rat snake uses almost every habitat in the Lower Keys, including rockland hammock, pine rockland, mangrove forest, and highly disturbed developed areas. It is unknown to what extent clearing of trees and other types of human development have impacted populations, because this species is often found in anthropogenic situations, sheltering in old buildings and hollow walls (Lazell 1989, Zappalorti personal observations).

Listing Recommendation

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Since the Lower Keys red rat snake population appears to be locally abundant within various locations in the Florida Keys, especially Big Pine Key, they probably do not merit being listed as a threatened species. However, the FWC should continue to recognize the Lower Keys red rat snake population as a "Species of Special Concern." Red rat snakes (and many other rare species), suffer from habitat loss and fragmentation due to human population increases along with many other threats to their survival. More research should be done on this species in order to better understand its current distribution, what the true population size is, identify the locations of population strongholds, what the average home-range size is, and what the reproductive status is in areas that have highly suitable habitat.

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Summary

The BRG concluded from the biological assessment that the Lower Keys population of the red rat snake did not meet any of the criteria for designation as a threatened species. Therefore the FWC staff recommended that the Lower Keys population of the red rat snake should not be listed as threatened. I agree with your assessment not to list it as a threatened species, but with the stipulation that FWC continue to recognize the Lower Florida Keys population of red rat snakes as a "Species of Special Concern."

The Lower Keys population of the red rat snake has suffered the loss and fragmentation of their habitat due to human population increases, land development and more motor vehicles on Route 1. Because of habitat loss, I strongly recommend that the red rat snake should remain listed as a "Species of Special Concern" in the state of Florida. Additionally, more research should be done on this species in order to better understand its true population size and status in areas that have suitable habitat.

Thank you for the opportunity to comment on this important conservation issue. If you have any questions, or need additional information, please do not hesitate to call upon me.

Sincerely yours,

Robert T. Zappalorti
Executive Director/President

HERPETOLOGICAL ASSOCIATES, INC.

c: Otto Heck, College of NJ
Howard Reinert, College of NJ
Walter Bien, Drexel University
Dave Schneider, HA
Matt McCort, HA
Mike Torocco, HA

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❀ LITERATURE CITED & R. ZAPPALORTI'S BIBLIOGRAPHY ❀

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Letters and emails received during the solicitation of information from the public period of September 17, 2010 through November 1, 2010

From: tomcrutchfield1 [mailto:tomcrutchfield1@aol.com]
Sent: Thursday, September 23, 2010 1:07 PM
To: Enge, Kevin
Subject: Re: Public comment period for state-listed species

Kevin, I can tell you that the "roscaea" in the lower keys are extraordinarily abundant and are not in any way RARE by any stretch of the imagination. If anything their more common now than 20 years ago. One could easily collect 10-20 in a day if really hunted....thanks

http://www.tomcrutchfield.com

Copy of the Red rat snake (Lower Keys population) BSR draft report that was sent out for peer review

Biological Status Review
for the
Lower Keys Population of the Red Rat Snake
(*Pantherophis guttatus*)

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 Lower Keys population of the red rat snake was sought from September 17 through November 1, 2010. A 3-member biological review group (BRG) met on November 19, 2010. Group members were Kevin Enge (FWC lead), Steve Johnson, and Paul Moler (Appendix 1). In accordance with rule 68A-27.0012 F.A.C, the BRG was charged with evaluating the biological status of the Lower Keys population of the red rat snake 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 Lower Keys population of the red rat snake did not meet any of the criteria for designation as a Threatened species. FWC staff recommends that the Lower Keys population of the red rat snake not be listed as Threatened.

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

BIOLOGICAL INFORMATION

Taxonomic Classification – The so-called "rosy" rat snake (*Elaphe guttata rosacea*) from the Lower Keys was first described by Cope in 1888 as a new species, *Coluber rosaceus*, from a single preserved specimen (*see* Wright 1935). Neill (1949) and Dowling (1952) concluded that it should be considered a subspecies of the corn or red rat snake (*Elaphe guttata*) instead of its own species. On the basis of clinal variation from north to south in number of dorsal blotches and amount of black pigment, various researchers concluded that *E. guttata rosacea* should be placed in synonymy with its nominate race, *E. g. guttata* (Duellman and Schwartz 1958, Thomas 1974, Mitchell 1977; however, *see* Paulson 1968). The Lower Keys population exhibits a wide degree of variation in coloration, and many specimens are indistinguishable from those in the Miami area (Mitchell 1977, Love 1978, Lazell 1989, Bartlett 2002). However, Christman (1980) considered the Lower Keys population to be noteworthy for its lighter dorsal color, absent or very narrow dorsal blotch borders, very high ventral and subcaudal scale counts, and more slender body. Using molecular data, Burbrink (2002) found that *Elaphe guttata* was comprised of 3 clades, which he elevated to species level, restricting *E. guttata* to populations east of the Mississippi River. Molecular data indicate that New World

Elaphe are part of a clade outside of Old World species, and *Pantherophis* was resurrected for most North American species (Utiger et al. 2002); hence, the correct species name is now *Pantherophis guttatus*. We will refer to the species as the red rat snake, which is the name used by FWC in its imperiled species list, although the most recent common name is red cornsnake (Crother 2008).

Life History and Habitat Requirements – Information on the species has been summarized by Weaver et al. (1992) and Ernst and Ernst (2003). The red rat snake in the Lower Keys inhabits pine rockland, rockland hammock, mangrove forest, and a variety of disturbed habitats, including urban areas (Love 1978, Lazell 1989, Weaver et al. 1992). It is very adaptable and can be found in habitats altered by humans, sometimes in bushes, trees, walls, and buildings, but also hiding beneath a variety of debris, including logs, rocks, plywood, and paper plates (Love 1978, Lazell 1989, Weaver et al. 1992). It is a good climber but also can be found underground, burrowing into loose sand or using existing burrows (Weaver et al. 1992). In the Lower Keys, red rat snakes are probably active year round, moving primarily at night during warm weather, feeding on small mammals, birds, bird eggs, and lizards. In many urban situations in Florida, red rat snakes primarily prey on nonnative lizard species, such as the very abundant brown anole (*Anolis sagrei*) (Enge 1993), and this is also true in the Lower Keys (Love 1978, Wilson and Porras 1983). Red rat snakes lay 3–40 eggs per clutch, with an average of 14 eggs (*see* Ernst and Ernst 2003). Red rat snakes in the Lower Keys tend to attain smaller sizes than those on the Florida mainland, which may mean that their clutch sizes are proportionately smaller.

Population Status and Trend – Carr (1940) considered the red rat snake to be rare in the Lower Keys, but most authors consider it to be common or locally abundant (*see* Love 1978, Lazell 1989, Weaver et al. 1992). Most submitters of Florida Natural Areas Inventory (FNAI) records indicate that good or excellent populations exist or that snakes are seen regularly or frequently in the area. According to T. Crutchfield (*see* Appendix 2), "rosy" rat snakes are extraordinarily abundant and possibly more common now than 20 years ago. Lazell (1989) claimed it was the second most commonly encountered snake species after the black racer (*Coluber constrictor*), and it could be found in good numbers in urban areas where racers were rare or extirpated. There are few recent museum or FNAI records from the Lower Keys, but this might be because red rat snakes are so common and people have the perception that finding a specimen is not worth reporting. Because it is presently listed as a Species of Special Concern, live or dead specimens cannot legally be collected without a permit for deposition in a museum. Since 2000, there are records from Big Torch, Middle Torch, and Summerland keys. There are records from the 1990s for Boca Chica, Saddlebunch, and Sugarloaf keys.

Geographic Range and Distribution – The red rat snake occurs in every county in Florida and throughout the Keys. The population of interest is known from many localities in the Lower Keys and has been observed or collected on the following keys: Bahia Honda, Big Pine, Big Torch, Boca Chica, Cudjoe, Geiger, Johnston, Key Vaca, Key West, Indian, Little Pine, Little Torch, Middle Torch, Ramrod, Saddlebunch, Stock Island, Sugarloaf, and Summerland (Weaver et al. 1992, museum records, Florida Natural Areas Inventory [FNAI] records) (Fig. 1). It was also found on the Marquesas Keys in 1917 and 1938 (Weaver et al. 1992, FNAI records).

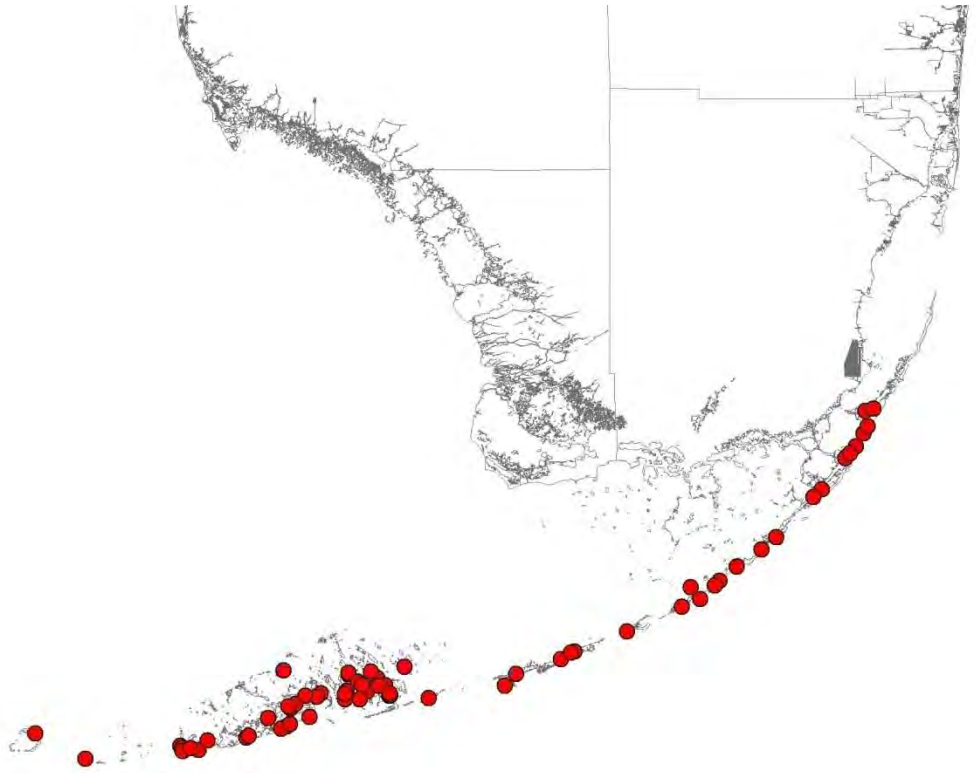

Fig. 1. Locality records from museum and FNAI for the red rat snake in the Florida Keys (the Lower Keys population consists of only the westernmost records).

Quantitative Analyses – Staff is not aware of a population viability analysis for the Lower Keys population of the red rat snake. However, staff believes it is unlikely that the red rat snake will become extinct in the Lower Keys within the next 100 years based upon the diverse habitats occupied, the amount of suitable habitat contained in conservation lands, and the species' adaptability to some habitat alteration. Sea-level rise due to climate change will flood some lands inhabited by this species, including part of the Lower Keys.

BIOLOGICAL STATUS ASSESSMENT

Threats – Enge et al. (2003) provided descriptions of the rockland habitats of South Florida, their threats, and their wildlife communities. The adaptable red rat snake inhabits almost every habitat in the Lower Keys, including rockland hammock, pine rockland, mangrove forest, and highly disturbed habitats. It is unknown to what extent clearing of trees and other types of human development have impacted populations, because this species is often found in edificarian situations, sheltering in old buildings and walls (Lazell 1989). Clearing of pine rockland and rockland hammock habitats has probably eliminated red rat snakes from some areas, but it is possible that populations are higher in some human-altered habitats than in the former natural habitats. A possible reduction in warm-blooded prey in human-altered habitats may be compensated for by an abundance of nonnative lizard species, particularly brown anoles (Wilson and Porras 1983). Red rat snakes are intentionally killed by persons, and many are killed on roads by vehicles (K. Enge, FWC, pers. commun. 2010); many of the museum and FNAI records are road-killed specimens. Hurricanes strike South Florida about every 3 years (Gentry 1974), but associated seawater surges and short-term flooding of upland habitats in the Keys probably do not kill many individuals of this species, which is a good swimmer and readily climbs trees, potentially finding shelter in a variety of arboreal and terrestrial situations. However, effects of flooding on some of its primary prey species, lizards and small mammals, may impact snake populations until prey populations recover, although many of the lizard species appear adapted to periodic flooding (Bartlett 1997). 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.

The red rat snake is the most heavily harvested snake species for the pet trade in Florida, with an average of >5,000 snakes collected annually in 1990–94, two-thirds of which were harvested south of Lake Okeechobee (Enge 2005). The Lower Keys population is listed as a Species of Special Concern and is protected from harvest, but some illegal harvest occurs (K. Enge, FWC, pers. commun. 2010). To most persons, the so-called Rosy Rat Snake is not as desirable as many of the other more colorful phenotypes, but some breeders produce them, although they may not advertise them as such because of their protected status (Tennant 1997).

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

LISTING RECOMMENDATION

The BRG found the Lower Keys population of the red rat snake did not meet any of the criteria for listing as a Threatened species. Staff recommends that the Lower Keys population of the red rat snake not be listed as a Threatened species.

SUMMARY OF THE INDEPENDENT REVIEW

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Biological Status Review Information
Findings

Species/taxon: Red Rat Snake, Lower Keys population
Date: 11/19/10
Assessors: Enge, Johnson, Moler

Generation length: 6 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 have not ceased (c)	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), 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 4.3% human population increase in Keys in next 20 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)	136.5 km^2	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	Uncertain of number of locations	S	Uncertain	
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	Probably not declining	P	N	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	>10,000 mature individuals	S	N	Love (1978), Lazell (1989), Weaver et al. (1992), FNAI records, 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	Probably not declining	S	N	
(c)2. A continuing decline, observed, projected, or inferred in numbers of mature individuals AND at least one of the following:	Probably not declining	S	N	
a. Population structure in the form of EITHER		S	N	
(i) No subpopulation estimated to contain more than 1000 mature individuals; OR				
(ii) All mature individuals are in one subpopulation		O	N	
b. Extreme fluctuations in number of mature individuals		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	136.5 km^2	E	N	
(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 are met)

Not Threatened	
Is species/taxon endemic to Florida? (Y/N)	N
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)
Not Threatened	

1	Biological Status Review Information Regional Assessment	Species/taxon: Red Rat Snake, Lower Keys population
2		Date: 11/18/10
3		Assessors: Enge, Johnson, Moler
4		
5		
6		
7		
8	Initial finding	
9		
10	2a. Is the species/taxon a non-breeding visitor? (Y/N/DK). If 2a is YES, go to line 18. If 2a is NO or DO NOT KNOW, go to line 11.	No
11	2b. Does the Florida population experience any significant immigration of propagules capable of reproducing in Florida? (Y/N/DK). If 2b is YES, go to line 12. If 2b is NO or DO NOT KNOW, go to line 17.	No
12	2c. Is the immigration expected to decrease? (Y/N/DK). If 2c is YES or DO NOT KNOW, go to line 13. If 2c is NO go to line 16.	
13	2d. Is the regional population a sink? (Y/N/DK). If 2d is YES, go to line 14. If 2d is NO or DO NOT KNOW, go to line 15.	
14	If 2d is YES - Upgrade from initial finding (more imperiled)	
15	If 2d is NO or DO NOT KNOW - No change from initial finding	
16	If 2c is NO or DO NOT KNOW- Downgrade from initial finding (less imperiled)	
17	If 2b is NO or DO NOT KNOW - No change from initial finding	No change
18	2e. Are the conditions outside Florida deteriorating? (Y/N/DK). If 2e is YES or DO NOT KNOW, go to line 24. If 2e is NO go to line 19.	
19	2f. Are the conditions within Florida deteriorating? (Y/N/DK). If 2f is YES or DO NOT KNOW, go to line 23. If 2f is NO, go to line 20.	
20	2g. Can the breeding population rescue the Florida population should it decline? (Y/N/DK). If 2g is YES, go to line 21. If 2g is NO or DO NOT KNOW, go to line 22.	
21	If 2g is YES - Downgrade from initial finding (less imperiled)	
22	If 2g is NO or DO NOT KNOW - No change from initial finding	
23	If 2f is YES or DO NOT KNOW - No change from initial finding	
24	If 2e is YES or DO NOT KNOW - No change from initial finding	
25		
26	Final finding	

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. Sexual maturity is often attained in 18 months, and snakes can live to be over 20 years old in captivity (Ernst and Ernst 2003). We infer a mean generation length of 6 years. Some specimens from the Lower Keys are not distinctive from those found elsewhere in the Keys or in the Miami area, and we are uncertain whether the population can be considered disjunct. Approximately 11.3 km (7 miles) of water separates Little Duck Key in the Lower Keys from Knight Key in the Middle Keys. The population may be occasionally augmented by snakes transported in agricultural and horticultural shipments (Tennant 1997), and by vehicles, such as motor homes. Another possible source of augmentation is the escape or release of pet red rat snakes, which is the most commonly kept native snake species. We are not convinced that the Lower Keys population should be considered separately from red rat snakes elsewhere in Florida.

Sub-criterion A2. – Actual estimates of red rat snake populations and trends do not exist, but we suspect that loss and degradation of habitat probably have resulted in some declines in populations within the past 18 years. 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). 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). The Lower Keys contain 43% of the vacant, buildable lots in the Keys (Monroe County 1999). According to the U.S. Census Bureau, Monroe County's population decreased by 8.1% from 2000 through 2009. The red rat snake probably still occurs on all of the keys within its historic range, so the extent of occurrence has not declined. This prolific species is adaptable and often inhabits urban areas; anecdotal evidence suggests that it remains abundant (*see* Appendix 2). Despite its protected status, some exploitation of the red rat snake occurs in the Lower Keys for pets, although the extent is unknown (K. Enge, FWC, pers. commun. 2010). The ready availability of captive-produced red rat snakes in a wide variety of colors and patterns, including some "rosy rats," has probably decreased the demand for wild-caught snakes from the Keys, but some persons prefer wild-type phenotypes with locality data (Enge, pers. obs.). Occasionally, the red rat snake will hybridize with the yellow (eastern) rat snake (*Pantherophis obsoletus* or *alleghaniensis*), but such an occurrence is rare and unlikely to affect populations. Introduced species have probably been more beneficial than detrimental to red rat snake populations. Although domestic dogs and cats and some nonnative lizard species occasionally kill red rat snakes (Love 2000), the abundant populations of nonnative lizards, such as brown anoles and house geckos (*Hemidactylus* spp.) provide a food source in urban environments.

Sub-criterion A3. – Three generations from 2010 would be 2028. By the Year 2030, Monroe County's population is projected to increase by 4.3% (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 (Zwick and Carr 2006). Of the potential habitat identified using GIS analysis, 64.8% 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.

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). However, the Lower Keys population does not appear to be distinctive, and red rat snakes occur throughout the Keys and the entire state. The total land area of the Florida Keys, which consists of ca. 1,700 islands, is ca. 356 km^2 (137.3 mi^2) (http://en.wikipedia.org/wiki/Florida_Keys).

Sub-criterion B2. – A GIS analysis of potential habitat for the Lower Keys population identified 136.5 km^2 (52.7 mi^2) of potential habitat (B. Stys, FWC, pers. commun. 2010), which we will assume is

equivalent to the area of occupancy. The predominant FWC 2003 land-cover classes that comprised most of the potential habitat were mangrove swamp (83.6 km^2; 32.3 mi^2), scrub mangrove (22.8 km^2; 8.8 mi^2), tropical hardwood hammock (15.7 km^2, 6.1 mi^2), pinelands (9.3 km^2; 3.6 mi^2), and low impact urban (4.5 km^2; 1.7 mi^2). Based upon future development and clearing of habitat, we project a continuing decline in area of occupancy, extent of habitat, and number of mature individuals. However, the population is not severely fragmented. Red rat snakes occur on at least 16 keys, not including the Marquesas, and although natural rockland habitats have been fragmented by development, snakes often inhabit altered habitats between these fragments. Many of these keys are separated by narrow channels that are sometimes <1 km wide, and "subpopulations" on these islands may experience demographic or genetic exchange (i.e., >1 migrant individual per year). We are uncertain if red rat snakes in the Lower Keys occur in $\leq$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 (Category 3 or higher) could completely overwash most islands in the Lower Keys, except for Key West, which has a maximum elevation of ca. 6 m (18 feet). Most keys are generally <1.5 m (5 feet) above sea level, and the maximum storm tide from Hurricane Wilma (Category 3) in 2005 was 1.5–2.4 m (5–8 feet) above mean sea level (*see* Threats section). Because red rat snakes are good swimmers, excellent climbers, adaptable, prolific, and relatively large, they probably survive storm surges better than other reptile species. Assuming sufficient prey survives storm surges, red rat snakes populations probably would not be affected enough to be able to assign locations. We have no evidence that the red rat snake experiences extreme fluctuations.

Criterion C. – No data on population densities exist for the red rat snake, and we suspect that population density estimates for other species of rat snakes elsewhere in the U.S. (e.g., Fitch 1958, 1963; Stickel et al. 1980; Blouin-Demers and Weatherhead 2002) do not apply to red rat snakes in Florida, where they may be very common in some habitats. For example, a commercial collector has intensively hunted canals on a farm in Martin County since 2002, removing up to 1,000 red rat snakes annually (J. Watt, pers. commun. 2010). Approximately 75% of the snakes were adults (i.e., >76 cm; 30 inches total length). The farm is ca. 405 ha (1,000 acres) in size, which would yield a minimum density of 1.85 adult snakes/ha (0.75/acre). However, densities are obviously higher than this, because all snakes were not removed. This collector has hunted snakes on this farm since 1979, when it consisted of citrus groves, but he did not find red rat snakes here until the 1990s, when the farm was converted to sugar cane (it is now a vegetable farm and rock mine). Despite the harvest pressure, there has been no reduction in numbers of red rat snakes harvested since the 1990s. On a good day, this collector has found 10–15 red rat snakes in the Keys under trash and in coconut palms (J. Watt, pers. commun. 2010), which agrees with T. Crutchfield's claim of 10–20 snakes per day (Appendix 2). We suspect that >10,000 red rat snakes occur in the Lower Keys.

Appendix 1. Review 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 public comments.

Letter and comments submitted by Tom Crutchfield:

From: Tom Crutchfield [tomcrutchfield1@aol.com]
Sent: Thursday, September 23, 2010 1:07 PM
To: Enge, Kevin
Subject: Public comment period for state-listed species

Kevin, I can tell you that the "rosacea" in the Lower Keys are extraordinarily abundant and are not in any way RARE by any stretch of the imagination. If anything, they're more common now than 20 years ago. One could easily collect 10–20 in a day, if really hunted…..thanks

http://www.tomcrutchfield.com

APPENDIX 3. **Information and comments received from independent reviewers.**

Will be added later.