

Atlantic salt marsh snake
(Nerodia clarkii taeniata)

**5-Year Review:
Summary and Evaluation**



Photo: USFWS

**U.S. Fish and Wildlife Service
Southeast Region
North Florida Ecological Services Field Office
Jacksonville, Florida**

5-YEAR REVIEW

Atlantic salt marsh snake (*Nerodia clarkii taeniata*)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

On September 23, 2014, the U.S. Fish and Wildlife Service (Service) published a notice in the *Federal Register* (79 FR 56821) announcing the 5-year review of 27 Southeastern species, and requesting new information concerning the biology and status of these species. This notice included the Atlantic salt marsh snake (*Nerodia clarkii taeniata*). A 60-day comment period was opened; however, no information on this snake was received from the public during the comment period.

The lead Service recovery biologist prepared this 5-year review, which summarizes new information gathered since the last 5-year review of this species (USFWS (Service) 2008). This document is based on the available information in our species files, distribution and status reports, and the best available information on the species' biology and ecology. Sources of information included the final rule listing the snake under the Endangered Species Act, the species' recovery plan, peer-reviewed literature, unpublished field observations, and Service biologists, and communications from other qualified biologists and experts. We sought peer review of this document (refer to Appendix A). Comments received were evaluated and incorporated as appropriate into this document.

B. Reviewers

Lead Region - Southeast Region: Kelly Bibb, 404-679-7132

Lead Field Office – North Florida ESFO: Bill Brooks, 904-731-3136

C. Background

1. **Federal Register Notice citation announcing initiation of this review:** 79 FR 56821; September 23, 2014.
2. **Species status:** Unknown. The taxonomy of the Atlantic Salt Marsh Snake (*Nerodia clarkii taeniata*) and the salt marsh snake species (hence forward SMS) (*Nerodia clarkii*) has been in question since its listing in 1977.

The Atlantic SMS Recovery Plan recommends addressing the taxonomy issue per recovery action 4.0 Conduct a taxonomic assessment (morphometric and genetic) (1993, p. 10-11). The 2008 Status Review also highlighted this need for a full taxonomic and genetic assessment of the SMS species and three subspecies, Atlantic SMS (*N. c. taeniata*), Mangrove SMS (*N. c.*

compressicauda), and Gulf Coast SMS (*N. c. clarkii*) (Service 2008, p. 4-7, 11, 12) to determine if Atlantic SMS is a listable entity.

Surveys, genetic sampling, and a morphometric assessment of this species began in 2010. Surveys in 2011-2012 and 2014-2015 collected approximately 700 specimens of which 39 that keyed out Atlantic SMS and were all collected only in Volusia County (Territo 2013 and Parkinson 2016). Morphometrics, mitochondrial and nuclear genomic analysis have been completed. This research found no evidence for genetic, morphological, or ecological distinction of Atlantic SMS as a subspecies (Territo 2013). The single nucleotide polymorphic (SNP) DNA sequencing was recently completed and data analysis is underway. Once completed, these assessments and updates will guide future recovery planning for the Atlantic SMS.

State and federal regulations provide protections to salt marsh habitats and GIS analysis indicates loss of habitat has slowed, however encroachment of mangroves marsh may be increasing and could possibly lead to mangrove SMS habitat totally overlapping with the Atlantic SMS range. Sea level rise is a long-term threat to the Atlantic SMS and other coastal marsh dependent species.

Status of the Atlantic SMS (*N. c. taeniata*) remains unknown and conclusions from ongoing research will guide future recovery efforts and conclusions.

3. **Recovery achieved:** 1 (1=0 to 25% species' recovery objectives achieved). Surveys and collection of genetic materials occurred in 2011-2012 and 2014-2015. Mitochondrial and nuclear gene sequencing for Atlantic SMS was completed in 2013. Single nucleotide polymorphic (SNP) assessment was initiated in 2016 and associated DNA sequencing data generation was recently completed and analysis will be completed in November 2019. Protection of salt marsh through state and federal regulations continues. Habitat restoration continues with almost 1,000 acres restored in Volusia County.
4. **Listing history:**
Original listing:
FR notice: 42 FR 60743
Date listed: November 29, 1977
Entity listed: subspecies
Classification: Threatened
5. **Associated rulemakings:** None
6. **Review history:**

The Service conducted five-year reviews for the Atlantic SMS in 1987 (52 FR 25523) and 1991 (56 FR 56882). In these reviews, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors as they pertain to the individual species. The notice summarily listed the species and stated that no changes in the designation of any of the species were recommended at that time. In particular, no changes were proposed for the status of the Atlantic SMS.

The 2008 5-year review was noticed April 26, 2007 (72 FR 20866) and was completed in 2008. In this review, we recommended that no change was required to the threatened classification for the Atlantic SMS.

Final Recovery Plan - 1993.

Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, we did a recovery data call that included status recommendations such as “Unknown or Declining” for this snake. We continue to show that species status recommendation as part of our 5-year reviews. The most recent evaluation for this snake was completed in 2019.

7. **Species’ Recovery Priority Number at start of review (48 FR 43098):**
12 - a subspecies with moderate degree of threat and low recovery potential
8. **Recovery Plan**
Name of plan: Atlantic Salt Marsh Snake Recovery Plan.
Date issued: December 15, 1993.

II. REVIEW ANALYSIS (hence forward in this document common names will be used)

A. Application of the 1996 Distinct Population Segment (DPS) policy:

1. **Is the species under review listed as a DPS?** No. The Atlantic SMS is one of three subspecies of salt marsh snake.
2. **Is there relevant new information regarding application of the DPS policy that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?** No.

B. Recovery Criteria

1. **Does the species have a final, approved Recovery Plan containing objective measurable criteria?** The Atlantic SMS has an approved final Recovery Plan (December 15, 1993) with objective measurable criteria.
2. **Adequacy of recovery criteria:**
 - a. **Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?** The criteria are based upon the knowledge base of the species at the time of drafting the Atlantic SMS Recovery Plan (Service 1993), which was over 25 years ago. This criterion is also included in the South Florida Multi-Species Recovery Plan (Service 1999). As recommended by the 1993 Recovery Plan, a taxonomic and genomic assessment of the SMS species is underway. Once completed, these assessments and updates will guide future recovery planning, including possible new recovery criteria, for the Atlantic SMS.
 - b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?** Three of the five listing factors are addressed in the recovery criteria because they are the three that caused the Atlantic SMS to be listed as threatened. These factors are the present or threatened destruction, modification, or curtailment of its habitat or range (Factor A); the inadequacy of existing regulatory mechanisms (Factor D); and other natural or manmade factors affecting its continued existence (Factor E). The recovery criteria are based upon minimizing habitat loss and having secure-discrete-dispersed populations within protected areas to address Factor A; providing adequate habitat protection to address Factor D; and monitoring genetic introgression to ensure ecological isolating mechanisms exist between SMS subspecies and adjacent freshwater snake species to address Factor E. Once the taxonomic and genomics assessment is complete, the threats analysis will be updated per the findings.
3. **List the recovery criteria as they appear in the Recovery Plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.**

Delisting the Atlantic SMS can be considered if the following conditions are met:

- (1) If there is no evidence of significant genetic introgression (genetic exchange limited to a very narrow hybrid zone) from the Florida banded water snake (*Nerodia fasciata pictiventris*) into adjacent populations of the Atlantic SMS.
- (2) Maintain adequate habitat protection and maintain habitat loss at or below current levels for the next 5 years.
- (3) Establish self-sustaining populations of 100-200 adult snakes at each of 10 secure, discrete sites dispersed throughout Volusia County. These numerical goals are subject to revision as more information becomes available on the biology of the Atlantic SMS.
- (4) These populations should be monitored for at least 5 years before considering delisting.

Until a full genomic assessment, comprehensive survey, and taxonomic assessment have been conducted, it will not be possible to determine the genetic introgression with the Florida banded water snake (needed to determine criterion 1), losses of habitat within the range (needed to determine criterion 2), or range and population locations (needed for criterion 3).

C. Updated Information and Current Species Status

1. Biology and Habitat

- a. **Abundance, population trends, demographic features, or demographic trends:** At the time of listing in 1977, the Atlantic SMS was thought to include SMSs as far south as Indian River County (42 FR 60743). The Recovery Plan indicated that the distribution may be much more restricted (Service 1993). Per 2010-2012 surveys, with 900 man-hours in the field only two specimen morphometrically keyed out to be Atlantic SMS and the genetic distribution was limited to snakes from coastal marshes of Volusia County (Territo 2013). The scope of this study was to determine presence and to collect morphometric information and genetic samples for the taxonomic and genomics assessment of Atlantic SMSs. An additional 37 Atlantic SMSs and over 600 individuals in this complex were collected by 2015 (Parkinson 2015) and the scope of this new study were to generate gene sequences for SMSs and Florida banded water snakes. The Atlantic SMS specimen were again limited in extent to Volusia County coastal marshes. There are no population or demographic trends available.

The demographic recovery criterion (Service 1993) requires the establishment of self-sustaining populations of 100-200 adult snakes at each of 10 secure, discrete sites dispersed throughout Volusia County. This criterion also indicates that these numerical goals are subject to revision as more information on the biology of the Atlantic SMS becomes available.

- b. Genetics, genetic variation, or trends in genetic variation:** Lawson *et al.* (1991) found no genetic introgression between the SMS complex and adjacent freshwater snakes. However, the Atlantic SMS does hybridize with a closely related freshwater species; the Florida banded water snake (Kochman 1977, Dunson 1979, Lawson *et al.* 1991). Wetland alterations from upland development adjacent to salt marshes from ditching, diking and impounding, can promote hybridization, by creating fresh water habitats in close proximity to salt marsh habitats. These alterations adjacent to the Atlantic SMS habitat disrupt the reproductive isolating mechanisms between the Florida banded water snake and the Atlantic SMS as the natural transitional boundary between salt water and fresh water habitats are in very close proximity or have been eliminated.

The extent of the genetic exchange via hybridization with the Florida banded water snake and the area of intergradations with the mangrove SMS has yet to be determined. The salt marshes of Brevard County may represent the area of intergradation between the Atlantic SMS and mangrove SMS subspecies (Service 1993, 1999). With the northward migration of mangrove's range along Florida's Atlantic coast, the range of the Atlantic SMS may now totally intersect with the northern range of the mangrove SMS.

Mitochondrial DNA and nuclear gene sequence results indicate that Atlantic SMS is not a unique lineage, but rather identify a mainland/panhandle split in the complex (Territo 2013, p. 55-56 and Parkinson 2016, p 1). This indicates that these data do not have the resolution to detect population level processes. Additionally, morphometric data from all three described subspecies indicate that there are no defining morphological characteristics of *N. c. taeniata* suggesting that *N. c. taeniata* might not deserve subspecific rank (Parkinson 2016, p. 3).

To complete a full genomic level assessment of the SMS species (*Nerodia clarkii*) and assess introgression (genetic exchange resulting from hybridization) with the freshwater Florida banded water snake (*Nerodia fasciata*), single nucleotide polymorphic

(SNP) assessment was initiated (2016). Double-digest restriction site associated DNA sequencing (ddRADseq) data generation was recently completed. Data analyses are currently underway, but preliminary analyses suggest conflicting results on whether *N. c. taeniata* represents a unique lineage depending on the analysis being done. Investigators have recommended that additional fine-scale sampling along transects between *N. c. taeniata* and *N. fasciata pictiventris* as well as between *N. c. taeniata* and *N. c. compressicauda* be done. A final report in regard to the SMS evolutionary history, assessment of genetic lineages and subspecies nomenclature are due November 30, 2019.

- c. **Taxonomic classification or changes in nomenclature:** The Atlantic SMS Recovery Plan (Service 1993) contains a detailed taxonomic classification description. The Atlantic SMS has a complex taxonomic history, having been known under various combinations of generic, specific, and subspecific names. The subspecies that the Service listed in 1977 as threatened is the Atlantic SMS, *Nerodia fasciata taeniata* (now *Nerodia clarkii taeniata*). At present, three subspecies of the SMS are recognized, the Atlantic SMS, the Gulf Coast SMS, and the mangrove SMS (Lawson *et al.* 1991) and is supported in ITIS (2019).

To facilitate the taxonomic assessment, morphometrics, scalation, color, banding and striping pattern information was collected along with the genetic sampling. This research found no evidence for genetic, morphological, or ecological distinction of Atlantic SMS as a subspecies (Territo 2013). The single nucleotide polymorphic DNA sequencing was recently completed and data analysis is underway. Once completed, these assessments and updates could inform any potential taxonomic update for the Atlantic SMS subspecies.

- d. **Spatial distribution, trends in spatial distribution or historic range:** The Atlantic SMS range appears to be confined to Volusia County. An ongoing genomics project is being finalized and findings in regards to the taxonomy of collected specimens, including locations will provided in a final report in November 2019 . The Service's Atlantic SMS Recovery Plan (Service 1993) and South Florida Multi Species Recovery Plan (1999) indicate the range may be more restricted than thought at the time of listing in 1977. An issue with listing of a subspecies is that the distribution and intergradation with another subspecies is difficult to define. The zone of intergradation coincides with the increasing dominance of mangroves swamps in Brevard County (Service 1993, Blihovde 1996, Service 1999) and this now also includes

Volusia County as the range of mangroves continues to extend north. Mangroves are found throughout Volusia County's estuaries along with salt marsh habitats. The northern range of the mangrove SMS may now intersect completely with the entire range of the Atlantic SMS. Recent population surveys indicate that viable populations Atlantic SMS only exist in Volusia County near Merritt Island National Wildlife refuge (Parkinson 2016).

- e. **Habitat:** The Atlantic SMS inhabits brackish coastal marshes predominantly vegetated with glasswort (*Salicornia* spp.) and salt grass (*Distichlis spicata*). Black mangrove (*Avicennia germinans*) is often present but not predominant. Habitat destruction for residential, commercial, and industrial development, and habitat degradation due to ditching, diking, stormwater impoundments on adjacent uplands, and historic mosquito ditching in the salt marsh, have affected the Atlantic SMS and its habitat but have slowed, per GIS analysis described below, and are minimized through regulatory protection. Cox et al. (1994) conducted a GIS analysis of Atlantic SMS habitat in Volusia County and documented approximately 11,700 acres of salt marsh habitat of which 3,500 acres was within the Canaveral National Seashore. Analysis by Florida Natural Areas Inventory in 2007 found 9,132 acres salt marsh habitat of which 2,349 acres are protected within publicly managed lands. An assessment of 2014 of the Cooperative Land Cover Version 3.3 salt marsh in Volusia County found a total of 9,345 acres of which 2,005 acres are mangroves (J. Cooke, Service, pers. comm., 2019). The extent of salt marsh habitats in Volusia County appears to have been stable, however the types of salt marsh may be changing as mangrove marsh appears to be increasing and possibly replacing other types of salt marsh. Salt marsh restoration projects continue to play an important role to the Atlantic SMS recovery and continue in Volusia County. The most recent project (2019) is the Flagler County Wetland Restoration Project to restore approximately 100 acres of dragline-impacted wetlands in northern Volusia County. To date more than 1,000 acres have been restored to salt marsh in Volusia County.

2. **Five-Factor Analysis**

- a. **Present or threatened destruction, modification, or curtailment of its habitat or range:** The Atlantic SMS is a salt marsh-dependent species. At the time of listing, the Atlantic SMS was thought to include SMSs as far south as Indian River County (Service 1977). However, its range now appears to be restricted to coastal marshes of

Volusia County (Parkinson 2016). If this is the case, then given its more restricted distribution, the Atlantic SMS's vulnerability to habitat loss and modification may be even greater than estimated at the time of listing.

A GIS analysis of the Volusia County salt marshes suggests that 2,000 acres (14%) have been lost since listing in 1977 to 2007 (L. White, Service, pers. comm., 2007); 2014 acreages were found to be similar to those from 2007 (J. Cooke USFWS, pers. comm., 2019). Most of the habitat where the Atlantic SMS likely occurs, salt marsh, is below the mean high water, which is sovereign submerged lands of the State of Florida and some are within publicly managed lands. Thus, future development or filling of salt marshes is unlikely. Both federal and state regulatory mechanisms rarely allow for filling or loss of salt marsh habitat. An initiative in Volusia County to restore all the disturbed salt marsh wetlands that were dragline ditched during the 1950s and 1960s continues today. Even though this effort has slowed in recent years, over 1,000 acres of disturbed salt marsh areas within the Mosquito Lagoon and Tomoka River/Bulow Creek areas have been restored and enhanced and provide improved habitat conditions for the Atlantic SMS.

Overall, however, the loss, modification and conversion of salt marsh habitat continues to be a threat to Atlantic SMS recovery. A detailed assessment of rates of loss, restoration, conversion to mangrove, fragmentation, and creation of salt marsh wetlands of value to Atlantic SMS has not been compiled. It is not known whether the current habitat base will support a population at levels sufficient to prevent extinction in the long term.

- b. Overutilization for commercial, recreational, scientific, or educational purposes:** No information indicates this is a threat and this factor was not considered a threat at the time of listing or at present.
- c. Disease or predation:** No information indicates this is a threat and this factor was not considered a threat at the time of listing or at present.
- d. Inadequacy of existing regulatory mechanisms:** Atlantic SMSs and/or their habitat are protected by the following regulatory mechanisms:

The Clean Water Act regulates dredge and fill activities that would adversely affect wetlands. Section 404 of Clean Water Act regulates the discharge of dredged or fill materials into wetlands. Discharges are

commonly associated with projects to create dry land for development sites, water-control projects, and land clearing. The U.S. Army Corps of Engineers and the Environmental Protection Agency share the responsibility for implementing the permitting program under Section 404 of the Clean Water Act.

Most salt marsh habitats of Florida occur waterward of the mean high water and are sovereign submerged lands of the State of Florida, therefore protected and regulated under 18-21.003, Florida Administrative Code. The Florida Department of Environmental Protection and the Florida Water Management Districts share responsibility for protecting and implementing permitting program under the sovereign submerged lands rules.

The Service's Merritt Island National Wildlife Refuge 2008 Comprehensive Conservation Plan (CCP) was written to guide management on Merritt Island NWR through 2023. The plan provides information about management direction and strategies for implementation. Key planning issues include wildlife management, habitat management, and resource protection. This plan addresses the protection of Atlantic SMS and habitat needs.

All parks in the National Park System (NPS) are required to develop a general management plan (GMP). The Canaveral National Seashore updated the GMP in 2014. It describes the general path the NPS intends to follow in managing salt marsh and mangrove habitats within the park. The GMP addresses the protection of Atlantic SMS and habitat needs.

The Atlantic SMS is on the State of Florida state-listed threatened species list. Florida State Law (Chapter 68A-27.004, Florida Administrative Code) prohibits taking of individuals on the state-listed threatened species list, or parts thereof, except as authorized; however, the statute does not prohibit destruction or modification of habitat occupied by such species. On Florida wildlife management areas, regulations protect individual Atlantic SMSs. Wildlife management area regulations prohibit destruction or modification of habitat, except for management and restoration activities.

At present, regulatory mechanisms appear to provide measurable levels of protection Atlantic SMS and its habitat but we are uncertain as to whether these protections are adequate in meeting the recovery criteria.

- e. **Other natural or manmade factors affecting its continued existence:** Fresh water habitats are adjacent or in close proximity to

all salt marsh habitats in the Atlantic SMS range and mangroves now overlap with all salt marsh habitat within the Atlantic SMS range. Exotic invasive plants are not known to affect Atlantic SMSs or their habitat. The extent of the genetic exchange between the Atlantic SMS populations from hybridization with the Florida banded water snake and intergradation with the mangrove SMS is being assessed and results and findings are due in November 2019.

Sea level rise

Sea level rise is a long-term threat to Atlantic SMS and to all coastal marsh dependent species based on numerous prediction models. According to the Third National Climate Assessment, release May 2014, sea level rise and increasing storm surge events are occurring and are impacting coastal species and ecosystems (Melillo et al. 2014 and Wolf 2014). It is expected that low-lying coastal habitats such as salt marsh will be affected most severely by sea level rise. Models such as the Sea Level Rise Affecting Marshes Model (SLAMM) can be used to project different levels of rise such as a 6-foot rise would remove significant amounts of habitat within Volusia County coastal estuaries. The varying and dynamic elements of climate science are inherently long-term, complex, and interrelated. At present, we may know the direction of change, but it is not possible to predict its precise timing or magnitude. Future recovery planning will include guidance and use scenario planning to develop management strategies that account for potential environmental and habitat changes, given the future uncertainties in climatic conditions.

D. Synthesis

As reported in the Recovery Plan (1993) and MSRP (1999), and surveys (2010-2012), Parkinson (2016), the Atlantic SMS range appears to be restricted to the salt marshes of Volusia County. This range contraction from the original listed range in 1977 is not be due to habitat loss but likely be related to developing a better understanding of the SMS species and where they occur. The loss of salt marsh habitat in Volusia County has slowed because of Federal and State protections but conversion from salt marsh to mangrove dominated marshes needs to be assessed. Approximately thirty percent of the salt marsh habitat in Volusia County is within publicly managed lands, and thus, future development in these areas will likely be limited. Salt marsh are protected by the Clean Water Act and as sovereign submerged lands of the State of Florida. An initiative to restore the salt marsh systems that were dragline ditched during the 1950s and 1960s continues. To date, over 1,000 of acres of disturbed salt marsh areas in Volusia County have been restored and enhanced and are likely improving the habitat conditions for the Atlantic SMS in those areas. Conservation land acquisitions

are targeting habitat that will add to, connect and buffer public lands with Atlantic SMS habitat.

Territo (2013) and Parkinson (2016), indicate the status of the Atlantic SMS is unknown. Until the genetic assessment and taxonomic assessment is completed, it is not possible to determine the distributional range of the Atlantic SMS and its status to an acceptable level of certainty. Habitat loss and modification are known to affect the Atlantic SMS and sea level rise is an added long-term factor to this threat. Salt marsh loss due to development appears to have slowed considerably due to state and federal protection of these wetland habitats. The extent of this threat in the foreseeable future cannot be quantified yet. Existing regulatory mechanisms appear to be adequate in protecting the Atlantic SMSs and most of its habitats. It cannot be determined if habitat is sufficient to minimize risk of extinction in all or a significant portion of the Atlantic SMS's range as the ongoing research will determine the current distribution. Natural or manmade factors affecting the Atlantic SMS's continued existence, specifically the extent of genetic introgression and intergradation with adjacent species is being examined and we do not have those results. Utilization of the species for commercial, recreational, scientific, or educational purposes, as well as disease and predation are not considered a threat to recovery.

Based on our analysis of the best available information regarding the Atlantic SMS, there appears to be a great deal of uncertainty with respect to 1) the distribution of the species; 2) the condition of its habitat; 3) whether it is or is not a subspecies. Due to the lack of clear and substantial information indicating that a change in status should be recommended, the Service recommends no change to the status of the Atlantic SMS and that it remain classified as threatened.

III. RESULTS

- A. **Recommended Classification:** No change in status, remain Threatened.
- B. **New Recovery Priority Number:** No change.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

Complete (including peer-review) the taxonomic and genetic assessment of *Nerodia clarkia taeniata*.

Review the taxonomic and genetic assessment and evaluate if its current classification as a subspecies is supported by the best available science.

Conduct fine scale surveys to generate geographic distribution and determine levels of hybridization/introgression among the different species and subspecies of water snakes that inhabit the coastal region. Continue collecting genetic samples. Extend surveyes north to include Flagler County salt marsh habitats.

Draft a Species Status Assessment and update the Recovery Plan.

Conduct a GIS analysis of Atlantic SMS habitat for Volusia County and northern Brevard County. Assess mangrove encroachment into salt marshes of Volusia County.

Continue restoration of disturbed salt marsh areas in Volusia County and northern Brevard County.

Continue exotic plant eradication programs with Atlantic SMS habitat.

Acquire Atlantic SMS habitat.

V. REFERENCES

Blihovde, W.B. 1996. Distribution of the *Nerodia clarkia* complex in Volusia, Brevard and Indian River Counties, Merritt Island National Wildlife Refuge Complex and Canaveral National Seashore. A Final Report to the U.S. Fish and Wildlife. 22 pages.

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. 239 pages.

Dunson, W.A. 1979. Occurrence of partially striped forms of the mangrove snake *Nerodia fasciata compressicauda* Kennicott and comments on the status of *N.F. taeniata* Cope. Florida Scientist 42(2):102-112.

Florida Natural Areas Inventory. 2007. Florida Forever conservation needs assessment technical report, version 2.2. Tallahassee, Florida. 123 pages.

Karl, S.A., H.R. Mushinsky, and K.P. Jansen. 2001. Ecological genetics of the threatened saltmarsh snake, *Nerodia clarkii*. Unpublished Final Report submitted to the Florida Fish and wildlife Conservation Commission's Nongame Wildlife Program for Project NG96-013. 66 pages.

Kochman, H.I. 1977. Differentiation and hybridization in the *Natrix fasciata* complex (Reptilia: Serpentes): a non-morphological approach. Unpublished Master's Thesis, University of Florida; Gainesville, Florida.

- Lawson, R., A.J. Meier, P.G. Frank, and P.E. Moler. 1991. Allozyme variation and systematics of the *Nerodia fasciata*-*Nerodia clarkii* complex of water snakes (Serpentes:Colubridae). *Copeia* 1991(3):638-659.
- Melillo, J.M., T.C. Richmond, and G.W. Yohe, Eds., 2014 Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2. Available at <http://nca2014.globalchange.gov/>
- Parkinson, C.L. 2016. Evaluating mole skink and salt marsh snake subspecific taxonomy in Florida using genomics. Interim Report submitted to Service. 14 pp.
- Parkinson, C.L. 2015. Atlantic salt marsh snake genomics update (3/17/2015). Annual permit report TE220923-0 submitted to Service. 3 pp.
- Territio, G.P. 2013. Biogeography and systematics of *Nerodia clarkia*/*Nerodia fasciata* clade in Florida. Masters Thesis. University of Central Florida. 128 pp.
- U.S. Fish and Wildlife Service. 2008. 5-Year Status Review for the Atlantic Salt Marsh Snake. Atlanta, Georgia
- U.S. Fish and Wildlife Service. 1999. South Florida Multi-Species Recovery Plan. Atlanta, Georgia
- U.S. Fish and Wildlife Service. 1993. Atlantic salt marsh snake Recovery Plan. Atlanta, Georgia. 19 pages.
- U.S. Fish and Wildlife Service. 1977. Listing of the Atlantic salt marsh snake as a threatened species. Federal Register 42:60743-60745.
- Wolf, S. 2014. Letter to the Service on behalf of Center for Biological Diversity (CBD). June 13, 2014. San Francisco, California.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Atlantic salt marsh snake (*Nerodia clarkii taeniata*)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review: No change

Review Conducted By: Bill Brooks

FIELD OFFICE APPROVAL:

Acting Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 2/30/2019

APPENDIX A

Summary of peer review for the 5-year review of Florida Salt Marsh Vole (*Microtus pennsylvanicus dukecampbelli*)

- A. Peer Review Method:** See B. below.
- B. Peer Review Charge:** The following letter and Guidance for Peer Reviewers of Five-Year Status Reviews were sent via e-mail to potential reviewers requesting comments on the 5-year review. Requests were sent to: Dr. Chris Parkinson (Clemson University), Rhett Rautsaw (Clemson University), Brian Emanuel (St. Johns River Water Management District), Greg Lepera (retired St. Augustine Alligator Farm), Cayle Pearson (Jacksonville Zoo and Gardens)

We request your assistance in serving as a peer reviewer of the U.S. Fish and Wildlife Service (Service) 5-year status review of the endangered Florida salt marsh vole.

The 5-year review is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.).

A 5-year review is a periodic process conducted to ensure the listing classification of a species as threatened or endangered on the Federal List of Endangered and Threatened Wildlife and Plants is accurate.

The attached draft of the status review has been prepared by the Service pursuant to the Act.

In keeping with Service directives for maintaining a high level of scientific integrity in the official documents our agency produces, we are seeking your assistance as a peer reviewer for this draft.

Guidance for peer reviewers is included below in this email. Please send your comments to me by e-mail to Billy_Brooks@fws.gov.

We appreciate your assistance in helping to ensure our decisions continue to be based on the best available science. If you have any questions or need additional information, do not hesitate to call.

Guidance for Peer Reviewers of Five-Year Status Reviews

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with Service policy.

Peer reviewers should:

- 1. Review all materials provided by the Service.*
- 2. Identify, review, and provide other relevant data apparently not used by the Service.*

3. *Not provide recommendations on the Endangered Species Act (ESA) classification (e.g., endangered, threatened) of the species.*

4. *Provide written comments on:*

- *Validity of any models, data, or analyses used or relied on in the review.*
- *Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.*
- *Oversights, omissions, and inconsistencies.*
- *Reasonableness of judgments made from the scientific evidence.*
- *Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.*
- *Strengths and limitation of the overall product.*

5. *Keep in mind the requirement that we must use the best available scientific data in determining the species' status. This does not mean we must have statistically significant data on population trends or data from all known populations.*

All peer reviews and comments will be public documents, and portions may be incorporated verbatim into our final decision document with appropriate credit given to the author of the review.

C. Summary of Peer Review Comments/Report

A summary of peer review comments from respondents and complete set of comments is available at the North Florida Ecological Services Field Office, U.S. Fish and Wildlife Service, 7915 Baymeadows Way, Suite 200 Jacksonville, Florida 32256-7517.

The Service accepted all minor edits from peer reviewers. Overall, the reviewers agreed the draft document adequately characterized the known information on the status and threats of the listed species.

*Dr. Chris Parkinson and Rhett Rautsaw (Clemson University): The document provides an excellent summary of our current state of knowledge on this subspecies and what I will call the *Nerodia clarkii/N. fasciata* species complex. Based on preliminary reports provided in your request and additionally unpublished mtDNA (cyt-b, NDI, & ND4) and nuDNA (TATA, PRLR, M & E) sequence data analyses from our lab it seems that *N. c. taeniata* is not a unique lineage; provided and track changes file with suggested edits, mostly grammatical and editorials to improve how the document reads and these were all accepted; concur that additional distributional surveys are needed and will allow for determination of hybridization/introgression among the different species and subspecies of water snakes that inhabit coastal Florida.*

Cayle Pearson (Jacksonville Zoo and Gardens): No editorials were provided. Comments pertained to an assessment of the review and included: All information provided for status

review supports the conclusion that additional results and taxonomic determinations are needed prior to any recommendations for a change in the listing; the biological conclusions are supported well by the data currently available; The review is comprehensive and indicates what information is needed for future evaluations; the synthesis, results, and recommendations are sound, based on the information available; These uncertainties are stated in the review and indicate decisions are based on only substantiated results; Strengths: All available data has been evaluated in this review and recommendations appear to be consistent with the needs to determine the potential survival of the subspecies if the taxonomic status holds; Limitations: Recent studies suggest that taxonomic reclassification is needed for Nerodia and will not be available until a future review of the listing is required.

Brian Emanuel (St. Johns River Water Management District): found it well written and informative; conclusions and recommendations reached are solid; sea level rise modeling comes into play when analyzing a coastal species future; it would be helpful if mangrove migration models could be integrated into the process; the threat of conversion from salt marsh to mangrove forest it may become necessary to work through FDEP to control mangroves in ASMS habitat.

- D. Response to Peer Review** – The Service has reviewed and addressed all comments, edits and suggestions provided by the peer reviewers. The draft five-year review was modified in accordance with the reviewers’ suggestions.