American crocodile (*Crocodylus acutus*)
U.S. Population

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Southeast Region
South Florida Ecological Services Office
Vero Beach, Florida

5-YEAR REVIEW
American crocodile / *Crocodylus acutus*
U.S. Population

I. GENERAL INFORMATION

A. Reviewers

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

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B. Methodology used to complete the review: In conducting this 5-year review we relied on available information pertaining to historic and current distribution, life history, and habitats of this species. We also published an announcement in the *Federal Register* (March 24, 2005, proposed rule reclassifying the American crocodile in Florida, 70 FR 15052) requesting information on the American crocodile. Specific requests for information and review were also solicited from 3 independent peer reviewers (Paul Moler, Florida Fish and Wildlife Conservation Commission (FWC); Perran Ross, University of Florida; John Thorbjarnarson, Wildlife Conservation Society). Our sources for this 5-year review include the species' recovery plan; peer reviewed scientific publications; unpublished field observations by Service, State, and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists or experts. Comments received were evaluated and incorporated as appropriate.

C. Background

1. **FR Notice citation announcing initiation of this review:** March 24, 2005: 70 FR 15052

2. **Listing history**
   Original Listing
   FR notice: 40 FR 44149
   Date listed: September 25, 1975
   Entities listed (*species, subspecies, DPS*): U.S. population of the American crocodile; species; DPS policy was not in place at that time
   Classification (*threatened or endangered*): endangered

3. **Associated actions**: 41 FR 41914, September 24, 1976, Final rule designating critical habitat for the American crocodile; 44 FR 75074, December 18, 1979, Final rule listing the American crocodile (with exception of the previously listed population in Florida) and the saltwater crocodile as endangered.

4. **Review History**:
   July 22, 1985 (50 FR 29901)
   November 6, 1991 (50 FR 56882)
   Final Recovery Plan 1999

Recovery Data Call 2006, 2005, 2004, 2003

5. **Species' Recovery Priority Number (48 FR 43098):** American crocodile: 2c

6. **Recovery Plan or Outline**
   Name of plan: South Florida Multi-Species Recovery Plan (MSRP), U.S. Fish and Wildlife Service, Vero Beach, FL. 2179 pp.
   Date issued: May 18, 1999

II. REVIEW ANALYSIS

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

1. **Is the species under review a vertebrate?** Yes
2. **Is the species under review listed as a DPS?** No
3. **Is there relevant new information for this species regarding the application of the DPS policy?** Yes

The Act defines "species" to include ". . . any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." On February 7, 1996, we published in the *Federal Register* our Policy Regarding the Recognition of Distinct Vertebrate Population Segments (DPS Policy) (61 FR 4722). For a population to be listed under the Act as a DPS, three elements are considered: (1) the discreteness of the population segment in relation to the remainder of the species to which it belongs; (2) the significance of the population segment to the species to which it belongs; (3) the population segment's conservation status in relation to the Act's standards for listing (i.e., is the population segment endangered or threatened?). The best available scientific information supports recognition of the Florida population of the American crocodile as a DPS. We discuss the discreteness and significance of the DPS within this section; the remainder of the document discusses the status of the Florida DPS.

Discreteness: The DPS policy states that vertebrate populations may be considered discrete if they are markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors, and/or they are delimited by international governmental boundaries within which significant differences exist in control of exploitation, management of habitat, conservation status, or regulatory mechanisms.

The Florida population segment represents the northernmost extent of the American crocodile's range (Kushlan and Mazzotti 1989a, p. 5; Thorbjarnarson 1989, p. 229). It is spatially separated by approximately 90 miles of open ocean from the nearest adjacent American crocodile population in Cuba (Kushlan 1988, pp. 777-778). The Gulf Stream, or the Florida Current (the southernmost leg of the Gulf Stream) flows through this 90-mile (145-km) gap. This strong current makes it unlikely that crocodiles would regularly, or even occasionally, move between Florida and Cuba. Behaviorally, American crocodiles are not predisposed to travel across open ocean.

They prefer calm waters with minimal wave action, and most frequently occur in sheltered, mangrove-lined estuaries (Mazzotti 1983, p. 45). No evidence is available to suggest that crocodiles have crossed the Florida Straits. There are no other American crocodile populations in close proximity to Florida (Richards 2003, p. 1) that would allow direct interaction of animals. The Florida population is effectively isolated from other crocodile populations and functions as a single demographic unit. Consequently, we conclude that the Florida population is discrete from other crocodile populations as a consequence of physical and behavioral factors.

The genetic makeup of the Florida population of the American crocodile is recognizably distinct from populations in other geographic areas within its range (M. Forstner 1998). Analysis of mitochondrial DNA suggests that the Florida population may be genetically more closely related to American crocodile populations in Central and South America than to those in Jamaica and Hispaniola (P. Moler 2005b).

Significance: The DPS policy states that populations that are found to be discrete will then be examined for their biological or ecological significance. This consideration may include evidence that the loss of the population would create a significant gap in the range of the taxon. The Florida population of the American crocodile represents the northernmost portion of the species' range in the world (Kushlan and Mazzotti 1989a, p. 5; Thorbjarnarson 1989, p. 229) and the only population in the United States. Loss of this population would result in a significant reduction to the extent of the species' range. Maintaining this species throughout its historic and current range is important to ensure its genetic diversity and population viability. While it is difficult to determine to what degree the Florida population of the crocodile contributes substantially to the security of the species as a whole, the apparent isolation and evidence of genetic uniqueness (M. Forstner 1998) suggest that the Florida population substantially contributes to the overall diversity within the species and is biologically or ecologically significant.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan, containing objective measurable criteria?** Yes

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?** Yes

   b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?** Yes

3. **List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing supporting information.**

The MSRP specifies a recovery objective of reclassifying the species to threatened and describes recovery criteria as:

Previous recovery efforts identified the need for a minimum of 60 breeding females within the population before reclassification could be considered. Since these criteria were developed, new information, based on consistent surveys, has indicated that the total number of nesting females has increased substantially over the last 20 years, from about 20 animals to about 50, and that nesting has remained stable at the major nesting areas. Based on the fact that the population appears stable, and that all of the threats as described in the original listing have been eliminated or reduced, reclassification of the crocodile will be possible, provided existing levels of protection continue to be afforded to crocodiles and their habitat, and that management efforts continue to maintain or enhance the amount and quality of available habitats necessary for all life stages.

Based on these criteria, the crocodile can be reclassified to threatened status in Florida at this time because the species and its habitat are protected and management efforts continue to maintain or enhance the amount and quality of available habitat. In addition, the nesting range has expanded on both the east and west coasts of the State; crocodiles are frequently documented throughout most of their historical range; nesting has returned to Biscayne Bay on Florida's east coast and now commonly occurs at the Turkey Point Power Plant (TPPP); and nesting has been increasing for several years. Since 2001, when there were 50 known nests in Florida, the number of documented nests in Florida has continued to increase to between 91 and 94 in 2005, which satisfies the MSRP recommended minimum of having 60 breeding females before reclassification can be considered.

C. Updated Information and Current Species Status

1. **Biology and Habitat** – Today, the crocodile population in Florida has grown to an estimated 1,400 to 2,000 individuals, not including hatchlings (P. Moler 2005a; F. Mazzotti 2005). This estimate, developed by two established American crocodile experts, is based on a demographic characteristic, derived from both Nile crocodiles and American alligators, where breeding females make up 4 to 5 percent of the non-hatchling population and where approximately 75 percent of reproductively mature females breed and nest each year. This estimate demonstrates a large range, because the researchers used a range of 70 to 80 crocodile nests in Florida in their calculations (P. Moler 2005a, F. Mazzotti 2005). We believe this is a reasonable but conservative estimate because nesting has increased to between 91 and 94 documented nests in 2005.

The nesting range has also expanded on both the east and west coasts of the State and crocodiles are frequently seen throughout most of their historical range. Nesting has extended back into Biscayne Bay on Florida's east coast, and now commonly occurs at the TPPP (Gaby et al. 1985, p. 197; Brandt et al. 1995, p. 29). Although crocodiles have been nesting on Marco Island since 1997, none of the nests have

produced a viable clutch (S. Bertone 2005). Based on peer review comments and because the relatedness and origin of these animals are unknown, we did not include the nesting attempts of these animals in estimating population size above. During 2005, 91 to 94 crocodile nests were documented in south Florida (S. Klett 2005, M. Cherkiss 2005a, J. Wasilewski 2005a), and nesting has been increasing for several years (Brandt et al. 1995, p. 31; Mazzotti et al. 2000, p. 5; 2002, p. 14; Mazzotti and Cherkiss 2001, pp. 4-5). Surveyors detect approximately 80 to 90 percent of nests (F. Mazzotti 2005, J. Wasilewski 2006) and are generally unable to distinguish those nests that contain more than one clutch of eggs from different females without excavating the nests. In some instances, surveyors are able to determine that more than one female has laid eggs at a communal nest by visiting the nest over a series of days and observing hatching of separate nests (J. Wasilewski 2005b). In instances where communal nests are not distinguishable, we believe this lends to a possible underestimation of nests or females, because on occasion two females lay eggs in the same nest.

The breeding range of the American crocodile is still restricted relative to its reported historic range (Kushlan and Mazzotti 1989a, p. 5), with most breeding occurring on the mainland shore of Florida Bay between Cape Sable and Key Largo (Mazzotti et al. 2002, pp. 9-14). In the recent past, it was thought that crocodiles no longer regularly occur in the Keys south of Key Largo (Jacobsen 1983, p. 13; P. Moler, 2002). However, confirmed sightings are occurring with increasing frequency in many of the lower Keys, and we believe that these observations may indicate that crocodiles are expanding their range back into the Keys. For the last 3 years (2003 to 2005), one individual has successfully nested on Lower Matecumbe (M. Cherkiss 2005a). A crocodile was also observed as far south as Fort Jefferson in the Dry Tortugas in May 2002 (O. Bass 2002); however, nesting has not been recorded at this location. In addition, a crocodile was documented as far north as Indian River County in October 2004.

2. Five Factor Analysis (threats, conservation measures and regulatory mechanisms)

a. Present or threatened destruction, modification or curtailment of its habitat or range: The original rule proposing listing (40 FR 17590, April 12, 1975) identified intensive human development and subsequent loss of habitat as a primary threat to crocodiles. Since listing, much of the nesting habitat has remained intact and been afforded some form of protection. In addition, nesting activity that was concentrated in a small portion of the historic range in northeastern Florida Bay at the time of listing now occurs on the eastern, southern, and southwestern portions of the Florida peninsula. The primary nesting areas in northern Florida Bay that were active at the time of listing are protected and under the management of Everglades National Park (ENP), which has consistently supported the largest number of nests and the largest population of American crocodiles in Florida. The habitat in ENP is protected and maintained for crocodiles, and ongoing hydrologic restoration efforts may improve the quality of the habitat in ENP. Managers at ENP emphasize maintaining

high quality natural habitat that includes crocodile nesting areas. Restoration of disturbed sites, hydrologic restoration, and removal of exotic vegetation like Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*) have improved nesting sites, nursery habitat, and other areas frequented by crocodiles.

Since the original listing, we have acquired and protected Crocodile Lake National Wildlife Refuge (CLNWR) on Key Largo, an important nesting area for crocodiles. The acquisition of CLNWR in 1980 provided protection for over 2,205 ha (5,000 acres) of crocodile nesting and nursery habitat. Habitat on CLNWR is protected and managed to support the local crocodile population. Almost all of the nesting on Key Largo occurs within CLNWR on artificial substrates composed of spoil taken from adjacent ditches that were dredged prior to acquisition of the property. These sites and the surrounding high quality nursery habitat consistently support five to eight nests each year. Nest success on CLNWR is strongly influenced by environmental factors, and typically only about half of the nests are successful (P. Moler 2005b).

The nesting substrate on CLNWR has begun to settle and, in an effort to maintain nesting habitat, the substrate has been augmented at two sites to return it to its original elevation. Nesting has been documented at both of the elevated sites. In order for these areas to remain as nesting and nursery sites, they need to be cleared of invasive exotics. Encroachment of native and exotic plants along the levees needs to be controlled for these areas to remain suitable for nesting crocodiles and their young. In general, CLNWR is closed to public access; access is granted by special use permit only.

Both CLNWR and ENP have implemented programs that provide for maintenance of natural conditions that will benefit the crocodile; ENP is in the process of preparing a General Management Plan that will formalize ongoing management actions and further protect crocodile habitat (S. Snow 2006), and CLNWR has finalized their plan (Service 2006, pp. 1-127). A management plan as defined here and throughout this document is not regulatory. These plans are developed by the property owners, and outline strategies and alternatives needed to conserve habitat and in some cases species on the property. Implementation of the plan is not mandatory. The plan should be updated on a regular basis so that managers and staff have the latest information and guidance for crocodile management.

In addition to the two primary, publicly-owned, crocodile nesting sites, nesting habitat has been created within the historic range on a site that may not have historically supported nesting. TPPP, owned and operated by Florida Power and Light (FPL), contains an extensive network of cooling canals (built in 1974) that provides good crocodile habitat in Biscayne Bay. The site is approximately 1,214 ha (3,000 acres), and the majority is considered crocodile habitat. The number of nests at this site has risen from 1 to 2 per year between 1978 and 1981 (Gaby et al. 1985, p. 193), to 10 to 15 nests per year in the 1990s (Brandt et al. 1995, p. 31; Cherkiss 1999, p. 15; J. Wasilewski 1999, 2005a), and supported 25 nests in 2005 (J. Wasilewski

2005a). This property now supports the second largest breeding aggregation of crocodiles in Florida. TPPP has developed and implemented a management plan that specifically addresses crocodiles. TPPP is also closed to access other than personnel who work at the facility. FPL personnel maintain the canals and crocodile habitat through activities like exotic vegetation control and planting of low-maintenance native vegetation. FPL personnel also have supported an extensive crocodile monitoring program since 1976. Operation of the TPPP is licensed by the Nuclear Regulatory Commission through 2032, and FPL plans to continue crocodile management and monitoring while the plant is in operation (B. Bertleson 2002).

FPL has also developed the Everglades Mitigation Bank along the western shore of Biscayne Bay immediately adjacent to the TPPP, which may help bolster the crocodile population in Biscayne Bay in coming years. This site is a wetlands mitigation bank, approximately 5,665 ha (14,000 acres) in size, of which about 5,050 ha (10,000 acres) is crocodile habitat. As of November 2005, crocodile nesting has not been recorded on this site, but it is anticipated that nesting will occur in the near future (J. Wasilewski 2005b). It is difficult to estimate in advance how many potential nesting sites will occur here, but we believe that it will be roughly equivalent to the TPPP site. This area will be protected in perpetuity and may help offset any loss of the artificial habitat at TPPP if that site is modified after the current operating license expires in 2032.

Even though nesting habitat at TPPP is created rather than natural, and all of the nesting at CLNWR and some areas of ENP is on artificial or created substrate, crocodiles have successfully moved into and used these habitats. We believe that it is important to continue to provide protection for the artificial habitats that crocodiles opportunistically use within their current range.

Outside of these areas that now comprise primary nesting habitat for crocodiles, land acquisition has provided protection to many other areas of potential habitat for crocodiles in Florida. A total of 44 public properties, owned and managed by Federal, State, or county governments, as well as two privately-owned properties managed at least partially or wholly for conservation purposes, contain potential habitat for crocodiles. Thirty-five of these conservation lands operate under management plans (e.g., Florida Department of Environmental Protection 2001, pp. 1-103). All of the plans prescribe management actions that will provide conditions beneficial for crocodiles and maintain or improve crocodile habitat and potential nesting sites. A common action called for in many of the plans is exotic vegetation control, and some plans (e.g., Rookery Bay National Estuarine Research Reserve, Collier-Seminole State Park) have goals to restore the natural freshwater flow patterns through hydrological restoration (e.g., Florida Department of Environmental Protection 2000, p. 4). These 44 public properties contain about 28,330 ha (70,000 acres) of potential crocodile habitat, whereas together ENP and CLNWR contain about 131,120 ha (324,000 acres). A total of approximately 166,000 ha (410,000 acres) of mangrove-dominated vegetation communities are present in south Florida on public and private lands (i.e., TPPP) that are managed at least partially for

conservation purposes. Approximately 10,117 ha (25,000 acres) of mangrove habitat occurs in south Florida outside of conservation lands. Only a small fraction (< 5 percent) of known nests currently occur on unprotected sites (F. Mazzotti 2006), and these sites may be less secure than sites under public ownership.

Construction and development within coastal areas continues to grow, and still poses a threat to remaining crocodile habitat that is not protected. With virtually all known crocodile habitat under protection for conservation purposes, the total Florida crocodile population (estimated between 1,400 and 2,000 individuals (not including hatchlings)), the expansion of the nesting range on both the east and west coast of Florida, and with crocodiles frequently seen throughout most of their historical range, we believe that the amount and quality of habitat in south Florida will continue to be maintained or enhanced sufficiently to provide protection for all life stages of the existing population. We also believe that available habitat can support population growth and expansion.

b. **Overutilization for commercial, recreational, scientific, or educational purposes:** Prior to listing in 1975, crocodiles were frequently collected for museums and zoos, and at least occasionally shot for sport. Though it is difficult to estimate the magnitude of collection and sport hunting, several lines of evidence suggest that they may have significantly impacted the Florida population prior to listing. Moore (1953, p. 54) reported on a collector who advertised that he would pay for any live crocodiles anywhere in south Florida; these were added to his collection at a zoological garden. This collector claimed to have the largest collection of American crocodiles in the United States. Incidental and intentional killing by fishermen in Florida Bay was common (Moore 1953, pp. 55-56). At the time of listing in 1975, the final rule stated that poaching for skins and eggs still sometimes occurred and crocodiles were occasionally shot for sport from passing boats. Ogden (1978, p. 193) reported that 4 of the 10 human-caused crocodile deaths he was aware of between 1971 and 1975 resulted from shooting.

Since listing in 1975, few malicious killings have been recorded (Kushlan 1988, p. 784; Moler 1991a, pp. 3-4; P. Moler 2006a). Kushlan (1988, p. 784) reported that only 3 of 13 human-caused mortalities between 1975 and 1984 resulted from shooting (approximately 23 percent). Moler (1991a, pp. 3-4) reported 27 human-caused mortalities from 1980 to 1991, only one shooting was reported (approximately 4 percent of human-caused mortalities). Since 1991, no crocodile mortalities resulting from shooting have been recorded. This declining trend in the number of recorded shootings suggests reduced risk to crocodiles from this threat. The few cases involving illegal take of crocodiles in south Florida have been publicized and may have deterred poaching and killing of crocodiles. Stories in newspapers and other popular press, as well as radio and television reports and documentaries, have aided in informing residents and visitors about the status and legal protection of American crocodiles.

CLNWR and TPPP both have restricted access and are in general closed to the public. ENP also restricts access to crocodile nesting areas during the breeding season. Adults and hatchlings produced in these areas are protected as a result of this restricted access.

We only receive a few requests for recovery permits during any given year for commercial or scientific purposes related to the crocodile in Florida. We have no reason to believe that trade or any other type of current or future utilization poses a risk to the American crocodile population in Florida.

c. **Disease or predation:** Depredation of crocodile nests by raccoons was cited as a threat in the original listing. Predation of nests by raccoons at TPPP and CLNWR has not been observed (F. Mazzotti 2004). Nest predation in ENP has been variable with an increasing trend that has not been tested for statistical significance (F. Mazzotti 2004). For example, the majority of nests near Little Madeira Bay, within ENP, have been depredated by raccoons from year to year (Mazzotti and Cherkiss 2001, p. 4). While a few years ago, most of the predation in ENP was on nests in artificial substrates, now most is on nests at beach sites, which are historically the most productive in ENP (F. Mazzotti 2004). This is of concern as these are the only nests on natural habitat left in the United States. On average, 20.1 percent of nest failures resulted from raccoon depredation in all areas where nesting surveys were conducted, including areas outside of ENP (Kushlan and Mazzotti 1989b, pp. 14-15; Mazzotti 1989, p. 222; Mazzotti et al. 2000, p. 4, 8; Mazzotti and Cherkiss 2001, p. 4, 7). Of the 56 to 59 nests at ENP in 2005, 13 (22 to 23 percent) were depredated by raccoons (M. Cherkiss 2005c).

Predation of nests by fire ants has occurred at ENP (one nest) and TPPP (several nests) (F. Mazzotti 2004). No fire ant problems have been recorded at CLNWR.

Nest depredation may become an increasing problem as the density of crocodile nests increases, allowing for raccoons and other nest predators to become specialized in locating nests (Mazzotti 1999, p. 557). However, localized efforts to control raccoons may boost productivity rates in areas where raccoon depredation has become problematic.

There is no evidence of disease in the American crocodile population in Florida. Therefore, disease does not present a known threat.

d. **Inadequacy of existing regulatory mechanisms:** The Act currently provides protection for the American crocodile as an endangered species, and these protections will not be significantly reduced by this reclassification to threatened status.

The State of Florida provides legal protection for the crocodile within its boundaries. In 1967, the State listed the crocodile as "protected." This status was revised in 1972, when the crocodile was listed as "endangered" under Chapter 68A-27 of the Florida Wildlife Code. Chapter 68A-27.003 of the Florida Code, entitled "Designation of endangered species; prohibitions; permits" specifies that "no person shall pursue,

molest, harm, harass, capture, possess, or sell" any of the endangered species that are listed. Violation of these prohibited acts can be considered a third degree felony, and is punishable by up to 5 years in prison and a $10,000 fine (Florida Statute 372.0725). At this time, the FWC is not reviewing the crocodile's status, but a change in Federal status is likely to initiate a State review (P. Moler 2006b). The FWC currently operates under a cooperative agreement with us, under section 6 of the Act, which formalizes a cooperative approach to the development and implementation of programs and projects for the conservation of threatened and endangered species.

On June 28, 1979, the American crocodile was added to Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). This designation reflected that the species, while not currently threatened with extinction, may become so without trade controls. On June 6, 1981, the crocodile was moved to Appendix I, indicating that it was considered to be in danger of extinction. Generally, no commercial trade is allowed for Appendix I species. Effective February 17, 2005, the Cuban population was downlisted to Appendix II. CITES is a treaty established to monitor international trade to prevent further decline in wild populations of plant and animal species. CITES permits may not be issued if import or export of the species may be detrimental to the species' survival, or if specimens are not legally acquired. CITES does not regulate take or domestic trade, so it would not apply to take within Florida or the United States.

Several other Federal regulations may provide protection for crocodiles or their habitat. Section 404 of the Clean Water Act (33 U.S.C. 1344 et seq.) requires the issuance of a permit from the U.S. Army Corps of Engineers (Corps) for the discharge of any dredged or fill material into waters of the United States. The Corps may deny the issuance of a permit if the project might adversely affect wildlife and other natural resources. Also, sections 401 and 403 of the Rivers and Harbors Act (33 U.S.C. 304 et seq.) prohibit the construction of bridges, roads, dams, docks, weirs, or other features that would inhibit the flow of water within any navigable waterway. The Rivers and Harbors Act ensures the protection of estuarine waters from impoundment or development and indirectly protects natural flow patterns that maintain crocodile habitat. In addition, the Federal agencies responsible for ensuring compliance with the Clean Water Act and the Rivers and Harbors Act are required to consult with the Service if the issuance of a permit may affect listed species or their designated critical habitat, under section 7(a)(2) of the Act.

The Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 et seq., as amended) requires equal consideration and coordination of wildlife conservation with other water resources development. This statute allows us and State fish and game agencies to review proposed actions and address ways to conserve wildlife and prevent loss of or damage to wildlife resources. The Fish and Wildlife Coordination Act allows us to help ensure that crocodiles and their habitat are not degraded by water development projects and allows us to incorporate improvements to habitat whenever practicable.

Additionally, ENP has established regulations for general wildlife protection in units of the National Park System that prohibit the taking of wildlife; the feeding, touching, teasing, frightening, or intentional disturbing of wildlife nesting, breeding, or other activities; and possessing unlawfully taken wildlife or portions thereof (36 CFR 2.2). CLNWR and TPPP do not have to deal with these sorts of issues as they are both generally closed to the public. The Service believes that adequate regulatory mechanisms are in place.

e. **Other natural or manmade factors affecting its continued existence:** As explained in the original listing (40 FR 44149), crocodile nest sites were vulnerable to disturbance from increasing human activity because of the remoteness and difficulty of patrolling nesting areas. Human disturbance can cause crocodiles to abandon habitat or nest sites (Kushlan and Mazzotti 1989b, p. 14). As the crocodile population and the human population in south Florida has grown, the number of human–crocodile interactions has increased (T. Regan 2006). However, ongoing acquisition of nesting, juvenile, and nursery sites and other crocodile habitat by Federal, State, and local governments and implementation of management plans on these properties have resulted in crocodile conservation.

Of the three primary properties that support nesting (ENP, CLNWR, and TPPP), only CLNWR and TPPP have a management plan in place that specifically addresses the crocodile. This plan calls for activities such as road maintenance, vehicle access, and construction to be conducted in crocodile habitat only at certain times or locations based on the crocodile's activity to reduce human disturbance. In addition, TPPP is closed to access other than personnel who work at the facility. ENP has established rules that provide protection from disturbance to benefit the crocodile, even without a species-specific management plan. At ENP, protection from disturbance is based on guidelines for general public use, such as instructions to stay on marked trails. CLNWR is generally closed to public access. Activities on or near the nesting sites are conducted during the non-breeding season to minimize crocodile disturbance. CLNWR has finalized a management plan that formalizes ongoing actions and future projects and more specifically address crocodiles (Service 2006, p. 38), and ENP is preparing their General Management Plan (S. Snow 2006). In addition, ENP is preparing a draft wilderness plan that will benefit the crocodile mostly by general prescribed changes in public use in portions of ENP.

In addition to these primary nesting sites, approximately 44 public properties, managed as conservation lands by Federal, State, or county governments, provide potential habitat for crocodiles in south Florida. In addition, two other privately-owned sites that are maintained as conservation lands or that conduct natural lands management provide potential crocodile habitat. Thirty-five of these properties operate under current management plans. Only two specifically mention management actions intended to benefit the crocodile. However, actions mentioned in the other plans that will reduce disturbance to crocodiles include restrictions on public use, implementation of boat speed limits (including areas of no-wake zones), and prohibition of wildlife harassment. Managing potential human–crocodile

conflicts remains an important factor in providing adequate protection for and reducing disturbance to crocodiles. However, the degree to which the crocodile occurs on conservation lands, and lands where management plans are in place and implemented, reduces the extent of human-related disturbance and threats.

The original proposed listing cites the risk of a hurricane or another natural disaster as a serious threat to the crocodile. Hurricanes and freezing temperatures may also kill some adults (Moler 1991a, p. 4), but their susceptibility to mortality from extreme weather is poorly documented. These events still have the potential to threaten the historically restricted nesting distribution of the American crocodile. However, increased nesting activity in western Florida Bay, Cape Sable, and TPPP has broadened the nesting range. Nesting now occurs on the eastern, southern, and southwestern portions of the Florida peninsula. While a single storm could still easily affect all portions of the population, it is now less likely that the impact to all population segments would be severe.

The original listing rule cited the restriction of the flow of fresh water to the Everglades because of increasing human development as a potential threat to the American crocodile. Ongoing efforts to restore the Everglades ecosystem and restore a more natural hydropattern to south Florida will affect the amount of fresh water entering the estuarine systems. Because growth rates of hatchling crocodiles are closely tied to the salinity in the estuaries (Mazzotti and Cherkiss 2003, p. 13), restoration efforts will affect both quality and availability of suitable nursery habitat. Decreased salinity should increase growth rates and survival among hatchling crocodiles. Proposed restoration activities in and around Taylor Slough and the C-111 canal, as discussed in the Central and South Florida Project Comprehensive Review Study (Corps and South Florida Water Management District [SFWMD] 1999, p. 4-28, K-135), could increase the amount of fresh water entering the estuarine system and extend the duration of freshwater flow into Florida Bay. Alternative D13R hydrologic plan simulation (Corps and SFWMD 1999, p. 1-20) predicts that the addition of fresh water could occur throughout many of the tributaries and small natural drainages along the shore of Florida Bay, instead of primarily from the mouth of the C-111 canal. Salinities in nesting areas, including Joe, Little Madeira, and Terrapin Bays, are projected to be lower for longer periods than they currently are within this area (based on alternative D13R hydrologic plan simulation) (Corps and SFWMD 1999, pp. D-24, D-A-81 to D-A-83, K-135). This restoration project should increase the amount and suitability of crocodile habitat in northern Florida Bay and increase juvenile growth rates and survival (Mazzotti and Brandt 1995, p. 7).

Hydrological restoration may also affect crocodile habitat in Biscayne Bay. Reductions in freshwater discharge will occur in the Miami River, Snake Creek, north and central Biscayne Bay, and Barnes Sound (extreme southern end of the Biscayne Bay system) (P. Pitts 2005). These projected changes will likely reduce habitat quality in the more urbanized northern half of Biscayne Bay. Freshwater flows to south Biscayne Bay are predicted to increase with Comprehensive Everglades Restoration Program (CERP), thus increasing habitat quality in this area. More

importantly, a primary objective of CERP's Biscayne Bay Coastal Wetlands and C-111 Spreader Canal projects is to rehydrate degraded coastal wetlands in south Biscayne Bay and Barnes Sound by redirecting fresh water from conveyance canals to wetlands. This will have the effect of lowering salinities in the wetlands, thus increasing habitat quality for crocodiles, particularly juveniles. Currently, the potential area affected by these projects in the Biscayne Bay system is on the order of 24,000 ha (60,000 acres). Considering the bay as a whole, Everglades restoration should increase the amount and suitability of crocodile habitat and benefit the species.

Mortality of crocodiles on south Florida roads has consistently been the primary source of adult mortality, and this trend has not changed (Mazzotti and Cherkiss 2003, p. 22, table 6). Road kills have occurred throughout the crocodile's range in Florida, but most have occurred on Key Largo and around Florida Bay, especially around Card and Barnes Sounds (Mazzotti and Cherkiss 2003, p. 22, table 6). Many of the recorded crocodile road kills are adults, which may result from the increased likelihood of large individuals being reported. We cannot accurately estimate the proportion of road-killed crocodiles that are reported. Therefore, it is difficult to accurately assess the magnitude of this source of mortality or its effect on the population. However, all segments of the crocodile population have continued to grow despite this continuing mortality factor. Signs cautioning drivers of the risk of colliding with crocodiles have been posted along the major highways throughout crocodile habitat. Measures identified to help reduce road mortality include installing fencing in appropriate places to prevent crocodiles from entering roadways and installation of box culverts under roadways so that crocodiles can safely cross roads.

The success of crocodile nesting is largely dependent on the maintenance of suitable egg cavity moisture throughout incubation, and flooding may also affect nest success. On Key Largo and other islands, failure of nests is typically attributed to desiccation due to low rainfall (Moler 1991b, p. 5). Data compiled by Mazzotti and Cherkiss (2003, p. 13, figure 5) document an average of 48 percent nest success from 1978 through 1999 (excluding 1991 and 1992 due to lack of data) at CLNWR on north Key Largo. Nest failures on the mainland may be associated with flooding or desiccation (Mazzotti et al. 1988, pp. 68-69; Mazzotti 1989, pp. 224-225). In certain areas, flooding and over-drying affect nest success. Data compiled by Mazzotti and Cherkiss (2003, p. 13, table 5, 7) document an average of 64.4 percent nest success from 1970 through 1999 at ENP (excluding 1975, 1976, 1983, 1984, and 1996 due to lack of data) and 98 percent nest success from 1978 through 1999 at TPPP (excluding 1980 and 1982 due to lack of data).

The final listing rule did not reference contaminants as a potential threat. However, several studies have shown that contaminants occur in crocodiles and their eggs in south Florida (Hall et al. 1979, p. 88; Stoneburner and Kushlan 1984, pp. 192-193), including organochlorine pesticides (DDT, DDE, and dieldrin, among others), and PCBs. Acute exposure to high levels of these contaminants may result in death, while prolonged exposure to lower concentrations may cause liver damage, reproductive failure, behavioral abnormalities, or deformities. Despite the fact that contaminants

have been documented in crocodile eggs in south Florida, the population and numbers of nests are increasing. Little information is known at this time about what constitutes dangerous levels of these contaminants in crocodiles or other crocodilians.

Overall, the crocodile population in Florida has more than doubled its size since it was listed to an estimated 1,400 to 2,000 individuals and appears to be compensating for these threats.

D. Synthesis – We have carefully assessed the best scientific and commercial data available regarding the past, present, and future threats faced by the crocodile in Florida. Based on this evaluation, we have determined that the crocodile in its range in Florida meets the criteria of a DPS as stated in our policy of February 17, 1996 (61 FR 4722). In regard to its status, we recommend designating the American crocodile in Florida as a DPS, and reclassifying it from an endangered species to a threatened species. The recovery plan for the crocodile states that, "Based on the fact that the population appears stable, and that all of the threats as described in the original listing have been eliminated or reduced, reclassification of the crocodile will be possible, provided existing levels of protection continue to be afforded to crocodiles and their habitat, and that management efforts continue to maintain or enhance the amount and quality of available habitats necessary for all life stages." We believe, based on our evaluation, that the criteria for downlisting the American crocodile in the Florida DPS have been met because: (1) the amount and quality of crocodile habitat in Florida continues to be maintained or enhanced sufficiently to provide protection for all life stages of the existing crocodile population and available habitat can support population growth and expansion; and (2) acquisition of nesting and nursery sites and additional crocodile habitat by Federal, State, and local governments and implementation of management on these publicly-owned properties have improved protection to crocodiles and their nests.

III. RESULTS

A. Recommended Classification: Downlist American crocodile in Florida DPS from endangered to threatened

B. New Recovery Priority Number N/A – proposed rule to downlist published in March 2005; final rule to downlist to be published soon

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

A. Revise recovery plan and include delisting criteria
B. Develop database to track relocations
C. Develop database to track injuries/deaths
D. Better coordinate collection/results of genetic information
E. Continue to maintain nesting sites
F. Restore/create nursery habitat
G. Increase public awareness of the conservation/habitat needs

H. Reduce the incidence of road mortalities by installing box culverts

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Peer Review: The proposed rule reclassifying the American crocodile in Florida (70 FR 15052) was mailed to the following knowledgeable individuals for their review and comment:

Paul Moler
FWC

Perran Ross
University of Florida

John Thorbjarnarson
Wildlife Conservation Society

Results of Peer Review: Peer review was conducted during the rule-making process. All three peer reviewers agreed that the Florida population of the American crocodile has significantly increased since listing and that the majority of the species habitat is protected or under special management consideration. All peer reviewers concurred with proceeding with reclassification.

U.S. FISH AND WILDLIFE SERVICE

SIGNATURE PAGE for 5-YEAR REVIEW on American crocodile Florida distinct population segment

CURRENT CLASSIFICATION

American crocodile: endangered

RECOMMENDATION resulting from the 5-Year: Reclassify to Threatened Status the American crocodile Florida distinct population segment

REVIEW CONDUCTED BY:

Cindy Schulz

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 10-30-06

Do not Approve_____Date_____

Lead Regional Director, Fish and Wildlife Service

Concur _____Date_____

Not concur_____Date_____