American Crocodile
Crocodylus acutus

Listing status: USFWS = Threatened
FWC = Endangered

Trend: Crocodiles were listed by the US Fish and Wildlife Service (USFWS) as endangered throughout their range in 1975, and critical habitat was established for this species in 1979. The species listing and habitat protection were required because of documented population declines most likely associated with habitat alterations and human disturbances (USFWS 1999). Since its listing in 1975, the American crocodile population in Florida has more than doubled, and its distribution has expanded. Today, the crocodile population in Florida has grown to an estimated 1,400 to 2,000 individuals, not including hatchlings. Nesting activity is now concentrated around Biscayne and Florida bays (Mazzotti 1999, Moler 1992).

Perceived Threats: The rapid rate of development in coastal areas in south Florida will limit future crocodile expansion through habitat loss, fragmentation, and interactions with humans (USFWS 2007). Since most of the nesting occurs on artificial substrate that must be maintained through active management, recovery of the species will depend on continued maintenance of existing nesting areas and/or expansion of nesting into areas with natural substrates (USFWS 2007). While depredation of nests has not prevented an increase in the crocodile population to date, the increasing incidence of predation on natural beach nesting sites is of concern (USFWS 2007). Human-crocodile interactions, vehicle strikes, and environmental contaminants are also threats to the crocodile USFWS 2007). Other threats in Florida include stochastic natural disasters such as hurricanes and cold weather (USFWS 1998). American crocodiles are sensitive to human presence (especially at nest site). In Florida, disturbance at nest sites caused females to abandon the site (Kushlan and Mazzotti 1989; NatureServe).

Notes: The American Crocodile was reclassified by USFWS as Threatened in April of 2007 (USFWS 2007). The FWC has a Crocodile – Human Interaction Response Plan (see links below).

Prioritization information:

PLCP PVA proportion of pops modeled to persist on public lands = **.33**
PLCP PVA probability of a 50% decline on public lands = **.95**
Millsap updated biological score = **29.7**
Millsap updated supplemental score = 12
Legacy population trend = increasing
Legacy population status = **low**
Summary: This species triggers 4 of the 6 parameters, which would likely make it a high priority on a statewide level. However, see notes on the PVA when considering these results. One item of consideration is that the management

recommendations for this species (i.e. restore freshwater flow to estuaries) are extremely large scale projects and may be impractical from a WMA-level perspective, but is ongoing as part of the Comprehensive Everglades Restoration Plan (CERP).

Life History: In the United States, the American Crocodile has always been restricted to southern Florida, however nesting range has been much reduced from its historic extent of Lake Worth through the Florida Keys and northeastern Florida Bay (Mazzotti 1999). On the Atlantic Coast their range historically extended north to Lake Worth, Palm Beach County; currently few are found further north than southern Biscayne Bay, Dade County. On the Gulf Coast, American crocodiles are rarely found as far north as Sanibel Island (Moler 1992). The majority of crocodiles are present in the vicinity of core nesting areas near Biscayne and Florida bays. Most of the current Florida breeding range is protected by Everglades National Park, Crocodile Lake National Wildlife Refuge, and the Florida Power and Light Turkey Point Facility.

The American crocodile is found in coastal swamps and along low-energy mangrove-lined bays, creeks, and inland swamps. When not engaged in nesting, they are found primarily in the fresh and brackish water inland swamps, creeks, and bays, retreating further into the back country in fall and winter. Their frequent use of fresh and brackish waters suggests crocodiles prefer less saline waters. They use sheltered areas such as undercut banks, mangrove snags and roots for protection from wind and wave action. Natural nesting habitat includes sandy shorelines and raised marl creek banks adjacent to deep water. Crocodiles also nest on elevated man-made structures such as canal berms and other places where fill has been introduced. Many nest sites are used recurrently, if not disturbed. Access to deep water is an important component of preferred habitats (Mazzoti 1983). An important component of crocodile habitat that should not be overlooked is canals. A large proportion of the population lives in canals and nests on canal banks, particularly undeveloped coastal canals. This is important because such existing canals and berms need to be protected, as they are at Crocodile Lake and Turkey Point.

Females reach sexual maturity at about 2.25 m, at about 10 to 13 years (Mazzotti 1983). As with most crocodilians, American crocodile breeding is stimulated by increasing ambient water and air temperatures. In south Florida, temperatures sufficient for of courtship behavior occur in late February through March. Male American crocodiles may mate several females.

Males typically defend their breeding territory from late February through March. Crocodiles can move long distances (100km+), and are frequently reported outside of their breeding range. Defensive behaviors include vocalizing, body posturing, and attacking other crocodiles. Females roam between territories searching for mates. Prior to copulation, American crocodiles perform courtship behaviors, considered some of the most structured of all crocodilians (USFWS 2004). Following successful copulation, females select a nest site to deposit their elongate oval eggs. Clutches average 38 eggs (range 8 and 56). Nest sites are abandoned if sufficiently disturbed and may not be used in following years.

Adults must help young crocodiles during hatching, but give little parental care afterwards. Juveniles remain in the vicinity of their nursery area for approximately one year before dispersing (Kushlan and Mazzotti 1989).

Preferred Habitat Parameters for American Crocodile:

- Access to water with depths exceeding 1m
- Sheltered areas such as undercut banks and mangrove snags and roots that are protected from wind and wave action

Minimum Habitat Requirement:

From PVA: Populations with > 17 females
From Literature: N/A

Best Management Practices:

- Protect nest sites and juvenile growth areas
- Protect crocodiles from human disturbance, cars and other killing
- Restore natural freshwater flows to estuaries by redirecting flows through mangrove swamps instead of canals when possible, and removing hindrances to freshwater flow
- Create elevated, well-drained zones in remote areas near coastal estuaries as nesting habitat for crocodiles

Survey Methods and Monitoring Protocols:

Mazzotti, F.J. and M.S. Cherkiss. 2003. Status and Conservation of the American Crocodile in Florida: Recovering an Endangered Species While Restoring an Endangered Ecosystem. University of Florida, Ft. Lauderdale Research and Education Center. Tech. Rep. 2003. 41 pp. (Standard protocols for monitoring, p. 24). See: http://crocdoc.ifas.ufl.edu/research/reports/american_croc2003.pdf

PVA Summary: The population viability analysis run for the American crocodile was conducted using a single estimated metapopulation for all Florida occurrences. They used a moderate initial abundance estimate of 300 individuals and used well-studied fecundity and survival data. The baseline growth rate was just slightly over 1.0, which makes the model very sensitive to small changes in fecundity and survival, with adult survival being the most significant characteristic in population changes. A 5% reduction in the adult survival rates lead to an increase in the risk of extinction (i.e., 38.6% probability) and in the risk of a large decline (e.g., 72.5% probability of an 80% decline in abundance).

The probability of extinction in the next 100 years was modeled to be 8.9% for the population containing all potential habitat and about 34.8% for managed habitat only. There was a risk of a large decline in abundance (e.g., a 27.3% probability of an 80% decline in abundance with all potential habitat). The probability of a decline was elevated under managed habitat only (e.g., 64.9% probability of an 80% decline in abundance).

It is important to note differences in population parameters between those used in the PVA and those found in the literature. The PVA uses a population

estimate of 300 adult females, while the literature estimates the population to be 1400 - 2000 (USFWS 2007). The literature also discussed juvenile and subadult survival as the most important characteristic in persistence, as opposed to the PVA which found adults to be the most critical factor. One important factor that is not addressed by the PVA is that adult mortality under natural conditions is relatively rare, and management must therefore focus on survivorship of all age classes. In addition, nearly all of the breeding range for the American crocodile is protected by government and a private corporation controlled by government. The PVA lists only publicly managed lands as protected, and therefore finds a much higher likelihood of decline than what may accurate. Based on the recent population increases of this species and the continued protection, the predicted rates of loss should be viewed with caution.

2003 Landcover used for model:

Coastal Strand	Scrub Mangrove
Salt Marsh	Tidal Flat
Mangrove Swamp	

FNAI Natural Communities Utilized:

Coastal Strand	Coastal Berm
Tidal Marsh	Unconsolidated Substrate
Tidal Swamp	

FNAI field guide description of habitat: Coastal estuarine marshes, tidal swamps, and creeks along edges of mainland and islands. Usually associated with mangroves. Nests on beaches, stream banks, and levees.

Important Links:

FWC. 2005. American Crocodile – Human Interaction Response Plan
http://myfwc.com/ABOUT/Issues/HSC/Crocodile-Conflict-Action-Plan.pdf

FNAI Inventory. 2001. – American Crocodile
http://www.fnai.org/FieldGuide/pdf/Crocodylus_acutus.PDF

USFWS. 2003. South Florida Ecological Services – American Crocodile Conservation Guidelines
http://www.fws.gov/verobeach/images/pdflibrary/Species_Guidelines_American_Crocodile.pdf

USFWS. 2004. South Florida Multi-Species Recovery Plan – American Crocodile
http://www.fws.gov/verobeach/images/pdflibrary/amcr.pdf

USFWS. 2007. Federal Register –Final Classification of American Crocodile from Endangered to Threatened
http://myfwc.com/crocodile/docs/Crocodile_reclassification_in_Florida.pdf

Pertinent Documents/Literature:

Kushlan, J.A. and F.J. Mazzotti. 1989(a). Historic and present distribution of the American crocodile in Florida. Journal of herpetology 23:1-7.

Kushlan, J.A. and F.J. Mazzotti. 1989. Population biology of the American crocodile. Journal of herpetology 23:7-21.

Mazzotti, F.J. 2007. American crocodile (Crocodylus acutus) in Florida: recommendations for endangered species recovery and ecosystem restoration. Journal of herpetology 41: 122-132.

Mazzotti, F.J. 1999. The American crocodile in Florida Bay. Estuaries 22: 552-561.

Mazzoti, F.J. 1983. Ecology of Crocodylus acutus in Florida. Ph.D. Thesis in Ecology, Pennsylvania State University, University Park, Pennsylvania.

Moler, P. E., C. L. Abercrombie III, and D. K. Jansen. 1992. Aspects of the population biology of the American crocodile. Florida Game and Fresh Water Fish Commission Report, Tallahassee, Florida, USA. 34pp.

Moler, P. E. 1992. American crocodile, Crocodylus acutus Cuvier. Pages 83–89 in P. E. Moler, editor. Rare and endangered biota of Florida. Volume III. Amphibians and reptiles. University Press of Florida, Gainesville, Florida, USA.