

Nile Crocodile (*Crocodylus niloticus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2022

Revised, March 2022

Web Version, 6/6/2022

Organism Type: Reptile

Overall Risk Assessment Category: Uncertain



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1 Native Range and Status in the United States

Native Range

From Somma (2018):

“Indigenous distribution of *C. [Crocodylus] niloticus* ranges throughout most of the African continent, excluding much of northern, especially northwestern, Africa and extreme southwestern Africa, but including Madagascar and the Nile River Valley (Cansdale, 1955; Groombridge, 1987; King, 1989; Ross and Magnusson, 1989; Grenard, 1991; Branch, 1993, 1998). Historically the Nile crocodile's range included Israel, Syria, Comoros, and the Seychelles (King, 1989; Ross and Magnusson, 1989).”

From Uetz et al. (2021a):

“Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Democratic Republic of the Congo (Zaire), Republic of Congo (Brazzaville), Egypt, Ethiopia, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Liberia, Madagascar, Nosy Faly, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa (Eastern Cape etc.), Sudan (Jumhūriyyat), Republic of South Sudan (RSS), Swaziland, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe.”

From Utete (2021):

“Habitat ranges of crocodiles traverses the Nile River in the north, Senegal and Benue Rivers in the west to the east in the Congo Basin (IUCN, 2017). The habitat ranges also stretches across the southern most limits of Lower Kunene River in Namibia (Griffin, 2003), through the Okavango Delta and Makgadikgadi Pans in Botswana, Zambezi River in Zimbabwe and Zambia (Wallace et al., 2013), and Lake Sibaya (Combrink, 2004) the St Lucia Wetlands in South Africa (Leslie, 1997; Feeley, 2010; Combrink, 2014; Marais, 2014), and right to the Island of Madagascar (Pooley, [2016]; Pooley et al., 2019).”

Status in the United States

According to Somma (2018), *Crocodylus niloticus* has been reported as introduced in Florida and Mississippi.

From Rochford et al. (2016):

“We, thus, documented the first known introduction of *C. niloticus* in Florida.”

“Our recapture data indicate that *Crocodylus niloticus* can survive in the wild in southern Florida for nearly two years. [...] there is no current evidence of an established population of *C. niloticus* in Florida or Mississippi [...]”

From Somma (2018):

“Internationally, different populations of Nile crocodiles are listed by C.I.T.E.S. in Appendix I (threatened or endangered) or Appendix II (trade regulated with permits); their trade or transport is subject to mandatory regulation both internationally and, in the U.S., federally (Levell, 1997).”

The CITES Trade Database (CITES 2021) reports at least 37 live *C. niloticus* individuals imported to the United States between 2011 and 2020 for a mix of purposes including personal use, commercial use, scientific use, and zoos.

From Hawaii Department of Agriculture (2019):

“*Crocodylus* (all species in genus) (Prohibited for short-term performance or exhibition in circuses, carnivals, or state fairs. Allowed for short-term performance for commercial filming, for exhibition in government zoos, or for other purposes permitted under section 4-71-6.5)”

C. niloticus is included in the New Mexico Department of Game and Fish’s (2010) species importation list group IV.

From New Mexico Department of Game and Fish (2010):

“Species importation list group IV may be for live non-domesticated animals that are considered dangerous, invasive, undesirable, state or federal listed threatened, endangered, a furbearer or any other species of concern as identified by the director. The importation of these species are prohibited for the general public but may be allowed for, scientific study, department approved restoration and recovery plans, zoological display, temporary events/entertainment, use as service animal or by a qualified expert.”

Means of Introductions in the United States

From Somma (2018):

“A natural catastrophe (flooding from Hurricane Georges [in Mississippi]) caused their release from confinement in a breeding facility (M. Duran in Anonymous, 1998).”

“Crocodile exhibit [in Florida] was vandalized and baby crocs escaped.”

From Rochford et al. (2016):

“Over the last decade several large groups of *C. niloticus* have been imported from South Africa and Madagascar for both zoological display (e.g., Disney’s Animal Kingdom) and the pet trade, with the latter being the most likely introduction pathway for these individuals.”

Remarks

From Isberg et al. (2019):

“Trade in *Crocodylus niloticus* is subject to the conditions for Appendix I of CITES except for the populations of Botswana, Egypt, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Namibia, South Africa, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe, which are included in Appendix II (Caldwell 2017).”

This assessment follows World Register of Marine Species (WoRMS; Uetz 2017) and the global Reptile Database (Uetz et al. 2021a,b) in treating *C. niloticus* as a single valid species native to much of Africa. However, in recent years some authors (e.g., Hekkala et al. 2011; Isberg et al. 2019) have split the taxon into *Crocodylus niloticus*, native to eastern and southern Africa, and *C. suchus*, native to western and central Africa. In addition, several sources list multiple subspecies and synonyms of *C. niloticus*, adding to the taxonomic confusion. All of the following subspecies and synonym names listed by Hekkala et al. (2011) were used in the information search for *C. niloticus*: *Alligator cowieii*, *C. binuensis*, *C. complanatus*, *C. hexaphractos*, *C. lacunosus*, *C. madagascariensis*, *C. marginatus*, *C. multiscutatus*, *C. n. africanus*, *C. n. chamses*, *C. n. cowieii*, *C. n. madagascariensis*, *C. n. niloticus*, *C. n. pauciscutatus*, *C. n. suchus*, *C. octophractus*, *C. suchus*, *C. vulgaris*, and *C. vulgaris var. madagascariensis*.

From Isberg et al. (2019):

“The African Nile Crocodile is now recognized as two distinct species: one occupying eastern Africa, the Nile valley and southern Africa and retaining the name *Crocodylus niloticus* Laurenti, 1768; and the other occupying west and central Africa, including the Congo, Niger and Ogoue drainages and assigned to the existing name *Crocodylus suchus* Geoffroy, 1807 (Schmitz et al. 2003, Hekkala et al. 2011). Red List assessments now treat these two taxa independently.”

From Hekkala et al. (2011):

“The Nile crocodile is comprised of 11 synonymized, historically described species and seven previously proposed subspecies [...] As currently managed, the species is recognized as a single entity, although recent molecular studies provide evidence to the contrary. Limited phylogenetic studies indicate that *C. niloticus* is paraphyletic (Schmitz et al. 2003; Meredith et al. 2011), and multilocus microsatellite comparisons have shown that populations across Africa are geographically differentiated (Hekkala et al. 2009).”

“[...] a centuries-long dispute over the taxonomic status of the Nile crocodile remains unresolved. [...] We have taken a total evidence approach involving phylogenetic analysis of mitochondrial and nuclear markers, as well as karyotype analysis of chromosome number and structure, to assess the monophyletic status of the Nile crocodile. Samples were collected from throughout Africa, covering all major bioregions. We also utilized specimens from museum collections, including mummified crocodiles from the ancient Egyptian temples at Thebes and the Grottes de Samoun, to reconstruct the genetic profiles of extirpated populations. Our analyses reveal a cryptic evolutionary lineage within the Nile crocodile that elucidates the biogeographic

history of the genus and clarifies long-standing arguments over the species' taxonomic identity and conservation status. An examination of crocodile mummy haplotypes indicates that the cryptic lineage corresponds to an earlier description of *C. suchus* and suggests that both African *Crocodylus* lineages historically inhabited the Nile River.”

From Schmitz et al. (2003):

“Nominal subspecies previously recognised [Fuchs et al. 1974; Wermuth and Mertens 1977; Wermuth and Fuchs 1978] are: *C. n. niloticus* Laurenti, 1768 (restricted type locality: Egypt); *C. n. africanus* Laurenti, 1768 (restricted type locality: Tanzania); *C. n. chamses* Bory, 1824 (restricted type locality: Congo River); *C. n. cowiei* Smith and Hewitt, 1937 (type locality: South Africa); *C. n. madagascariensis* Grandidier, 1872 (type locality: Madagascar); *C. n. pauciscutatus* Deraniyagala, 1948 (type locality: Lake Rudolph); and *C. n. suchus* Geoffroy, 1807 (type locality: Niger River).”

“Initial results suggest significant genetic differentiation between relict and Eastern Nile crocodile populations. However, data from additional West African populations suggest an even more complex evolutionary history for *C. niloticus*, as very marked genetic differences could be found between samples from West- and East Africa.”

“Clearly more work is needed to properly reconstruct the evolutionary history of Africa’s largest predators. What was once thought of as the common Nile crocodile, is perhaps not so common after all.”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Uetz (2017), *Crocodylus niloticus* is the current valid and original name for this species. See Remarks for list of synonymized species names.

From ITIS (2022):

- Kingdom Animalia
 - Subkingdom Bilateria
 - Infrakingdom Deuterostomia
 - Phylum Chordata
 - Subphylum Vertebrata
 - Infraphylum Gnathostomata
 - Superclass Tetrapoda
 - Class Reptilia
 - Order Crocodilia
 - Family Crocodylidae
 - Genus *Crocodylus*
 - Species *Crocodylus niloticus* Laurenti, 1768

Size, Weight, and Age Range

From Somma (2018):

“A very large crocodile averaging an overall length of 5 m (16 ft) and, perhaps exceeding 5.5 m (18 ft) (Cott, 1961; Ross and Magnusson, 1989; Grenard, 1991; Branch, 1998; Jones, 1998).”

From Isberg et al. (2019):

“As with all crocodilians, size among *C. niloticus* is sexually dimorphic with the larger males reaching total lengths of up to 6 m in exceptional cases (Fergusson 2010). The size at which females become sexually mature is variable. Cott (1961) reported the smallest sexually mature female from northern Zambia was 238 cm total length (TL) and southern Zambia 259 cm TL. [...] The smallest live nesting female ever recorded by Pitman over a 15 year period (n = 1500 examined) was 219 cm TL (Cott 1961). Graham (1968) found the onset of maturity in Lake Rudolf (Turkana) crocodiles even smaller, from 180 cm onwards. The largest mature female shot by Pitman was 4.62 m (Graham 1968).”

Environment

From Isberg et al. (2019):

“The Nile Crocodile is found in a wide diversity of water bodies (rivers, lakes, swamps, and coastal estuaries) [...] Populations are also reported from desert oasis pools and subterranean streams in caves.”

“In some areas, they extend into brackish water environments (Pooley 1982, Pauwels et al. 2004) and sometimes occupy highly saline water. In the St Lucia estuarine system of South Africa, two adult males were recorded with satellite telemetry utilising areas of the estuarine lake for months at time, with mean salinity levels of 51.9 ± 2.5 psu, although there were nearby freshwater seepages (Combrink 2014).”

Climate

From Isberg et al. (2019):

“[...] desert oasis pools and subterranean streams [...]”

From Hekkala et al. (2011):

“[...] sub-Saharan distribution [...]”

From Rochford et al. (2016):

“In its native range, *C. niloticus* reaches latitudes of approximately 32 degrees, north and south of the equator, incorporating both tropical and temperate zones.”

Distribution Outside the United States

Native

From Somma (2018):

“Indigenous distribution of *C. [Crocodylus] niloticus* ranges throughout most of the African continent, excluding much of northern, especially northwestern, Africa and extreme southwestern Africa, but including Madagascar and the Nile River Valley (Cansdale, 1955; Groombridge, 1987; King, 1989; Ross and Magnusson, 1989; Grenard, 1991; Branch, 1993, 1998). Historically the Nile crocodile's range included Israel, Syria, Comoros, and the Seychelles (King, 1989; Ross and Magnusson, 1989).”

From Uetz et al. (2021a):

“Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Democratic Republic of the Congo (Zaire), Republic of Congo (Brazzaville), Egypt, Ethiopia, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Liberia, Madagascar, Nosy Faly, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa (Eastern Cape etc.), Sudan (Jumhūriyyat), Republic of South Sudan (RSS), Swaziland, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe.”

From Utete (2021):

“Habitat ranges of crocodiles traverses the Nile River in the north, Senegal and Benin Rivers in the west to the east in the Congo Basin (IUCN, 2017). The habitat ranges also stretches across the southern most limits of Lower Kunene River in Namibia (Griffin, 2003), through the Okavango Delta and Makgadikgadi Pans in Botswana, Zambezi River in Zimbabwe and Zambia (Wallace et al., 2013), and Lake Sibaya (Combrink, 2004) the St Lucia Wetlands in South Africa (Leslie, 1997; Feeley, 2010; Combrink, 2014; Marais, 2014), and right to the Island of Madagascar (Pooley, [2016]; Pooley et al., 2019).”

Introduced

No records of introductions outside of the United States were found for *Crocodylus niloticus*.

Means of Introduction Outside the United States

No records of introductions outside of the United States were found for *Crocodylus niloticus*.

Short Description

From Somma (2018):

“Unlike the noticeably blunt-snouted American alligator (*Alligator mississippiensis*), the only crocodilian indigenous to Mississippi, the snout of *Crocodylus niloticus* is more pointed, with a larger number of teeth conspicuously protruding from the mouth when closed (Neill, 1971; Ross and Magnusson, 1989; Branch, 1993, 1998). The dorsal coloration in adults is a uniformly or blotched olive or gray, with darker crossbands on the tail, while juveniles are olive brown to

green with more conspicuous black crossbands on the body and tail (Branch, 1993, 1998; Ross and Magnusson, 1989). The belly is typically straw-yellow (Branch, 1998). Illustrated in Neill (1971), Guggisberg (1972), Ross and Magnusson (1989), Graham (1990), Branch (1993, 1998), and Lamar (1997).”

Biology

From Somma (2018):

“*Crocodylus niloticus* is an omnivorous, primarily aquatic, predator that eats fish, turtles and other reptiles, small and large mammals (including zebra and buffalo), birds, carrion, invertebrates and any other animal it can overpower, swallow whole or rip apart, and ingest (Roosevelt, 1909; Cansdale, 1955; Cott, 1961; Grenard, 1991; Branch, 1993, 1998; Lamar, 1997). In many parts of Africa, humans are commonly preyed upon by Nile crocodiles; therefore, fatal attacks and consumption by these large predators are well-documented (Cansdale, 1955; Guggisberg, 1972; Pooley et al., 1989; Graham, 1990; Allen, 1998; Branch, 1998). Nile crocodiles are highly fecund; females lay eggs dug out of the sand and aggressively guard the nest (Cansdale, 1955; Cott, 1961; Lang, 1987; Magnusson et al., 1989; Branch, 1993, 1998; Allen, 1998). Hatchling gender is determined by the heat of the sun-warmed nest; lower temperatures produce mostly females while higher temperatures produce mostly males (Branch, 1998). Hatchling *C. niloticus* may die if the mother is not present to dig them out of the nest (Jones, 1998). Parental care of the hatchlings and growing juveniles by the mother (and sometimes an attendant male) is relatively sophisticated; ranging from transport of the young to water, to aggressive defense of the brood from predators (T. Jones in Cansdale, 1955; Hadley, 1969; Pooley, 1974a, b, 1977; Pooley and Gans, 1976; Lang, 1987, 1989; Magnusson et al., 1989; Branch, 1993, 1998).”

From Isberg et al. (2019):

“Nile crocodiles lay 35-50 eggs, although this varies considerably among populations. The nesting season varies with geographic areas but can be generally described as a dry season activity in the north, tending to an early wet season activity in the south. Female *C. niloticus* excavate hole nests in sandy banks, up to 50 cm deep, a few meters from the water’s edge and actively guard the nest during incubation. A high percentage of eggs are still lost to predation from monitor lizards (*Varanus niloticus*; Combrink et al. 2016, Calverley and Downs 2017), marsh mongoose (*Atilax paludinosus*; Combrink et al. 2016), hyenas and humans when the females leave to thermoregulate (cooling in the water) or feed. Those eggs that do survive hatch after 75-95 days, with females opening the nest and guarding the young for 6-8 weeks after hatching (Fergusson 2010, Combrink et al. 2016).”

“Habitat utilization differs between juveniles, sub-adults and adults with juveniles entering a dispersal phase at approximately 1.2 m length (Hutton 1989). Modha (1967) described some aspects of the social behaviour, including the establishment of breeding hierarchies. Combrink et al. (2017) reported that gravid females selected winter basking/breeding areas close to nest-sites with a significantly smaller home range (0.85 ha) than non-gravid females (108.4 ha), providing further evidence of maternal commitment. The highest reported nest fidelity recorded with satellite telemetry during incubation was 99.7% over 96 days (Combrink et al. 2017). Nile

crocodiles display an ontogenetic shift in diet consuming insects and small aquatic invertebrates when [sic] young moving to predominantly vertebrate prey as they become larger (Cott 1961, Wallace and Leslie 2008, Lyet et al. 2016). This can also include humans, particularly when anthropogenic activities occur within crocodile habitats (Sideleau 2016).”

From Utete (2021):

“Sexual maturity is attained at 2.6 m for females and 3.1 m for males (Cott, 1961). Females lay around 40–60 eggs in guarded nests and the incubation times ranges from 70 to 100 days, after which they open the nest and carry juveniles to the shallow edges of wetlands (Cott, 1961; Kofron, 1993). Socially, crocodiles are gregarious and observe hierarchy (based on age and sex) but do not actually form clusters rather they congregate in shallow sections of wetlands to feed, defecate, bask, court and mate (Hutton, 1987; CSG, 2009). Typically, aggression occurs among males when establishing territoriality and fighting for mates, and among females when guarding hatchlings at the edges of wetlands (Kofron, 1993).”

Human Uses

The CITES Trade Database (CITES 2021) reports over 120,000 live *C. niloticus* individuals traded internationally between 2011 and 2020, including over 114,000 traded for commercial purposes. For the United States, specifically, the database reports at least 37 live *C. niloticus* individuals imported to the United States between 2011 and 2020 for a mix of purposes including personal use, commercial use, scientific use, and zoos.

From Somma (2018):

“Throughout history, Nile crocodiles have been widely hunted for their skins, meat, and for sport (Roosevelt, 1909; Cansdale, 1955; Cott, 1961; Graham, 1990; Grenard, 1991; Allen, 1998; Jones, 1998; also see numerous reviews compiled in Webb et al., 1987; Ross, 1989). Additionally, *C. niloticus* is extensively "farmed" and the subject of much conservation management throughout its range (Child, 1987; also see numerous contributions compiled by Webb et al. (1987) and Ross (1989).”

From Isberg et al. (2019):

“Consequently, the management of HCC [human-crocodile conflict] has now become the major focus of programs in several countries, replacing the previous emphasis on sustainable use through ranching and trophy hunting. Several countries have significant export quotas for wild harvested skins and these are mostly derived from programs nominally aimed at alleviating HCC (Fergusson 2010).”

“The Nile Crocodile is one of the most commercially utilized crocodilians, the skin being acknowledged as one of the “classics” (Fergusson 2010). [...] and reports annual trade exports of over 250,000 skins from the *C. niloticus* range states (CITES Trade Database 2017, Caldwell 2017). The majority of these are from Zimbabwe (50%), South Africa (30%) and Zambia (14%). The formal crocodile skin industry is now well established and market forces together with

ongoing trade controls have largely negated illegal international trade in crocodile skins, which is thought to be insignificant.”

“Human-crocodile conflict is reported to be intense with crocodiles killed whenever possible. One community member reported that crocodile eggs, when found, were eaten by people.”

“Three farms collect eggs on the Tana River, with approximately 15,000 eggs in the 2015/16 season [...]”

“In Kenya, the indigenous Pokomo people have eaten crocodile meat and eggs, [...] Uncontrolled use of crocodiles for traditional medicine such as blood, fat, brains and other organs is posing pressures on some *C. niloticus* populations (Combrink et al. 2011).”

“Furthermore, fishermen trap crocodiles with hooks, nets and laced bait and use the crocodile meat as baits for their fish traps, [...]”

“Crocodile fat is used in traditional medicines in some countries, including Madagascar, for the treatment of asthma (CITES 2016). There is a trade in crocodile penises within Egypt and the Sudan (M. Shirley per. Comm. 208).”

“Ecotourism also uses *C. niloticus* as an iconic drawcard (e.g. Lyet et al. 2016).”

Diseases

The influenza A virus is an OIE-reportable disease (OIE 2022) that is found in *Crocodylus niloticus*. However, OIE (2022) only lists the disease as reportable in birds and swine.

According to Poelen et al. (2014), *Crocodylus niloticus* can have the following pathogens or parasites: *Micropleura vivipara*, roundworms (Nematoda), Coccidium, Nerilla, Nephrocephalus, Pseudoneodiplostomum, *Hepatozoon petiti*, *Trypanosoma grayi*, Dujardinia, *Shuni orthobunyavirus*, *Mycoplasma crocodyli*, *Serratia fonticola*, Influenza A virus, and Nile crocodilepox virus.

According to Uetz (2017) *Crocodylus niloticus* can have the following parasites: *Acanthochoasmus gonotyl*, *Acanthochoasmus productus*, *Acanthochoasmus vicinus*, *Acanthostomum productum*, *Acanthostomum vicinum*, *Distoma bifurcatum*, *Ingwenascaris sprengi*, *Oistosomum caduceus*, *Opisthophallus bagriincapsulatus*, *Pseudocrocodylicola aswaniensis*, *Pseudoneodiplostomum bifurcatum*, *Pseudoneodiplostomum niloticum*, *Stephanoprora ornate*, and *Typhlophoros kwenae*.

It has also been reported that *Crocodylus niloticus* can be the host to *Trichinella zimbabwensis* (La Grange et al. 2009), *Salmonella choleraesuis* (Ocholi and Enurah 1989), *Aeromonas hydrophila* (Turutoglu et al. 2005), Adenoviral hepatitis (Pfitzer et al. 2019), and Mycoplasma-associated polyarthritis (Mohan et al. 1995).

Threat to Humans

From Isberg et al. (2019):

“*Crocodylus niloticus* is a large predator and the recovery of *C. niloticus* numbers in close proximity to an increasing human population often results in fatal conflicts. 2015 statistics compiled within CrocBITE (2013, Sideleau 2016) report 58 fatal and 29 non-fatal *C. niloticus* attacks. However, reporting of attacks, both fatal and non-fatal, is poor across the range states of *C. niloticus*, so these numbers are conservative. It has been estimated that over 250 human fatalities occur each year in Kenya alone (D. Haller pers. comm. 2016). Retaliation killings of crocodiles are common across range states.”

“However, fatal attacks from *C. niloticus* are the most numerous of all crocodilian species, even saltwater crocodiles (*C. porosus*), and pose a real threat to some conservation and management strategies and programs.”

From Aust et al. (2009):

“The principle objective of this study was to quantify the impact of crocodiles on rural livelihoods. Data were obtained from existing records and through community surveys on the lower Kavango, Chobe and Kwando rivers and upper Zambezi River. Existing estimates suggest an annual loss of ~255 domestic cattle per year for northeastern Namibia whilst community survey estimates suggest a substantially greater annual loss of ~6864 cattle per year. Community surveys also revealed conflict between crocodiles and artisanal fishermen, with an estimated 71 500 fishing nets damaged by crocodiles per year.”

3 Impacts of Introductions

Even though *Crocodylus niloticus* has been recorded as introduced outside of its native range in Florida and Mississippi, the species has not become established and there were no reports of impacts associated with those introductions. *Crocodylus niloticus* has not been recorded as introduced outside of the United States.

The following quotation pertains to potential impacts of introduction of *C. niloticus*.

From Rochford et al. (2016):

“If *C. niloticus* became established, it may threaten the native species of Florida through predation (documented herein [i.e., stomach of one specimen contained remains of a largemouth bass, *Micropterus salmoides*]) and competition [...] Additionally, many crocodilian species are already known to hybridize in captivity and where their native ranges overlap in the wild (Weaver et al. 2008; Machkour-M’Rabet et al. 2009; Rodriguez et al. 2011; Srikulnath et al. 2012). Introducing *C. niloticus* to the native range of *C. acutus* may result in hybrids degrading the genetic integrity of *C. acutus*, a state and federally listed species.”

“There are both economic risks and risks to human health and safety presented by establishment of Nile Crocodiles in Florida. [...] We recommend a scientific risk assessment to evaluate the potential for *C. niloticus* establishment, spread, and impact in Florida.”

The importation, possession, or trade of *Crocodylus niloticus* is prohibited or restricted in the following States: Hawaii (Hawaii Department of Agriculture 2019) and New Mexico (New Mexico Department of Game and Fish 2010). Various populations of *C. niloticus* are listed under Appendix I or Appendix II of the Convention on International Trade in Endangered Species (CITES; Isberg et al. 2019), which regulates their trade internationally.

4 History of Invasiveness

Crocodylus niloticus has been introduced outside of its native range into Florida and Mississippi but the species is not established in either location. *C. niloticus* has not been introduced anywhere else outside of the United States. Well over a hundred thousand live *C. niloticus* were traded internationally between 2011 and 2020, and the skin, meat, and organs of *C. niloticus* are also heavily traded throughout the world. The importation, possession, or trade of *Crocodylus niloticus* is prohibited or restricted in Hawaii (Hawaii Department of Agriculture 2019) and New Mexico (New Mexico Department of Game and Fish 2010) and is regulated by Appendix I and Appendix II of CITES. Although the volume of live trade in *C. niloticus* is substantial, it is not high enough (i.e., not millions of organisms) to warrant a history of invasiveness classification of Low, so the history of invasiveness for *C. niloticus* is classified as No Known Nonnative Population.

5 Global Distribution

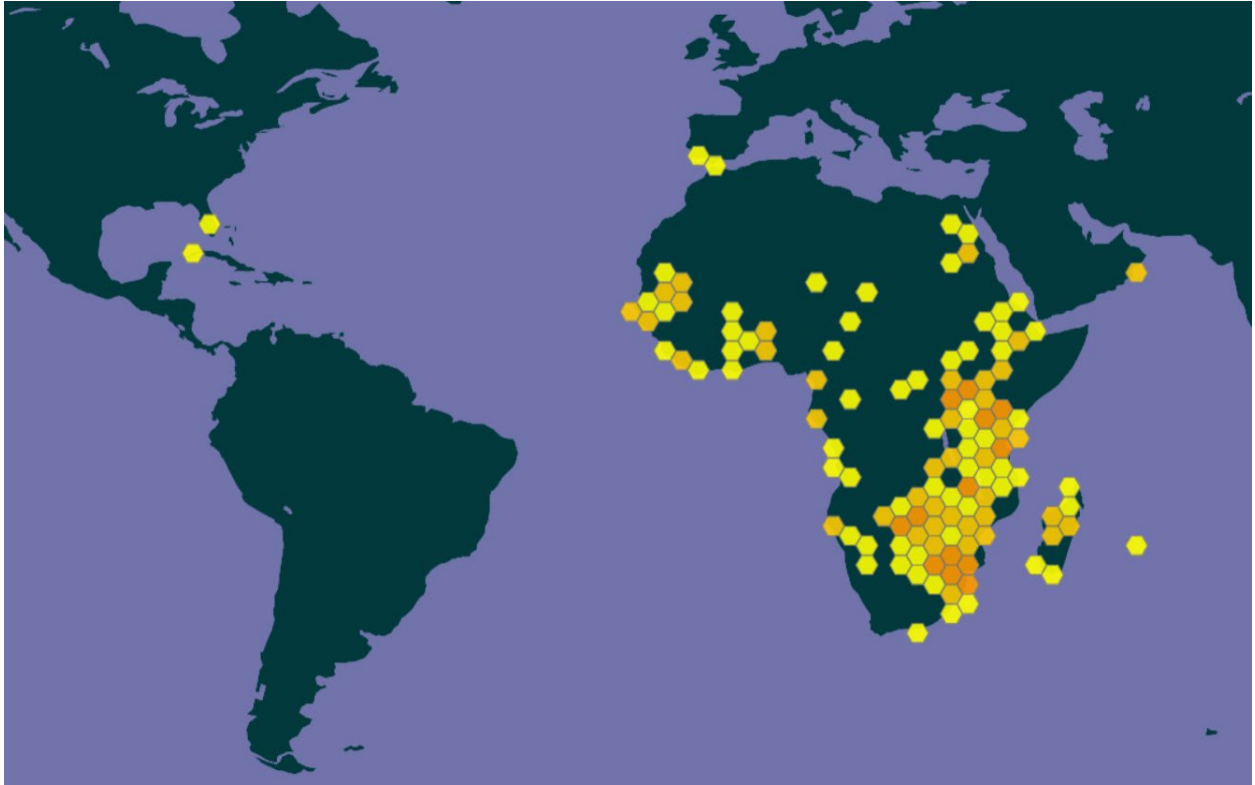


Figure 1. Known global distribution of *Crocodylus niloticus*. Observations are reported from Africa (including Madagascar and Mauritius), the United States (Florida), Cuba, and Spain. Map from GBIF Secretariat (2022). Points from the United States, Cuba, and Spain were not used in the climate matching analysis because the species is not known to be established in these locations. The points located off the coast of Oman were also not included in the climate matching analysis because they are in the ocean and likely inaccurate.

6 Distribution Within the United States



Figure 2. Known distribution of *Crocodylus niloticus* in the United States. Map from Somma (2018). The points in both Florida and Mississippi are not representative of wild established populations, and therefore will not be included in the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match to the contiguous United States was mostly medium, with patches of both high and low match. Areas of high match were found along the southern border from California to Florida, and into much of Arizona, New Mexico, and western Texas. Areas of low match were found in the Northeast, along the northern border, and throughout much of the Rocky Mountains. The overall Climate 6 score (Sanders et al. 2021; 16 climate variables; Euclidean distance) for the contiguous United States was 0.184, high (scores greater than 0.103, exclusive, are classified as high). The following States had high individual Climate 6 scores: Arizona, California, Colorado, Florida, Louisiana, New Mexico, Oklahoma, and Texas. The following States had a medium individual Climate 6 scores: Alabama, Georgia, Idaho, Kansas, Mississippi, North Carolina, Nevada, Oregon, South Carolina, Utah, and Washington. All other States had a low individual Climate 6 score.

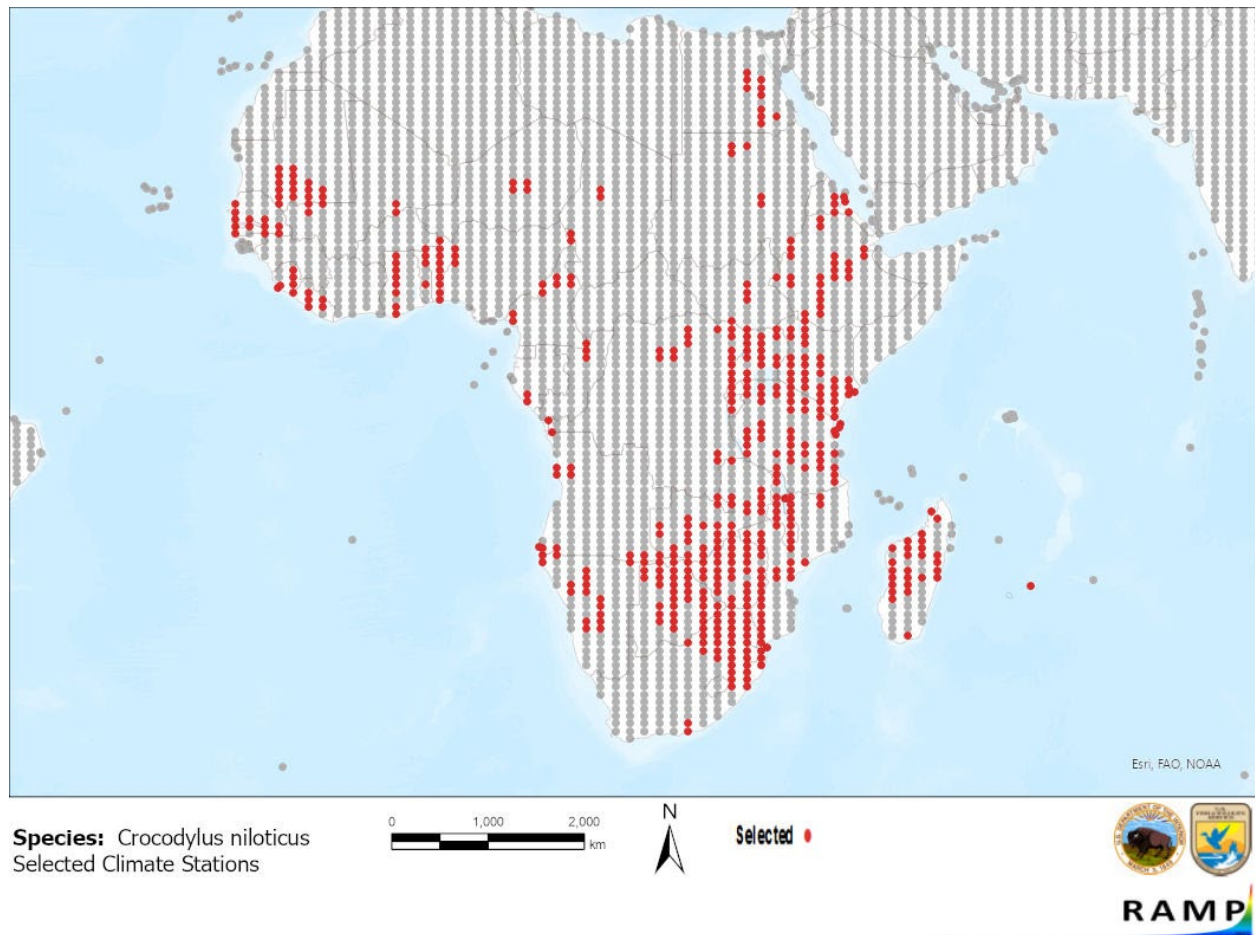


Figure 3. RAMP (Sanders et al. 2021) source map showing weather stations in Africa selected as source locations (red; continental Africa, Madagascar, Mauritius) and non-source locations (gray) for *Crocodylus niloticus* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

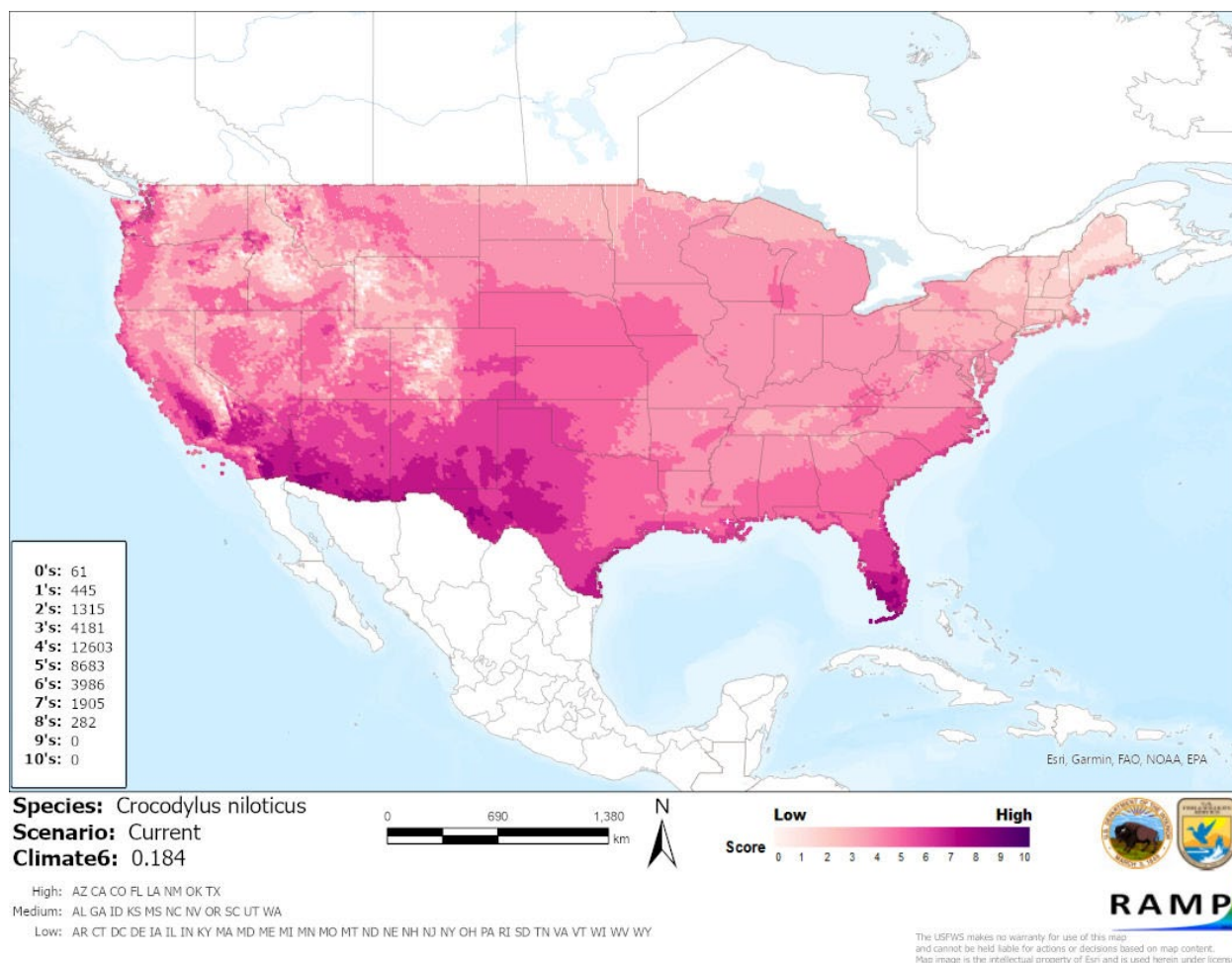


Figure 4. Map of RAMP (Sanders et al. 2021) climate matches for *Crocodylus niloticus* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Light Pink = Lowest match, 10/Dark Purple = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

| | |
|--|--------------------------------------|
| Climate 6:
(Count of target points with climate scores 6-10)/
(Count of all target points) | Overall
Climate Match
Category |
| $0.000 \leq X \leq 0.005$ | Low |
| $0.005 < X < 0.103$ | Medium |
| ≥ 0.103 | High |

8 Certainty of Assessment

The certainty of assessment for *Crocodylus niloticus* is low. There is ample information available on the species biology and trade history. There is also evidence that it was introduced into Florida and Mississippi, but it did not establish in either location despite surviving in Florida for two years. Impacts of introduction are unknown. In addition, there is disagreement in the

literature as to whether this species is a single species or two species, *Crocodylus niloticus* and *Crocodylus suchus*.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Crocodylus niloticus is a freshwater crocodile native throughout Africa. There is a great deal of information available on this species biology and distribution. It is heavily traded, both as a live organism and as animal parts. It has been introduced outside of its native range in Florida and Mississippi. Individuals introduced to Mississippi were quickly captured; individuals introduced to Florida survived in the wild for two years but did not form an established population within that time. Threats posed by *C. niloticus* to humans, livestock, and fishing gear have been documented within the native range. However, neither impacts nor lack of impacts has been documented from locations outside the native range. The history of invasiveness is classified as No Known Nonnative Population because of the lack of establishment outside the native range and because trade in live organisms is not sufficiently high to warrant a classification of Low history of invasiveness. There is significant taxonomic uncertainty as to whether *Crocodylus niloticus* is a single species or two species, *Crocodylus niloticus* and *Crocodylus suchus*. This ERSS follows World Register of Marine Species (WoRMS; Uetz 2017) and the global Reptile Database (Uetz et al. 2021a,b) in treating *C. niloticus* as a valid single species. The climate match for the contiguous United States was High overall, with the highest matches occurring along the southern border from California to Florida. The certainty of this assessment is Low due to a lack of information on impacts of introductions and taxonomic uncertainty. The overall risk assessment category for *Crocodylus niloticus* is Uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 4): No Known Nonnative Population**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Low**
- **Remarks, Important additional information: The influenza A virus is an OIE-reportable disease (OIE 2022) that is found in *Crocodylus niloticus* but OIE (2022) only lists the disease as reportable in birds and swine.**
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 11.

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Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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