

CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA



Seventeenth meeting of the Conference of the Parties
Johannesburg (South Africa), 24 September – 5 October 2016

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Maintenance of the Malagasy population of *Crocodylus niloticus* in Appendix II, pursuant to Resolution Conf. 9.24 (Rev. CoP16) Annex 2(a), paragraph B) rather than to Resolution Conf. 11.16 (Rev. CoP15), subject to the following annotations:

1. No skins or products within the artisanal industry from wild *C. niloticus* less than 1 m or greater than 2.5 m total length will be permitted for national or international trade.
2. An initial wild harvest ceiling of 3000 animals per year for the artisanal industry will be imposed for the first three years of operation (2017-2019).
3. No export of raw or processed skins harvested from the wild will be permitted for the first 3 years.
4. Farm production shall be restricted to ranching and/or captive breeding, with national skin production quotas.
5. Management, wild harvest ceiling and national skin production quotas will be audited and reviewed annually by international experts for the first three years to ensure sustainability.

B. Proponent

Madagascar*

C. Supporting statement

1. Taxonomy

- | | |
|--------------------------|---|
| 1.1 Class: | Reptilia |
| 1.2 Order: | Crocodylia |
| 1.3 Family: | Crocodylia |
| 1.4 Species: | <i>Crocodylus niloticus</i> Laurenti (1768) |
| 1.5 Scientific synonyms: | <i>Alligator cowieii</i> , <i>Crocodylus binuensis</i> , <i>Crocodylus chamses</i> , <i>Crocodylus complanatus</i> , <i>Crocodylus lacunosus</i> , <i>Crocodylus madagascariensis</i> , |

¹ This document has been provided in these languages by the author(s).

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Crocodilus marginatus, *Crocodilus multiscutatus*, *Crocodilus octophractus*,
Crocodilus robustus, *Crocodilus suchus*, *Crocodilus vulgari*

1.6 Common names: Malagasy: Voay
English: Nile Crocodile
French: Crocodile du Nil
Spanish: Crocodilo del Nil

1.7 Code numbers: L-306.002.001.006

2. Overview

- 2.1 Within Madagascar, the national population of *Crocodylus niloticus* has been utilized by local people, within an artisanal crocodile leather industry involving vegetable tanning and product manufacture, since at least the 1950s.
- 2.2. As the 17th Party to ratify and join CITES (1975), Madagascar found *C. niloticus* already listed on Appendix I, and the criteria for a transfer to Appendix II beyond its resources to comply with, despite the national artisanal industry continuing.
- 2.3. In 1985, at the 5th Conference of the Parties to CITES, the Malagasy population of *C. niloticus* was transferred from Appendix I to Appendix II pursuant to Resolution Conf. 5.21, and subject to an annual export quota to allow limited trade in wild *C. niloticus* skins.
- 2.4. Madagascar submitted proposals at the 7th, 8th and 9th Conferences of the Parties to transfer its *C. niloticus* population to Appendix II pursuant to Resolution Conf. 3.15 on ranching [now Resolution Conf. 11.16 (Rev. CoP15)], but the population was maintained on Appendix II pursuant to Resolution Conf. 7.14 (previously Resolution Conf. 5.21). The annual export quota shifted from wild skins (1985-1989) to mainly ranched skins, with annual quotas of 100-200 wild skins in 1992-1997, 500-750 wild skins in 1998-2007 and 200 wild skins in 2008-2011. The much larger harvest (average of around 5000 animals per year) for the artisanal industry was not included.
- 2.5. In 1997, at the 10th Conference of the Parties, Madagascar achieved a successful and non-time bound transfer of its population to Appendix II under the provisions of ranching, which again included a quota for wild (nuisance) animals. These decisions pre-date Resolution Conf. 9.24 (Rev. CoP16) and various changes made to Resolution Conf. 11.16 (Rev. CoP15).
- 2.6. Within the local Malagasy context, it proved difficult to meet the criteria for Resolution Conf. 11.16 (Rev. CoP15), prompting intervention by the CITES Standing Committee (2009), suspension of ranching and trade (2010-2014), and with technical assistance from the CITES Secretariat, the European Union and the IUCN-SSC Crocodile Specialist Group, the rebuilding of a revised management paradigm and program was undertaken.
- 2.7. This newly installed program (since 2014) aims primarily at sustaining and rebuilding the wild *C. niloticus* population, and consolidating and better regulating the wild harvest associated with the artisanal industry.
- 2.8. The imposition of strict national size limits on wild crocodiles that can be taken and traded is a key tool in the revised approach to management. Reinstating ranching will only be permitted subject to adherence to strict criteria. This revised program requires an annotated Appendix-II listing, pursuant to Resolution Conf. 9.24 (Rev. CoP16).

3. Species characteristics

3.1 Distribution

Crocodylus niloticus is widely distributed in Africa, occurring in Angola, Botswana, Burundi, Egypt, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Namibia, Sierra Leone, Somalia, South Africa, South Sudan(?), Sudan, Swaziland, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe.

Crocodylus suchus, previously considered to be *C. niloticus* (Hekkala *et al.* 2011), occurs in West Africa, in Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Democratic

Republic of Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea Bissau(?), Cote d'Ivoire, Liberia (?), Mali, Mauritania, Niger, Nigeria, Senegal, Togo and Uganda.

In Madagascar, *C. niloticus* is widely distributed throughout the country (Fig. 1), being most abundant in the river and lake systems bordering the northwestern and western sides of the high plateau, and the northeast of the country (eg Maningoza, Sambao, Marotondro, Bemarivo, Hafay, Ampandranana and Maningozamaty Rivers; Marovoaikely, Marovoaike, Ankiliholiho, Befandraria, Ampanihy, Sotria, Ankililio, Sahapy and Ampandra lakes). During the wet season, crocodiles may follow floodwaters and be found in seasonal rivers/habitats (eg Begogo, Antsorobalala, Betsotaky, Amborometroka, Mocarana, Betombotomboky, Manarihena, Mangotroka, Anjanambo Rivers; ROM 1997). Although river drainages may not be directly connected, the distribution of *C. niloticus* is considered to be continuous, and not fragmented.



Figure 1. Core distribution (green shading) of *C. niloticus* in Madagascar, at 0 to 1000 m asl. Crocodiles are also found further inland, at 1000-1500 asl, and are only absent at the highest altitudes (>1500 m asl).

3.2 Habitat

Nile crocodiles occur in a variety of habitats in Madagascar, including rivers, creeks, lakes and freshwater swamps at altitudes below 1500 m, and may also inhabit agricultural landscapes (eg rice fields). Breeding tends to occur in suitable habitats below 1000 m asl. At some locations *C. niloticus* occurs in brackish (eg Fort Dauphin, Vohemar) and saline (eg coastline; Behra 2012) habitats, as has been described elsewhere within the species' distribution (Pooley 1982; Pauwels *et al.* 2004). In Ankarana Nature Reserve *C. niloticus* has been found living in caves (Handwerk 2003), but this is the exception rather than the rule.

Lakes comprise around 27,200 km of shoreline (ROM 1987) and the main rivers comprise around 8100 km of mainstream (ROM 1989, 1994).

3.3 Biological characteristics

The Nile crocodile is a large crocodylian, with males attaining lengths of up to 5.5 m (Whitaker and Whitaker 2008). The largest animals known from Madagascar appear to be around 5 m long (D. Bessaguet, pers. comm.). Adult females (2.5-3.0 m TL) lay their eggs during the dry season (September-October in Madagascar; ROM 1997), in a hole-type nest in friable substrates. Clutch size (35-50 eggs) varies greatly among populations (Fergusson 2010). Eggs and hatchlings are predated by a variety of reptilian, mammalian and/or avian predators, and survival from eggs to hatchlings to mature adults is not known precisely but considered to be very low (<1%). Females actively guard their nests against predators, and display strong maternal instincts towards their young in the first few weeks of life.

3.4 Morphological characteristics

Adult *C. niloticus* are grey-olive in colour, with a white-yellowish belly. The dark cross-bands on the tail and back of juveniles tend to be more faint in adults.

There are typically 4-6 post-occipital scales, and the nuchal crest generally comprises 4 large scales flanked by a scale on each side. Malagasy *C. niloticus* are characterized by: 28-31 transverse scale rows; 14-16 scales in a row; 3-4 lateral scale rows; 17-18 double-crest caudal scutes; distinct collar; and, integumentary sense organs (Fuchs 2006). Belly scales lack osteoderms.

Fuchs (2006) recognised 6 sub-species of *C. niloticus* on the basis of skin morphology and morphometrics. In trade, the skins of what was considered *C. n. madagascariensis* (Grandidier, 1872) from Madagascar were considered readily distinguishable from those from the African continent (assigned to *C. n. niloticus*, *C. n. africanus*, *C. n. chamses* (= *C. suchus*), *C. n. cowiei*, *C. n. pauciscutatus*).

3.5 Role of the species in its ecosystem

The Nile crocodile is normally considered an "apex" predator, feeding on a variety of aquatic and terrestrial prey species (eg Somaweera *et al.* 2013; Cott 1961), but they seem to eat relatively little compared with warm-blooded animals (Cott 1961) Nile crocodile eggs and hatchlings are also a food source for a range of predator species, including other crocodiles (cannibalism). Crocodiles eat carrion and probably play a role in removing dead and injured animals

4. Status and trends

4.1 Habitat trends

Some habitats have been converted for agricultural purposes, predominantly rice cultivation, which often encroaches to and includes the riverbanks. Planting of fodder plants for cattle is undertaken in some areas, and the expansion of human settlements invariably leads to clearing of habitats. These alterations in habitat do not necessarily impact on crocodile populations *per se*, except where such changes directly involve the degradation and/or loss of nesting areas, and reduction in prey availability.

Sandbanks used for nesting may be subject to natural changes due to the extent of wet season rainfall and river flow, which can alter the shape, position and vegetation composition of nesting areas over time (ROM 1997), as has been noted with other hole-nesting crocodylians (eg *C. johnstoni*; WMI, pers. comm. 2016). Changes to nesting banks and rivers have also been caused as a result of increased siltation due to anthropogenic factors such as clearing, burning and subsequent erosion (ROM 1994, 1997).

Habitat changes and human activity in a number of river systems subject to crocodile population surveys were assessed in 2013 (CITES Secretariat 2013), but no attempt was made to quantify the possible impact of habitat change on those populations.

4.2 Population size

The survey situation in Madagascar appears to be similar to that in Papua New Guinea, where surveys of the crocodile population in accessible areas, using spotlight counts or basking counts, do not provide a good index of the population size. As found by Montague (1981), open water areas accessible to survey teams are also accessible to hunters, and so populations are both reduced and wary, with the majority of the population located outside of open water areas where survey is difficult. Nest counts may provide indices in areas where ranching can be reinstated but most of the ranching program in Madagascar has ceased and needs to be rebuilt.

Using the available data (see below) on relative densities recorded from recent surveys, with conservative correction factors for sighting fraction in surveys, and extent of available habitat, the total wild population of *C. niloticus* in Madagascar is estimated as 30,000 to 40,000 non-hatchlings. This estimate is consistent with the population size that would be required to support the historical harvest of around 5000 crocodiles per year, if it involved 10-15% of the total population each year.

4.3 Population structure

Up until 2015, survey methodology involved the allocation of crocodiles sighted into broad size categories (hatchling, juvenile, sub-adult, adult, eyeshines). In 2015, crocodiles sighted were allocated to 30-cm length categories, providing more precision on size structure. Based on these surveys, the population comprises a high proportion of juvenile and sub-adult individuals (36% of sightings were between 0.6 and 2.4 m TL). A relatively high proportion (30%) of sightings were “eyeshines”, mostly wary animals (Webb and Messel 1979), that could not be approached close enough for size to be estimated, probably due to relatively high anthropogenic activity in most rivers (CITES Secretariat 2013), including hunting. In other crocodylians this component is usually comprised mainly of larger individuals, including adults (Webb *et al.* 1989).

Based on various indices available, the adult population is thought to be 1500 to 2000 individuals. During the ranching period, the number of nests collected annually was 30 to 270, but from only a few sites. New regulations, designed to protect the adult population, limit the size of wild crocodiles that can be harvested to greater than 1.0 and less than 2.5 m total length. Ongoing monitoring will ultimately determine the impact of the wild harvest and allow trends (recovery) to be quantified.

4.4 Population trends

Population surveys have been undertaken in Madagascar at different times, in different areas, and using different methodologies (Table 1). Extensive aerial surveys were carried out in 1988 (Behra and Hutton 1988) and 1997 (Games *et al.* 1997), but a review of the survey program in 2007 concluded that this type of survey was expensive and probably not sensitive enough to detect changes in population abundance and structure over time. Aerial surveys detect the larger animals in the population (Webb and Manolis 2006), and relative to spotlight surveys, a small proportion of the population is sighted.

Table 1. Survey methodology used for *C. niloticus* in different years. The sample of rivers/lakes surveyed has also varied from year to year.

Year	Method	Day/Night?	Reference
1987	Boat	Night	Behra (1987)
1988	Aerial	Day	Behra and Hutton (1988)
1988	Boat	Night	Behra and Hutton (1988)
1997	Aerial	Day	Games <i>et al.</i> (1997)
2006	Boat	Day/Night	Andrianasolo and Rakotondrazafy (2006)
2007	Boat	Day/Night	Andrianasolo and Rakotondrazafy (2007)
2008	Boat	Day/Night	Rakotondrazafy (2008)
2008	Boat	Night	Ottley <i>et al.</i> (2008)
2009	Boat	Night	Rakotondrazafy (2009)
2011	Boat	Night and Day	R. Gandola (pers. comm.)
2012	Boat	Night and Day	R. Gandola (pers. comm.)

Year	Method	Day/Night?	Reference
2013	On foot	Day	CITES Secretariat (2013)
2013	Boat	Day	CITES Secretariat(2013); R. Gandola (pers. comm.)
2013	Boat	Night	R. Gandola (pers. comm.)
2014	On foot	Night	R. Gandola (pers. comm.)
2014	Boat	Night and Day	R. Gandola (pers. comm.)
2014	Boat	Day/Night	Andrianjaratina and Rafenomanana (2014)
2015	Boat	Night	DGF records; R. Gandola (pers. comm.)
2015	Boat	Day	R. Gandola (pers. comm.)
2015	On foot	Night and Day	DGF records

The available data on population trends, expressed as the mean percentage increase per annum, vary from area to area (Table 2). However, the most recent data suggest that in most areas surveyed the populations are increasing or at worst stable (Table 2). This is supported by anecdotal information from hunters and local communities who also consider that crocodile abundance has increased over the last few years: this is probably due to the reduced wild harvest since 2010 following CITES intervention (see Table 5).

Table 2. Average rate of increase (% per annum) for *C. niloticus* populations in areas from which trends could be derived.

Survey Area	Period	Average Rate of Increase (% p.a.)
Betsiboka River	1988-1997	+14.7%
Mahajamba River	1988-1997	+7%
Manambolo River	1988-1997	+3.5%
Mangoky River	1988-1997	-15%
Sofia River	1988-1997	-5%
Tsiribihina River	1988-1997	-10%
Ambato Boeny (Betsiboka River)	2008-2015	+13%
Ambilobe (Ankarana River)	2009-2015	+48%
Ambilobe (Mananjeba River)	2009-2015	+80%
Antserena River	2011-2015	+3%
Complexe Lagunaire Mandena	2006-2014	-1%
Lac Ambala	1988-2013	>+5%
Lac Vert (Vohemar)	1988-2014	+1%
Manambato River	2013-2014	-12%
Maroala (Betsiboka River)	2008-2015	+1%

Adult and juvenile *C. niloticus* have been reintroduced into Lac Vert, in the northeast of the country (2 adults in 1999, <200 hatchlings in 1995-1996 and 865 captive-raised juveniles in 2011) (CITES Secretariat 2013; J.C. Peyre, pers. comm. 2016). This area is considered “sacred” to the local people, and a “fady” (taboo) prohibits the hunting of crocodiles in the lake. Due to the beliefs of the people, population surveys are unable to be undertaken by boat on the lake. The latest survey results (in 2014), carried out for a portion of the lake, indicated that adults are established and breeding occurs there (as evidenced by the presence of hatchlings) (R. Gandola, pers. comm. 2016).

In 2011, 106 captive-raised juveniles were released into Lake Amparihibe, which is fed by the Betsiboka River at Maevatanana (CITES Secretariat 2013). The releases in 2011 were in response to the trade suspension in 2010-2014, when one of the ranches was forced to close its satellite facility at Maevatanana, and was approved to release their crocodiles back into the wild. The pre-2011 releases into Lac Vert were reportedly carried out to boost the population in that area (J.C. Peyre, pers. comm. 2016).

4.5 Geographic trends

Crocodiles generally have the same distribution now as they did historically. As in other countries, expansion of the human population has resulted in the local extinction of crocodiles due mainly to habitat loss (eg urbanization) and public safety concerns. Crocodiles may have also been completely removed from some areas that were designated as hunting areas in the late 1990s, with a view to mitigating human-crocodile conflict, but a lack of survey data makes confirmation difficult.

Crocodile densities are not homogenous within or between rivers in Madagascar, and were unlikely to have been so historically. Anecdotal evidence suggests some rivers supported relatively higher densities of crocodiles historically, and others low densities, which is the rule rather than the exception with crocodylian populations (eg Webb *et al.* 1984).

5. Threats

The main threat to *C. niloticus* in Madagascar is habitat degradation and loss, due to burning and alteration for agricultural production (see 4.1). New size limits and restrictions on wild harvest will reduce the risk of overexploitation, and allow *C. niloticus* populations in most parts of the country to recover over time.

With the exception of areas where the local people have a cultural association with crocodiles and killing them is prohibited (Zehrer 2013), they are generally viewed by rural communities as a dangerous predator. The egg harvest program did, and when rebuilt will continue to provide economic benefits to poor rural communities, creating incentives for “tolerating” crocodiles. During the trade suspension (2010-2014), when ranches ceased to collect eggs (see Table 5), there were numerous reports of crocodile nests/eggs being destroyed and adult crocodiles being killed (Manolis 2014), because the incentives were no longer in place. A problem exacerbated by delays in fulfilling the conditions for lifting the ban.

6. Utilization and trade

6.1 National utilization

Wild crocodiles are mainly hunted for their skins, which enter the artisanal leather industry exclusively, and are vegetable tanned and used in the manufacture of a range of leather products. Some communities consume crocodile meat, and the fat is used for traditional medicines (for asthma) in some communities.

Skins produced from ranching and captive breeding are mostly destined for international markets, and are exported in a raw salted form. In the future skins that do not meet the increasingly high grading standards of overseas markets may also enter the artisanal leather market. Up to 2010, meat produced by ranches was sold on the domestic market, at tourist facilities, restaurants and supermarkets in Antananarivo. The logistics of hunting in remote areas means that meat from wild crocodiles is unlikely to reach markets.

6.2 Legal trade

Prior to 2007, commercial skin exports from Madagascar were primarily ranched and captive-bred *C. niloticus* skins, although wild skins are known to have entered international trade as “ranched” skins through the misuse of source codes (Table 3). Since 2009, wild skins have been used exclusively by the artisanal leather industry, and have not been exported commercially.

Table 3. Commercial exports of *C. niloticus* specimens from Madagascar, 2002 to April 2016 [Caldwell 2013 (skins; 2002-2014); UNEP-WCMC 2016 (other specimens, 2002-2010); CITES Secretariat 2012 (2010-2011); DGF data (2015-2016)].* captive-bred source.

Year	Skins	Leather Products	Taxidermied Specimens	Live Animals	Skulls	Other
2002	6936	397	9	10	601	0
2003	7300	1001	4	1	1367	0
2004	4760	996	7	12	804	0
2005	4850	503	11	0	202	0
2006	6660	1185	55	0	3069	0
2007	5500	513	0	0	420	0
2008	2640	2093	2	0	0	0
2009	2450	1859	30	0	0	53
2010	0	51	0	0	0	0
2011	0	0	0	0	0	0
2012	0	0	0	0	0	0
2013	0	2	0	0	0	0
2014	0	0	0	0	0	0
2015	48 *	14 *	0	0	3090	0
2016	124 *	0	0	0	0	0

The proposed amendment is not expected to affect the nature of the trade significantly, but will allow the wild harvest to be managed more effectively, and allow the artisanal leather industry to potentially expand into international markets to some degree.

6.3 Parts and derivatives in trade

The artisanal leather industry produces a wide variety of finished products from wild *C. niloticus* skins, including leather goods (eg shoes, wallets, purses, belts, handbags, etc.) and taxidermied specimens (eg whole mounts, heads, skulls, keyrings, etc.), of which approximately 75% are currently sold and used domestically. Since 2010 no commercial exports have taken place, but artisanal products are purchased by tourists and taken with them as personal effects, pursuant to Resolution Conf. 13.7 (Rev. CoP16).

Ranches intend to continue exporting raw salted skins produced from ranching and/or captive breeding. All skins continue to be tagged in accordance with Resolution Conf. 11.12 (Rev. CoP15). The main importers of Malagasy skins since 2000 were France, Italy, Singapore and Japan. Products were mainly exported to France, but many other countries imported them in small numbers.

One local manufacturer (Sobek) imports finished *C. niloticus* leather (non-Madagascar origin) from European tanneries, and produces products for domestic and international markets. The imported leather is chrome-tanned, and is readily distinguishable from the vegetable-tanned leather produced by the artisanal leather industry.

Two other local manufacturers (Aye Aye and Sassebo) import finished, chrome-tanned crocodylian leather (*Caiman crocodiles fuscus*, *Alligator mississippiensis*) that has already been cut into pieces, ready for final manufacture (eg sewing, fittings) into specific products, which are all exported to Switzerland and France. Discarded trimmings and leather offcuts are accumulated, and later burned in the presence of DGF and Customs personnel.

6.4 Illegal trade

The supply chain for wild skins involves rural people, many of whom have limited education. That size limits now apply to crocodiles that can be taken from the wild has been disseminated through artisanal tanners who operate with networks of hunters and intermediary suppliers, and local

Government agencies. The new regulations are also part of an awareness program now being developed for rural schools and communities, to ensure compliance with new regulations.

In 2015-2016, four over-sized and 9 under-sized skins at tanneries, and 20 leather products, manufactured using under-sized skins, at retail outlets, were seized by enforcement officers. In addition, 18 legal-sized skins that were acquired from a hunter/intermediary who had not been nominated on the tannery's permit to acquire/transport wild skins, were also seized. Penalties are calculated as three times the value of the skin/product and confiscation.

In 2013, products held by artisanal manufacturers and retailers were inventoried by DGF, and product labels attached (CITES Secretariat 2013). Any finished leather products produced from under- and/or over-sized skins since the size limits were legally imposed, are subject to confiscation. Morphometric relationships that predict the size of crocodile from which a finished product was derived (see Webb *et al.* 2012) have been developed by DGF and are being used to verify compliance with skin size limits.

6.5 Actual or potential trade impacts

Ranching based on wild egg harvest is considered a safe and sustainable form of management (Jenkins *et al.* 2006), with the potential to generate positive incentives for the conservation of crocodylians. Even where a high proportion of nests/eggs are harvested, crocodylian populations have demonstrated their ability to continue to recover (eg Elsey and Kinler 2012; Fukuda *et al.* 2011). Although the full extent of *C. niloticus* nesting in Madagascar is unknown, the proposed egg harvests are considered unlikely to impact detrimentally on the wild population.

The ceiling of 3000 wild skins for the artisanal industry is at least 40% lower than historical harvest levels, and the skin size limits target the juvenile/sub-adult life stages, thereby protecting the adult portion of the population. This harvest, in addition to generating economic incentives for the conservation of crocodiles at the hunter level, generates diverse livelihood benefits right through the production chain to retail sale. Monitoring through surveys will provide indices of whether the population subject to harvesting is being sustained, but at the retail level, detailed information can be gained on the size structure of animals within the artisanal industry, again indicating whether sustainability is being achieved. It is considered that by 3 years of monitoring, Madagascar will be in a much sounder position to demonstrate population trends than it has ever been before.

7. Legal instruments

7.1 National

Madagascar has a range of legislation that relates to the conservation and management of crocodiles and their habitats (Table 4). It is important to note that since 2010, changes have been made to certain pieces of legislation to better reflect the current management regime, and in particular to ensure more effective compliance with international obligations (CITES Secretariat 2013). The legislation is considered effective for controlling illegal trade in crocodiles.

Table 4. Key legislation relating to *C. niloticus* in Madagascar.

Ordinance No. 60-126 (3 October 1960): specifies rules for hunting, fishing and protection of wildlife in Madagascar. Authorisation of hunting is subject to royalty payments and hunting seasons.

Ordinance No. 60-128 (3 October 1960): specifies procedure applicable to punishment for infractions of forest law, hunting, fishing, and the protection of nature.

Ordinance No. 75-014 (5 Aug 1975): concerns Madagascar's ratification to CITES.

Law No. 97-017 (8 August 1997): concerns revision of forestry legislation.

Law No. 2005-05 (22 January 2003): specifies code of management for protected areas, of which Madagascar has 6 categories: I -Integral Natural Reserve; II -National Park and Natural Park; III - Natural Monument; IV -Special Reserve; V -Protected Harmonious Landscape; VI -Natural Resource Reserve.

Law No. 2005-018 (17 October 2005): law on international trade in wild fauna and flora.

Decree No. 97-1200 (2 October 1997): concerns the adoption of Malagasy forestry policies.

Decree No. 2004-167 (3 February 2004): modifies Decree No. 99-954 of 15 December 1999, concerning update on the compatibility of the investment with the environment (MECIE).

Decree No. 2006-097 (31 January 2006): lays down detailed rules on the application of Law No. 2005-018 of 17 October 2005 on the international trade in wild fauna and flora. This decree essentially concerns the Management Authority and the Scientific Authorities defined in CITES. It identifies the Management Authority as a department of the Ministry responsible for forests, and the Scientific Authorities as scientific personnel from university institutions and scientists.

Decree No. 2006-098 (31 January 2006): concerns the publication of revised annexes of CITES.

Decree No. 2006-400 (30 June 2006): concerns the classification of fauna as protected, nuisance/problem and game animals: Category I -protected species; Category I, Class I; absolute protection; Category I, Class II -species that can be captured, hunted, in conformity with the regulations in force in the territory, including CITES obligations; Category II - nuisance/problem species that can be hunted at any time; Category III –game species that can be captured or hunted subject to holding an authorised permit and observing hunting periods.

Decree No. 2014-1105 (9 October 2014): establishes the regime for the protection of crocodiles in Madagascar and the conditions for marketing specimens and products.

Arrêté No. 0176/2012 (7 January 2013): modification of Arrêté No. 3032/2003 concerning the designation of members of the CITES Scientific Authority of Madagascar.

Arrêté No. 34014/2014 (13 November 2014): approving the schedules of requirements that lay down the general stipulations concerning the exploitation regime and the conditions for transformation of specimens and products from Malagasy crocodiles.

7.2 International

International trade in *C. niloticus* from Madagascar is regulated in accordance with CITES. This amendment proposal aims to provide a more appropriate Appendix-II listing [under Resolution Conf. 9.24 (Rev. Cop15)], which is vital to matching the management of Nile crocodiles in Madagascar to local context and constraints. The recent suspension of international trade is evidence of the effectiveness of CITES in controlling non-compliance with the Convention.

8. Species management

8.1 Management measures

8.1.1. Ranches

There are currently four licensed crocodile ranches in Madagascar:

- “Croc Farm”(at Ivato), established in 1992, also has tourist facilities.
- “Crocommad”(at Fenoarivo), established in 2015.
- “Four BS” (at Ambalanjanakomby), established in 2015.
- “Croco Ranching II” (at Fenoarivo), established in 1992, has largely ceased operations.

8.1.2. Egg harvest

Egg harvesting will continue to be the main source of stock for 3 ranches. The harvest involves nominated “egg collectors” who organize the collection on behalf of ranches (which

are approved annually to undertake collection), including consultation with local Government authorities and clan chiefs (Manolis 2014). Ranches are obligated to record data relating to each nest collected, and submit data to DGF after the harvest. This system has been in place since the 1980s, when ranching was first established in Madagascar.

Although this egg collection system worked effectively in the past, ways in which it could provide increased benefits to rural communities were recently assessed. They included: increased payment per egg to “egg hunters” (local people who locate nests); additional payments made towards the village as a whole (eg to local schools, health clinics, etc.) such that there is a broader distribution of economic benefits; and, more involvement by local people in the collection (eg as “egg collectors”). The 3 ranches have indicated a desire to implement such improvements to the system of egg collection, but progress has been limited by little/no collections taking place since 2010 (Table 5).

Table 5. Numbers of *C. niloticus* eggs harvested by ranches, 1991-2015.na= not available.

Year	No. of Eggs	Year	No. of Eggs	Year	No. of Eggs
1991	1545	2000	5857	2008	5700
1992	2616	2001	7510	2009	879
1993	7109	2002	6648	2010	0
1994	5003	2003	5513	2011	0
1995	4369	2004	4876	2012	0
1996	8089	2005	3992	2013	0
1997	na	2006	5062	2014	1961
1998	na	2007	6254	2015	0
1999	5250				

Two ranches have plans in place, in cooperation with DGF, for training workshops for key stakeholders, including village chiefs, from areas proposed for egg collection in 2016. This is a first step towards improving the egg collection system. The extension of egg collection responsibilities to rural communities will be assessed by DGF to ensure that training is effective, and welfare considerations associated with egg collection and transport (eg Manolis and Webb 2016; NRMCC 2009) are taken into account.

All ranches and captive-bred hatchlings are scute-clipped (Richardson *et al.* 2000) with an identification number specific to the ranch, the source (captive-bred or ranches) and year of production. Skins from ranches can therefore be distinguished from wild skins, or from skins from other ranches.

8.1.3. Hatchling Harvest

The harvest of hatchlings has at times been approved to assist ranches in their start-up phase (ROM 1997). To date this has involved 4034 hatchlings in 1991-1996 (ROM 1997), 104 hatchlings in 2007, and 29 hatchlings in 2016 (to April). At this stage, hatchling harvests are not intended to be a significant element of the ranching strategy, although it is recognized that it is a “safe” form of harvest (Jenkins *et al.* 2006).

8.1.4. Wild Harvest

The number of wild skins taken for the artisanal industry between 1987 and 2009 has been estimated to be around 5000 per annum. Since 2010 this wild harvest has diminished to an average of around 2400 skins per annum (Table 6), due largely to the economic crisis in the country, which has reduced local demand for artisanal leather products. The new skin size limits have greatly reduced the number of small crocodiles harvested for the artisanal industry, while also reducing the number of large crocodiles taken.

Table 6. Numbers of wild *C. niloticus* skins entering the artisanal leather industry, 2010-2015.

Year	2010	2011	2012	2013	2014	2015
Skins	2586	2198	2892	2881	3034	1483

Annual Wild Harvest Ceiling

Since 2015, the annual wild harvest has been restricted to a ceiling of 3000 skins, with the majority (2500) allocated to primary hunting zones in the west and northeast regions of the country (see Fig. 2). These zones were designated on the basis of historical skin production, crocodile abundance and frequency of human-crocodile conflict (HCC). The balance of the harvest ceiling (500) has been applied to the rest of the country. Around 85% of the harvest ceiling is actually allocated as skin quotas to the artisanal tanneries (see 8.3.2.1), and the remaining 15% is maintained as a buffer to allow new tanneries into the industry, and to ensure that the harvest ceiling is not exceeded.

This harvest ceiling of 3000 skins will be maintained, unless a review (2019) provides sound scientific evidence that it should to be decreased or increased to meet sustainable levels. Annual reviews of the program will be undertaken by independent experts (eg IUCN-SSC Crocodile Specialist Group) for at least the first 3 years of the program.

Problem Crocodiles

Problem crocodiles, that kill or injure people, or which move into areas of high human density, represent a serious risk in Madagascar. Since 2008, reported attacks have ranged from 6 to 22 per annum (Maheritafika *et al.* 2016). Permits to take problem animals must be approved by the relevant Provincial Forestry authority, and the skin (if retrieved) must be delivered to the local forestry or local government authority (pursuant to Decree 2014-1105). Skins of problem crocodiles larger than 2.5 m total length are currently not allowed to enter the domestic or international markets, and remain the property of the Government.

Options are being examined for the legal disposal of such skins, which could possibly be auction or tender, with the funds raised used specifically for conservation activities, under the oversight of a credible organization (eg IUCN-SSC Crocodile Specialist Group).

Size Limits

The wild harvest is restricted to juvenile and sub-adult crocodiles greater than 1.0 and less than 2.5 m long.

Hunting Season

The current hunting season for wild crocodiles, between January and September, established through Ordinance 60-126 (enacted mainly to protect fish during the breeding season) will be retained. Crocodiles are considered under this legislation to be “aquatic animals” and are thus subject to the same seasonal limitations. In reality, little hunting occurs during that part of the open season that coincides with the wet season, so the effective hunting season is April to November.

Capture Methods

Restrictions on hunting methods have been imposed to assist compliance with the size limits. Capture by hand, harpoon/spear and snares (set to target crocodiles of certain sizes) are the approved methods of capture. The use of spotlights or other forms of lighting, drugs or poisons, and firearms and explosives, are prohibited. Baited hooks or similar methods, traditionally used to catch medium-large crocodiles, are no longer approved, except for problem crocodiles (see above). The artisanal tanneries have proved to be an effective conduit for communication of information on new regulations to hunters and intermediaries.

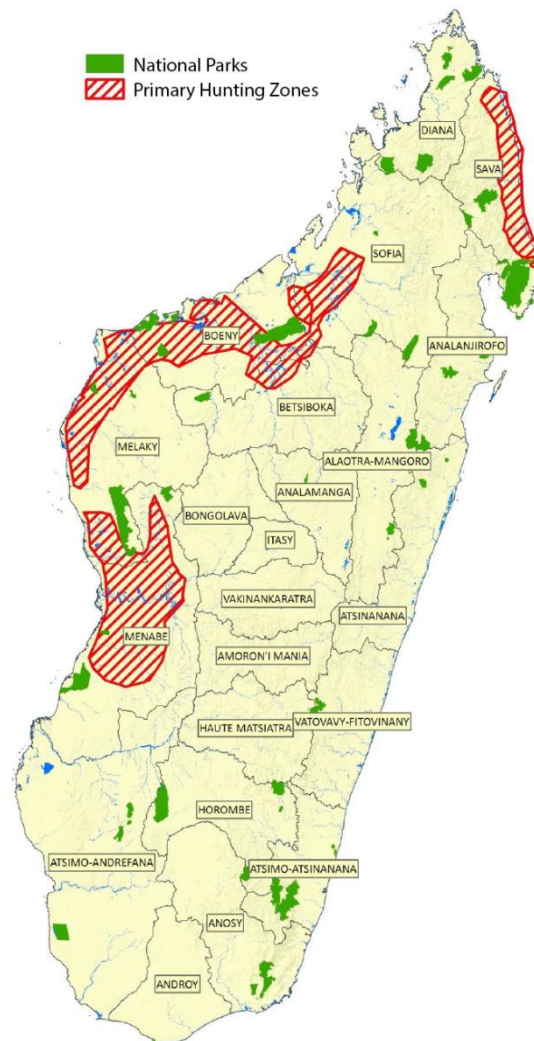


Figure 2. Primary Hunting Zones for *C. niloticus* wild harvest in Madagascar.

Hunters

Crocodiles are mostly taken by dedicated rural hunters, but they may also be opportunistically captured by farmers and fishermen, sometimes during the course of their daily activities. The supply chain involves intermediaries who accumulate skins from various hunters, and then on-sell them to artisanal tanneries (Manolis 2014; CITES Secretariat 2013).

8.2 Population monitoring

Compliance with Article IV, particularly the non-detriment provisions, will be assessed annually through monitoring programs using different indices of abundance:

8.2.1. Population surveys

The survey program mainly involves standardized spotlight count surveys in areas subject to hunting, but also includes areas in which little/no hunting occurs. The sample of rivers that are surveyed each year is based on available historical data, logistics (accessibility) and local customs (eg taboos, that may prevent access or certain methodologies being used). Spotlight surveys provide detailed information on population size structure and relative abundance.

8.2.2. Wild harvest

The artisanal tanneries are the critical point in the supply chain through which all wild skins must pass. Data on skins will allow the size structure of the harvest to be examined over time, as well as harvest trends from different hunting zones (see 8.1.4 and Fig. 2).

8.2.3. Egg harvest

The egg harvest provides data on nest numbers, clutch size and egg size, which provide indices of abundance (numbers of breeding females) and size of nesting females (through clutch mass and egg size; possibly tracks).

8.2.4. Problem crocodiles and human-crocodile conflict

The number of problem crocodiles taken/reported provides indices of abundance and (HCC). Experiences from other countries indicate that increases in the frequency of HCC (attacks) coincide with the recovery of crocodile populations (eg Amarasinghe *et al.* 2015; Fukuda *et al.* 2014; Manolis and Webb 2013, 2014; Manolis *et al.* 2013).

The available HCC data for Madagascar were analysed by Maheritafika *et al.* (2016). In the 1990-1995 period, there was an average of 24.8 attacks per year on humans reported following direct consultation with rural communities. The decline to an average of 12.0 attacks per year in 2008-2015 reflects a change in how reports on HCC are now compiled (eg media reports), and these most recent data are considered an underestimate of the actual numbers of attacks that occur. The highest incidence of HCC (humans and livestock) occurs in areas with the highest densities of crocodiles (Maheritafika *et al.* 2016).

8.2.5. At the retail level, morphometric formulae will be used to sample the size structure of crocodiles contributing to the products being sold.

8.2.6. Management responses

Management and levels of harvest will be assessed annually, in collaboration with international experts in at least the first 3 years of the program (2017-2019). Harvest levels may be adjusted up or down after 3 years, on the basis of these independent assessments.

8.3 Control measures

8.3.1 International

As an island nation, Madagascar does not share a land border with other countries. Exports occur almost exclusively by air, at two points (Antananarivo and Toamasina). Product labeling and skin tagging (scar from scute-clipping at time of hatching) serve as additional measures to mitigate illegal trade.

8.3.2 Domestic

A recent analysis of the supply chain identified critical points for assessing compliance with harvest ceilings and for providing data on the extent and size structure of the wild harvest (Manolis 2014; CITES Secretariat 2013). Some artisans are involved in tanning, manufacturing and retailing activities, but for the purposes of monitoring, each activity is treated separately, and has its own reporting obligations. Some artisans have expressed an interest in ranching in the future.

8.3.2.1. Tanneries

All wild skins must pass through artisanal tanneries (N= 14), which are a critical assessment point in the production chain. Each tannery is registered with DGF, and each is allocated an annual skin quota, based on its historical use of skins, and issued permits, on which the names of hunters and intermediaries from which wild skins will be sourced, are nominated.

The permit allows skins to be acquired and transported to the tannery. To allow for new hunters and intermediaries to be added to a tannery's permit, particularly in the early stages of the program, a number of permits (each covering a portion of a tannery's quota) are issued through the year.

On arrival at the tanneries, skins are tagged, and information entered into a skin register [eg hunter/intermediary, location/region, date, type of skin (belly, hornback), skin width]. Information from registers is required to be submitted to DGF on a quarterly basis. Random inspections are carried out on tanneries by DGF and the Department of Forestry Control (DCF).

8.3.2.2. Manufacturers

Artisanal manufacturers (N= 33) are required to be registered with DGF. They are also required to maintain a register that details the origin of tanned skins purchased (or used if the manufacturer is also a tanner), and products manufactured and sold. Information from registers is required to be submitted to DGF on a quarterly basis. Random inspections are carried out on manufacturers by DGF and DCF.

Products must be tagged with a label that is provided by DGF (eg see CITES Secretariat 2013 and Fig. 3). The current paper label has been trialed over the last two years, problems exist and new options (eg plastic tags, embossing, etc.) are being examined. The use of a label/tag for very small products (eg teeth) is problematic, and these have been exempted from the requirements of labelling for the time being. However, small products must still comply with skin/crocodile size limits.



Figure 3. Product label for finished crocodile leather products produced by artisanal manufacturers.

8.3.2.3. Retailers

Artisanal retailers of crocodile products (currently 50 main ones) are registered with DGF, and a certificate of registration must be displayed on the shop/market stall. However, it has become clear that it is impossible to register each small retail outlet that holds at least one crocodile product. Thus, although the registration system for major retailers has been retained, as it identifies artisanal retailers from general shops, efforts have been directed at the manufacturer level for identifying legal products. As registered manufacturers are the only legal source of crocodile products (see 8.3.2.2), then retailers on-selling these products, by default, are legally doing so.

8.3.2.4. Ranches

Skins produced through ranching and captive breeding, and being exported, are tagged in accordance with Resolution Conf. 11.12 (Rev. CoP15). Skins that enter the domestic market will also be tagged, and monitored through the registers maintained by tanneries and manufacturers (see 8.3.2.1 and 8.3.2.2). Most such skins will also be identifiable by the scar produced by scute-clipping at the time of hatching (see 8.1.2).

8.4 Captive breeding and artificial propagation

Only one ranch (Croc Farm; see 8.1.1) has captive adult crocodiles (86 males and 120 females at 31 March 2016), and it produced 1985 hatchlings from captive breeding in 2015. This captive adult population is part of the farm's tourism activities, but it also serves as a form of production insurance for years where egg production in the wild is reduced by climatic factors: this farm has been involved in the releasing of captive-raised crocodiles back into wild habitats (see 4.4).

Captive breeding of *C. niloticus* is carried out in many range states (South Africa, Kenya, Namibia, Uganda) and non-range states (Tunisia, Mauritius) (Manolis and Webb 2016; Caldwell 2013).

8.5 Habitat conservation

Madagascar has 6 categories of protected areas (I to VI), based on the IUCN definitions. There is a range of protected areas throughout Madagascar (see Fig. 2; CITES Secretariat 2013). The main category I-IV areas are: Analamerana Park (24,750 ha), Ankarana Special Reserve (18,025 ha), Ankarafantsika Park (130,026 ha), Bemaraha Park (66,630) and Marotandrano Park (42,200 ha). Sustainable use may be practiced in category V and VI areas (CITES Secretariat 2013).

Habitat protection is also offered to crocodiles and their habitats through the "culture of the crocodile", where they are considered "sacred" and hunting is prohibited (Zehrer 2013). It still exists in various regions of Madagascar (eg Loky Manambato, Lac Vert (Sava region); Lake Anivorano (Diana region); Mahavavy River, Lake Ravelobe (Boeny region), Tsiribihina River (Menabe Region) (CITES Secretariat 2013).

8.6 Safeguards

The new management regime for *C. niloticus* in Madagascar addresses the concerns raised in the past, including the CITES Standing Committee and IUCN-SSC Crocodile Specialist Group. An adaptive management approach has been adopted, to ensure the sustainability of use and to allow the program to be improved annually on the basis of monitoring data.

9. Information on similar species

The Nile crocodile in Madagascar is similar to sub-species on the African mainland, and to *Crocodylus suchus*, which until recently was considered to be *C. niloticus*. It also shares similarities with the Mugger crocodile (*C. palustris*) of South Asia and Iran.

10. Consultations

All 42 range states for *C. niloticus* and/or *C. suchus* (see below) were informed of Madagascar's intent to submit this proposal, and provided with English and French versions accordingly. Responses will be addressed as they are received, and the Parties will be informed through an Inf. Document and/or revised proposal; after the Parties have had the opportunity to review it.

Comments was sought from: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Democratic Republic of Congo, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Liberia, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, Somalia, South Africa, Sudan, South Sudan, Swaziland, Rwanda, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

11. Additional remarks

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12. References

- Amarasinghe, T.A.A., Madawala, M.B., Karunarathna, D.M.S.S., Manolis, S.C., de Silva, A. and Sommerlad, R. (2015). Human-crocodile conflict and conservation implications of saltwater crocodiles *Crocodylus porosus* (Reptilia: Crocodylia: Crocodylidae) in Sri Lanka. *Journal of Threatened Taxa* 7(5): 7111-7130.
- Andrianasolo, R. and Rakotondrazafy, A.M.N.A. (2006). Evaluation de la population de *Crocodylus niloticus* dans le système Lanirano-Besaroy-Ambavarano, Taolagnaro. Association Langaha, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo et Conservation et Biodiversité, QMM S.A.
- Andrianasolo, R. and Rakotondrazafy, A.M.N.A. (2007). Suivi et Evaluation de la population de *Crocodylus niloticus* dans le système Lanirano-Besaroy-Ambavarano, Taolagnaro. Association Langaha, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo et Conservation et Biodiversité, QMM S.A.
- Andrianjaratina, L. and Rafenomanana, F. (2014). Etude de l'état de la population de crocodiles du secteur de Mandena.
- Behra, O. (1987). Rapport d'étude préliminaire sur l'état et la conservation des populations de crocodiles à Madagascar.
- Behra, O. (2012). Les crocodiles de Madagascar peuvent être considérés comme une espèce marine. Pp. 143 in Madagascar. Guide de la Biodiversité Marine, by Andrew Cooke. Wildlife Conservation Society: Antananarivo, Madagascar.
- Behra, O. and Hutton, J.M. (1988). Rapport sur l'état et la conservation des populations de crocodiles de Madagascar.
- Caldwell, J. (2013). World Trade in Crocodylian Skins 2009-2011. UNEP-WCMC: Cambridge.
- CITES Secretariat (2012). Overview of trade in *Crocodylus niloticus* from Madagascar during the period 2006-2011. SC63 Inf. 1.
- CITES Secretariat (2013). 2013 - Madagascar Crocodile Project Final Report. Report prepared by General Directorate for Forests, Ministry of Environment and Forests of Madagascar (CITES Management Authority). CITES: Geneva, Switzerland. 155 pp.
- Cott, H.B. (1961). An enquiry into the ecology and economic status of the Nile crocodile (*Crocodylus niloticus*) in Uganda and northern Rhodesia. *Journal of Zoology* 29(4): 211-356.
- Elsley, R.M. and Kinler, N. (2012). The management of American alligators in Louisiana, USA: a history, review and update. Pp. 136-148 in Crocodiles. Proceedings of the 21st Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Fergusson, R.A. (2010). Nile Crocodile *Crocodylus niloticus*. Pp. 84-89 in Crocodiles. Status Survey and Conservation Action Plan. Third Edition, ed. by S.C. Manolis and C. Stevenson. Crocodile Specialist Group: Darwin, Australia.
- Fukuda, Y., Manolis, C. and Appel, K. (2014). Management of human-crocodile conflict in the Northern Territory, Australia: review of crocodile attacks and removal of problem crocodiles. *The Journal of Wildlife Management* 78(7): 1239-1249.
- Fukuda, Y., Webb, G., Manolis, C., Delaney, R., Letnic, M., Lindner, G., and Whitehead, P. (2011). Recovery of saltwater crocodiles following unregulated hunting in tidal rivers of the Northern Territory, Australia. *The Journal of Wildlife Management* 75(6): 1253-1266.
- Games, I., Ramandimbison and Lippai, C. (1998). Air survey of crocodiles in Madagascar. Report to CITES and the Government of Madagascar.
- Hekkala, E., Shirley, M.H., Amato, G., Austin, J.D., Charter, S., Thorbjarnarson, J., Vliet, K.A., Houck, M.L., Desalle, R. and Blum, M.J. (2011). An ancient icon reveals new mysteries: Mummy DNA resurrects a cryptic species within the Nile crocodile. *Molecular Ecology* 20(20): 4199-4215.
- Jenkins, R.W.G, Jelden, D., Webb, G.J.W. and Manolis, S.C. (eds.) (2006). Review of Crocodile Ranching Programmes. Conducted for CITES by IUCN-SSC Crocodile Specialist Group. AC22 Inf. 2.

- Manolis, C. (2014). Value Chain for the Artisanal Crocodile Leather Industry in Madagascar. International Trade Centre: Geneva, Switzerland.
- Manolis, S.C. and Webb, G.J.W. (2013). Assessment of Saltwater Crocodile (*Crocodylus porosus*) attacks in Australia (1971-2013): Implications for management. Pp. 97-104 in *Crocodyles*. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Manolis, S.C. and Webb, G.J.W. (2014). Human-Crocodile Conflict in the Australia and Oceania region. Pp. 200-208 in *Crocodyles*. Proceedings of the 23rd Working Meeting of the IUCN-SC Crocodile Specialist Group. IUCN: Gland, Switzerland.
- Manolis, S.C. and Webb, G.J.W. (compilers) (2016). *Best Management Practices for Crocodylian Farming*. IUCN-SSC Crocodile Specialist Group: Darwin, Australia.
- Montague, J. (1981). *Characteristics of a Crocodile Population in Papua New Guinea*. Michigan State University: Michigan, USA. 92 pp.
- Handwerk, B. (2003). Investigating Africa's mysterious cave crocodiles. *National Geographic News* (http://news.nationalgeographic.com/news/2003/06/0620_030620_cavecrocs.html).
- Maheritafika, H.M.R., Robsomanitrdrasana, E., Rabesianaka, S., Rafenomanana, F., Ravaoarimalala, A., Andrianjaratina, L., Manolis, C. and Lippai, C. (2016). Preliminary assessment of human-crocodile conflict in Madagascar. *Crocodile Specialist Group Newsletter* 35(1): 19-21.
- Manolis, C. and Lippai, C. (2010). Report on Crocodile Ranch Audit and Training Workshop in Madagascar (February 2010). Report to CITES Secretariat.
- NRMMC (Natural Resource Management Ministerial Council) (2009). *Code of Practice for the Humane Treatment of Wild and Farmed Australian Crocodiles*. NRMMC: Canberra, Australia.
- Ottley, B., Lippai, C. and Rakotondrazafy, A.M.N.A. (2008). Surveys of wild crocodile populations in Madagascar. Programme Germano-Malagasy pour l'Environnement, GTZ: Antananarivo, Madagascar. 77 pp.
- Pauwels, O.S.G., Branch, W.R. and Burger, M. (2004). Reptiles of Loango National Park, Ogooue-Maritime Province, South Western Gabon. *Hamadryad* 29: 115- 127.
- Pooley, T. (1982). *Discoveries of a Crocodile Man*. William Collins Sons & Co. Ltd.: Johannesburg.
- Rakotondrazafy, A.M.N.A., Andrianasolo, R. and Ramamonjisoa, H. (2008). Inventaire de crocodiles dans la rivière de Mahavavy-Sud, Etudes biologiques, écologiques et socioéconomiques sur les crocodiles dans le complexe Mahavavy-Kinkony. Report to WWF. 35 pp.
- Rakotondrazafy, A.M.N.A. (2009). Rapport de synthèse sur les études de *Crocodylus niloticus* à Madagascar. Ministère de L'Environnement et des Forêts, Département de Biologie Animale, Faculté des Sciences, Université d'Antananarivo. 38 pp.
- Richardson, K.R., Webb, G.J.W. and Manolis, S.C. (2000). *Crocodyles: Inside and Out*. Surrey Beatty & Sons: Chipping Norton, Australia.
- ROM (Republic of Madagascar) (1987). Maintenance of the Malagasy population of *Crocodylus niloticus* in Appendix II, subject to an annual export quota. Amendment proposal submitted to CoP6.
- ROM (Republic of Madagascar) (1989). Maintenance of the Madagascar population of *Crocodylus niloticus* in Appendix II. Amendment proposal pursuant to ranching submitted to CoP7.
- ROM (Republic of Madagascar) (1992). Maintenance of the Madagascar population of *Crocodylus niloticus* in Appendix II. Amendment proposal pursuant to ranching submitted to CoP8.
- ROM (Republic of Madagascar) (1994). Maintenance of the Madagascar population of *Crocodylus niloticus* in Appendix II. Amendment proposal pursuant to ranching submitted to CoP9.
- ROM (Republic of Madagascar) (1997). Prop. 10.2. Madagascar. Amendment proposal pursuant to ranching submitted to CoP10.
- Somaweera, R., Brien, M. and Shine, R. (2013). The role of predation in shaping crocodylian natural history. *Herpetological Monographs* 27(1): 23-51.
- UNEP-WCMC (2016). CITES Trade Database. (<http://trade.cites.org>).
- Webb, G.J.W., Bayliss, P.G. and Manolis, S.C. (1989). Population research on crocodiles in the Northern Territory, 1984-86. Pp. 22-59 in *Crocodyles*. Proceedings of the 8th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.

- Webb, G., Brien, M., Manolis, C. and Medrano-Bitar, S. (2012). Predicting total length of spectacled caimans (*Caiman crocodilus*) from skin measurements: a tool for managing the skin trade. *Herpetological Conservation and Biology* 7(1): 16-26.
- Webb, G.J.W. and Manolis, S.C. (2006). Guidelines on the Harvesting and Management of Wild Crocodilian Populations and the Determination of "Detriment" within the Context of CITES. Report to CITES Secretariat.
- Webb, G.J.W., Manolis, S.C., Whitehead, P.J. and Letts, G.A. (1984). A proposal for the transfer of the Australian population of *Crocodylus porosus* Schneider (1801), from Appendix I to Appendix II of C.I.T.E.S. Tech. Report No. 21. Conservation Commission of the Northern Territory: Darwin, Australia.
- Webb, G.J.W. and Messel, H. (1979). Wariness in *Crocodylus porosus*. *Australian Wildlife Research* 6: 227-234
- Whitaker, R. and Whitaker, N. (2008). Who's got the biggest? *Crocodile Specialist Group Newsletter* 27(4): 26-30.
- Wilson, J.M. (1987). The crocodile caves of Ankarana. *Oryx* 21: 43-47.
- Zehrer, W. (2013). *Le crocodile malgache, vu à travers des proverbes et contes*. Edition Tsipika.