Nile Crocodile *Crocodylus niloticus*

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Common Names: Nile crocodile, Mamba (Swahili), Garwe (Shona), Ngwenya (Ndebele), Voay (Malagasy), Kwena (Tswana), Crocodilo (Portuguese), Crocodil du Nil (French), Temsah (Arabic), Denkyem (Twi)

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

Figure 1. Distribution of *Crocodylus niloticus*.

Taxonomy: Pending the formal description of the newly recognised west and central African clade as a new species, this account refers to *C. niloticus* as previously understood. Many populations located to the west of the Albertine Rift may prove to be *Crocodylus* sp. nov. based on molecular taxonomy.

Conservation Overview

CITES:

- Appendix II (Resolution Conf. 11.16 for "Ranching" in: Botswana, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, South Africa, Uganda, Zambia and Zimbabwe).
- Appendix II (Resolution Conf. 9.24 "unqualified" listing in: Egypt, Tanzania and Namibia).
- CITES Wild Harvest quota (for trophy hunting, management or problem animals) in: Botswana, Ethiopia, Madagascar, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe.
- Appendix I: all other Range States.

CSG Action Plan:

Availability of survey data: More than 750 surveys using a variety of methods have been carried out for *C. niloticus* since the 1950s. Despite covering 315 different locations only 8 of these have been surveyed enough to allow estimation of population trends (Lainez 2009). All of these are located in southern and East Africa where there have been significant recent improvements in monitoring. In central and West Africa the availability of survey data is very poor. Overall, survey data are insufficient or non-existent in 25 of 42 Range States. .

Need for wild population recovery and/or conservation: Moderate throughout much of east and southern Africa. Recent detailed studies suggest an urgent need for conservation action in specific areas (Bishop *et al*. 2009). High in central and West Africa. Many populations are believed to have recovered by the 1990s but are now constrained or in decline due to anthropogenic factors.

Potential for sustainable management: High - but dependent on international market and skin quality constraints.

2009 IUCN Red List: LRlc (Lower Risk, least concern. The species may be threatened in some parts of the range; IUCN 2009) (last assessed in 1996).

Principal threats: General habitat loss (pressure on resources including water, fish, sand and wetlands throughout much of the species' range), direct conflict with people (uncontrolled killing in response to attacks on humans), indirect anthropogenic effects (eg pollutants, poor water quality and dam-building coincided to cause the deaths of most of the Olifants River crocodile population in South Africa during 2008), uncontrolled hunting for artisanal trade in leather goods.

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.

Ecology and Natural History

The Nile crocodile is among the largest and best known biologically of all the crocodilians. Nile crocodiles are widely distributed throughout sub-Saharan Africa, and historical records indicate its range formerly extended into southern Israel and Algeria. The species previously existed on the Comoros Islands, and still exists on Madagascar.

As with all crocodilians, size among *C. niloticus* is sexually dimorphic with the larger males reaching lengths of up to 6 m in exceptional cases. A large volume of published information exists on topics such as diet, thermoregulation, reproduction, social behaviour, habitat preference, and population dynamics. The first modern monograph on the ecology of a crocodilian was that by Cott (1961) on *C. niloticus*.

Figure 2. Adult male *C. niloticus*. Photograph: Richard Fergusson.

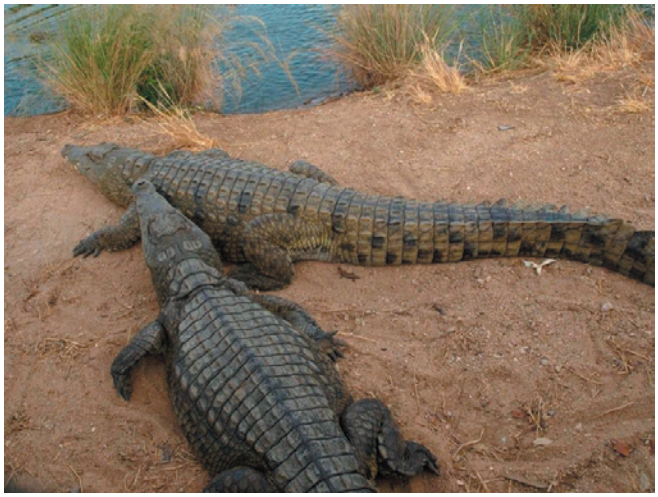

Figure 3. Basking *C. niloticus*. Photograph: Richard Fergusson.

Nile crocodiles are found in a wide variety of habitat types, including large lakes, rivers, and freshwater swamps. In some areas they extend into brackish water environments (Pooley 1982; Pauwels *et al*. 2004). Nile crocodiles display an ontogenetic shift in diet, from insects and small aquatic invertebrates when young, to predominantly vertebrate prey among larger crocodiles (Cott 1961; Wallace and Leslie 2008). Habitat utilization differs between juveniles, sub-adults and adults, and juveniles enter 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. Fergusson (1992) studied the success of farm-raised crocodiles released into the wild.

Nesting is done in holes excavated in sandy banks during the annual dry season. Females become sexually mature between 1.8 m (Games, unpublished data) and 3.0 m (Detouf-Boulade 2006), and lay 35-50 eggs, although this varies considerably among populations. Incubation period is 75-95 days, and females open the nest and guard the young for a period of 6-8 weeks after hatching.

A model of Nile crocodile population growth and use is provided by Craig (1992). The responses of the Zimbabwean population to prolonged sustainable harvest are well studied (Loveridge and Hutton 1992; Taylor *et al*. 1992). More recently, Bishop *et al*. (2009) discuss the reduced effective population size in the overexploited Okavango Delta population.

Figure 4. Captive juvenile *C. niloticus*. Photograph: Grahame Webb.

Conservation and Status

A number of surveys for *C. niloticus* have been conducted in recent years, and information on population status, particularly in southern and east Africa, is acceptable. However survey data are insufficient or non-existent in many Range States, particularly in Central and West Africa. A database of African crocodile surveys was recently developed through UNEP-WCMC and the Crocodile Specialist Group (Lainez 2009).

Recent survey information is available for: South Africa (SANParks, unpublished data; Combrink *et al*. 2009); Botswana (Borquin 2008); Namibia (Brown *et al*. 2005; Aust 2009); Zimbabwe (Fergusson 2006); Zambia (Fergusson 2006, 2007; Zambezi Crocodile Research Project, unpublished data); Democratic Republic of the Congo (Fergusson 2003a); Malawi (Fergusson 2005; Bhima, pers. comm. 2008); Mozambique (Carr Foundation 2009; Fergusson and Pentolfe 2007; Fergusson 2009); Tanzania (Mafole *et al*. 2008); Kenya (Fergusson 2003b); Ethiopia (Whitaker and Whitaker 2007);

Madagascar (Ramandimbison *et al*. 1998; Ottley *et al*. 2008); and, Egypt (Shirley and Salem 2008). Much of this work has been part of CSG-facilitated initiatives to implement sustainable management programs in countries that wish to utilize crocodiles.

Figure 5. *Crocodylus niloticus,* Burkina Faso. Photograph: Christine Lippai.

Additional recent information, mostly in the form of anecdotal reports and species checklists is available for much of Central and West Africa as well as East and southern Africa (Broadley and Cotterill 2004; Lainez 2009). In comparison to East and southern Africa, survey data for central and western Africa remains poor, although the situation has greatly improved since the 1990s. The CSG's West African regional group is specifically focused on addressing this shortcoming.

There is evidence to suggest that Nile crocodiles in West Africa are found at naturally lower densities due to habitat factors and the presence of two other sympatric crocodilians (*C. cataphractus* and *Osteolaemus tetraspis*). Niche separation points towards central and western Nile crocodile populations inhabiting mainly coastal areas (Kofron 1992; Pauwels *et al*. 2004; Shirley *et al*. 2009) and larger water bodies (Pauwels and Vandeweghe 2008; Fergusson 2003) compared to the more general habitat preferences of eastern and southern African populations. More survey and ecological studies in central and western Africa are required to resolve this question.

Remnant populations of Nile crocodiles exist in eastern Mauritania and northern Chad (Smet 1999; Shine *et al*. 2001). The biogeography of *C. niloticus*, together with behavioural and molecular evidence (Shine *et al*. 2001; Schmitz *et al*. 2003), suggests likely speciation. Further taxonomic work at the molecular level is currently being carried out to confirm the extent of this (M. Shirley, pers. comm. 2009).

Nile crocodile populations have been depleted throughout much of their range and extirpated from at least three countries: Israel, Algeria and Comoros. The disappearance of crocodiles from the former two countries may be partially related to climate change and the resulting loss of wetland habitats. Crocodiles reported as extirpated from the Seychelles are now shown to have been *Crocodylus porosus* (Gerlach and Canning 1993) and not *C. niloticus* as previously thought.

The current status of the Nile crocodile is relatively secure throughout much of East and Southern Africa, whilst the situation in Central and West Africa is less certain but probably similar. Crocodile densities exhibit a significant negative correlation with human densities at the inter- and intra-river level in Namibia and it is likely that the status of crocodiles throughout Africa is closely linked with human densities and development patterns (Aust 2009). In addition, crocodile densities were found to be positively correlated with IUCN protected areas and it is likely that the future status of national populations will be linked to the extent and management of nationally protected habitat (Aust 2009).

As with all of the other large, commercially valuable species, hunting between the 1940s and the 1960s (in some countries as late as the 1970s) resulted in dramatic declines in *C. niloticus* populations throughout most of its range. However, protection afforded by national legislation and international trade conventions (CITES) has resulted in recovery in many parts of the species' range. As a whole, it appears that Nile crocodiles are not threatened, although there are increasing threats to high-density populations existing outside protected areas.

In some areas human-crocodile conflict (HCC) has become a major problem. Management of HCC has 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. Thomas (2006) documented HCC in the Okavango Delta, Botswana, but innovative and appropriate mitigation methods and an in-depth study of the actual extent and impact of HCC at a sub-regional scale are urgently needed.

Figure 6. Human activities such as fishing potentially bring local people into conflict with *C. niloticus*. Photograph: Richard Fergusson.

Figure 7. Injury caused by *C. niloticus*. Photograph: Richard Fergusson.

The Nile crocodile is one of the most commercially utilized crocodilians, the skin being acknowledged as one of the "classics". Up to 160,000 *C. niloticus* skins are produced and traded internationally each year from ranching and captive breeding (IACTS 2008), with the majority derived from Zimbabwe (43%), South Africa and Zambia. Illegal trade is thought to be insignificant, at least in Southern and East Africa. There is a persistent illegal trade that is of some concern in Central and West Africa where products and small leather goods are locally produced by artisanal craftsmen. The formal crocodile skin industry is now well established and market forces together with ongoing trade controls have largely negated the illegal trade in crocodile skins.

In the 1980s the CITES Nile Crocodile Program played an important role in developing sustainable yield programs, and tried to emphasize ranching as the preferred means of obtaining conservation benefits from crocodile utilization (MacGregor 2002). The crocodile population of Namibia was transferred from Appendix I to Appendix II in 2004. No Central or West African countries have implemented sustainable management programs as yet.

Priority projects

High priority

1. **Assessment of wild crocodile populations in West and Central Africa**: Population survey data are urgently needed for this region for all three species of African crocodilians. At the very least country-by-country surveys of crocodile status and distribution are a prerequisite for developing conservation and management programs.

   Coupled with this, there is a need to raise the importance of crocodile management, as perceived by national wildlife authorities throughout Africa, to that given to charismatic species such as elephant, large primates and the big cats.

2. **Study of HCC impacts and mitigation in the Southern and East Africa sub-region and assessment of "problem crocodile" management programs**: Conflict between rural communities and crocodiles has become the primary concern in the management of the wild crocodile population of many African countries. The problem however is poorly understood because of the lack of systematic recording of incidents. Numerous avoidance and mitigation options other than killing large numbers of crocodiles exist but are not implemented, possibly because of the revenue to be earned from the sale of wild crocodile skins. A sub-regional collection and compilation of data on HCC is required, followed by a focused effort in education and use of alternative mitigation techniques. The one long running wild harvest aimed at providing protection from crocodile attacks must be reviewed to assess it efficacy and the impact on the wild population.

3. **Impact of anthropogenic contaminants, with particular attention to the South African population**: Much of the South African population appears to be at risk from contamination, with large-scale die-offs documented in prominent conservation areas (eg Loskop Dam Nature Reserve and Kruger National Park) since 2005. Populations in St. Lucia may not be secure, with agriculture, industry (sugarcane) and human settlements in the catchment on the increase.

4. **Taxonomy of Central and West African populations**: When the defining characters of the "new" western clade have been decided extensive sampling of West and Central African populations will be required to allocate these to one species or the other. Thereafter an entire new conservation assessment and species action plan will be required for the new species.

Moderate priority

5. **Allocation/demarcation of locally protected areas**: Shacks (2006) looked at nest site habitat suitability versus available habitat in the Okavango Delta, Botswana. These data were then overlaid to produce a protected areas map that has led to the establishment of a nesting sanctuary for *C. niloticus*. This process could be repeated at many other sites.

6. **Reassessment of IUCN Red Listing**: *Crocodylus niloticus* was previously assessed in 1996, and a re-assessment would assist in the evalaution of the effects of habitat loss and HCC control.

7. **Facilitation of management programs for countries planning or implementing sustainable utilization**: A number of African nations lack the appropriate policy environment, management plans or technical expertise to plan and/or implement use programs. Population surveys and monitoring, training and program support are needed to foster these programs. Hutton (1990) outlined priority areas that need to be addressed for the development of sustainable use programs in these countries:

a. Pre-feasibility studies (eg harvest potential);
b. Policy and legislation to provide the management framework;
c. Feasibility studies (identification of potential production sites, evaluation and quantification of factors inherent in sustainable use programs);
d. International requirements for trade (CITES submissions, documentation and tagging of hides);
e. Population census and monitoring (technical support and training);
f. Technical support for developing ranching/farming programs; and,
g. Marketing.

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Figure 8. Adult female *C. niloticus*. Photograph: Christine Lippai.

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