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Distribution and status of crocodiles in Liberia's Sapo National Park, West Africa

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Abstract

The population and conservation status of crocodiles throughout West and central Africa is poorly known and the IUCN Crocodile Specialist Group's highest priority recommendations are country status surveys and examination of potential threats. This study will present survey data and review the conservation status of the Nile crocodile (*Crocodylus niloticus*), slender-snouted crocodile (*Mecistops cataphractus*) and African dwarf crocodile (*Osteolaemus tetraspis*) throughout various waterways situated in zone 1 of Sapo National Park. To achieve this objective the study will monitor the distribution of the crocodiles and their nests, and nest sites. The heavy metal concentration in the waterways will be measured and relationships between distribution and water pollution accessed. The presence of Siamweed (*Chromolaena odorata*) will be recorded and its impact on nest incubation temperature and hatch rate success will be monitored.

Introduction

Crocodiles are charismatic megafauna that act as a keystone species and often have served as indicators in ecosystem monitoring and restoration programmes. They maintain structure and function in aquatic ecosystems by such ecological roles as selective predation on fish species, recycling of nutrients and maintenance of wet refugia (Ross 1998; Mazzotti *et al* 2007). They are widely considered as flagship conservation species and have the potential to stimulate efforts in wetland conservation. Three species are native to West Africa: the Nile crocodile (*Crocodylus niloticus*), the slender-snouted crocodile (*Mecistops cataphractus*), and the African dwarf crocodile (*Osteolaemus tetraspis*). As in other central and West African countries history shows there have been tremendous pressures on land use, deforestation continues illegally and also a rich cultural history indicates both worship and overexploitation of these species (Toonen 2003; Moiser & Barber 1994). Kofron (1992) states that he observed hunters exiting Sapo, empty shotgun shells and crocodile skulls displayed at the parks headquarters suggests past and present hunting may have reduced the adult population. Despite this there appears to be an almost complete deficit of knowledge regarding ecology and population status of crocodiles across many of the regions (Ross 1998).

Other possible factors that could well place strain on the crocodile populations in Sapo are the presence of illegal gold mining activities (Stearns 2009). The methods used my the miners produces a solution called 'mine water' which, on contact with bodies of water can cause undesirable turbidity and/or sedimentation as well as its chemical composition causing negative effects on vegetation and animals (Norris 1980). The effect of this process has been know to cause a build up of heavy metals in fish species, effecting primarily the liver and kidneys ultimately leading to death (Peplow 2002) With fish species providing for 90% of the crocodiles diets, this could put a tremendous strain on available food resources and/or be detrimental to the crocodiles through

increasing build up of these hazardous substances up the trophic level.

Siam weeds (*Chromolaena odorata*) an invasive plant native to southern tropical America has been recorded to be present in Liberia (GISD 2009). In other countries where this plant is present it has been noted that it has prevented crocodiles nesting in traditional nest sites and by shading caused problems in thermoregulation for incubation, manipulating the sex balance towards females (Leslie 2001).

The Nile crocodile (*Crocodylus niloticus*) is amoung the largest and best known biologically of all the crocodilians. Although they are widely distributed throughout sub-saharan Africa, with historical records indicating a former range extending into southern Israel and Jordan, it has been little studied in West and central Africa (Pooley 1980). It is apparent that of the little information that does exist, only presence/absence data is available (Moiser & Barber 1994; Shine *et al* 2001; Kofron 1992). Recent studies have highlighted the importance of understanding its population status due to recent debates on then taxonomic status of this crocodile in West and central Africa (Shirley *et al* 2009). The IUCN Red list has this species categorized as Lower Risk/Least Concern (IUCN 2008) with all West African populations in CITES Appendix 1 (UNEP-WCMC 2008). Surveys throughout this region are considered the highest priority for Nile crocodile conservation by the IUCN Crocodile Specialist Group (Shirley 2009).

Until recently the slender-snouted crocodile (*Mecistops cataphractus*) was placed in the genus *Crocodylus*, a group which represents the true crocodiles. However work on mitochondrial DNA suggests that this species is more distantly related to other *Crocodylus* species than previously thought (Britton 2009). This has led to the unofficial change to a monotypic genus *Mecistops* (McAliley *et al* 2006). Thorbjarnarson & Eaton (2004) suggest that this species may still be common in over ranges including Gabon and Republic of Congo. Despite this, recent surveys carried out in West Africa report that there is a serious population decline (Shirley 2009; Kofron 1992; Waitkuwait 1986). Although the Crocodile Specialist Group expresses concern that this species may well fall under the criteria for Endangered (Ross 1998), the IUCN has yet to change it from its present status of Data Deficient on the Red List (IUCN 2008), with all populations in CITES Appendix 1 (UNEP-WCMC 2008). Establishment of conservation programmes and surveys of population status to determine a Red List status are considered the highest priority (Ross 1998; Shirley 2009).

The African dwarf crocodile (*Osteolaemus tetraspis*) is a little known species of crocodilian, ranging throughout the lowland regions of West and central Africa where it is a denizen of swamps, slow moving and calm bodies of water (Ross 1998; Shirley 2009; Kofron & Steiner 1994). Of the more recent surveys in West and central Africa that include this species, a strategy directed more for finding the Nile and slender-snouted crocodiles was carried out (Shirley 2009). Despite local knowledge primarily producing anecdotal evidence of species abundance (Kofron 1992; Shirley 2009) Abercrombie (1976) states that there is no occurrence of distinguishing between dwarf and juvenile Nile crocodiles. The IUCN Red List currently categorizes this

species as Vulnerable (IUCN 2008) with all populations in CITES Appendix 1 (UNEP-WCMC 2008). The inaccessibility of rumored populations and the extensive utilization for human consumption on local trade markets has led to range-wide status surveys and evaluation of the bush-meat trade to be a high priority for this species (Ross 1998; Shirley 2009).

The objective of this study is to survey the distribution and population status of the Nile, Slender-snouted and dwarf crocodiles in Sapo National park. This study will also focus on the potential threats that occur in the park and how they effect the three species distribution, nest site choice and breeding success.

Methods

Previous surveys have detected low densities and therefore I decided to carry out this study during the wet season (May-October). This also marks the beginning of the breeding season and so the occurrence of larger groups is to be anticipated. Surveys were conducted from available canoes and on foot. Diurnal surveys were utilized to detect active crocodiles, tracks, nest sites and to plan nocturnal survey routes. Nest sites were to be monitored regularly and core temperatures of the nests recorded using a 50cm penetration probe (See manufacturer's manual for specifications). The presence/absence of Siam weed was also to be recorded to compare thermoregulation of sites with and without it present. Upon time of rupture (Hatching), each nest site was to be checked and number of hatched eggs to un-hatched eggs were to be counted, providing a percentage hatch success rate. Nocturnal spotlight surveys are a standard method of surveying crocodilians (Webb & Smith 1987); reflection of light from a 200,000 candle power spotlight/floodlight off of the eyes allows for detection of the crocodiles. The length of these routes were calculated using a global positioning system. This method should result in data that represents an index of relative encounter rate due to some individuals of a population being undetectable on any given survey (Thorbjarnarson *et al* 2000). Survey sites were predetermined by the presence of the Sino, the main river in the park. 10km of this river was sampled and all the permanent creeks running into it, over the 10km stretch, park side were surveyed. Gbaboni creek, a main tributary to the Sino was also survey due to its proximity to mining activity, hunting and its central positioning in the park. On an encounter the identification was determined and total length estimated. EO (eyes only) will be recorded for individuals where further data is visually obscured or missed. Although it will be impossible to deduce the species identity of EO's with certainty, location, behavior, size and other sittings allowed some to be provisionally assigned. In addition, water samples were taken directly from the water every 1km down a survey route. The water samples were then tested using a professional heavy metal test kit (See manufacturer's manual for specifications) for the presence and concentration of heavy metals in the water.

Results Summary

Water way	Length	Transect length	Number of transects	Time spent for each transect	Number of surveys	Day surveys	Night surveys	Total time surveying	Number of crocodiles sighted	Species	Number of nests	Presence of Siamweed
Sino	10km	1km	10	20min	3	1	2	10hr	9	Slender-snouted	0	No
Gbaboni	2km	1km	2	1hr 30min	3	1	2	4hr 30min	7	African Dwarf	0	No
Creek 1	72m	72m	1	10min	3	1	2	30min	0		0	No
Creek 2	90m	90m	1	15min	3	1	2	45min	0		0	No
Creek 3	120m	120m	1	20min	3	1	2	1hr	0		0	No
Creek 4	390m	390m	1	28min	3	1	2	1hr 24min	0		0	No
Creek 5	120m	120m	1	18min	3	1	2	54min	0		0	No
Creek 6	75m	75m	1	11min	3	1	2	33min	0		0	No
Creek 7	200m	200m	1	21min	3	1	2	1hr 3min	0		0	No
Creek 8	150m	150m	1	14min	3	1	2	42min	0		0	No
Creek 9	960m	960m	1	45min	3	1	2	2hr 15min	3	African Dwarf	0	No
Creek 10	900m	900m	1	1hr	3	1	2	3hr	1	African Dwarf	0	No
Creek 11	540m	540m	1	41min	3	1	2	2hr 3min	1	African Dwarf	0	No
Total	15.617km	/	/	/	39	13	26	28hr 39min	21	/	/	/

Table 1. A Summary table of the data collected from the field over the three month crocodile survey.

Results

The data shown in table 1 represents a summary of the data collected from the field over the three month crocodile survey. All raw data will be compiled and analysed back in the UK for use as a dissertation and later a publication.

Of the two potential threats that were monitored for impact on the crocodile population, no Siamweed (*Chromolaena odorata*) was found in the park along the river banks in primary forest and all water tests for the presence of heavy metals showed no contamination of any degree.

Over the total distance covered and surveyed, no nest sites were found and so as a result the thermoregulations of the nests were not monitored.

Covering a distance of 15.617km, surveyed over a field period of 28 hours and 39 minutes, a total of 21 crocodiles were sighted, 9 Slender-snouted crocodiles (*Mecistops cataphractus*) and 12 African Dwarf crocodiles (*Osteolaemus tetraspis*). No Nile crocodiles (*Crocodylus niloticus*) were sighted on this survey.

Discussion

It would appear, without any statistical analysis that the crocodiles are abundant here in zone 1 of the park. Indeed it seems the case that the situation has bettered since Kofron's (1992) visit where a total of only 7 crocodiles were counted over a longer period of surveying. Despite possible differences in survey technique, I feel that the damaged populations from past and present hunting (Kofron 1992) are at least returning to a stable state. This being said, it should be noted that hunting pressures are still an occurrence in the park. Over the course of this survey a total of 4 fishing nets, which represent a serious danger for crocodiles were found and destroyed. It should also be mentioned however that these nets were found in small creeks on the opposite side of the Sino to the park. In Gbaboni, we came across a small hunting camp and several used shotgun shells. Although all anecdotal evidence points to a heavy hunting bias to duikers, the potential for crocodile hunting should not be ruled out or considered absent.

In connection to that, I was approached by a hunter from a town roughly 2 hours away. After a short informal interview he explained that he and his brother had three baby Dwarf crocodiles in their possession, all taken straight from rupture at a nest site outside of the park. From my experience with baby crocodiles the size he described did indeed point towards newly hatched crocodiles. The hunter told me this event happened in mid June which, if you take into account the 90-100 days incubation time, the time of deposit would be placed around mid March. This is contradictory to all the present literature on this species breeding season, said to occur early June. However this may explain why no nest sites were found on this survey, and may indicate either a change in breeding schedule or a locality specific regime not previously identified.

All water samples analysed tested well and produced the same results for every stretch of water tested. These results showed that the water has no trace heavy metal elements as a result of mining techniques in the park. This is even the case at Gbaboni creek where the site is surrounded by mining camps and the impact from the mining, because

of its proximity to it, would be the greatest. And so this potential threat, recognized at the beginning of the study can be realized as having no direct effect on the crocodile populations or distribution as a result of water pollution.

Siamweed (*Chromolaena odorata*) was not present along the banks or anywhere within the primary forest. It was abundant however in areas of past clearance where successional stages were in effect. Therefore its impact on thermoregulation in nests sites was not monitored and indeed it seems the case that for now at least its terrain does not cross over with that of the nest sites. It should be noted however that Leslie (2001) confirmed Siamweed as a common invader of open riverbank habitats and so its distribution should be monitored over time.

Of the three species reported to inhabit the park, only the slender-snouted crocodile (*Mecistops cataphractus*) and the African Dwarf crocodile (*Osteolaemus tetraspis*) were sighted. These two species show a clear habitat separation and niche partitioning that allows them to exist here, both as super predators without any apparent competition. A total of 9 *M. cataphactus* were found exclusively on the main Sino River. These varied in size from 0.6m to 3m, all but one was spotted during a night survey and all were seen to be utilising the microhabitats formed by the fallen trees in the river. A total of 12 *O. tetraspis* were found exclusively in the larger creeks connecting to the Sino River. Again these were mostly spotted on the night surveys and size varied from 0.5 m to 2m. No *C. niloticus* were sighted on this survey. Heavy anecdotal evidence suggests that this species occurs in the dry season here in the park, making use of the exposed sand banks for digging nest sites. This would suggest what has been proposed to me previously, that this species returns to the brackish water towards the coastal regions out of dry season. If this is the case, a survey that monitors the migration of this species and its time in the park should be the next priority. It would also be of great interest to see if the presence of this much larger much more aggressive species displaces either of the other two species from their preferred habitats temporarily and what the dynamics of this displacement intails.

Of the three researchers selected to join me for training in this survey technique, two Liberian students and one FDA researcher, only the FDA researcher has completed the training. The two students picked for this assignment did not fore fill the criteria needed to approach this project with any real impact. I stress that in the future, when students are selected, that the project and its logistics be explained fully as to prevent wasted time and money, as was the case with this particular survey.

A full paper analysing the data collected and covering this subject matter will be written with intention to publish in the near future.

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