AMENDMENTS TO APPENDICES I AND II OF THE CONVENTION

Proposals Submitted to Resolution on Ranching

A. PROPOSAL

Maintenance of the Kenya population of Crocodylus niloticus in Appendix II.

B. PROPONENT

The Republic of Kenya.

C. SUPPORTING STATEMENT

1. Taxonomy

11. Class: Reptilia

12. Order: Crocodylia

13. Family: Crocodylidae

14. Species: Crocodylus niloticus

15. Common Names: English: Nile crocodile
French: crocodile du Nil
Spanish: Cocodrilo del Nilo

16. Code Numbers:

2. Biological Data

21. Distribution: Considerable biological information concerning the distribution of the Nile crocodile is available (Modha, Watson). Presently it occurs abundantly in almost all fresh water lakes, rivers, swamps and man made dams in Kenya from sea-level to about 6000 ft. i.e. Lake Turkana, Tana, Dauwa, Uaso Nyiro, Masai Mara, Athi-Galana, Tsavo-Sabaki Rivers, Lakes Baringo, Kamnarok, Jipe, Chala and Victoria (see map).

22. Population: Population surveys undertaken in 1988 and 1989 (see Reports by Hutton and Mukhi Annexes 1 and 2). Population estimates of the most important crocodile areas in Kenya indicate that Lake Turkana has the highest number of crocodiles followed by the Tana, Dauwa and Uaso Nyiro Rivers in that order.

Main Breeding Grounds: Central and south islands of Lake Turkana, Sibiloi National Park, Tana River Primate Reserve, Arawale Reserve, Kora Reserve, Rahole Reserve and Meru National Park.

23. Habitat: Apart from drought which sometimes causes some of the smaller lakes and rivers to dry up, the crocodile habitat is secure. Due to the increase in human population which tend to concentrate near rivers, lakes and dams, where crocodiles also inhabit, there has been a lot of conflicts where people and livestock have been killed and/or eaten by crocodiles (see Annex I - Survey Report).

3. Trade Data

31. National Utilization: Kenya has not been utilizing its crocodiles fully due to the fact that there has been a trade ban since 1978 (by an Act of Parliament, June, 1978). However, Kenya Wildlife Service is now in the process of reviewing various utilization programmes with a view of introducing game farming. With this in mind, we hope to encourage conservation of crocodiles through controlled utilization programmes which will be geared to benefiting the people living in crocodiles areas (see Management Plan - Annex 3).

Mamba Village and Baobab Farms have been in operation for sometime now. Mamba Village was registered with CITES in 1987 and Baobab in January 1990. Meat of the animals shot on control and eggs are utilized by the local people, mainly in Tana River and Lake Turkana.

We are in the process of establishing two more farms on the Tana and Malindi areas.

32. Legal International Trade: Since the hunting ban of 1977 and trophy trade ban of 1978 there has been very little trade in crocodile trophies. Mamba Village has been exporting a limited number of crocodile skins and meat since 1987 (see table below).'

Year	Skins	Hatchlings	Live mature	Live pre-mature
1987	150	1000	150	-
1988	1400	1000	-	20
1989	2100	1000	150	-
1990	1100	-	-	-

33. Illegal Trade: There has been no licences issued for commercial hunting since the hunting ban of 1977. However, illegal trade although insignificant cannot be ruled out.

34. Potential Trade Threats:

341. Live Specimens: The Kenya Management Plan for crocodiles discourages export of live animals.

342. Parts and Derivatives: The Wildlife (Conservation and Management) Act requires possession of an export permit for exporting any skins or other parts of crocodiles.

Locally, because of the trade ban (by an Act of Parliament in 1978) there has been no trade in crocodile skins or meat. The only skins and meat exported has been by Mamba Village. There is thus no incentive for illegal trade in the species.

4. Protection Status

41. National: Crocodile is a protected species under Section 68, Part III of the Wildlife (Conservation and Management) Act Cap. 376 of the laws of Kenya. At present, as for any other game animal, crocodiles may not be hunted (Legal Notice No. 120 of May, 1977). However, there are registered crocodile farms which are allowed to collect eggs and hatchlings outside the National Parks and Reserves for the purposes of farming. In this case, crocodile products may only be exported on the strength of an export permit issued in terms of CITES regulations.

42. International: Any export permit issued by Kenya has been in compliance to the regulations agreed upon by CITES Parties. For the last 5 years Kenya has been exporting crocodile products under the Resolution Conf. 5.21 quota system.

5. Information on Similar Species

None.

6. Comments from Countries of Origin

Kenya is one of the African crocodile producing countries which is exporting crocodile products under the CITES quota system. There is a general consensus among the African producer countries that the Nile crocodile should be maintained in Appendix II where it can be traded under the ranching system.

Marking System

The CITES crocodiles tags have been in use for the last five years under a strict quota system.

7. Additional Remarks

71. Management Plant

Kenya has a detailed Management Plan for crocodiles (see Annex 3). The Management Plan gives multidimensional aspects including protection and control.

72. Ranching

The Management Plan requires that ranching is the only permissible form of consumptive utilization of crocodiles in Kenya. Ranching will be restricted to eggs and juveniles of 80 cm in length.

Kenya has two ranches operating under the CITES quota system. Baobab Farm has been in existence since 1978 and Mamba Village since 1983. These farms have been collecting eggs, hatchlings, juveniles and adults since then (see Tables below).

BAOBAB FARM

Year	Eggs	Hatchlings
1982	198	197
1983	700	542
1984	60	56
1990	950	795

Please note that no eggs or hatchlings were collected during 1985-1989 period.

MAMBA VILLAGE

Year	Eggs	Hatchlings	Pre-mature	Adults
1984	-	-	217	43
1985	2000	221	432	47
1986	-	-	228	37
1987	3690	731	-	37
1988	2801	226	-	25
1989	1343	492	-	21
1990	785	-	-	-

Both of these are registered with CITES as captive breeding operations. Once this ranching proposal is accepted they will be removed from the register.

All the criteria outlined in CITES Resolution Conf. 3.15, 5.16 and 6.22, marking and reporting, will be fully met by Kenya.

ANNEX 1

1

THE STATUS AND DISTRIBUTION OF CROCODILES IN KENYA IN 1988

J.M. Hutton

INTRODUCTION

Crocodiles were heavily exploited in an uncontrolled manner throughout much of Africa around the 1950's and 60's (Behra, 1988; Cott, 1961; Parker and Watson, 1970). Although not well documented it is clear that many accessible populations were reduced to low numbers, though there is little evidence that skin hunting alone was responsible for the extirpation of any. Parker and Watson (1970) were among the first to point out that in countries such as Uganda rapidly expanding human populations made the decline of crocodiles inevitable.

By the early 1970's hunting crocodiles for skins had declined throughout much of eastern, central and southern Africa. This was partly the result of protection, but also because numbers had fallen to sub-economic levels. Around the same period (1973) the foundations of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) were laid down. By the early 1980's almost every country in this part of Africa had acceded to CITES and, as the species was on Appendix I of the Convention, traffic in wild Nile crocodile skins virtually ended.

Since the end of widespread uncontrolled hunting, a period which varies from country to country but is generally 20 years or more, many crocodile populations appear to have shown a marked recovery and expansion, though this is not well documented. In some countries new crocodile habitat has been created (such as Lakes Kariba and Cahora Bassa) while in some crocodile strongholds human interference either direct (deliberate eradications at Lakes Victoria and Malawi) or indirect (drying out of habitat at Marromeu in Mozambique) has made it unlikely that any significant recovery of numbers can take place.

Crocodile recovery, expanding human populations and the continuing high value of the animal's skin made it inevitable that crocodile conservation and use would again become an issue in Africa. By 1985, pressures to recommence exploitation induced CITES to introduce a quota scheme under which a limited number of wild-taken crocodile skins could be legally exported each year. This was a temporary measure to allow countries to gather the information required for detailed proposals to enable them to participate in ranching, hitherto the only legal scheme through which wild populations could be utilized. Knowledge of the status and distribution of wild crocodiles is required for ranching proposals. So is information on habitats and trends with respect to both. Kenya has an advanced crocodile ranching programme and an urgent need to submit a ranching proposal.

This report to the Director of the Kenya Wildlife Conservation and Management Department presents results of aerial surveys of Kenya's main crocodile populations made by the CITES Nile crocodile project in March 1988. Some trends were apparent and the quantity and quality of habitats and other factors affecting crocodile density were observed. The suitability of the surveys as a basis for monitoring scheme is discussed.

METHODS

Areas Surveyed

Because of time and finance constraints, local information was used to identify the larger crocodile populations prior to the survey. Lakes Turkana and Baringo, and the northern Ewaso Ngiro, Mara, Tana and Sabaki/Galana Rivers were all subjectively said to have many crocodiles. Additionally, large sections of these waters are outside protected areas and therefore potentially subject to crocodile exploitation. Lake Turkana (which had been surveyed before) and the Tana River (which had not) were believed to harbour the two largest crocodile populations, and, together, the majority of Kenya's crocodiles. These were

therefore treated as priority areas. Eventually only the Mara River was left unsurveyed.

Survey

Bayliss (1987) and Graham (1988) review techniques for estimating crocodile numbers. The method with the least bias is spotlight counting, though the value of uncorrected spotlight counts for the estimation of absolute abundance is usually overestimated (Hutton and Woolhouse, 1989). Aerial counts may be quick, simple and cost effective, but have large biases. Parker and Watson (1970) summarize the rationale behind the aerial survey of crocodiles. Graham (1988) notes that techniques for both ground and aerial census have stayed the same, but that survey design and analysis have advanced. In this survey it was decided that the main aim was to obtain precise, repeatable estimates of abundance for use in an inexpensive, simple and rapid monitoring programme to detect trends. Although there is a great deal of satisfaction to be gained from accurate absolute abundance estimates, there is often little biological necessity for such information.

A Cessna 206 aircraft with a STOL Conversion was used throughout the survey. Crocodiles were counted from altitudes between 30 m and 150 m and at speeds between 130 and 180 km/h. To reduce observer bias, double or 'tandem' counts were made after the method of Magnusson *et al.* (1978) and Caughley and Grice (1982).

By preference double counts were made by two observers sitting in a line behind the pilot, leaving him free to fly and position the aircraft for maximum visibility of the waters edge. However, for much of the survey only one trained observer was available and the pilot doubled as an observer. Variation due to observer differences are accounted for in the Coefficient of Variation (CV) measured for each count (Caughley and Grice, 1982).

Where lake shoreline was being surveyed the aircraft was flown 20-30 m offshore, except when the sun's reflection in the water dazzled the observers. In such instances the aircraft was positioned over land.

Wherever possible the aircraft was flown straight and level. Banks of narrow rivers were surveyed simultaneously; the banks of wide rivers were surveyed consecutively. Dendritic shorelines or winding rivers were surveyed as completely as possible from tight anti-clockwise turns.

Total counts were made of crocodiles in small rivers and lakes, but Lake Turkana and the Tana and Sabaki/Galana Rivers were divided into strata and sampled. For Lake Turkana the strata chosen were the same as the sections described by Graham (1968), and within strata an effort was made to make sample with a frequency proportional to crocodile density as noted by Graham (1968). The Tana and Sabaki/Galana River samples were selected to give increased coverage in those sections where subjective reports said that crocodiles were most common. Strata were adjusted according to habitat types and qualities as noted during the survey.

Sightings were recorded within samples as S_1 (crocodile seen by observer 1, but not by observer 2), S_2 (seen by observer 2 only), and B (seen by both observers). The total number of crocodiles subject to observation was calculated from:

Estimated numbers (N) = $(((S_1+B+1)(S_2+B+1))/(B+1))-1$

Variance (V) = $(((S_1)(S_2)((S_1+B+1)(S_2+B+1)))/(((B+1)^2)(B+2))$

The coefficient of Variation (CV) was used as a measure of the precision of counts. Counts with a CV less than about 15% are necessary to decide whether a series of estimates are truly different. CV was calculated as $((\sqrt{V})/N)100$

RESULTS

Lake Baringo

A total count was made between 0950 and 1022h on 9 March 1988 during which: S = 14, S = 24, B = 43, and therefore: N = 88.6 with CV = 4.4% Most crocodiles were seen along the south west and north east shorelines.

Lake Turkana

The 13 sections described by Graham (1968) and the 19 samples surveyed on 9-10 March 1988 are shown in Figure 1. In all 328 km of the estimated 1037 km of shoreline (32%) was examined.

The results of this survey are detailed in Table 1. Note that the estimated total in each of the strata corresponds to the number of animals actually counted in each section by Graham. The total number of crocodiles actually seen on the lakeshore by Graham on each occasion of counting was 3 573 and 5 654. The corresponding figure from the 1988 survey is 2 376 (Table 2).

Ewaso Ngiro River

About 90 km of the Ewaso Ngiro River were surveyed on 11 March 1988. Results are presented in three broad strata from east to west (Table 3). The density fell from 0.90 crocs/km in the sparsely inhabited area to the east of Samburu Game Reserve to 0.07 crocs/km in the more heavily settled area to the west.

Tana River

On 12 March 1988 fourteen samples of approximately 10 km each were made of the estimated 715 km of river channel, a coverage of about 20% (Figure 2) The results of this survey are detailed in Table 4. Densities tended to decrease downstream towards Garsen where the highest human population was found.

Sabaki/Galana River

About 198 km of the Sabaki/Galana River was surveyed in twelve 10 km samples on 14 March 1988. The survey started at Malindi and progressed upstream. During the survey three broad strata were identified (Fig. 2) and the results within these are detailed in Table 5. Densities increased from 0/km near the sea, where the river passed through heavily settled country, to 1.5/km in Tsavo National Park.

DISCUSSION

Historically, crocodiles are reported from virtually all permanent water in Kenya below 1 800 m above sea level, including water holes on seasonal rivers (Graham, pers. comm.). Recently, observers have reported that numbers are low in Lake Victoria and the Ewaso Ngiro, but high in Lake Turkana (formerly Lake Rudolf), Lake Baringo and the Tana, Sabaki and Mara Rivers (R. Haller, M. Modha, I. Parker, D. Rottcher pers. comm.).

There have been a number of systematic accounts of crocodiles in Kenya. Modha (1967) gave some information on the crocodile population of Central Island, Lake Turkana while Graham (1968) reported on a survey of the whole Lake population. Watson, Graham, Bell and Parker (1971) gave some information on the crocodile population of the Lorian Swamp into which the Ewaso Ngiro River empties. In 1968 Parker (pers. comm.) counted crocodiles along the Mara River. In the early 1980's, at the start of a ranching scheme at Baobab farm, Mombasa, surveys of egg production were made on Central Island, Lake Turkana, the Tana and the Sabaki/Galana Rivers (Balarin, 1983; Haller and Balarin, 1982.) Balarin and Armitage (1982) and Zilber (1988, in Litt.) report on spotlight and nest counts along the Tana River.

Lake Baringo

There is no information from Lake Baringo with which to compare this survey's results. Anecdotal evidence was contradictory, some suggesting that crocodiles (and hippo) declined dramatically during the 1970's and 80's, others suggesting they had increased with large numbers of crocodiles occurring in the Molo River. During this survey the water was at least 4 m below its normal level and the Molo River was dry. Crocodiles were everywhere denied the cover of fringing vegetation: Under these conditions visibility should have been good and concealment biases low. These circumstances appear to be unusual, difficult to duplicate and, consequently, our results may be an inappropriate benchmark. However, with a low CV of 4.4% the count of 89 adult-sized crocodiles around Lake Baringo (1.4 crocs/km excluding the islands) will be useful comparison for future counts made under similar drought conditions.

The majority of crocodiles were found along the south-west and north-east shores. Reasons for this discontinuous distribution were not clear, but it might be explained by prevailing winds and local human distribution.

Lake Turkana

Graham (1968) gave details of total counts of the Lake Turkana crocodile population in 1965 and 1966. As noted, his strata (Sections 1-13) were retained in the present survey, though estimates were derived from sampling rather than total counting. While the two techniques are not strictly comparable our results suggest that Lake Turkana's crocodile population has been halved since Graham's study.

Data from this survey have been adjusted with 1965 and 1966 night-count correction factors to give estimates more compatible with those reported by Graham (Table 2). These have then been inspected to see if the 1988 totals fall between the 1965 and 1966 estimates (Table 2, Columns 6 and 10). Out of Graham's 13 sections one (north island) was not surveyed and one (Ferguson's Gulf) was dry. Of the remaining 11 sections nine estimates from this survey fell below those for 1965 and 1966 (Table 2, Columns 17 and 18).

Modha, (1967, 1968) provided information on the Central Island breeding population between 1965 and 1967 and this was augmented by Haller and Balarin (1982). Between 1965-1967 the island's Lake C held 500 crocodiles, many of which were breeding (Modha, 1967). Graham (1968) recorded uncorrected densities of 8.07 on the island and 9.89 crocs/km when those around its shoreline were included. However when resurveyed by Balarin in 1982, only 12 crocodiles were seen of which only one was in Lake C (Haller and Balarin, 1982). In March 1988, 25 crocodiles were seen (and 27 estimated) on and around the island, a density of 1.01 crocs/km. of shoreline. Lake C was completely dry. The 1982 and 1988 surveys were both made during the peak nesting season, when, in the past, crocodiles were most abundant and this large and impressive crocodile concentration,

reported by Graham (1968) and Modha (1967) in the late 1960's, has been eliminated or dispersed.

In 1965/66 there were no residents, and few transient humans on Central island. By 1982 12 Turkana fishermen were living there, despite the island's National Park status. Haller and Balarin (1982) attributed six crocodile skeletons and the destruction of 13 crocodile nests to these residents (Turkana people habitually eat crocodiles and their eggs). Haller and Balarin thought that this disturbance and predation was responsible for the dramatic decline of the Central Island population. Parker (pers. comm.) observed the decline coincided with the growth of Lake Turkana's gill-net fishery: many crocodiles are entangled and drown in nets set near their favoured basking areas. During this survey, six people and two boat yards were seen on the island. In addition, Lake C was dry.

Under these conditions the re- establishment of a large breeding population of crocodiles is unlikely. Central Island seems to be used as an example of a crocodile population which has declined due to human activities. Although fewer data are available, a similar situation occurs on South Island (also a National Park) and in Graham's Sections 3,4,5,6 and 8 (Table 2) where the crocodile population has also, apparently, fallen.

Climatic conditions may also have influenced the apparent crocodile decline. In 1965/1966 Ferguson's Gulf supported 22 crocs/km despite a relatively high human density (Graham, 1968). Following several years of severe drought the level of Lake Turkana fell by over 6 m in 1988. Ferguson's Gulf, with an average depth of 3.7 m in 1966 (Parker and Watson, 1970) was completely dry. In the 1960's the shoreline between Ileret and Allia Bay was particularly suitable crocodile habitat, being swampy and sheltered with inundated fringing vegetation and extensive beds of aquatic macrophytes in shallow water (Graham, 1968). In 1988 the water level had fallen so far that this fringing vegetation had dried-out and largely disappeared. Perhaps more importantly the beds of aquatic macrophytes, and with them high densities of crocodiles, had contracted southwards to the deeper water in Allia Bay. It appears as though falling lake levels have resulted in a corresponding loss of optimum crocodile habitat.

The rapid fall in water level on Lake Turkana would have two effects on the crocodiles. Firstly, they would be crowded into smaller areas of suitable habitat and under these conditions a high mortality of sub-adults could be expected (Craig and Hutton, unpublished). Secondly, nests are probably easier to find and the animals themselves easier to hunt for food.

Watson *et al.* (1971) noted that fishing activity and human density increased markedly around Lake Turkana in the early 1970's. They suggested that this would lead to a decline in the crocodile population. It appears that this prediction has come true, the decline being more severe in view of the propensity for local people to prey on both crocodiles and their eggs, and the recent drought.

In summary, the marked decline of crocodiles on Lake Turkana does not appear the result of exploitation for skins, either legal or illegal. It appears more likely to be related to the inexorable expansion of the local human population and recent climatic trends.

The Ewaso Ngiro River

The Ewaso Ngiro, and especially the Lorian Swamp into which it drains, have historically been important crocodile habitats in Kenya. Watson et al. (1971) reported a density of 4.25 crocs/km (8.5 crocs/km after correction) from aerial survey of the upper Lorian Swamp. However this area has become much more arid since the 1970's, and by the 1988 survey had dried out completely. The Ewaso Ngiro River had for some time been reduced to a series

of pools, but just prior to the survey heavy rain had resulted in a strong, muddy flow. The 90 km section surveyed was from 25 km below the Samburu National Reserve to 30 km upstream of the Reserve, a section about 50 km upstream of the area examined by Watson et al. (1971). Densities declined markedly as the survey progressed into the area of moderate to high human density west of the Reserve (Table 3). Even the highest density (0.9 crocs/km) was less than 25% of that reported by Watson et al. (1971). It appears likely that increased human pressure on a shrinking water resource has resulted in a marked decline in crocodile numbers.

The Tana River

The Tana River is famous for its crocodiles (in view of the high human fatality rate, perhaps infamous is more apt). The popular Kenya press regularly reports human death due to Tana River crocodiles. Both local and national politicians regularly call for the animals' eradication (e.g. The Standard, Wed. Jan. 27, 1988). However, there have been no previous systematic surveys of the whole Tana River crocodile population. Taken on their own, the results of this survey suggest that crocodile densities are high (4.8 crocs/km) in the Meru National Park, but decline to zero as the river flows down to the highly cultivated area around Garsen (Table 4). The estuary beyond Garsen was not surveyed. A similar gradient in hippo density was even more marked, with few seen outside Meru. For both species the protected area of the Tana River Primate Reserve produced a break in the trend. In the Reserve, some 500 km below Meru (Sample 12, Fig. 2), crocodile density rose slightly and hippo reappeared in the river. One sample in stratum E returned a high density of crocodiles against the trend because numerous large specimens gathered to feed on the carcass of a dead camel.

Balarin (1983) reported results from daytime boat counts, an aerial survey and a nest survey on part of the Tana River below Garsen. After this aerial survey Zilber (in litt.) reported on a systematic count of crocodiles by spotlight on the river from Hola and Kau (about 280 km, Fig. 2). He also reported on a survey of nests over the same distance (but excluding the Tana River Primate Reserve). These separate density estimates are combined in Table 6 for comparison. In Strata E and F densities of animals >2 m, estimated from aerial survey, are similar to those estimated by spotlight count. In strata G and H, downstream of the Primate Reserve, the aerial survey appears to have revealed only a fraction, if any, of the crocodiles which were actually there (see also Table 7).

The Tana was divided into strata in anticipation of differing crocodile visibility profiles. Along its course the character of the river changes considerably (see descriptions of strata in Table 4) being straight, wide and shallow or winding, narrow and deep in its upper reaches and finally split into several narrow, winding channels near Garsen. Additionally, human densities and land uses along the banks vary considerably, but are highest and most intense around Garsen. Thus, it is not valid to assume that aerial survey gave the same information about the crocodile population in each stratum. It is however, valid to use the results from each as the basis for monitoring. In fact, based on extensive experience elsewhere in Africa, I consider that the river above Section F was sufficiently homogenous for aerial survey to reflect real density differences between strata. However, in sections G and H, the river changes character completely, and the proportion of the population revealed by aerial survey appears to have been so low that its value for monitoring is dubious. It was impossible to keep the narrow, twisting and divided channels in view from a fixed wing aircraft and human pressures on the river are so great that crocodiles are likely to be wary and shy.

The detailed results of a spotlight survey and a nest survey in these lower reaches of the river are given in Tables 7 and 8. Both spotlight counting and nest surveys would probably be adequate for monitoring. Spotlight surveys are expensive, time consuming and commonly

dangerous. Nest surveys can be cheaply and easily integrated into schemes where eggs are collected for ranching purposes. A breakdown of the broad size distribution of crocodiles in seven sections of river is given in Table 7. Crocodiles of all sizes appeared in roughly equal proportions, but without information on trends this information is of limited use. It is presented in anticipation of monitoring and a general population model for the species.

The Tana River runs through arid eastern Kenya and human population pressure on this water is escalating rapidly (Haller, pers. comm.). Evidence of recent bush clearance, settlement and new cultivation was seen in strata B, C and D, and even the "protected" areas of A and F. Strata E and G appear to have been settled for some time. Human/crocodile conflicts were high along much of the river. Around Bura (Strata D/E), wooden stockades were seen around watering places to protect people and their stock from crocodiles. Reports, in the Kenyan press, of 200 fatal crocodile attacks each year may not be exaggerated. The toll in livestock for peasant people is a large economic burden (Haller, pers. comm.). Of 670 nests along the river 82 (12.4%) were destroyed by animals and 370 (55%) by people, a total predation rate (excluding collection for ranching) of 68% (Table 8). Eggs are taken for food by people, but also in an attempt to rid the River of crocodiles.

The Sabaki/Galana River

The Sabaki/Galana crocodile population has been examined on several occasions (Parker, pers. comm.), but there is no written report giving densities prior to 1982. In 1982, the river from the sea to just within the boundary of Tsavo National Park was surveyed from the air (Balarin, 1983). Sightings were plotted on to maps and for comparison (Table 5) these have been reanalyzed with respect to the strata and samples of my 1988 survey (Fig. 2). The two sets of data show that there were few crocodiles in the 95 km of river closest to the sea (Stratum A) in 1982, and probably none in 1988. In Stratum B, crocodile density appeared to have declined by 50% between 1982 and 1988. Stratum C, within Tsavo, was not surveyed in 1982, but a substantial population (1.5 crocs/km) was found in 1988.

The decline in Stratum A can probably be explained by the recent drought and extremely shallow profile of the river. That numbers were already low in 1982 is a reflection of the moderate to high human population of this region. Stratum B includes the frontage of Galana Ranch, where Balarin found a particularly high density of crocodiles in 1982. These were not in evidence in 1988. It is possible that they had migrated to within Tsavo, but persistent rumours, from local people, of illegal hunting for skins cannot be ignored.

CONCLUSIONS

There appears to be sufficient information to conclude that four of the five major crocodile populations of Kenya have markedly declined, either since the late 1960's (in the case of Lake Turkana) or in recent years. This decline is not the result of deliberate exploitation, (since their has been none, except on the Tana River where animals have been removed to captivity) but is probably the result of human population expansion coupled, in recent years, with shrinking water resources. This trend can be expected to continue and no amount of legislation and law enforcement will reverse it. As elsewhere in Africa, the only factor in the crocodiles favour is its potential economic value.

The Kenyan Government is no doubt correct in encouraging crocodile ranching schemes from which wild populations (outside protected areas) will assume a significant economic value. Whether or not this value will be sufficient in all (or any) cases to encourage protection, or even tolerance of the animal depends on the design and administration of the schemes, and the quality and character of the ranchers themselves.

All five of the populations examined appear to have some potential for controlled exploitation, but principal amongst these is the Tana River. The loss of 352 nests to predation in 1988 (principally to humans) represents 18 000 eggs which could have been moved into captivity. To put this into perspective, the value of these eggs is about US$ 144 000.

Aerial survey as it is reported here appears to have considerable potential for rapid, cost effective monitoring of crocodile populations on Lakes Baringo and Turkana and the Ewaso Ngiro and Sabaki/Galana Rivers. However, the Tana River population is subject to particularly heavy exploitation and aerial monitoring may be inadequate. It would be more powerful if combined with other population indices such as the number of nests laid.

While a decline in crocodile numbers outside protected areas is expected, a decline inside National Parks and Game Reserves is unnecessary if it is due to illegal human activities. There is little that the Kenyan authorities can do about drought and receding water levels, but they can protect the three National Parks on Lake Turkana which are probably critical to crocodiles.

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Finally, Lynne Taylor cheerfully typed the manuscript which was critically (and fairly cheerfully) reviewed by Ian Parker. Ian Games uncheerfully retyped the manuscript in exchange for miserable amounts of cash.

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Figure 1: Lake Turkana showing strata (1–13, after Graham, 1968) and samples (A–S) for the 1988 aerial survey

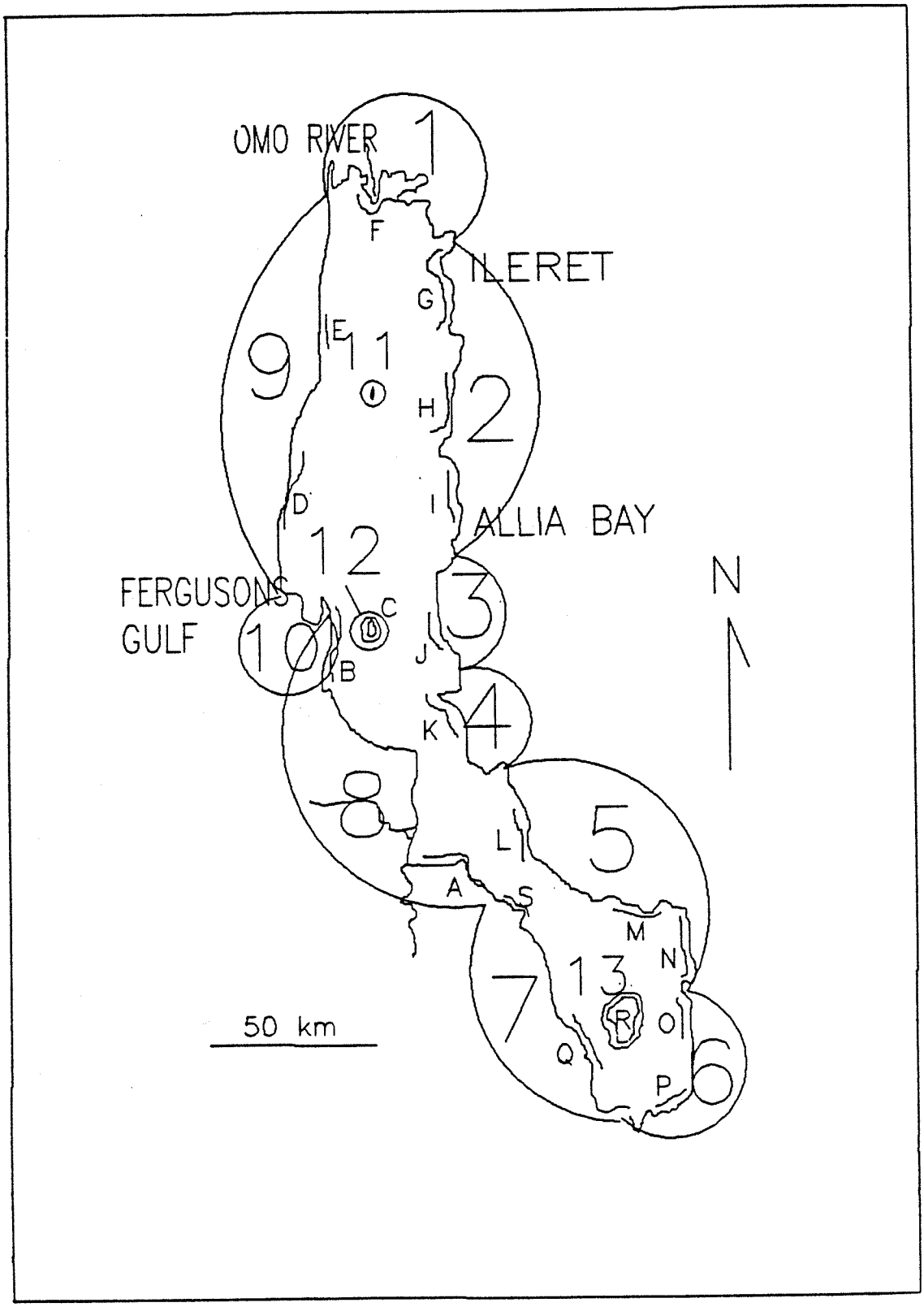

Figure 2. The Tana and Sabaki/Galana rivers showing strata (A–H for the Tana, A–C for the Sabaki/Galana) and samples (1–14 for the Tana and 1–12 for the Sabaki/Galana) for the 1988 aerial survey of crocodiles.

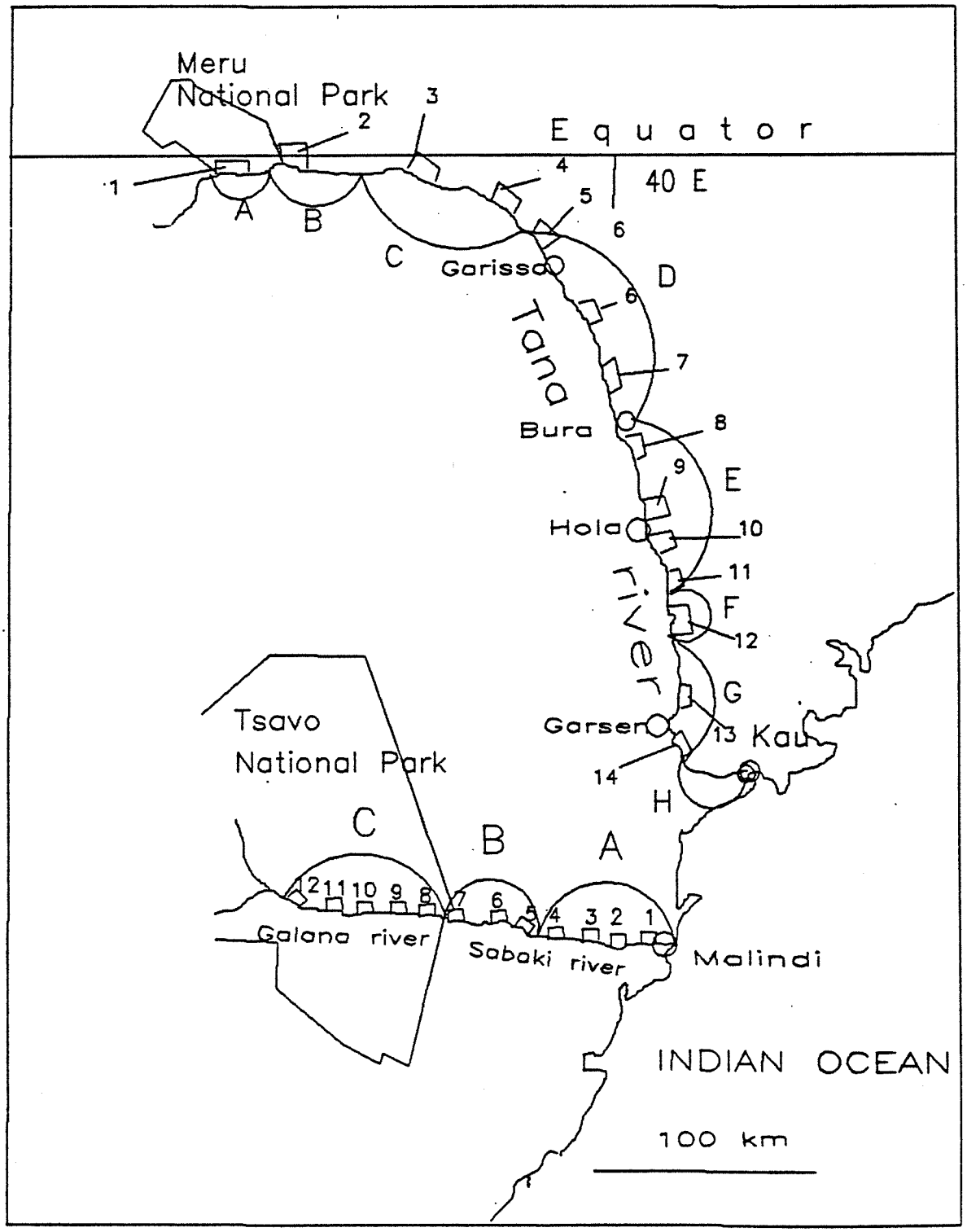

Table 1: Results of an aerial survey to count Nile crocodiles on Lake Turkana in March, 1988. Samples were taken within strata (the sections used by Graham [1968] for surveys in 1965/66) and tandem counts were made to reduce observer bias (see text).

Strata	km	Sample	Gridref/ locality	km	S1,S2,B	N	CV	D	Mean D in strata	Est. Total in strata	Date	Time
1	158	F	Bh3595-Bh5095	20	2, 7,43	52.3	1.2	2.62	2.62	415	10.3.88	0923-0929
2	131	G	BH5687-BH5765	25	6, 0, 7	13	-	0.52				0938-0945
		H	BH5851-BH5536	15	6, 11, 50	68.3	1.9	4.55	11.04	1451	10.3.88	0953-0957
		I	BH5925-BH6208	21	114,119,313	589.2	1.5	28.06				1000-1027
3	43	J	BH5690-BB5978	15	0, 0, 0	0	-	0	0	0	10.3.88	1033-1036
4	43	K	BB5868-BB6560	10	0, 3, 3	6	-	0.6	0.6	26	10.3.88	1040-1046
5	122	L	BB7642-BB7930	12	1, 2, 3	6.5	13.3	0.54			10.3.88	1055-1103
		M	BB9620-BC0818	8	0, 0, 0	0.0	-	0	0.18	123	10.3.88	1110-1115
		N	BC1212-BC1205	8	0, 0, 0	0.0		0			10.3.88	1116-1120
6	43	O	AR1099-AR1187	12	1, 0, 1	2.0	-	0.17	0.37	16	10.3.88	1510-1514
		P	AR1078-AR0566	15	1, 3, 4	8.6	11.4	0.57			10.3.88	1519-1523
7	115	Q	BB9278-BB8589	12	2, 1, 0	5.0	-	0.29	0.35	42	9.3.88	1122-1130
		S	BB7615-BB6250	12	1, 1, 1	3.5	24.7	0.42			10.3.88	1530-1534
8	65	A	BB6620-BB4928	25	1, 0, 0	1.0	-	0.04	0.02	1	9.3.88	1130-1139
		B	BB2868-BB2595	27	0, 0, 0	0.0	-	0.0			9.3.88	1142-1151
9	218	D	Bh1507-BH1725	20	0, 3, 0	3.0	-	0.15	1.25	272	10.3.88	0850-0857
		E	BH2657-BH2768	12	1, 4, 23	28.2	1.6	2.35			10.3.88	0908-0913
10	29		Ferguson Gulf	-	-	-	DRY	-	-	-	-	-
11	9		North Island	-	-	-	NS	-	-	-	-	-
12	27		Central Island and lakes	27	2, 13, 10	27.3	8.7	1.01	1.01	27	9.3.88	1510-1521
13	32	R	South Island	32	1, 8, 16	25.5	3.3	1.25	1.25	3	10.3.88	1540-1552

N = Estimated number in sample
D = Estimated density in sample
CV = Co-efficient of variation

able 2: Apparent changes in the density of Nile crocodiles on Lake Turkana between 1965/66 and 1988 as estimated from

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Section (after Graham, 1968)	km	N Feb, 65	D	Corrected D est. (x3.1)	Est. Total	N June, 66	D	Corrected D (x2.2)	Est. Total	N est. visible March, 1988 (= to col. 3 & 7)	Mean D	Est D with CF of 2.2	Est D with CF of 3.1	Est total with 66 CF	Est total with 65 CF	Is 1988 total with 65 and 66 range?	Direct -ion of change
1	158	202	1.28	3.95	626	546	3.45	7.58	1201	415	2.62	5.76	8.12	912	1286	yes	-
2	131	1946	14.80	45.89	6033	2974	22.63	49.79	6543	1451	11.04	24.29	34.22	3192	4497	no	↓
3	43	162	3.75	11.63	502	97	2.25	4.94	213	0	0.00	0.00	0.00	0	0	no	↓
4	43	130	3.01	9.33	403	288	6.67	14.67	634	26	0.60	1.32	1.86	57	80	no	↓
5	122	300	2.45	7.6	930	574	4.69	10.32	1263	123	0.18	0.40	0.56	49	69	no	↓
6	43	45	1.04	3.23	140	34	0.79	1.73	73	16	0.37	0.81	1.15	35	50	no	↓
7	115	114	0.99	3.07	353	195	1.69	3.72	429	42	0.36	0.79	1.12	91	129	no	↓
8	65	138	2.13	6.60	428	173	2.67	5.87	381	1	0.02	0.26	0.37	17	24	no	↓
9	218	170	0.78	2.42	527	147	0.67	1.48	323	272	1.25	3.44	5.63	749	1226	no	↑
10	29	41	1.42	4.41	127	165	5.73	12.60	363	No	Water	-	Not	Counted			
11	9	10	1.11	3.44	31	2	0.22	0.49	4	No	Survey	-	Not	Counted			
12	27	218	8.07	25.03	676	267	9.89	21.76	587	27	1.01	2.22	3.13	60	85	no	↓
13	32	97	2.99	9.28	301	192	5.93	13.04	422	3	1.25	2.75	3.90	88	125	no	↓
TOTAL	1037	3573			11706	5654			12439	2376				5250	7571		↓

= Density
= Correction Factor

Table 3: Results of an aerial survey to count crocodiles in the Ewaso Ngiro river in the region of the Samburu Game Reserve in March, 1988. Three strata were recognized and tandem counts were made to reduce observer bias.

Stratum	km	Grid Ref/ Locality	S_1, S_2, B	N	CV	D	Time of Survey	Description of Stratum
A	25	CL7075-CL5271 From start, west to Archer's Post	7,4,2	22.3	32.9	0.90	1030-1041	River shallow and very rocky, very muddy water. Low human density
B	35	CL5271-CL2565 Archers Post to west edge of Samburu Game Resrve	5,4,2	17.7	31.5	0.51	1041-1053	River winding and shallow with both rocky and sandy sections. Low human density within Samburu Game Reserve
C	30	CL2565-CL0982 Western edge of Samburu to end of survey	1,0,1	2.0	-	0.07	1053-1102	River winding and shallow, moderate human density.

N = Estimated number in stratum
CV = Co-efficient of variation
D = Estimated density

le 4: Results of an aerial survey to count crocodiles in the Tana river in March, 1988. Sample counts of approx 10 km were made within 7 strata and tandem counts were made to reduce observer bias (see text).

Stratum	km	Sample ± 10 km	Grid Ref	S_1, S_2, B	N	CV	D	Mean D	Est Total	Time of Survey	Notes	Description of stratum
A	25	1	DK3292-DK4393	22, 5,14	48.3	9.8	4.83	4.83	121	0924-0929	Both banks	Within protected areas. Low human and livestock densities especially on north bank. River wide with sandy and rocky areas.
B	50	2	DK5298-DK6195	2, 3, 3	9.5	18.8	0.95	0.95	48	0934-0944	Both banks	First part wide ans shallow and sandy then rocky with rapids. Moderate vegetation cover. Low human and livestock density.
C	100	3	EK0795-EK1388	5, 5, 6	19.6	6.8	1.96			1005-1015	Both banks	River wide + shallow with many islands and side streams. Dense tree cover on inside of bends. Low-moderate human and livestock density
		4	EK3685-EK4479	8,10, 9	35.0	12.7	3.50	2.73	273	1026-1032	Both banks	
D	155	5	EK5768-EK6560	4, 3,10	18.1	13.0	1.81			1046-1056	Circled	River narrow and deep with high banks and fewer islands. Moderate human and livestock densities increasing to high before section E.
		6	EK8530-EK8222	1, 1, 3	5.3	10.6	0.53	1.15	178	1108-1115	Circled	
		7	EK9106-EJ9718	1, 6, 2	11.0	21.1	1.10			1121-1129	Circled	
E	205	8	FJ0467-FJ0968	0, 0, 1	1.0	-	0.10			1135-1142	Both banks	River varies between narrow and deep, wide and shallow, but high human and livestock population throughout. Cultivation on islands.
		9	FJ1249-FJ1540	0, 0, 3	3.0	-	0.30	0.62	127	1150-1158	Circled	
		10	FJ1830-FJ2322	2, 3,11	16.5	5.0	1.65			1246-1254	Circled	
		11	FJ2413-FJ2304	1, 1, 2	4.3	14.0	0.43			1256-1303	Circled	
F	40	12	FH2495-FH2685	5, 3, 6	16.1	13.3	1.6	1.6	64	1306-1313	Both banks + Circled	Protected area of private reserve. River narrow and deep, well vegetated. Low human and livestock population.
G	80	13	FH3164-FH3056	0, 0, 0	0.0	0.0	0.0	0.0	0.0	1326-1330	Circled 1 channel. Incomplete coverage	River narrow with several alternate channels. Lake Skakababo water level low. Very high human density throughout.
		14	FH2730-FH3335	0, 0, 0	0.0	0.0	0.0			1341-1337		
H	60	-	DELTA								NOT SURVEYED	

Estimated number
Co-efficient of variation
Estimated density

ble 5: Results of an aerial survey to count crocodiles in the Sabaki/Galana river in March, 1988. Samples were made within three strata and tandem counts were made to reduce observer bias. Mean densities in the three strata in 1982 and 1988 are compared (see text).

Stratum	km	Sample	km	Grid Ref	Time	S_1, S_2, B	N	CV	N	Mean D in 1988	Est Total in 1988	N in 1982	Mean D in 1982	Description of stratum
A	95	1	10	FG1352-FG1752	0910-1000	0,0,0	0.0	-	0.00			1		River wide, winding and shallow with
		2	10	FG9652-FG0343		0,0,0				0.0	0	1	0.13	many islands and a high human density.
		3	10	EF8555-EG9257		0,0,0						2		
		4	10	EG7058-EG7756		0,0,0						1		
B	45	5	11	EG5352-EG6158	1000-1006	2,1,3	6.5	66.7	0.60			1		River wide and winding at start, rocky
		6	10	EG4460-EG5060	1008-1013	2,2,2	7.3	20.6	0.73	0.44	20	7	0.81	with sandy islands and lots of
		7	11	EG2461-EG3362	1116-1123	0,0,0	0.0	-	0.00			18		Phragmites by stratum 7. Low human density.
C	85	8	10	EG1568-EG1862	1026-1031	5,4,5	17.3	17.1	1.73					In protected area of Tsavo National
		9	8	EG0466-EG0963	1034-1037	3,0,0	3.0	-	0.40					Park. River with deep pools and rocky
		10	11	DG8865-DG9365	1042-1056	3,4,6	14.7	12.5	1.34	1.50	128	-	-	and sandy sections. Almost no human
		11	8	DG7195-DG7893	1055-1058	1,6,9	16.6	5.9	2.08					presence.
		12	10	DG5898-DG6695	1106-1110	3,6,6	17.6	13.9	1.76					

= Estimated number in sample
= Co-efficient of variation
= Estimated density

Table 6: Summary of survey information of crocodile densities along the lower reaches of the Tana river from Hola to the sea (see text).

River Section	Grid Ref	Approx km	Density Aerial Survey	Density Night Survey	Density Day Survey	Density Nests
Hola-Wenje	FJ1635-FJ2303	60	1.04+	1.12x	-	0.53x
Wenje-Mnazini (Tana river Primate Reserve)	FJ2303-FH2781	40	1.60+	2.60x	1.68#	-
Mnazini-Garsen	FH2781-FH1450	50	0.00+	3.34x	-	0.96x
Garsen-Kibusi	FH1450-FH3740	22	-	-	0.91#	2.73#
Kibusi-Ngao	FH3740-FH3434	23	-	-	1.41#	-
Ngao-Tobwe	FH3434-FH3725	17	0.16#	2.37x	-	-
Tobwe-Samikaro	FH3725-FH4423	18	-	-	-	0.38x
Samikaro-Kau	FH4423-FH6025	50	-	4.26x	-	-

+ = Hutton, 1988
x = Zilber, 1988
# = Balarin and Armitage, 1982

Table 7: Results of a spotlight survey to count crocodiles in the lower reaches of the Tana river in 1988. (From Zilber, 1988 in litt.)

Stratum in 1988 Aerial Survey	Locality	km	N crocs < 1m TL	N crocs 1-2 m TL	N crocs > 2m TL	Total
E	Hola-Wenje	60	255	92	67	414
F	Wenje-Mnazini	40	160	136	104	400
	Mnazini-Garsen	50	74	181	167	422
G	Garsen-Ngao	45	87	211	185	483
	Ngao-Semikaro	35	51	123	83	257
	Semikaro-Kau	50	234	157	213	604
H	Kau-Kipini	20	36	31	20	87
	Total	300	897 (33.6%)	931 (34.9%)	839 (31.5%)	2667

Table 8: Results of a survey of crocodile nests along the lower reaches of the Tana river in 1988 (Zilber, 1988 in litt).

Stratum in 1988 Aerial Survey	Locality	N Nests found	N Nests collected	N Eggs collected	N Nests destroyed	Destroyed by:
F	Hola/Wenje	35	4	144	5 26	Monitor lizards People
G	Mnazini/Garsen	48	10	324	4 34	Hippopotamus People
H	Garsen/Ngao	97	45	1184	11 41	Monitor lizards People
-	Ngao-Kau	32	11	357	2 21	Monitor lizards People
-	Regetta	123	39	1424	21 63	Monitor lizards People
	Total	335	109	3433	39 185	Monitor lizards People

ANNEX 2

SPOTLIGHT CENSUS OF THE NILE CROCODILE(*Crocodylus niloticus*) FROM GARISSA TO KIPINI - TANA RIVER, AUGUST 1989
(A preliminary report)

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Introduction:

Between the 14th and the 22nd of August 1989 a census of the Nile Crocodile (Crocodylus Niloticus) was conducted between Garissa and Kipini - Tana River.

The census was carried out by members of the Wildlife Department,Research Division in collaboration with Mamba Village. A total distance of approximately 480 kms was covered by boat at an average of 7.5 hours per night for 8 days.

Objectives

The aim of the census was to establish the number of crocodiles, their distribution and population structure in that section of the river. This would go a long way in assisting the department in making decisions on policy issues e.g. whether to allow any crocodile ranching activities and if so where and of what magnitude (Mamba Village collects eggs and capture live crocodiles within this section of the river).

The results it is hoped, would assist the department in developing short and long term management guide lines within the Tana and elsewhere.

Methods

The method used for the survey was nocturnal spotlight counts while riding in a motorized boat. The whole section covered was divided into sub-sections demarcated by two stations. Two observers using strong spotlights, spotted the crocodiles within the river and on the banks. They categorised them into three; categories were visually determined by the amount of light reflected from the eyes and by close observation. The more light reflected, the bigger the eyes and hence the crocodile. The observers reported their findings to two recorders who tallied the results.

Though taxing, a bit demanding and evidently dangerous the method of crocodile surveys by spotlight has been hailed as the most accurate as compared to other methods such as aerial and day counts. Hutton and Woolhouse, (in press) note that the method with the least bias is spotlight counting, though the value of uncorrected spotlight counts for the estimation of absolute abundance is usually overestimated.

In aerial counts only crocodiles longer than 1 meter are visible and only those on the river banks with little or no vegetation cover are sighted. The margin of error is therefore very big and it's only by the use of complicated formulars that the errors are taken care off. Even then, the method is unreliable.

In day counts visibility in the water is poor and besides, most of the crocodiles are basking on the banks, maybe several meters

away from an observer and therefore not sighted.

The nocturnal spotlight counts method assume that, during the night, all the crocodiles are found inside the water or on near banks. In as much as this could be true, some of those on the banks could be hidden by vegetation and therefore not visible. The method also assumes that the crocodiles in the water are floating and not submerged, but as was clearly observed, some immediately dived under the water on being disturbed.

These assumptions constitute the major part of the errors inherent in the method. Again on encountering large groups of crocodiles, counting each and every one was difficult and thus the numbers could only be estimated. On nights when the counts continued until the wee hours of the morning, fatigue made concentration a bit impaired and repeating or missing out counting was not uncommon. The hatchlings were also difficult to sight due to their size. Determination of age group/size categories was, to say the least, gross, and might have varied from one observer to the other, however we tried to maintain the same observers throughout the census, thus ensuring consistence.

Previous studies and estimates

Modha 1988 (pers. comm.) estimated the number of crocodiles living along the Tana river at 10,000. Aerial Surveys by Hutton. 1988 gives an estimate of 690 crocodiles of more than 1 metres from Meru National Park to Kau (approximately 16 kms upstream from Kipini)

Bruesssow. (a) 1988. Spotlight counts recorded a total of 1227 Crocodiles from Hola to Kipini while Zilba in Hutton 1988 gives a total estimate of 2667 within the same section. This survey recorded a total of 1809 crocodiles between Hola and Kipini.

The great variance in the total obtained in the different surveys is difficult to explain. however, the figures obtained in this survey should be adopted as they are close to the average of the other two. See table 2.

Results/Discussion

Distribution Trend

(a) **Average Densities**: Computed from the number of crocodiles per kilometre of river, reflect the distribution trend downstream. In general, crocodile densities decreased as we progressed downstream, from over 19 crocodiles per kilometre from Garissa to Bili, to below 4 crocodiles per kilometer between Mnazini and Garsen. A marked variation from this general trend was found within the reserve (Wenje to Mnazini) which had an amazing density of 12.1 crocodiles per kilometre, as compared to 7.6 and 3.8 crocodiles per kilometre on section bordering the reserve upstream and

downstream respectively. (See table 1, diagram 1 and graph 1)

The mean density recorded in the survey between Garissa and Hola was over 14 crocodiles per kilometre, while it was below 7 crocodiles per kilometre downstream from Hola, (outside the Tana River Primate Reserve)

Aerial census conducted by Hutton in 1988 indicated a similar trend. He noted that densities tended to decrease downstream towards Garsen.

(b) Population Structure:

Table 2 shows the totals and percentages of each of the three age group/size category per each subsection of the river.

From the percentages, a cumulative graph was constructed. Further pie charts showing each of the age group/size categories for each subsection of the river were drawn. The graph and the pie chart reflect the population structure trend downstream.

From Hola downstream there is a marked decrease in the percentages of crocodiles of the juvenile/sub-adult and hatchling/yearling age groups.

The Percentages of these two age groups in this section constitute less than 20% of the total as compared to over 70% in the upper part of the section covered in the census. (See graph 2 and pie charts 5-9).

This can only be explained by the fact that operations by Mamba village limited concentrate mainly on egg collection and capture of hatchlings and sub-adults mostly from Hola downstream to the coast.

Possible explanations for these trends:

1. Human populations along the river increase downstream with the highest densities being at Garsen, Hola and Bura respectively. These high human population densities have resulted to intensive land use in the form of agriculture. This in turn has resulted to a serious destruction of the traditional crocodile habitats. Upstream of Bura, the predominant tribes are the Malakotes and Ormas, who are mainly pastoralists. Pastoralism has little, if any, destructive effects on the crocodile habitats.

   There is a marked increase in crocodile densities in the reserve section of the river, this could be due to lower human populations and thus less habitat destruction.

2. **Over exploitation, poaching and destruction:**

Mamba village has tended to concentrate their egg collection and live crocodile capture between Hola and Kipini over the years. This continued (over) exploitation within the same section of the river has had a significant effect in decimating crocodile numbers .

Between January and April 1988, Mamba village limited collected a total of 2080 eggs. This constituted all nests they could locate i.e. everything they could find. In addition they captured a total of 1646 crocodiles, most of them of hatchling and sub-adult age group between Hola and Kipini. Bruessow 1988 (b) notes that Mamba Village total egg collection and capture produced over 5000 crocodiles between 1987 and 1988. The effects off this is obvious.

Should this wanton (over) exploitation continue, without regard to the detrimental effects it has on the population, it will soon be necessary to restock the natural habitats from captive crocodile populations, a (reverse) situation we would hate to witness.

Recommendations:

Specific Recommendations for Tana River

1 From the results it is clear that crocodiles have been over exploited as from Hola downstream. So, the area should be given a grace period of not less than 2 years during which no crocodile operations should take place. This should allow the number to recuperate.

2 Eggs can be collected from Bura upstream. The following formula should be used to calculate the allowable number for collection per given section of the river.

0.5 total adult numbers x 40 x 10%

whereby:- 0.5 total adult numbers represent number of female crocodiles.

- 40 = Average number of eggs per nest.

- 10% = acceptable offtake.

3 Live crocodiles should only be captured to establish a breeding stock for the farms (the figure should be absolute for any farm). For no other reasons should live crocodiles be captured. The numbers to be captured should not be more than 10% of the total adult number in any one section of the river.

4 A hatchery in Tana River District run by the Department or the County Council and with the assistance of Mamba Village, or any other persons with the necessary technical expertise, would be a most appropriate undertaking. It would fetch money for the local community, create employment and most important control the overzealous exploitation of eggs and live crocodiles by unscrupulous dealers.

Policy recommendations:

5 **Law Enforcement:** To prevent illegal activities leading to over exploitation and habitat destruction, the department must enhance its law enforcement abilities in the Tana river area especially in the lower reaches, and more so in the protected areas. (It is in record that Mamba village limited collected eggs and captured live crocodiles within the Tana River primate Research as follows: 14th March to 9th April 1988 174 crocodiles captured between Wenje, through Baomo to Kitere. This information is contained in a report by Daren M. Bruessow (A former employee of Mamba Village Limited,) made available to WCMD Director (ref WCMD/CONF.68) These operations within the reserve, whether knowingly or unknowingly constitute a contravention of the Wildlife act and are therefore illegal.

The relevant wildlife and administration officials must be notified of any crocodile operations in their areas of jurisdiction. A Wildlife personnel should always accompany persons undertaking such operations.

6 **Licencing:** Specific rules governing crocodile licencing policy must be drawn. This rules should eliminate unscrupulous crocodile ranchers and farmers who have no regard for the species conservation.

A formula must also be found to enable the department to know the volume of eggs and live crocodiles which should be harvested from a given population without hurting the self sustaining ability of such a population.

7 **Utilization:** Specific and broad based policy guidelines which will encourage and enhance utilization of the species to the benefit of the local populace, the government and the nation should be formulated.

8 **Census:** Similar census should be undertaken in other known crocodile inhabited waters including the upper Tana. This of inventories should concentrate first on areas of interest (i.e conflict and utilization)

9 **Information Exchange:** To enhance awareness and appreciation of the species, it will be necessary for the department to collect and collate all forms of information pertaining to the conservation and management of the species, such

information should include; wild and captive biology and populations, capture operations, farming practices, processing and marketing etc.

10 **Management Plan:** It is, high time the department developed a comprehensive crocodile management plan, highlighting on the a fore mentioned issues.

Acknowledgement

We wish to acknowledge most profoundly the Director Wildlife Conservation and Management Department, for making it possible for us to be engaged in the census, by providing the funding, and the necessary working environment. We also wish to thank Mrs. L. Onsongo for her valuable advice and encouragement. Many thanks go to the General Manager, Mamba Village Ltd. who provided most of the equipment and a very competent and friendly team. The Wildlife Research Team Belle-Vue, was most helpful, through their encouragement, and lively discussions. Finally we wish to thank the computer team who typed the work for us and helped in tabulating and graphing the data. We wish to thank all, who contributed in any way in this exercise .

* MUAII, WAWERU
** TUVAL

CROCODILE NUMBER AND DENSITIES
BETWEEN GARISSA AND KIPINI
AUGUST 1989

DATE	STATIONS	TIME TAKEN IN HOURS	APPROX DIST.KM	HATCHLING YEARLINGS	JUVENILE SUB-ADULTS	ADULTS	TOTALS
14.8.89	GARISSA-BILI	4.5	25	107	237	140 70	464
15.8.89	BILI-NANIGI	6.25	56	177	511	187 90	875
16.8.89	NANIGI-BURA	6	50	163	411	65 40	659
17.8.89	BURA-HOLA	5.25	73	96	272	268	636
18.8.89	HOLA-WENJE	6	63	35	109	331	475
19.8.89	WENJE-MNAZINI	4	29	31	64	235	350
19.8.89	MNAZINI-GARSEN	6.5	76	35	60	192	287
20.8.89	GARSEN-NGAO	3.5	32	23	69	192	286
21.8.89	NGAO-KIPINI	5	78	72	88	246	406
	TOTALS		482	745	1641	1676	4462

* WIMD
** MAMBA VILLAGE LTD

Table 1

CROCODILE AGE GROUP/SIZE STRUCTURE
(NUMBERS AND PERCENTAGE)
DISTRIBUTION FROM GARISSA TO LIFINI

	HATCHLING/ YEARLING	JUVENILE/ SUB-ADULT	ADULTS	
GARISSA-BILI	107	237	140	484
	22	49	29	100
BILI-HANIGI	177	311	187	675
	30	58	31	100
HANIGI-BURA	163	411	63	637
	25	62	13	100
BURA-HOLA	96	272	268	636
	15	43	42	100
HOLA-WENJE	39	109	331	479
	8	23	69	100
WENJE-MMAJINI	31	84	235	350
	9	24	67	100
MMAJINI-GARSEN	33	60	192	287
	12	21	67	100
GARSEN-NGAO	25	69	192	286
	87	24	67	100
NGAO-LIFINI	72	88	246	406
	18	22	61	100

Table 2

COMPATIVE TOTALS FROM THREE DIFFERENT SURVEYS BETWEEN HOLA AND KI

	ZILBER (1966)	BRUESSOW (1965)	MUKIIWAWA YUVAL ** (1965)
HOLA-WENDE	414	191	479
WENDE-MNAZINI	400	200	350
MNAZINI-GARSEN	422	219	267
GARSEN-NGAO	467	270	286
NGAO-KIPINI	946	347	406
TOTAL	2667	1227	1606

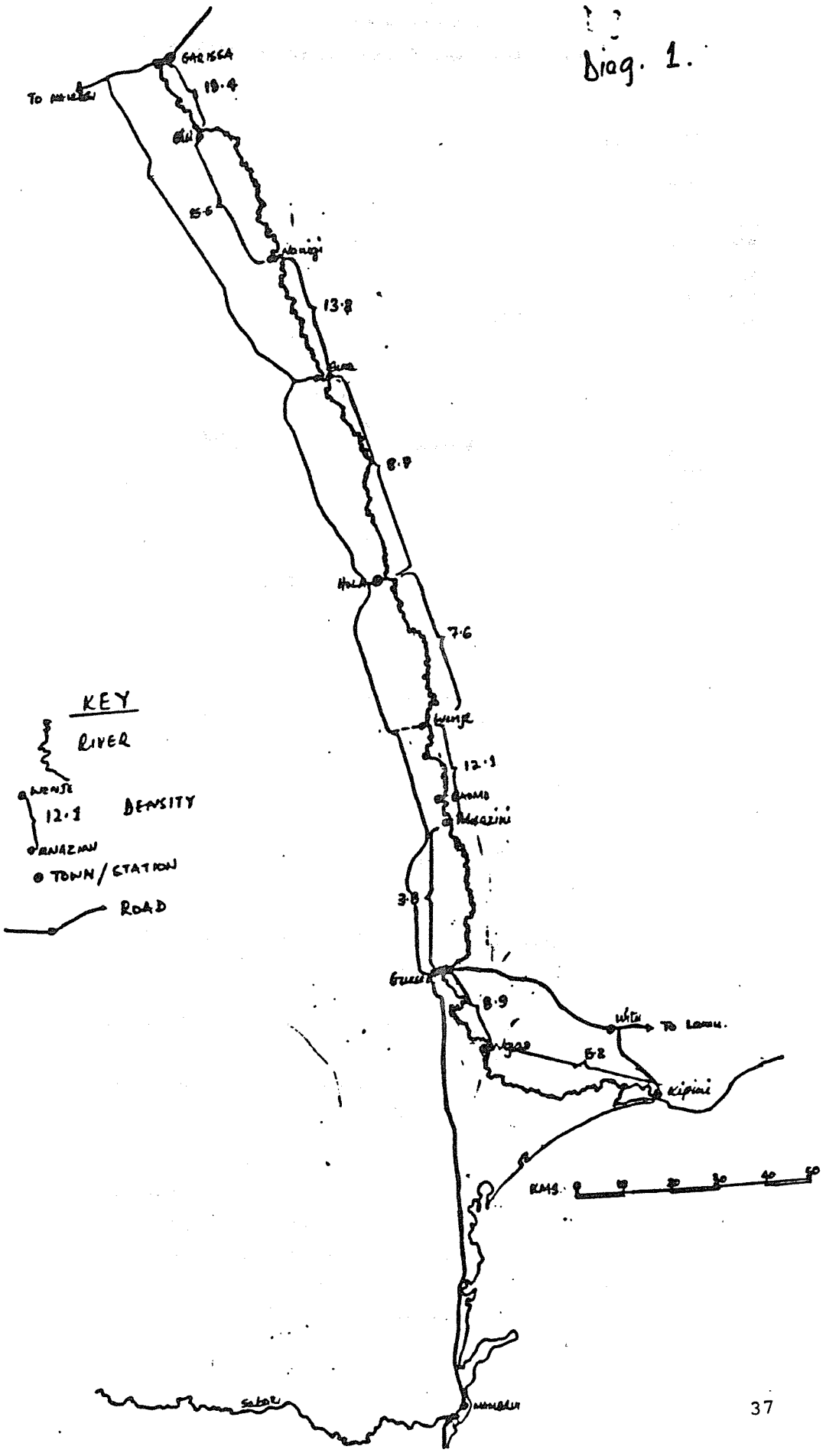
* WIND

** MANBA VILLAGE LTD

Table 3

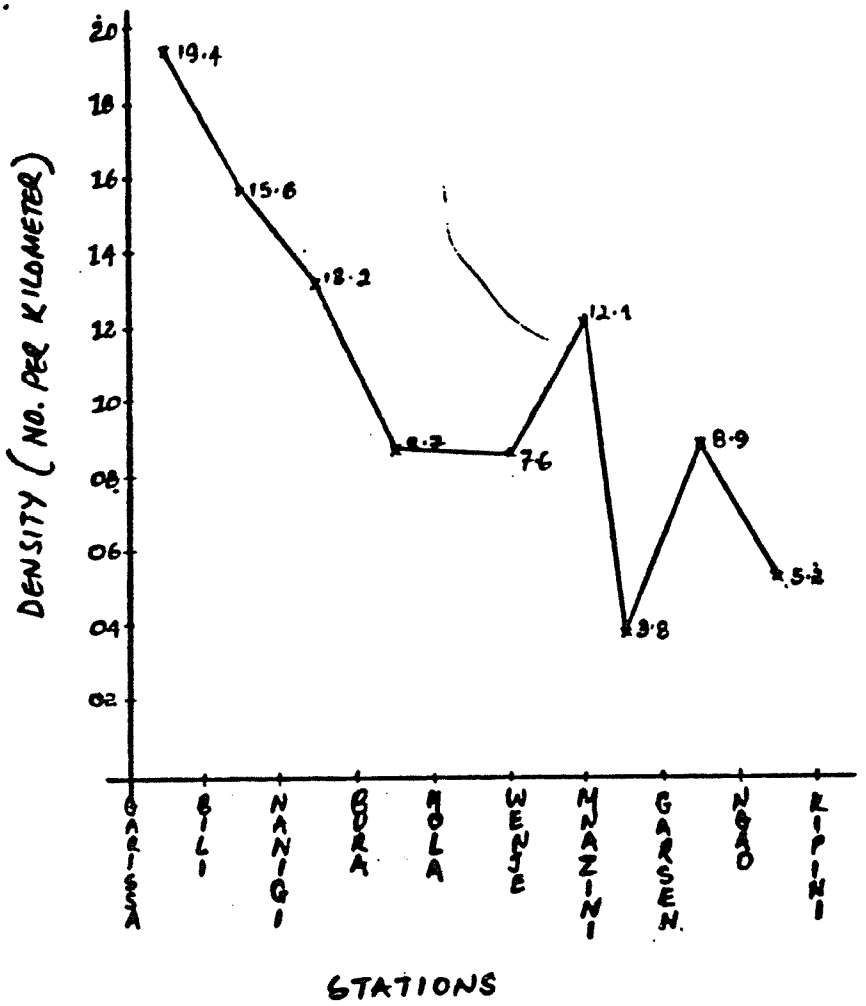
CROCODILE DENSITIES (NO. PER KM.)
[GARISSA BRIDGE TO KIPINI]

Diag. 1.



Graph 1.

CROCODILE DENSITIES TANA RIVER (GARISSA TO KIPINI)



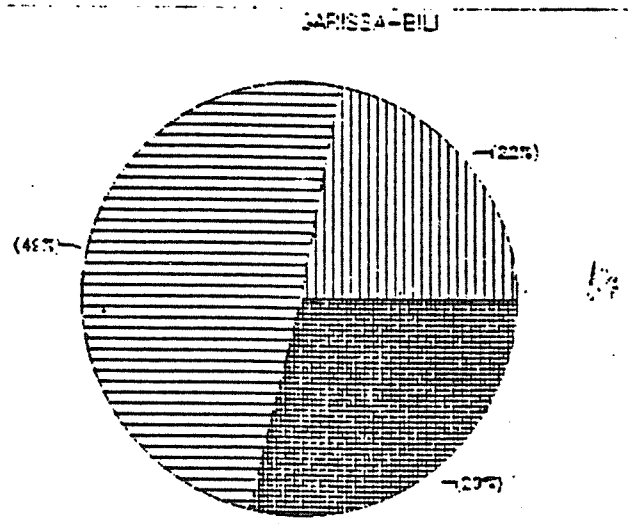
NOTE: 1. WENJE TO MNAZINI IS WITHIN TANA RIVER PRIMATE RESERVE

2. DENSITIES DECREASE MARKEDLY FROM GARISSA TO HOLA, THEN A SIGNIFICANT INCREASE BETWEEN WENJE AND MNAZINI (RESERVE)

3. THE LEAST DENSITIES ARE ON THE LOWER REACHES OF TANA, ESPECIALLY AROUND GARSEN, WHERE THERE ARE A SERIES OF CANALS, ALSO THIS IS THE AREA OF MAXIMUM ACTIVITY BY MAMBA VILLAGE.

PIE CHARTS SHOWING CROCODILE AGE GROUP/SIZE STRUCTURE DISTRIBUTION FROM GARISSA TO KIPINI

1.



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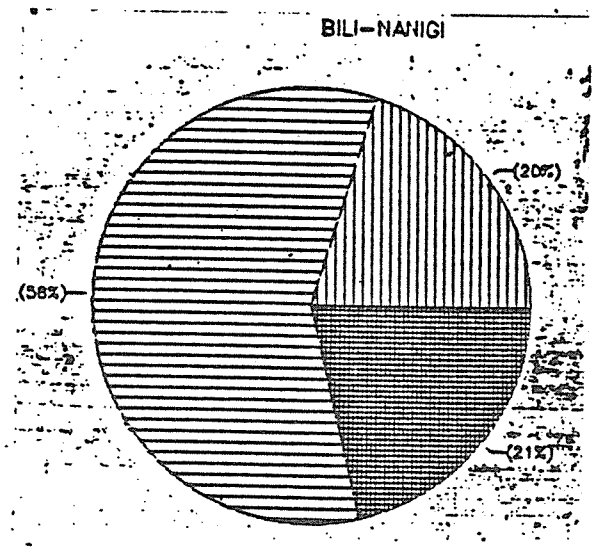

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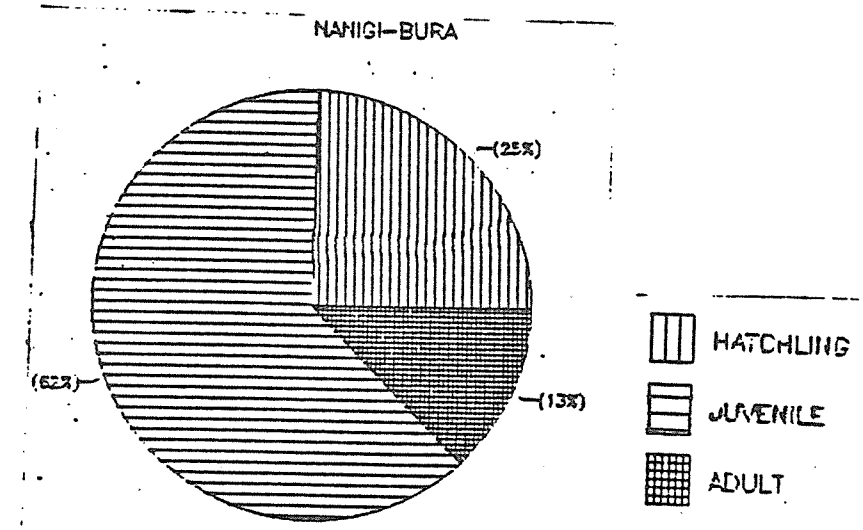

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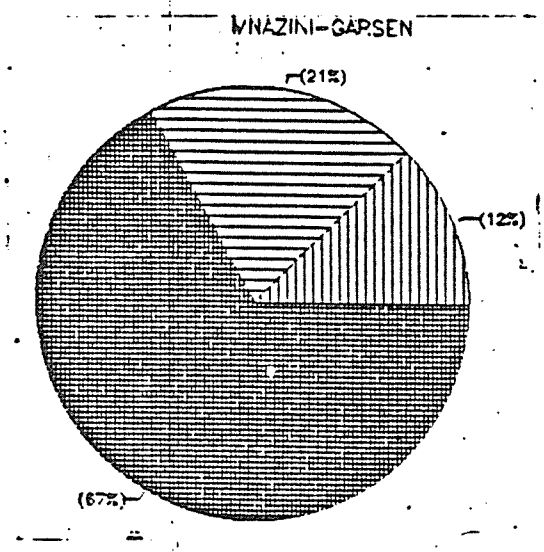
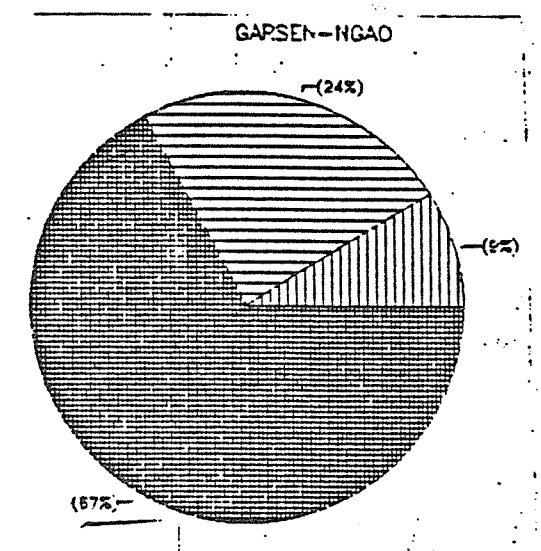
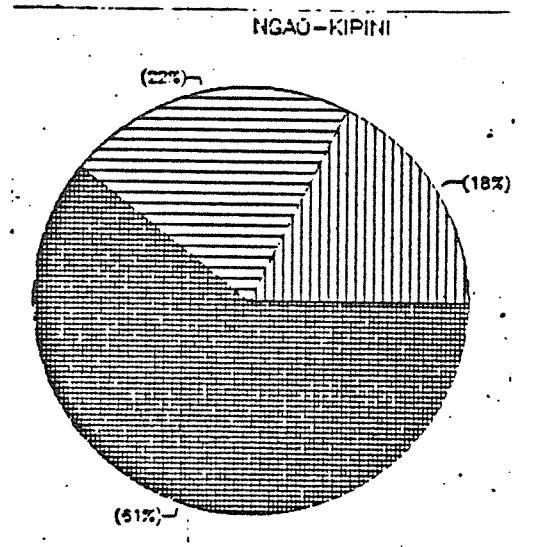
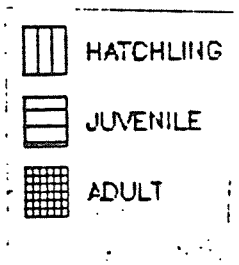

MNAZINI–GAPSEN
(21%)
(12%)
(67%)

5.

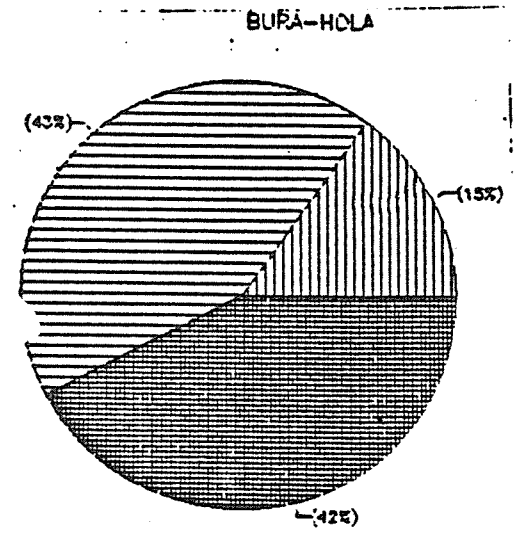

GAPSEN–NGAO
(24%)
(57%)

6.

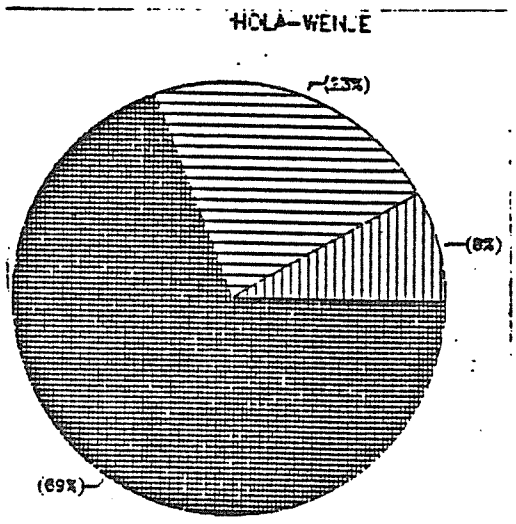

NGAÚ–KIPINI
(22%)
(18%)
(51%)


HATCHLING
JUVENILE
ADULT

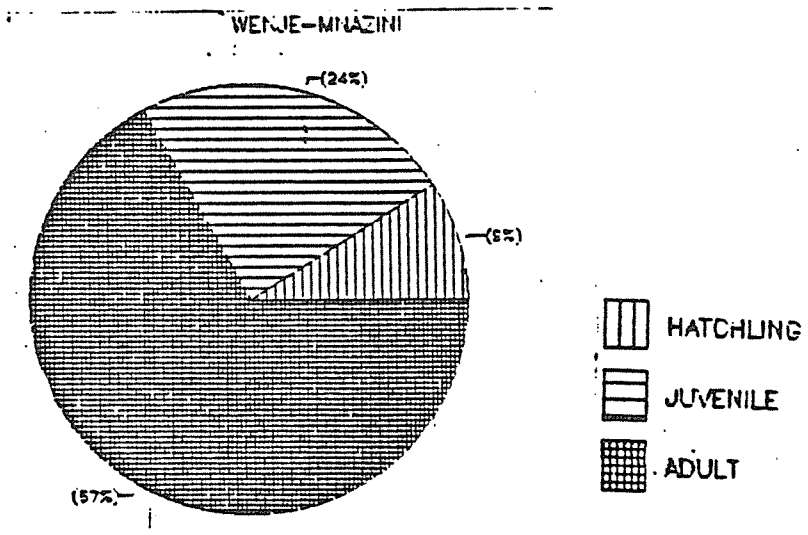
7.


BUŠA–HOLA
(43%)
(15%)
(42%)

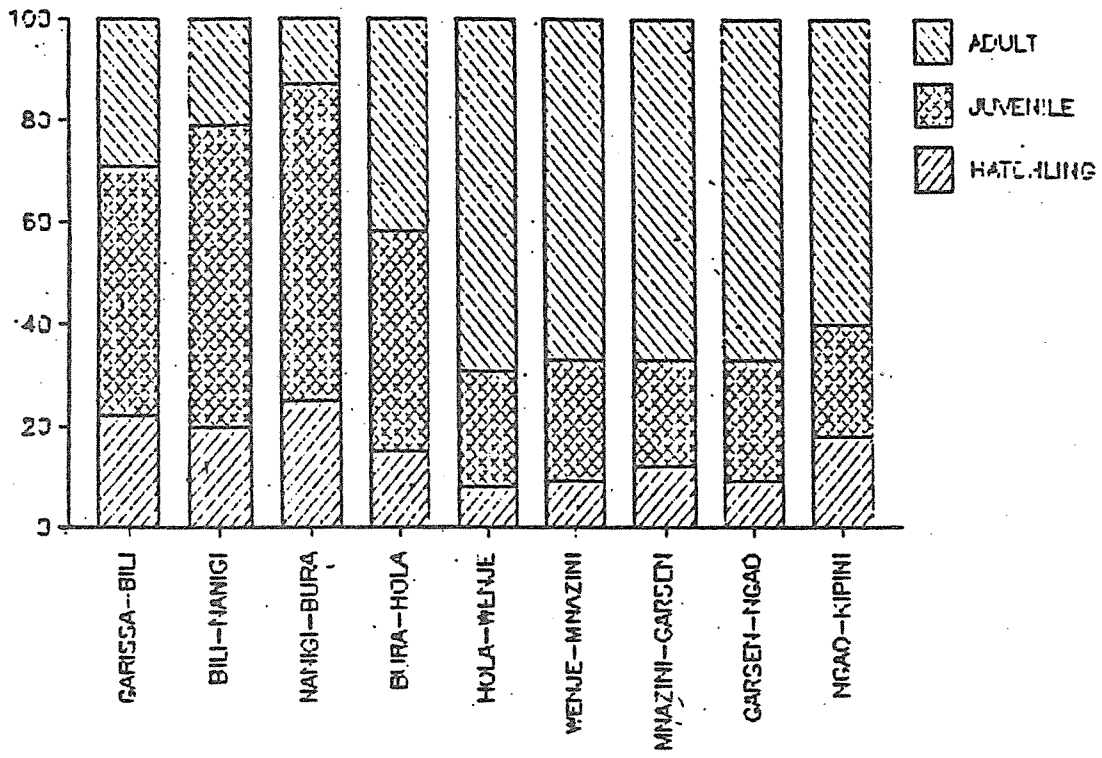
8.


HOLA–WENJE
(23%)
(8%)
(69%)

9.


WENJE–MNAZINI
(24%)
(5%)
(57%)
HATCHLING
JUVENILE
ADULT

CUMULATIVE PERCENTAGE OF THREE AGE GROUPS/SIZES OF CROCODILES PER GIVEN SUB-SECTION OF THE LOWER TANA RIVER (GARISSA TO KIPINI)



GRAPH 2

STATIONS MARKING SUB-SECTIONS

NOTE: A MARKED REDUCTION OF THE HATCHLINGS/YEARLINGS AND THE JUVENILES/SUB-ADULTS FROM HOLA DOWNSTREAM. THIS COULD BE THE EFFECT OF OVER EXPLOITATION OF THESE AGE GROUPS/EGGS

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* Not referred in text.

NILE CROCODILE MANAGEMENT PLAN

INTRODUCTION

Kenya Wildlife Service wishes to manage Kenya Nile crocodile populations in different ways. This may include ranching, controlling and encouraging conservation through sustainable utilization for the benefit of the people of Kenya. Kenya Wildlife Service will also encourage crocodile ranching as an asset to tourism. This Management Plan will be reviewed whenever necessary.

PROTECTION

All crocodiles in protected areas (National Parks & Reserves) will be fully protected and managed to ensure their survival. There shall be no consumptive utilization allowed in protected areas where tourism as a form of utilization will be encouraged.

Kenya Wildlife Service will educate the Kenyan public and tourists about the conservation and management of the crocodiles through the proposed community conservation programmes. KWS will also undertake research related to the conservation of crocodiles.

CONSERVATION OUTSIDE PROTECTED AREAS

It is necessary to manage and conserve crocodiles outside protected areas to minimise the present conflicts with human interests i.e. fishing, livestock and threats to human lives in areas where these abound. It is appropriate to give people living with crocodiles a value in order to encourage conservation. Crocodiles will therefore be utilized in the following ways:-

(a) Encouragement of specific tourist activities KWS will encourage crocodile ranchers to offer tourist facilities. As in other parts of the world KWS recognises the potential for wild crocodiles to contribute to tourist industry. Therefore we will encourage crocodile safaris which strongly benefit the local people.

(b) Through ranching of eggs and juveniles as defined by CITES

Sport hunting of crocodiles will not be allowed. The export of live animals will be discouraged. Every effort will be made to ensure highest possible returns to the people who live within crocodile areas. KWS will control and administer all programmes of utilization and fund its work through a system of licences and levies.

RANCHING AREAS

There will be no harvesting of crocodiles in National Parks, Reserves or Sanctuaries. Harvesting will be considered in all other localities but the following areas will be set aside at specific concessions for permit holders:-

(a) Tana River North of Hola
(b) " " South of Hola
(c) Galana/Sabaki River
(d) Lake Baringo
(e) Lake Turkana
(f) River Mara outside the Mara Reserve

Such concessions may be combined at the discretion of the Director, KWS.

REQUIREMENTS FOR A RANCHING OPERATION

Where KWS identifies potential for harvesting crocodile resources, applications will be invited and all applicants wishing to be considered for crocodile ranching will submit to KWS detailed feasibility studies with information on the following:-

(a) Locality
(b) Food supply
(c) Financial resources
(d) Expertise
(e) Farm Plans

In addition KWS will promote pilot small holding units in rural areas where crocodiles conflict with human activities. As the number of ranches increases, ranchers may be required to deal with KWS through an association.

CONTROL OF RANCHING OPERATIONS

KWS recognises that ranching operations require long term security, but it will issue licences for their operations on an annual basis with an appropriate fee. KWS will set minimum standards for all aspects of crocodile production. Ranching operations will require annual permits from KWS to collect crocodile eggs or juveniles. Permits will carry the following terms of conditions:-

(a) Locality of collection will be specified
(b) Period of collection " " "
(c) Number and type of specimen will be specified

(d) Where appropriate, fees to County Councils and local people will be specified.

(e) In respective of any specimen collected the locality will be marked on a suitable map together with a reference number.

(f) The fate of each specimen (clutch of eggs + juveniles) will be recorded and returns will be submitted to the Director within 4 months of the specimen reaching the farm.

(g) Ranchers must report to the appropriate wildlife officer of the area before collection.

(h) A full summary of harvesting operations must be submitted by the rancher to the Director, KWS and local KWS officer within 2 weeks of the finishing of harvesting.

(i) Permits will not be transferrable.

(j) In the event of any dispute the decision of the Director KWS will be final

(k) By the 31st December of each year ranchers must submit a summary of their activities for the year including details of:-

(i) Number and type of specimens taken from the wild

(ii) Number of animals released to the wild, if any

(iii) Number of eggs incubated and hatched, broken down into wild and farm production.

(iv) Number of animals alive in each yearly age group at the start of the year and the number which died or were moved or sold.

(v) Number of animals cropped

(vi) Number of skins exported together with their tag numbers and destinations.

(l) In two years from the date of issue of the permit to collect specimens, ranchers may be required to release a number of female crocodiles of 1.2m length equivalent to 5% of the number of specimens actually collected from the wild in terms of the permit. All releases will be made in accordance of KWS requirements in the presence of KWS officer. This requirement will lapse if the release is not requested in the appropriate year.

METHODS OF HARVESTING

1. Harvesting will be restricted to eggs and juveniles of less than 80 cm total length.

2. Permits for harvesting will normally be issued direct to Ranching Operations but these will be expected to involve local people in the harvesting process.
3. Any harvest of eggs will be within specific areas and will be to the maximum that the areas can sustain.
4. A return of young female crocodiles to the wild equivalent of 5% of the harvest will be made werever appropriate

5. The juvenile capture will be restricted to capture by hand from a boat.

MONITORING

KWS recognises the imprtance of population monitoring to ensure sustainability of harvesting. A cost effective monitoring programme will be established through the egg collection process. Within specific areas ranchers will be encouraged to collect all the nests they can find. This index of female abundance will then allow basic trends to be detected. Additional monitoring through aerial surveys will be undertaken at the discretion of the Director KWS.

TAGGING, MARKETING & TRADE

All crocodile products for export will be tagged in accordance with CITES regulations. KWS will require that ranching operations purchase CITES tags for delivery direct to KWS. CITES export documentation will only be issued on receipt of detailed packing list, including skin size and tag numbers and a copy of the original invoice to the purchaser. All unused tags must be returned to the Director, KWS for destruction by the year's end.

CONTROL OF CROCODILE POPULATIONS

In many parts of Kenya outside protected areas crocodiles ar nuisance animals. Where problems are reported to KWS, each will be assessed and where action is necessary capture will be attempted. Where capture is not possible they will be shot.

Whenever possible KWS will require that ranchers assist in the capture of problem crocodiles. In this case, the appropriate KWS officer will issue the necessary permit to the Ranchers. Ranchers will be required to submit a detailed report on the capture to the Director KWS with a copy to this permit issuing officer

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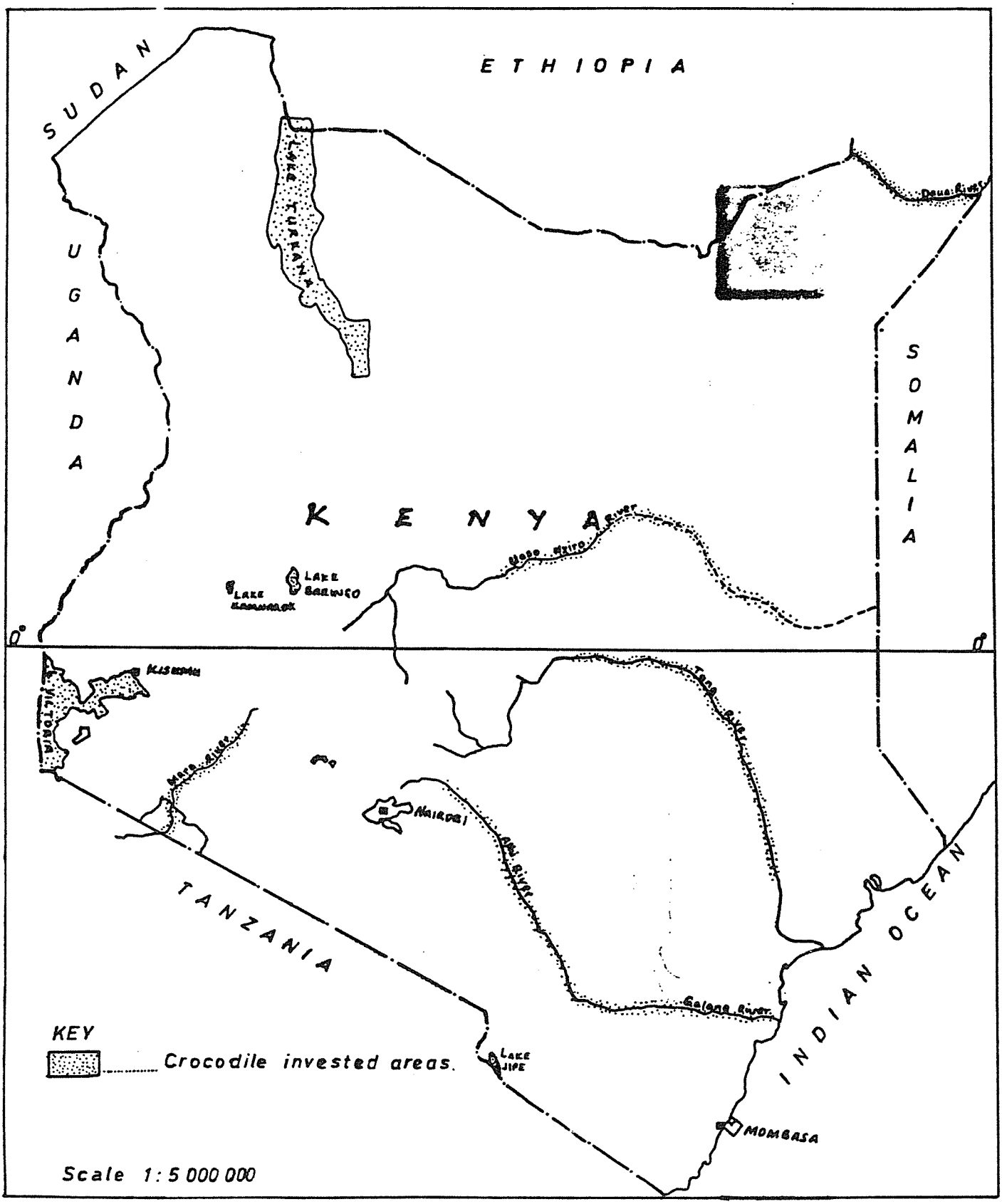
SUDAN
ETHIOPIA
LAKE TURKANA
UGANDA
SOMALIA
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INDIAN OCEAN
LAKE JIPE
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Crocodile invested areas.
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