WATTLED CRANE AND WETLAND SURVEYS IN THE GREAT ZAMBEZI DELTA, MOZAMBIQUE

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INTRODUCTION

Wattled Cranes and hydrological change

The Wattled Crane (*Bugeranus carunculatus*) is a globally endangered resident of sub-saharan Africa. The large size and unique gray and white plumage of the Wattled Crane make it a conspicuous member of the wetland communities upon which it depends, and a valuable focal point for wetland conservation initiatives.

The total population of Wattled Cranes is estimated to be no more than 13,000-15,000 birds (Urban *this proceedings*). The vast majority (more than 95%) of the population occurs in southcentral Africa, in the floodplains and dambos of the Zambezi, lower Zaire, and Okavango River catchments (see Dodman *this proceedings*; Kamweneshe *this proceedings*; Mangabuli *this proceedings;* Singini *this proceedings*) (Figure 1). Wattled Cranes in this core range are highly territorial and may defend areas greater than 1 km^2 in size (Konrad 1981). They are found in greatest numbers in large wetland systems such as the Kafue Flats, Bangweulu wetlands, and Liuwa Plains in Zambia, the Okavango Delta and Makgadikgadi Pans in Botswana, and the Zambezi Delta in Mozambique.

Fluctuations in the populations of Wattled Cranes among these and other sites suggest that there may be substantial seasonal movement depending on regional hydrological conditions. Wattled Crane pairs begin nesting as floodwaters recede after peak flooding. Nests are typically built in open grass and sedge marshes bordered by drier flat or sloping grassland meadows, with minimum-height vegetation, and water up to one meter in depth. Konrad (1981) observed that this strategy takes advantage of large areas of shallow floodplain which provides open water around the nest that is deep enough to provide some protection from predators and an abundant food supply of sedge tubers and rhizomes that cannot be successfully foraged during high floods.

The timing, duration, and extent of flooding at a particular wetland and among wetland systems depends on hydrological factors unique to each wetland, including the amount of inflow from local rainfall and the timing of floodwaters from upstream basins, and the amount of outflow via evaporation, transpiration, and natural drainage. In the Zambezi system, peak flooding begins at the end of the rainy season in February/March. In the Okavango Delta, peak flooding occurs during the dry season in August/ September.

Douthwaite (1974) observed that 40% of all Wattled Crane pairs attempted to breed in a year of average flooding conditions in the Kafue Flats, but only 3% of all pairs bred in a year of negligible flooding conditions due to drought. With Wattled Crane nesting success so highly sensitive to natural hydrological variations, artificial changes to a wetland flooding regime due to drainage, dams, or water diversions would be expected to have a substantial impact on Wattled Crane nesting success. When the hydrological regime of the Kafue Flats was altered by the Itezhi-Tezhi Dam, for example, Konrad (1981) predicted a dramatic restriction in Wattled Crane nesting sites and feeding area. To date, no research has been done to determine the impact of hydrological alteration on Wattled Cranes or other wetland species in their core range.

The Zambezi Delta

The occurrence of Wattled Cranes in the Marromeu Complex of Zambezi Delta of Mozambique offers an excellent opportunity to better understand the effect of hydrological change on Wattled Cranes and the wetland communities upon which they depend. The Marromeu complex is located off the southern bank of the Zambezi River and includes the largest floodplain of the Zambezi Delta (Figure 2). The complex includes three managed hunting units (coutadas 10, 11, and 14) and the Marromeu Buffalo Reserve.

Goodman (1992a) counted 2,570 Wattled Cranes in the 2,500 km^2 Marromeu floodplain during aerial surveys in September 1990. During April surveys of the same area, Goodman (1992b) and P. Dutton (*pers. comm.*) reported numerous pairs of Wattled Cranes across the floodplain.

The flooding regime of the Zambezi Delta has been severely degraded by the construction of the Kariba and Cahora Bassa dams (the third and fourth largest dams in Africa, respectively) on the upstream Zambezi River (Figure

1). The dams have nearly eliminated all downstream flooding, such that water in delta is now provided strictly from local rainfall during the rainy season months of October-April (approximately 1,200-1,400 mm/year) and drains away rapidly to the river and ocean. The floodplain, once inaccessible for more than nine months out of the year due to high water, is now accessible throughout the year. Saltwater intrusion, the spread of exotic vegetation in stagnant waterways and overgrazed floodplain areas, the desiccation of floodplain habitats, and uncontrolled grassland fires have resulted (Anderson *et al.* 1990).

The presence of breeding Wattled Cranes in the delta raises questions as to how well the birds have adapted to such a highly altered flooding regime, how successful is their nesting relative to the natural flooding conditions that occurred prior to upstream dams, and how might the restoration of more natural flooding conditions in the delta affect their nesting success. We hoped that the Wattled Crane could serve as a focal point for restoration initiatives to benefit the people and wildlife of the great Zambezi Delta.

In March 1995, we traveled to central Mozambique to survey the Zambezi Delta and begin to address these questions. Our goals were to:

- assess the breeding population of Wattled Cranes at the peak of the normal flooding season (March);
- assess the population of other important waterbird and mammal species using the delta at the peak of the normal flooding season;
- assess the current hydrological and ecological status of the Marromeu complex relative to the conditions observed by Davies *et al.* (1975), P. Dutton (*pers. comm.*), and others prior to the closing of the Cahora Bassa dam;
- explore the feasibility of prescribed water releases from the Cahora Bassa dam to simulate natural flooding and improve ecological and socio-economic conditions in the Zambezi Delta.

METHODS

Sixteen hours of aerial surveys of the Marromeu complex and lower Zambezi River were conducted during the period 8-10 March 1995. Surveys were conducted in a manner to be comparable to previous surveys of the area (Anderson *et al.* 1990; Goodman 1992b; P. Dutton *pers. comm.*). Surveys were flown in a six-seat Cessna 210 from the base at Beira Municipal Airport. A landing strip at Chinde, located at the mouth of Zambezi River, was also used.

Nineteen transects, spaced 4 km apart, were flown to provide uniform coverage of the Marromeu complex. The average length of each transect was 80 km toward the mouth of the Zambezi and 30 km at the upstream edge of the floodplain-miombo forest ecotone. An additional transect was flown down the length of the Zambezi River from Marromeu Village to the Indian Ocean coast. Transects were flown at an average height of 90 m above ground level, at an average air speed of 100 knots. Navigation was undertaken by the pilot using an in-cockpit Global Positioning Satellite (GPS) system. GPS target points were determined by plotting all transect lines on an aviation map and determining the exact coordinates of the beginning and end of each transect. GPS navigation accuracy was verified using visual reference points and 1:250,000 scale maps.

All waterbird species that could be accurately identified were counted (Norton-Griffiths 1975). From landmarks, we estimated that large conspicuous waterbirds, including Wattled Cranes, storks, and pelicans, could be identified to a distance of 1.5 km on each side of the aircraft. Smaller and less conspicuous waterbirds, such as ducks, egrets, and herons, could be reliably identified to a distance of no more than 1 km on each side of the aircraft.

Waterbird counts were recorded by the front right and middle left passengers. The middle right and back left passengers assisted the counters. Species observed in pairs were recorded as such. Observations of large mammals, including elephants, Cape buffalo, and hippos were also recorded.

In addition to waterbird and mammal counts, we assessed the hydrology and vegetation of the Marromeu Complex. We noted water levels in the Zambezi River and the extent of flooding in the delta during the time of peak flooding conditions. We identified the major vegetation communities of the complex, their observable hydrological conditions, and the extent of wildfires across ecotones. We also noted the quality of waterways and degree of weed infestation.

Efforts to conduct ground surveys of the Marromeu Complex were suspended due to the presence of landmines on the main road to Marromeu village and in some of the floodplain areas. Efforts are now underway to further demine this area and improve accessibility (DNFFB 1995).

RESULTS AND DISCUSSION

Wattled Crane assessment

We counted 156 Wattled Cranes in the Marromeu floodplain (Table 1), including 58 pairs (74%) on territories and others in small flocks of 3-11 birds. Two observations were made of Wattled Cranes on nests. We observed a few Wattled Crane pairs in dambos in the miombo forests on the floodplain fringe.

Approximately 25% of the floodplain was not surveyed because of the 1 km "gray zone" between the transects. Significant double-counting was unlikely because few birds were observed in flight at any time during the survey, and was likely offset by possible missed observations of other Wattled Cranes. Under the assumption that 75% of the floodplain was accurately surveyed, we extrapolate a total population of 208 Wattled Cranes and 77 breeding pairs. Only the Okavango Delta (Bousfield 1986) and Kafue Flats (Konrad 1981) have reported a greater number of breeding pairs in one setting.

Hydrologic changes in the Zambezi Delta have tremendous implications for the overall breeding success of the Wattled Crane. Several months after Wattled Crane chicks fledge, the family groups temporarily leave their breeding territories and gather in flocks prior to the onset of the next breeding cycle. Bonds between parents and young dissolve and the immature birds join other non-breeders in the flocks and sexually mature but mated birds have an opportunity to meet potential mates (G. Archibald *pers. comm.*). Then the crane pairs return to breeding areas where they defend large territories in which they breed when water levels peak with the flood (Okavango Delta) or the rains and floods (Kafue floodplains).

Goodman (1990a) reported large flocks of Wattled Cranes on the Zambezi Delta in September of 1990. Our survey was in March, a time when most large flocks of cranes had dispersed. For other crane species during the non-breeding period, approximately 15% of the population is comprised of juveniles on average. Approximately 50% of the population is of breeding age, many of which are not successful each year (C. Mirande *pers. comm.*). Assuming a population of 2,570 cranes, we would expect about 642 breeding pairs, or approximately 1,285 cranes should be in breeding pairs. However, only 77 pairs were calculated to be resident on the Delta in March of 1995. Most of the remaining pairs must be elsewhere.

In Botswana, surveys by Mangabuli and Motalaote (*this proceedings*) during the peak breeding season revealed that only 3.1% of the resident Wattled Cranes had nests, and 4.1% had either young chicks or juveniles. Konrad (1981) observed 64.3% as breeding pairs in the wetlands of Zambia during 1978-79. More recent surveys by Kamweneshe (*this proceedings*) in the Bangweulu Basin during the peak nesting period in July report 40 adults in pairs and 30 in threes out of an estimated population of 1,453, suggesting a breeding population of no more than 11.6 %. Dodman (*this proceedings*) also notes that at least 70% of the Wattled Crane population remained in flocks during the middle of the breeding season in the Kafue Flats in 1992, and perhaps only 20% of the population was breeding during better flooding conditions in 1993.

Considering the vast distances migratory cranes cover in their annual movements, it is not unreasonable to assume that Wattled Cranes from South Africa, Zimbabwe, and eastern Zambia may move to the Zambezi Delta prior to the breeding season and that the delta is therefore important in the welfare of a much large segment of the world's population of Wattled Cranes than previously assumed. Answering such questions necessitates future research using marked birds or satellite radio telemetry.

Assessment of other waterbirds

Twenty-nine waterbird species totaling 5,930 individuals were counted during the transect surveys (Table 1). *Egretta alba, E. intermedia, and E. garzetta* were each observed but could not be distinguished with certainty in some instances.

Six species of storks were observed, including a substantial populations of 1,896 African Openbilled Storks (*Anastomus lamelligerus*) concentrated in large flocks on sandbars of the lower Zambezi River. A total of 2,234 Openbills were reported from all other areas in Southern Africa in the 1995 African Waterfowl Census (Dodman and Taylor 1995), 7,065 were reported in 1994 (Taylor and Rose 1994). Thirty-six endangered Saddlebilled Storks (*Ephippiorhynchus senegalensis*) were observed.

Nine pairs of Grey Crowned Cranes (*Balearica regulorum*) were observed. Most of the Grey Crowned Cranes observed were associated with Wattled Crane territorial pairs.

Only nine Eastern White Pelicans (*Pelecanus onocrotalus*) were observed, although major breeding colonies were reported in earlier surveys by Goodman (1992b).

The relatively few observations of ducks and geese probably reflect the inadequacies of aerial sampling, although clearly the substantial waterfowl populations reported by Anderson *et al.* (1990) during September 1990 and Goodman (1992b) during April 1992 were not present at the time of this survey.

Mammal assessment

Repeated mammal surveys have been conducted in the Marromeu complex since 1968 as reported in Tinley (1969), Tinley and Sousa Dias (1970), Tello and Dutton (1979), Anderson *et al.* (1990), and Goodman (1992b). The civil war in Mozambique prevented surveys between 1979 and 1990. Our surveys further confirm the dramatic decline in large mammal species that has occurred since the civil war and the closure of the Cahora Bassa dam.

Tello and Dutton (1979) observed 55,595 Cape Buffalo in 1977, 43,992 in 1978, and 30,394 in 1979. By 1990, only 3,696 were observed (Anderson *et al.* 1990). In the present survey, an estimated 1,000 Cape buffalo were counted. The buffalo occurred in three separate herds in the open floodplains.

Similarly, counts of 40,300 and 47,227 waterbuck were reported in 1968 (Tiney 1969) and 1978 (Tello and Dutton 1979), respectively. The 1990 survey team observed 4,480 (Anderson *et al.* 1990), and only a few hundred waterbuck were observed during the present survey. Almost no zebra were observed, down from a peak count of 2,720 in 1979 and 2,820 in 1977, respectively (Tello and Dutton 1979). A few observations were recorded of Lichtenstein's hartebeest and sable antelope.

The decline in elephant and hippo is perhaps even more recent. A population of 330-360 elephants was reported in surveys in the last 1970s and 1990. We observed only 36 elephant, all in one herd in a patch of mesic forest surrounded by floodplain. Only a few hippos were observed during our survey.

No direct signs of active hunting or hunting camps were observed during the surveys. Anderson *et al.* (1990) reported six hunting parties and five temporary camps. Hunting parties were heavily armed with automatic weapons, likely part of a commercial operation that included air lifting of dried meat by helicopter. The decrease in hunting parties observed during the current survey is likely a sad reflection of the fact that most of the mammal populations are now so low as to be of limited commercial value relative to the effort required to locate and kill them.

Wetland assessment

Vegetation communities observed in the Zambezi Delta include dry acacia savanna and thickets in the upper delta and palm savanna along elevated streambanks and upper floodplain areas, deciduous miombo (*Brachystegia*) forests on the floodplain fringe, sedge and grassland floodplain interspersed with patches of mesic forest over much of the central delta, swamp forest in lowland depressions of the floodplain, papyrus swamps in oxbow meanders, and a few shallow open water bodies. Near the coast, the floodplain gives way to extensive mangrove swamps, and then coastal dunes and beach. Dambos occur throughout the miombo forest area, many appeared to be nearly dry.

We observed agricultural and livestock grazing fields around Marromeu and Luabo villages, but no agricultural development across most of the floodplain. Widespread settlement now occurs along the banks of the Zambezi River for subsistence fishing and agriculture.

More than 90% of the input to Cahora Bassa is regulated by the Kariba, Itezhi-Tezhi, and Kafue Gorge Dams. Before the Zambezi River was dammed at Kariba a regular flood cycle was observed with peak flows of 6,000 to 28,000 m^3/s in the lower Zambezi in February-March (Hughes and Hughes 1992). The flood regime is now greatly reduced, with only erratic flood discharges. During the current surveys in mid-March, the Zambezi River was several meters below bankfull discharge in even the lowest stretches of the delta. Much of the floodplain had little or no standing water.

Extensive burned areas were noted throughout the sedge and grassland floodplain, although we observed little evidence of fire in the forests or mangroves. Overgrazing and burning have become a severe problem in the delta area, where the regulated flood regimes have favored the spread of wildfires and the encroachment of grazing and browsing animals into the interior floodplain (Hughes and Hughes 1992). The shift from a patchwork of small fires set by local villagers to the widespread wildfires now occurring has serious repercussions for Wattled Cranes and other nesting birds in the delta.

IMPLICATIONS FOR RESTORING THE ZAMBEZI DELTA

The cessation of flooding has resulted in the severe degradation of the Zambezi Delta for both people and wildlife. Cahora Bassa, which began filling in 1974, "has the dubious distinction from an ecological perspective of being the least studied and possibly least environmentally acceptable major dam project in Africa." (Bernacsek and Lopez 1984). The dams have adversely affected the living standards of thousands of downstream households by lowering the floodplain's watertable, reducing the extent of seasonally flooded land used for flood recession agriculture and grazing of livestock, and decreasing the productivity of local fisheries (T. Scudder *pers. comm.*). The shrimp fisheries along the south bank of the Zambezi River have declined due to reduced flooding (Gammelsrod 1992). Large-scale commercial hunting, which has virtually extirpated most large mammals from the delta, has been facilitated by the drying conditions as well.

Davies *et al.* (1975) predicted that the dam would reduce fisheries productivity, reduce silt deposition and nutrient availability, lead to salt water intrusion and the replacement of wetland vegetation by upland species, result in the failure of vegetation to recover from grazing, and cause disrupted or mis-timed reproductive patterns for wildlife species. Scudder (1989) provides a general overview of river basin projects in Africa, many with impacts similar to these. Observations during the current surveys and by Anderson *et al.* (1990), Goodman (1992b), T. Scudder (*pers. comm.*), P. Dutton (*pers. comm.*), and others suggest that many of these predictions are or likely will occur. Future research will document these changes further.

Many of the problems facing the delta might be reversed through a program of carefully timed water releases from the Cahora Bassa Dam to simulate the natural flooding patterns in the delta. During a five-day period in March 1978, 1.27 billion m^3 of water was released from Cahora Bassa to protect the dam from over-topping after water levels in the reservoir reached an all-time high. A maximum discharge rate of 14,753 m^3/s was achieved by opening all eight flood gates simultaneously (Hughes and Hughes 1992). P. Dutton (*pers. comm.*) observed that floodplain conditions improved dramatically relative to previous years since the dam began filling, and were maintained for nearly two years afterwards.

The feasibility of future prescribed water releases to simulate natural flooding in the lower Zambezi River depends on the political and socio-economic trade-offs between water demands for hydroelectric power, irrigation, water transport, reservoir maintenance, and downstream release. The net benefits of prescribed water releases have been shown for other river systems in Africa, including the Manantali Dam on the Senegal River (Horowitz 1994), the Itezhi-Tezhi Dam on the Kafue River in Zambia (Acreman and Pirot *in press*), the Tiga Dam on the Hadejia River in Nigeria (Hollis 1989), and the Pongolapoort Dam on the Pongola River in South Africa (Bruwer *et al. in press*). Future research will test this hypothesis for the lower Zambezi.

CONCLUSION

Mozambique has only recently emerged from a brutal 15-year civil war that left it the world's poorest country, with ninety percent of the population in poverty, at least 200,000 orphans, one-third of all schools and hospitals destroyed or closed, at least three million people displaced from their homes, and more than one million lives lost, most of them civilian (Nordstrom 1990). Hundreds of thousands of landmines spread across the country have taken about 15,000 lives and will continue to do so for decades to come.

A precious resource like the Zambezi River, if managed wisely, can help form the backbone of Mozambique's recovery. Efforts to restore a home for people and wildlife in the Zambezi Delta will require international cooperation to demonstrate the national benefits of releasing prescribed floodwaters to the communities of the lower Zambezi. The plight of the endangered Wattled Crane may help serve as a symbol for the need to restore natural flooding patterns to great Zambezi Delta.

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REFERENCES CITED

Acreman, M. and J.-Y. Pirot, eds. *In press*. Hydrological management and wetland conservation in Africa. IUCN, Gland, Switzerland.

Anderson, J., P. Dutton, P. Goodman, and B. Souto. 1990. Evaluation of the wildlife resource in the Marromeu complex with recommendations for it's further use. LOMACO, Maputo, Mozambique.

Beilfuss, R., W. Tarboton, and N. Gichuki, eds., Proceedings of the 1993 African Crane and Wetland Training Workshop. International Crane Foundation, Baraboo, Wisconsin, USA.

Bernacsek, G. M. and S. Lopez. 1984. Cahora Bassa. Page 62 *in* J. M. Kapetsky and T. Petr, eds., Status of African reservoir fisheries. Technical paper no. 10. FAO, Rome, Italy.

Bousfield, R. 1986. Wattled Cranes in the Okavango Delta. The Crowned Crane 2: 10.

Bruwer, C., C. Poultney, and Z. Nyathi. *In press*. Community based hydrological management on the Pongola floodplain. *In* M. Acreman and J.-Y. Pirot, eds., Hydrological management and wetland conservation in Africa. IUCN/World Conservation Union, Gland, Switzerland.

Davies, B. R., A. Hall, and P. B. N. Jackson. 1975. Some ecological effects of the Cabora Bassa Dam. Biological Conservation 8: 189-201.

Direcçao National de Florestas e Fauna Bravia (DNFFB). 1994. Gorongosa-Marromeu: Management plan for integrated conservation and development 1995-1999. DNFFB, Ministerio da Agricultura, Maputo, Moçambique.

Dodman, T. and V. Taylor. 1995. African waterfowl census 1995. IWRB. Slimbridge, UK, 192 pp.

Douthwaite, R. J. 1974. An endangered population of Wattled Cranes. Biological Conservation 6: 134-142.

Gammelsrod, T. 1992. Variation in shrimp abundance on the Sofala bank, Mozambique, and its relation to the Zambezi runoff. Estuarine, Coastal, and Shelf Science 35:91-103.

Goodman, P. S. 1992a. Wattled Cranes on the Marromeu floodplain. Pages 155-156 *in* D. J. Porter, H. S. Craven, D. N. Johnson, and M. J. Porter, eds., Proceedings of the First Southern African Crane Conference. Southern

African Crane Foundation, Durban, South Africa.

Goodman, P. S. 1992b. Zambeze Delta - an opportunity for sustainable utilisation of wildlife. IWRB News 8:12.

Hollis, G. E. 1989. Artificial flood releases for the Sahelian floodplain wetland between Hadejia and Goshua in northeastern Nigeria. Pages 236-241 *in* J. A. Kusler and S. Daly, eds., Wetlands and river corridor management. Association of Wetland Managers, Berne, New York, USA.

Horowitz, M. 1994. The management of an African river basin: alternative scenarios for environmentally sustainable economic development and poverty alleviation. Pages 73-82 *in* Koblenz, ed., Proceedings of the International UNESCO symposium: Water resources planning in a changing world. International Hydrological Program of UNESCO/OHP National Committee of Germany, Karlsrue, Germany.

Hughes, R. H. and J. S. Hughes. 1992. A Directory of African Wetlands. The World Conservation Union, Gland, Switzerland and Cambridge, UK / UNEP, Nairobi, Kenya / WCMC, Cambridge, UK, pp. 657-688.

Konrad, P.M. 1981. Status and ecology of Wattled Crane in Africa. Pages 220-237 *in* J. C. Lewis and H. Masatomi, eds., Crane Research Around the World. International Crane Foundation, Baraboo, Wisconsin, USA.

Meine, C. and G. Archibald, compilers. 1996. The cranes: status survey and conservation action plan. The World Conservation Union, Species Survival Commission, Gland, Switzerland and Cambridge, UK.

Nordstrom, C. 1993. Treating the wounds of war. Cultural Survival Quarterly 17(2):28-30.

Norton-Griffiths, M. 1975. Counting animals. African Wildlife Leadership Foundation, Nairobi, Kenya.

Scudder, T. 1989. River basin projects in Africa. Environment 31(2): 4-9; 27-32.

Taylor, V. and P. M. Rose. 1994. African waterfowl census 1994. IWRB, Slimbridge, UK. 184 pp.

Tello, L. P. and P. Dutton. 1979. Programa de Operacao Bufalo. Relatorio de Fauna Bravia, Maputo, Mozambique.

Tinley, K. L. 1969. First air count of the buffalo of Marromeu. Veterin. Mozam. Lourenco Marques 1(2):155-170.

Tinley, K. L. and A. Sousa Dias. 1970. Wildlife reconnaissance of the lower mid-Zambezi Valley, before the formation of the Cabora Bassa Dam, Mozambique. Mozambique, Reparticao Technica da fauna. Direccao dos Servicos Veterinaria.

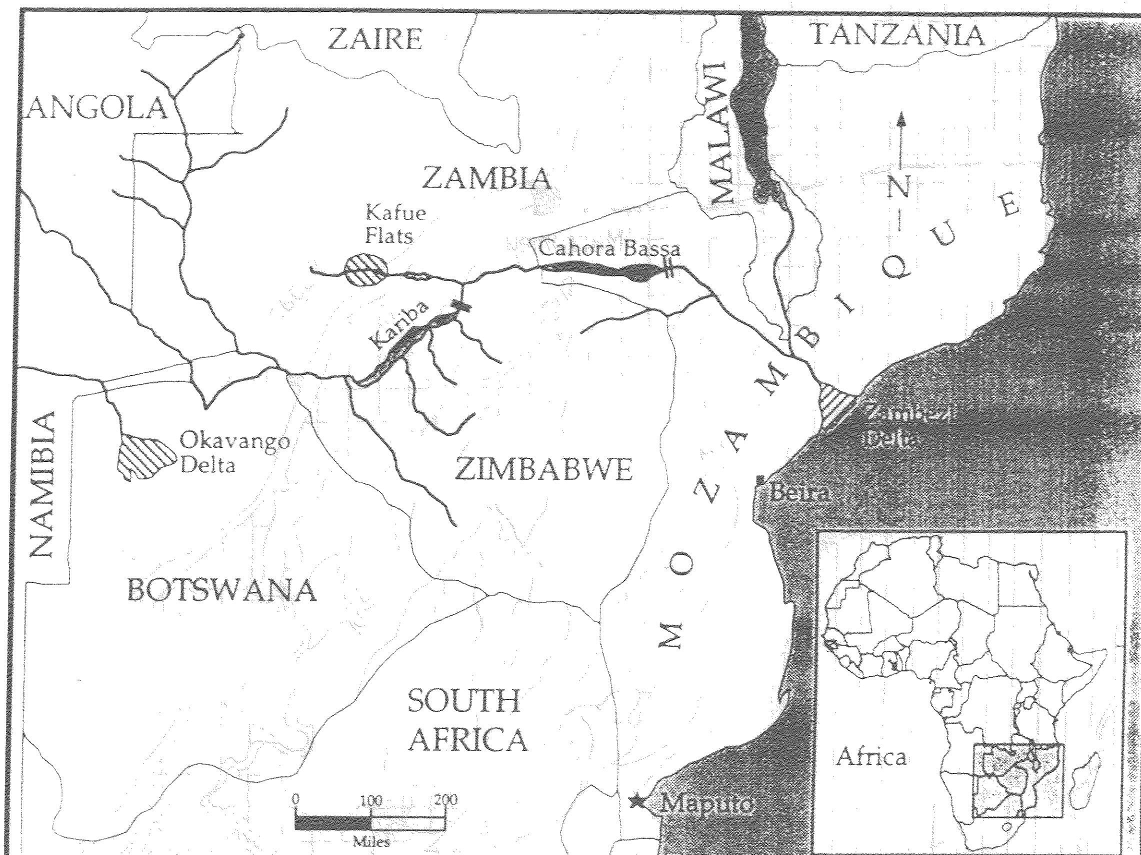

Figure 1. The Zambezi River of Southern Africa flows from headwaters in Zambia and Angola to its delta in coastal Mozambique. The massive Kariba and Cahora Bassa dams prevent most floodwaters from reaching the lower Zambezi River. Map by Milford Muskett.

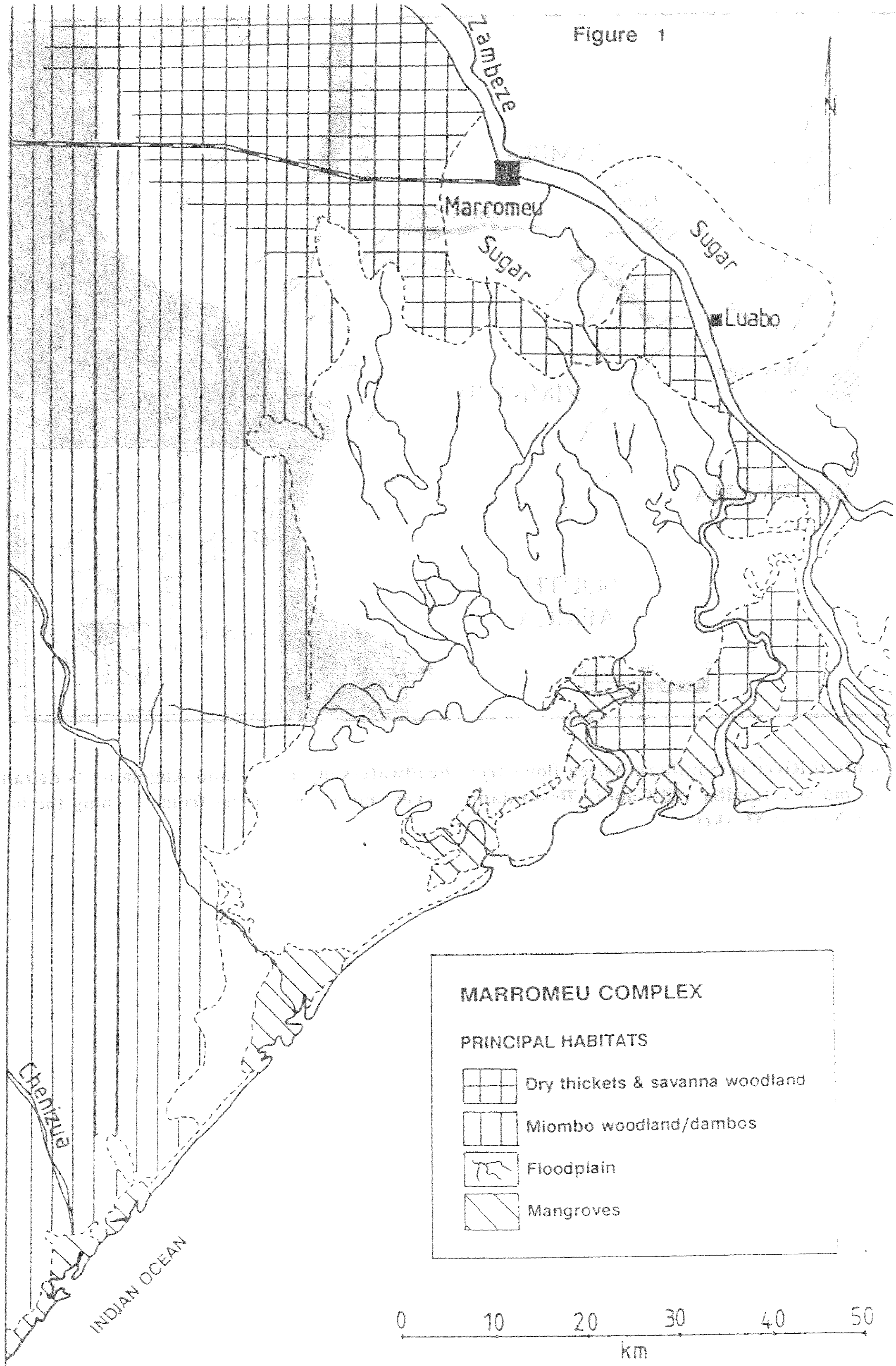

Figure 2. Major vegetation communities of the Marromeu Complex, Zambezi Delta (from Anderson *et al.* 1990).

Table 1. Results from waterbird surveys of the Marromeu Complex of the Zambezi River, March 1995.

Species	Count
Eastern White Pelican (*Pelecanus onocrotalus)*	9
Pinkbacked Pelican (*Pelecanus rufescens)*	65
Goliath Heron (*Ardea goliath)*	10
Purple Heron (*Ardea purpurea)*	2
Blackheaded Heron (*Ardea melanocephala)*	1
Egrets* (*Egretta* spp.*)*	289
Cattle Egret (*Bubulcus ibis)*	2,975
Black Stork (*Ciconia nigra)*	6
Abdmin's Stork (*Ciconia abdimii)*	30
Yellowbilled Stork *(Mycteria ibis)*	41
Marabou Stork (*Leptoptilos crumeniferus)*	52
Saddlebilled Stork (*Ephippiorhynchus senegalensis)*	36
African Openbilled Stork (*Anastomus lamelligerus)*	1,896
Woollynecked Stork (*Ciconia episcopus)*	6
Hamerkop *(Scopus umbretta)*	2
Glossy Ibis (*Plegadis falcinellus)*	73
Sacred Ibis *(Threskiornis aethiopicus)*	35
Spurwinged Goose (*Plectropterus gambensis)*	101
Knobbilled Duck (*Sarkidiornis melanotos)*	7
Whitefaced Duck (*Dendrocygna viduata)*	57
Fulvous Duck (*Dendrocygna bicolor)*	4
African Fish Eagle *(Haliaeetus vocifer)*	11
African Marsh Harrier (*Circus ranivorus)*	12
Wattled Crane (*Bugeranus carunculatus)*	156
Grey Crowned Crane (*Balearica regulorum)*	25
Longtoed Plover (*Vanellus crassirostris)*	21
Greyheaded Gull (*Larus cirrocephalus)*	3
Total	5,930

*Great White Egrets (*Egretta alba*), Yellowbilled Egrets (*Egretta intermedia*), and Little Egrets (*Egretta garzetta*) were not differentiated during aerial surveys, but all three species were observed