

UC Merced

Biogeographia - The Journal of Integrative Biogeography

Title

The bird community of riverine forest in Somalia

Permalink

<https://escholarship.org/uc/item/1cd7n4zk>

Journal

Biogeographia - The Journal of Integrative Biogeography, 14(1)

ISSN

1594-7629

Author

Wood, Brian

Publication Date

1990

DOI

10.21426/B614110329

Peer reviewed

The bird community of riverine forest in Somalia

BRIAN WOOD

*Ecology and Conservation Unit, Department of Biology, University College London,
Gower Street, London WC1E 6BT, UK.*

SUMMARY

The area of riverine forest in the Jubba valley has been reduced by over 90% since 1960. Only two sizeable blocks now remain and these were studied by the Somalia Research Project in 1986. As part of these studies, over 500 birds were mist-netted in the forest understorey. A group of 47 bird species is considered to be dependent on riverine forest and all of these have very restricted ranges in Somalia.

As yet, the substantial reduction in area of riverine forest does not seem to have caused a comparable reduction in bird species. The remoteness of the Jubba valley from Quaternary forest refugia appears to have exerted a more important control on its number of bird species. Competitive interactions between the species which make up this community are considered, as they may also restrict the number of species that occur. There are several examples of guilds of species which seem to coexist through size separation.

If the remaining forest was protected, most of the typical bird species would probably survive. However, the threats from further clearance and from insecticidal sprays are considerable. There are also economic benefits to be gained by protecting riverine forest, since it is a source of medicinal plants, construction materials and honey from wild bees. Forest helps to reduce erosion and flooding of agricultural land. It is to be hoped that the Somali government will take this opportunity to demonstrate a commitment to nature conservation by introducing effective protection measures as soon possible.

INTRODUCTION

Little riverine forest now remains in Somalia. At one time it clothed the banks of both the major rivers for most of their length (Pichi-Sermolli 1957), but only tiny fragments now exist along the Shabeelle. For the Jubba valley it has been possible to quantify the recent rate of loss of riverine forest by comparing aerial photographs taken on three different dates (Deshmukh 1987). From 1960 to 1987 a reduction from 9350 ha to 900 ha was recorded. Most of what remains is fragmented and there are now sizeable areas of riverine forest only in the Middle Jubba between Fanoole and Bu'aale. Even in this stretch, over 850 ha was cleared between 1983/84 and 1987, a loss of 63% in less than 4 years. Clearly, unless protection measures are rapidly introduced and enforced, there will be no forest remaining by the end of this century.

A gradual and continuous erosion of the area of riverine forest has probably taken place for as long as there have been settlements in the valley, but recent developments have given added impetus to its removal. A major dam is to be constructed north of Bardheere in order to generate electricity and

to regulate the river flow. Construction should be completed in 1993 and the dam should be fully operational by 1998*. This will also provide opportunity for the development of more extensive irrigated agriculture. At the same time, spraying operations against tsetse fly are continuing, with the aim of eradicating this pest. The effect of both these developments has been to encourage the destruction of riverine forest to make way for crops and livestock.

During 1986 a study of the riverine forest remaining in the Middle Jubba was undertaken by the Somalia Research Project (Madgwick *et al* 1988). Most blocks of riverine forest in the Middle Jubba were visited, on both sides of the river between Fanoole and Bu'aale, and their extent was recorded. Detailed studies were made of plants and animals in the largest remaining blocks and information was collected on soils, physiography and human use of the forests. The aim of this study was to assess the conservation value of the remaining areas of riverine forest, to determine if they are worthy of protection and, if so, to make recommendations for their management. The results are incorporated into a report on many aspects of wildlife and human use of the Jubba valley (ARD 1989) to form part of the Master Plan for Jubba Valley Development.

This paper reports some of the findings of the Somalia Research Project. It deals with the bird community living in riverine forest in the Jubba valley and compares this with bird communities in lowland moist forests elsewhere in East Africa. By an analysis of the morphology of riverine forest birds, consideration of their ecology, and their present-day distributions in Africa, an assessment is made of how this particular bird community was formed and which species are most likely to be lost if further degradation of the remaining riverine forest takes place.

STUDY SITES AND METHODS

Only two large blocks of riverine forest were found to remain in the middle Jubba valley in 1986 (Madgwick *et al* 1988). These are situated on opposite sides of the river at Barako Madow and Shoonto (Figure 1) and are partially protected as forest reserves by the National Range Agency. Both were studied in detail by the Somalia Research Project. By setting 3 m tall mist-nets on the forest floor over 500 birds were captured, and these were weighed, measured, ringed and then released. Although this sample is likely to be biased towards those birds that inhabit the understorey of the forest, several individuals of species normally seen only in the upper canopy were also caught (Wood 1990). The presence of species that were never caught in nets was also recorded whenever they were seen in the forest. To supplement

(*) Political disturbances, which began after this article was written, are likely to considerably delay completion of the Bardheere dam project.

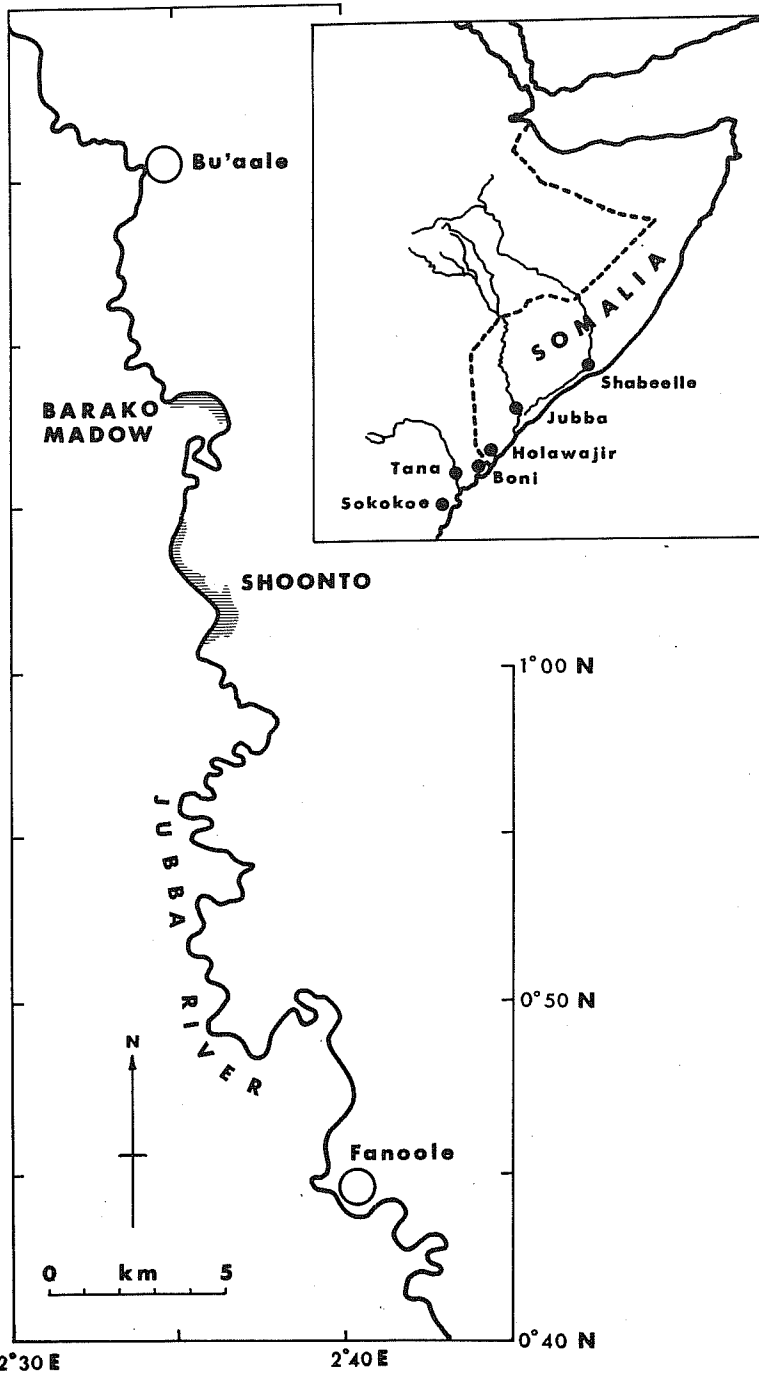


FIG. 1 - Location of study sites in the Jubba Valley, and of lowland, moist, evergreen forests in East Africa.

the morphological data collected from captured birds, measurements of at least five individuals of all riverine forest bird species were obtained from skins in the British Museum collection at Tring.

RESULTS AND DISCUSSION

Bird species found in riverine forest

It is not possible to arrive at a standardised definition of forest bird species since the degree of dependence upon riverine forest probably varies from species to species. However, casual observations indicate that many species rarely venture outside the largely evergreen forest, and several are replaced by ecologically similar (and often taxonomically closely related) species in adjacent areas of semi-deciduous woodland and bush. For the purposes of this study a fairly narrow definition of riverine forest birds has been used. Species are only included if they were recorded on at least two separate occasions within the forest but were not found outside it. Large birds (mostly raptors) that were sometimes seen perching in forest trees, but were more commonly observed overflying the forest, have been excluded, even though some of them may be truly forest dependent. The 47 species classed as birds of riverine forest are listed in table 1.

Other authors have often used a much wider definition of forest bird species (and some also include woodland and bushland near to the river as forest vegetation). There is often rather little agreement as to which species should be included. For example, Stuart (1981) lists 61 forest bird species for Sokokoe Forest in coastal Kenya, whilst Douthwaite (1985) records 101 species for the same forest. It is consequently difficult to make detailed comparisons between the lists of species compiled by various authors and those included in this paper.

Despite this problem, there is close agreement between the list of species found to occur in the remaining blocks of riverine forest in 1986 and those listed for the Jubba forests by Douthwaite (1985) from all published sources and his own observations throughout the valley. Douthwaite included 25 species additional to those in table 1. Ten of these were recorded during our surveys in the Jubba valley (Madgwick *et al* 1988) but are not included as forest species because they were recorded only once, or were found largely in other habitats. Others, which we did not find, are not inhabitants of forest vegetation. Altogether, only six bird species that were not found in 1986 but have been previously recorded could be expected to be genuine members of the bird community of riverine forest. Of these, all except one species have been recorded six times or less in Somalia (Ash and Miskell, 1983). It is therefore apparent that even the tiny fragments of forest that remain in the Jubba valley still support the great majority of forest bird species that have ever been found to occur there.

The geographical range of riverine forest bird species in Somalia is very

TABLE 1 - Bird species occurring in riverine forest in the Jubba Valley.

SPECIES	AFRICAN DISTRIBUTION	
1. <i>Polyboroides radiatus</i>	HARRIER HAWK	W
2. <i>Accipiter badius</i>	SHIKRA	W
3. <i>Accipiter minullus</i>	LITTLE SPARROWHAWK	W
4. <i>Accipiter tachiro</i>	AFRICAN GOSHAWK	W
5. <i>Falco cuvieri</i>	AFRICAN HOBBY	W
6. <i>Guttera pucherani</i>	KENYA CRESTED GUINEAFOWL	C
7. <i>Turtur tympanistria</i>	TAMBOURINE DOVE	W
8. <i>Tauraco fischeri</i>	FISHERS TAURACO	C
9. <i>Ciccaba woodfordi</i>	AFRICAN WOOD OWL	W
10. <i>Glaucidium capense</i>	BARRED OWLET	SE
11. <i>Scotopelia peli</i>	PELS FISHING OWL	W
12. <i>Apaloderma narina</i>	NARINAS TROGON	W
13. <i>Ispidina picta</i>	PYGMY KINGFISHER	W
14. <i>Halcyon albiventris</i>	BROWN HOODED KINGFISHER	SE
15. <i>Halcyon senegaloides</i>	MANGROVE KINGFISHER	C
16. <i>Eurystomus glaucurus</i>	BROAD-BILLED ROLLER	W
17. <i>Phoeniculus purpureus</i>	GREEN WOODHOPOE	W
18. <i>Tockus albeterminatus</i>	CROWNED HORNBILL	SE
19. <i>Lybius melanopterus</i>	BROWN-BREASTED BARBET	C
20. <i>Indicator variegatus</i>	SCALY-THROATED HONEYGUIDE	SE
21. <i>Campethera abingoni</i>	GOLDEN-TAILED WOODPECKER	W
22. <i>Campethera cailliautii</i>	LITTLE SPOTTED WOODPECKER	W
23. <i>Thripias namaquus</i>	BEARDED WOODPECKER	W
24. <i>Dicrurus ludwigii</i>	SQUARE-TAILED DRONGO	W
25. <i>Oriolus larvatus</i>	BLACK-HEADED ORIOLE	SE
26. <i>Turdoidea squamulatus</i>	SCALY BABBLER	C
27. <i>Andropadus importunus</i>	ZANZIBAR SOMBRE GREENBUL	C
28. <i>Chlorochicla flaviventris</i>	YELLOW-BELLIED GREENBUL	SE
29. <i>Nicator chloris</i>	NICATOR	W
30. <i>Phyllastrephus strepitans</i>	NORTHERN BROWNBUL	C
31. <i>Cercotrichas quadrivirgata</i>	EASTERN BEARDED SCRUB ROBIN	C
32. <i>Cossypha heuglini</i>	WHITE-BROWED ROBIN CHAT	C
33. <i>Cossypha natalensis</i>	RED-CAPPED ROBIN-CHAT	W
34. <i>Apalis melanocephala</i>	BLACK-HEADED APALIS	C
35. <i>Camaroptera brachyura</i>	GREY-BACKED CAMAROPTERA	W
36. <i>Muscicapa caeruleascens</i>	ASHY FLYCATCHER	W
37. <i>Platysteria peltata</i>	BLACK-THROATED WATTLE-EYE	SE
38. <i>Erythrocerus holochlorus</i>	LITTLE YELLOW FLYCATCHER	C
39. <i>Tersiphone viridis</i>	PARADISE FLYCATCHER	W
40. <i>Trochocercus cyanomelas</i>	CRESTED FLYCATCHER	SE
41. <i>Dryoscopus cubla</i>	BLACK-BACKED PUFFBACK	SE
42. <i>Laniarius ferrugineus</i>	TROPICAL BOUBOU	W
43. <i>Priniops retzii</i>	RETZ' HELMET SHRIKE	SE
44. <i>Lamprotornis corruscus</i>	BLACK-BREASTED GLOSSY STARLING	C
45. <i>Anthreptes collaris</i>	COLLARED SUNBIRD	W
46. <i>Nectarinia olivacea</i>	OLIVE SUNBIRD	W
47. <i>Ploceus bicolor</i>	DARK-BACKED WEAVER	SE

W = Widespread, SE = south-eastern, C = east coastal (see Fig. 5).

restricted. By using the information compiled by Ash and Miskell (1983) it is possible to plot the number of riverine forest species occurring in each half-degree square (Figure 2). Almost all are largely confined to the valleys of the Shabeelle and Jubba and, because, of forest clearance, their present-day ranges are probably even more restricted than these long-term records suggest. A

TABLE 2 - Species recorded from riverine forest in the Middle Jubba in 1986 which are rare or very local within Somalia.

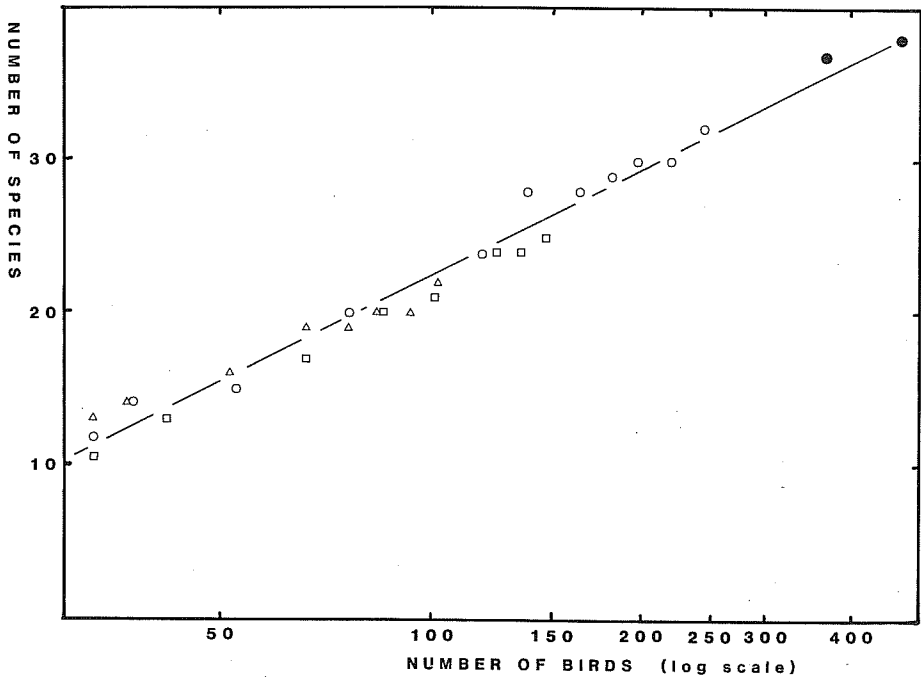
SPECIES	RECORDED OR NETTED BY SRP (1986)	PREVIOUS RECORDS FOR SOMALIA (Ash & Miskell 1983)
Harrier hawk	7	6
African goshawk	4 + 1 caught	7
Wahlberg's eagle <i>Aquila wahlbergi</i>	1	7
Bat hawk <i>Macheiramphus alcinus</i>	1	2
African wood owl	4 caught	6
Barred owlet	4 caught	8
Pel's fishing owl	6	2
Scaly-throated honeyguide	16 caught	8
Black-headed apalis	4 (1 caught)	8
Little yellow flycatcher	4 (1 caught)	7
Crested flycatcher	23 caught	8
Olive sunbird	103 caught	10
Mouse-coloured sunbird <i>Nectarinia veroxii</i>	4 (1 caught)	5

However, moist lowland forest was probably much reduced in extent throughout Africa during the Quaternary period (Diamond and Hamilton 1980, Hamilton 1981) and it is likely that none survived within Somalia at that time. The bird species inhabiting present-day riverine forest have thus probably colonised the valleys of the Jubba and Shabeelle rivers from forest refugia, the nearest of which was in coastal Kenya near to the present-day Sokokoe Forest. Consequently, three principal factors may have influenced the species richness of the bird community now found in riverine forest along the Jubba:

- I) The present extent of this forest and recent reductions in its area.
- II) Its remoteness from the nearest forest refugium, which would influence rates of arrival of potential colonists (MacArthur and Wilson 1967).
- III) Competition between colonizing species and species already living in riverine forest. Some of these would be forest species which were rapid colonizers. Others would be species better adapted to less dense vegetation (e.g. woodland and bushland) which may occupy riverine forest in the absence of more specialized inhabitants.

Area effects

There is no direct information currently available to determine the relationship between bird species richness and the area of blocks of riverine forest in East Africa. However, our ringing studies revealed a precise relationship between the number of individuals and the number of species caught, that is log-linear over a considerable range of values (Figure 3). Although this refers only to species that were caught in mist-nets set on the forest floor, it provides a means of making estimates of species richness in relation to area. If the conservative estimate of 47 riverine forest bird species



curing in Sokokoe Forest may be similar to that which survived in the nearby refugium at the end of the Quaternary. If Sokokoe is taken as the source of colonization, the number of species now found in other coastal and riverine forests in East Africa should decline exponentially with their distance from Sokokoe.

In order to establish the existence of such a pattern, I have used data from Douthwaite (1985) for the number of forest bird species in each area. This is not ideal, since he uses a rather wide definition of forest bird species, but it eliminates the problems associated with attempts to compare the lists of different authors (see above). The relationship found (Figure 4) is quite close to that expected. Douthwaite (1987) claimed that the avifaunas of riverine forest on the Jubba and Shabeelle are impoverished, since they contain far fewer species than forest on the Tana River on at Sokokoe. However, when its location is taken into account it is apparent that there are at least as many bird species in riverine forest in the Jubba valley as could be expected. Even if records for the Holowajir are omitted, because it is not well surveyed, and the Shabeelle is discounted as a consequence of the great reduction in its forest area in recent years, a relationship of lesser slope fitting the

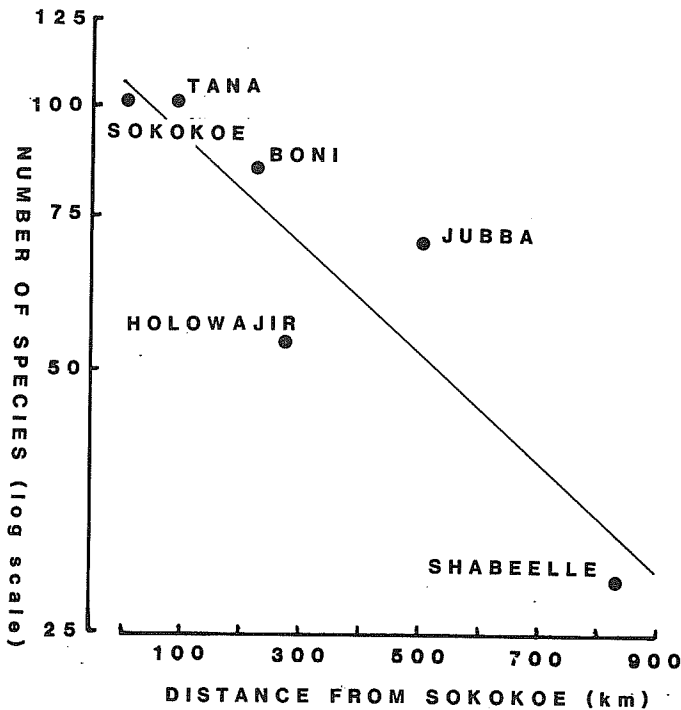


FIG. 4 - Relationship between the number of bird species in blocks of lowland evergreen forest and their overland distance from Sokokoe Forest. (Bird numbers from Douthwaite 1985). Fitted regression line is $\log Y = 2.027 - 0.00062 X$ ($R^2 = 82.4\%$).

remaining four data points shows that there is no indication of an impoverishment of the bird community in the Jubba forests.

There is no reason to suppose that only the nearest Quaternary refugium will have contributed species to colonize riverine forest in the Jubba valley. The maps compiled by Hall and Moreau (1970) and Snow (1978) provide distributional data for all species that form its present bird community. Whilst there are differences in the detailed distribution of each species, in general three major patterns are apparent (Figure 5 and Table 1). Twenty five species have very widespread distributions throughout the well-wooded parts of the continent, 11 species are fairly widespread but with essentially south-eastern distributions, and the remaining 11 species are distributed mainly along the east coast of Africa. Each of the three distributional groups comprises species of a wide range of ecological and morphological characteristics. The only noticeable distinctions are that all of the diurnal raptors, all woodpeckers and both sunbirds that are found in riverine forest in Somalia fall within the group of species of widespread distribution.

O'Connor (1981) has demonstrated the presence of important ecological traits in ubiquitous bird species in Britain. Resident species of widespread distribution have greater annual survival and widespread migrant species have greater reproductive productivity than species of more circumscribed ranges. There is not sufficient data to look for similar traits in African forest bird species. However, there is at least one important morphological distinction between the group of 11 coastal species and all the more widespread species considered here. When the wing length of each species is compared to its body size (standardized according to metabolic requirement) coastal species are seen to be shorter-winged than riverine forest birds in general (Figure 6). Short wings are an adaptation for living in structurally complex forest where flight is restricted, so these species could be the ones that are most precisely forest-adapted of the community as a whole. They were all probably confined to east coastal refugia at the end of the Quaternary. Having rather shorter wings (and possibly a greater dependence on forest) than other species could have limited their powers of dispersal since that time, resulting in their still restricted range in Africa. If they were displaced from riverine forest in Somalia they would thus be unlikely to readily recolonise any forest reserves.

Competition effects

These are the most difficult to judge since there is little detailed information on the ecology of riverine forest birds and it is consequently impossible to undertake an objective analysis of niche separation within the riverine forest bird community (cf. Holmes *et al* 1979). Probably the easiest way for potentially competing species to divide the available niches is to differ from one another in size (Giller 1984). There are several examples of this from riverine forest in the Jubba valley (Figure 7).

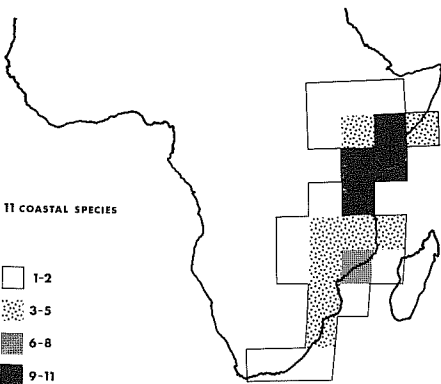
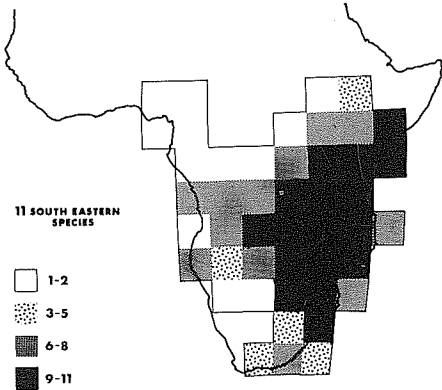
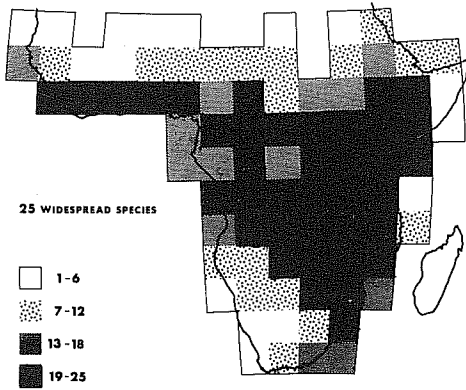
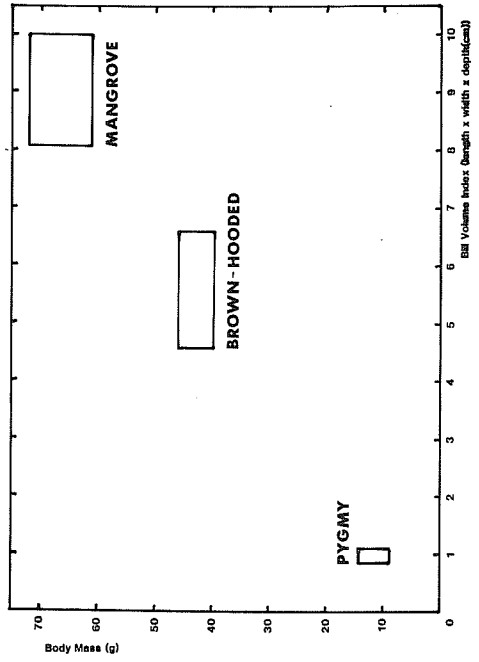
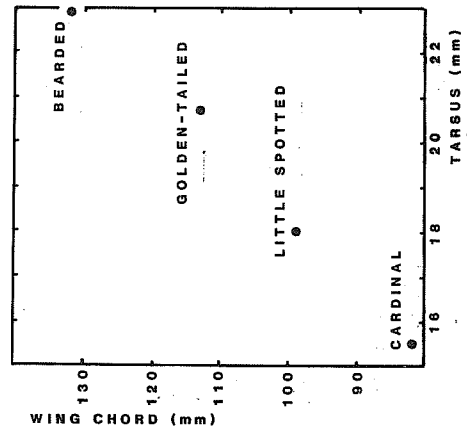
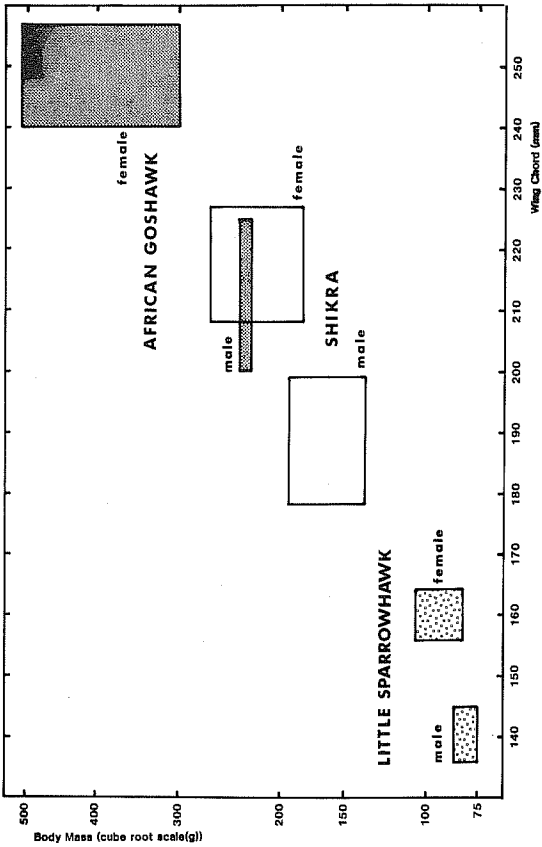


FIG. 5 - The African distribution of species forming the bird community of riverine forest in the Jubba Valley. Three types of distribution are apparent: species are indicated in Table 1. The number of species found on each 5 degree square is shown, in quartiles. (Distributional data from Hall & Moreau 1972 and Snow 1978).

FIG. 7 - Size differences between guilds of potentially competing riverine forest birds.

- a) Diurnal raptors. Published ranges of weight and wing-length shown.
- b) Woodpeckers. Average values from five measured skins of each species are shown. (Cardinal woodpecker *Dendropicos fuscescens* was recorded only once in riverine forest, so is not included in table 1).
- c) Kingfishers. Ranges from 10 specimens of each species are shown.



on crabs and is largely confined to east coastal forests. It does not differ sufficiently in weight or wing length from the brown hooded kingfisher as to prevent their competition, but both are substantially bigger than the pygmy kingfisher. However, these three species are strikingly separated in bill size (Figure 7c) and so probably overlap little in the size range of ground-dwelling arthropods that they exploit in riverine forest. In Somalia the brown hooded kingfisher is smaller than elsewhere in Africa (Wood 1989), which perhaps indicates character displacement within this guild (Grant 1972).

When substantial size differences do not exist, species with similar food requirements probably minimise competition by behavioural differences. Most riverine forest bird species are insectivores. Comparison of bill morphology can help to discriminate species according to the size, hardness and accessibility of their principal arthropod prey (Figure 8). But this analysis can still provide only a partial explanation for the coexistence of species in riverine forest. For example, of the seven riverine bird species that feed primarily by flycatching, the five smallest species all have bills of essentially the same design (Figure 8b). Within this group there are two pairs of species with bills of almost identical dimensions. These must either compete with one another for the same prey, or coexist by feeding in different parts of the forest. Detailed observations are required to explain why such species pairs are to be found together in this habitat. The wealth of flycatchers in riverine forest seems to indicate that it provides many niches for birds foraging on aerial insects.

CONCLUSIONS AND CONSERVATION PROSPECTS

Although an alarming reduction in the extent of riverine forest in Somalia has occurred in recent years, it is apparent that the small area remaining in the Jubba Valley still contains an almost complete community of birds that are largely confined to this habitat. Even if no further clearance of forest were to take place, it is probable that some species will become extinct as development causes environmental changes to the surrounding land. Unless plans are made to preserve what riverine forest is left and to adopt environmentally-sympathetic development strategies, many of the species which still survive are likely to be eliminated from Somalia.

However, a marvellous opportunity exists to preserve a nearly complete example of the bird community of riverine forest by managing the remaining blocks appropriately. Although they are designated as forest reserves, the protection that this status affords to the two largest remaining blocks of riverine forest at Shoonto and Barako Madow is inadequate. To make this protection effective would cost Somalia very little. By doing so it could protect a unique environment of great educational and cultural value. More especially, such a gesture would demonstrate a real commitment by the government to the conservation of examples of its natural resources, and this could lead to much greater help from international agencies.

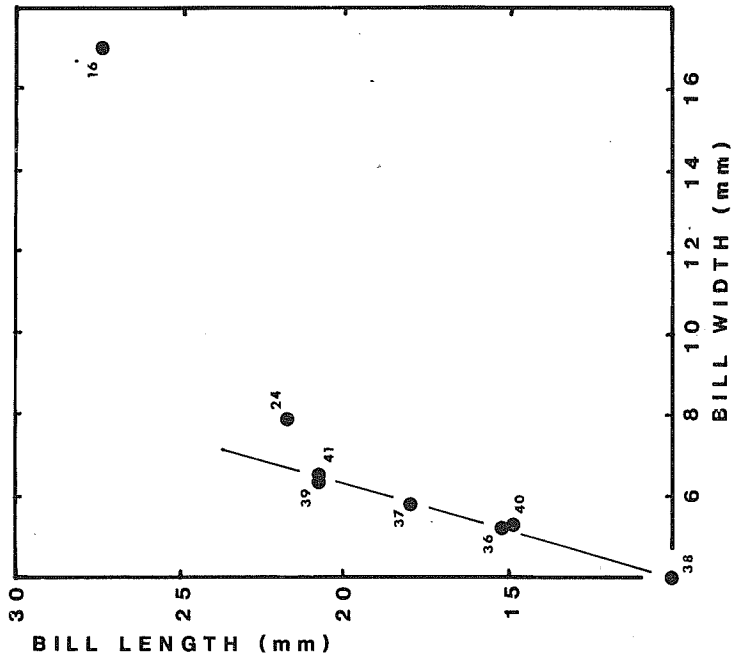
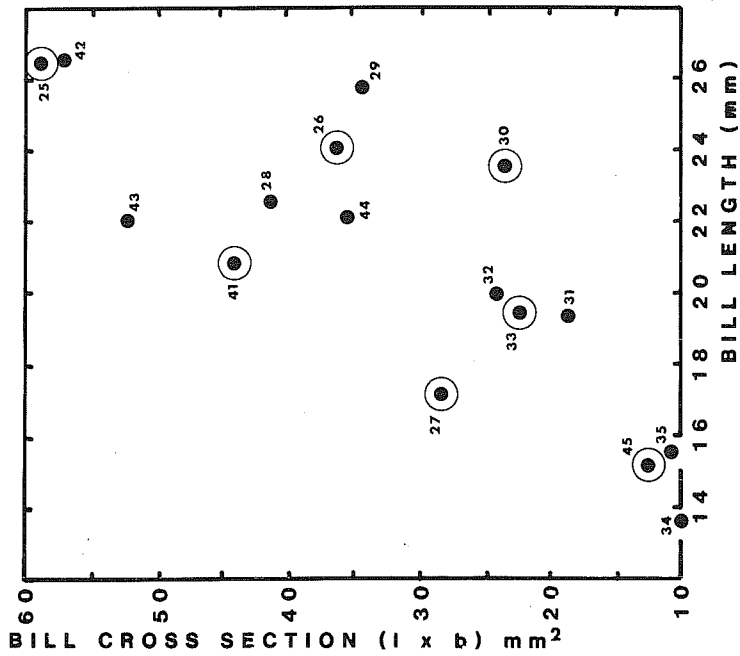


FIG. 8 - Bill dimensions of insectivorous birds from riverine forest in the Jubba Valley. Species are indicated as numbered in table 1.
 a) General insectivores. Points encircled are for species found in degraded riverine forest at Balcaad on the Shabeelle River, indicating wider separation and possibly wider niches.
 b) Flycatchers.

The elimination of the remaining riverine forest in the Jubba valley would not cause the global extinction of any bird species, since all can be found in forests elsewhere in Africa. However, analysis of the data currently available from this bird community shows that we can learn a great deal about its ecology and evolutionary history by making comparisons with bird communities in neighbouring parts of Africa. Much still remains to be learnt about the individual species, and especially about the ways in which they coexist.

Even without further clearance, there are still enormous threats to the continuing existence of this bird community. Many species are insectivorous: continuing use of sprays to eradicate tsetse flies from the valley may have disastrous consequences for these species. The larger species of riverine forest, particularly the raptors, probably survive as very small populations and depend to some extent on well-wooded areas outside riverine forest. Development will certainly lead to changes in the environment of the river and the small forest blocks that remain, in ways we are unable to predict. If the ecological requirements of riverine forest species are taken into consideration, sympathetic development could ensure their persistence for the foreseeable future.

To be realistic, although the bird community is of considerable interest, this alone is unlikely to be sufficient to encourage the preservation of riverine forest. There are other benefits to be gained by protection which could tip the balance in its favour (Madgwick *et al* 1988). The roots of forest trees bind the levee soil and thereby reduce erosion and the risk of flooding. Local people use the forest as a sustainable source of materials for house construction and the manufacture of artefacts. Honey obtained from wild forest bees is the most important cash crop in the valley (Douthwaite 1987). Over a hundred medicinal plants come from riverine forest. These have great local importance at present and could eventually become an important source of international revenue. Whilst the infrastructure of the country may hamper the development of a tourist trade, riverine forest reserves and the wildlife that they protect could in future make a substantial contribution to the economy of the area.

Biologically, the remaining riverine forest in Somalia is worthy of the status of a Biosphere Reserve (UNESCO 1974). It is to be hoped that the Somali government will recognise its responsibility and ensure that its people may, in the future, be able to benefit from the protection and conservation management of what is left of a now almost vanished part of their natural heritage.

ACKNOWLEDGEMENTS

The data presented here were collected as part of a survey of the remaining riverine forest in the Jubba Valley by the Somalia Research Project 1986. This was financially supported by numerous organisations and individuals who are fully acknowledged in our Final Report. Particular thanks are due to

major sponsors: The Royal Society, University of London, Royal Geographical Society, British Ecological Society, The Augustine Trust and the Flora and Fauna Preservation Society. In Somalia, the cooperation and assistance of the National Range Agency is gratefully acknowledged. The Forestry Project of the Overseas Development Administration provided logistical support without which the work would have been impossible.

REFERENCES

- A.R.D., 1989 - *Final report of the Jubba Environmental and Socioeconomic Survey*. - Associates in Rural Development Inc. Burlington, Vermont, U.S.A.. In press.
- ASH J.S. and MISKELL J.E., 1983 - *The birds of Somalia: their habitat, status and distribution*. - Scopus special supplement 1, 97 pp.
- DESHMUKH I., 1988 - *Environmental issues in development of the Jubba valley*. - Paper presented to National Workshop on Desertification and the Environment, Mogadishu; 5-9 March 1988.
- DIAMOND A.W. and HAMILTON A.C., 1980 - *The distribution of forest passerine birds and Quaternary climatic change in tropical Africa*. - *Journal of Zoology (London)*, **191**: 379-402.
- DOUTHWAITE R.J., 1985 - *Birds*. In: *Report on the species of vertebrates in riverine and coastal forest habitats of southern, Somalia, and the lower Tana in Kenya*. - Report for the N.T.T.C.P., Somali Democratic Republic, by Ecology and Conservation Unit, University College London and Tropical Development Research Institute, London.
- DOUTHWAITE R.J., 1987 - *Lowland forest resources and their conservation in southern Somalia*. - *Environmental Conservation* **14**: 29-35.
- GRANT P.R., 1972 - *Convergent and divergent character displacement*. - *Biological Journal of the Linnean Society* **4**: 39-68.
- GILLER P.S., 1984 - *Community Structure and the Niche*. - Chapman and Hall, London. 176pp.
- HALL B.P. and MOREAU R.E., 1970 - *An atlas of speciation in African passerine birds*. - British Museum, London. 423pp.
- HAMILTON A., 1981 - *Quaternary history of African forests: relevance to conservation*. - *African Journal of Ecology* **19**: 1-6.
- HOLMES R.T., BONNEY R.E. and PACALA S.W., 1979 - *Guild structure of the Hubbard Brook bird community: a multivariate approach*. - *Ecology* **60**: 512-520.
- HUTCHINSON G.E., 1959 - *Homage to Santa Rosalia, or why are there so many kinds of animals?* - *American Naturalist* **93**: 145-159.
- MACARTHUR R.H. and WILSON E.O., 1967 - *The Theory of Island Biogeography*. - Princeton University Press, Princeton, N.J.
- MADGWICK J., MAUNDER M., VARTY N. and WOOD B., 1988 - *Somalia Research Project: an ecological study of the remaining areas of riverine forest in the Jubba Valley, southern Somalia*. - Final Report. 172pp.
- O'CONNOR R.J., 1981 - *Comparisons between migrant and non-migrant birds in Britain*. - In: D.J. Aidley (ed.) *Animal Migration*. Cambridge University Press, pp167-195.
- PICHI-SERMOLLI R.E.G., 1957 - *Una carta geobotanica dell'Africa Orientale (Eritrea, Etiopia, Somalia)*. - *Webbia* **13**: 15-132.
- SNOW D.W. (ed.), 1978 - *An atlas of speciation in African non-passerine birds*. - British Museum, London. 390pp.
- STUART S.N., 1981 - *A comparison of the avifaunas of seven east African forest islands*. - *African Journal of Ecology* **19**: 133-151.
- UNESCO, 1974 - *Programme on Man and the Biosphere (MAB). Task Force on criteria and guidelines for the choice and establishment of biosphere reserves*. - MAB report series No. 22, Paris.
- WOOD B., 1987 - *Hunting technique of African goshawk and its possible relationship to competition with other Accipiter species*. - *Scopus* **11**: 6-8.
- WOOD B., 1989 - *Biometrics, iris and bill colouration, and moult of Somali forest birds*. - *Bulletin of the British Ornithologists Club*.
- WOOD B., 1990 - *A mist-netting study of birds in riverine forest, Somalia*. - *Tauraco*. In press.



A guild of diurnal raptors that co-exist in riverine forest principally by inter-specific and intra-specific size differences L. to R. Little Sparrowhawk, Shikea, African Goshawk.