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ENVIRONMENTAL CHANGES IN WESTERN DARFUR, SUDAN, OVER HALF A CENTURY AND THEIR EFFECTS ON SELECTED BIRD SPECIES

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INTRODUCTION

It is almost 60 years since Capt. (later Admiral) H. Lynes, accompanied by C. McConnel in 1920 and by W. Lowe in 1921-22, studied the avifauna of Darfur. His intention was to remove the blank "as far as natural history is concerned ... constituted by Darfur and western Kordofan" and he did it splendidly. His basic ornithological studies in *Ibis* (Lynes 1924-25) remain the only major work on the birds of Darfur, and in addition his visits resulted in important contributions in botany, mammalogy and geology.

Information on the bird life of Darfur prior to Lynes' visit was very scant, generally unscientific and scattered in a variety of books of travel and memoirs in various languages; a brief review was given by Lynes (1924). Three subsequent papers (Madden 1934, 1935, 1946) and some scattered references in official reports represent the total new information, with some earlier results of the present study (Wilson 1976, 1981; Wilson & Ball 1979).

I spent two 18-month periods in Darfur; from 1972 to 1974 and from 1976 to 1977, working on livestock and range resource surveys throughout much of southern Darfur province. Its environment was described by Lynes (1924) in some detail. The first part of the present paper details some of the inevitable environmental changes in the intervening period.

CLIMATE

Few firm rainfall data are available for Darfur although a general climatic description is given in Wickens (1977). Nicholson (1978) suggested there were 'wet periods' from 1875 to about 1910 in the southern Sahara and Sahel zones (Fig. 1) and that 1910-1920 was 'dry', even with a 'severe drought'. He postulated that rainfall increased from 1920 to culminate in a 'wet' period in the 1950s, which was followed by a severe dry period from 1968 to 1973.

An analysis of rainfall at four stations with long run data (Table 1) supports Nicholson's conclusions. Running means for five stations in western Darfur all exhibit a generally high level of rainfall in the 1950s with a marked fall in the average in the 1960s and 1970s (Figure 2).

The general reduction in rainfall, undoubtedly accompanied by reduced cloud cover, greater solar radiation, and higher wet season temperatures has produced a more arid landscape, reflected in the hydrology and vegetation.

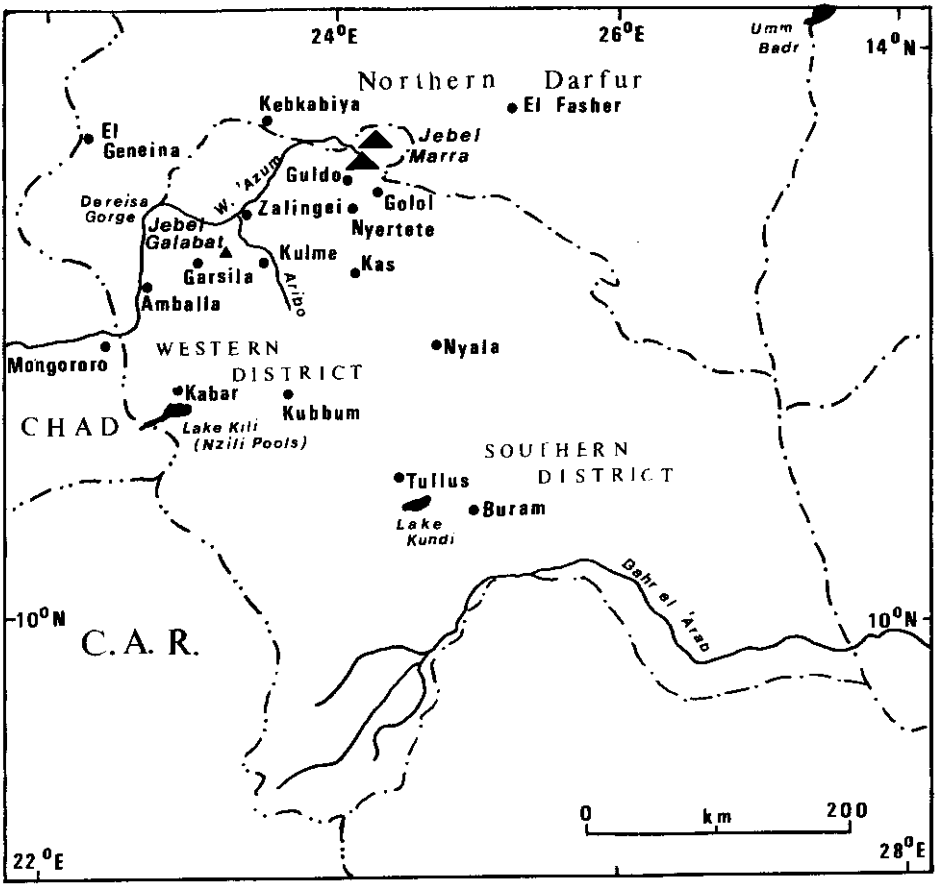

Figure 1 Map of the main part of Darfur showing all geographical names mentioned in the text

Table 1 Trend analysis of rainfall in Darfur

Station	Record period	Average (mm)	Rainfall regression equation (on 5-year running mean)
Zalingei	1931-1976	637.8	y = 655.53 - 0.31x
El Geneina	1928-1976	545.8	y = 576.26 - 1.49x
El Fasher	1917-1976	283.7	y = 331.27 - 1.45x
Nyala	1920-1976	473.0	y = 547.42 - 2.25x

HYDROLOGY

There has been a marked decline in vegetative cover over the last few years, with much overgrazing and increased areas of cultivation. River flow is now of shorter duration, and sheet erosion is becoming widespread with some gullying.

Lynes remarked on the lack of surface water in the dry season, but some permanent waters may have escaped his notice. At the present time (even after the recent drought) 'lakes' Kundi and Kili usually contain some water all year round. There are also ox-bow lakes along the 'Azum, for example at Amballa and Mongororo, which normally contain water. At El Fasher the improvement of the town pond has ensured an almost permanent area of surface water and at Zalingei, Nyala s recent excavations for brick making and building earth have created per anent, if small, bodies of water.

VEGETATION

In the past the Wadi 'Azum basin has provided some of the best dry season pasture grounds along the southern edge of the Sahara. Studies carried out in 1964-65 (F.A.O. 1968, Wickens 1977) and by the same ecologist in 1977 (Hunting Technical Services 1977) show that the vegetation is now very much poorer. The most serious degradation, arising from increased cultivation and overgrazing, is probably occurring in the alluvial valleys of the Wadi 'Azum and its major tributaries. The most important tree is *Acacia albida*, but cultivation has reduced natural regeneration to a negligible level and mature trees are being lopped and burnt. Government plans for irrigation schemes will cause even more degradation of *Acacia albida*. No adequate conservation measures are apparently being taken.

There have been, on the other hand, certain improvements to the vegetation as a bird habitat. While the 150,000 ha of gazetted or proposed forest reserve are that only in name, 2,600 ha of plantation on Jebel Marra have undoubtedly provided new habitats. Similarly the area under fruit, particularly mango and guava, has greatly increased in recent years and now provides shelter and food for a variety of birds.

STATUS OF SELECTED BIRDS

OSTRICH *Struthio camelus* Very uncommon and in danger of extinction through egg collection and shooting for plumes. Eggs are still used to decorate mosques and private houses: in 1977 they were offered for sale in Darfur for as little as 10 piastres (US $ 0.28) and in Khartoum tourist shops for £SUD 5 (US $ 14). Prime white plumes were on sale in Mongororo in February 1977 at £SUD 3 per rotl (about 430 g). I saw one young bird from the ground south of Kabar, but saw several from the air. One nest containing 12 eggs was seen from a helicopter a few kilometres east of Zalingei in 1965 (Wickens, pers. comm.). Recent aerial surveys (Watson *et al.* 1977) gave estimates of 3,600 Ostriches in Darfur in three main areas, about 250 centred on 11°30'N, 23°30'E, nearly 3,100 in 10°30'-11°30'N, 24°00'-27°00'E (sandy soils with *Combretum* woodland) and nearly 300 centred on 10°00'N, 27°00'E. Wilson (1976) has reviewed briefly the history of the Ostrich in Darfur.

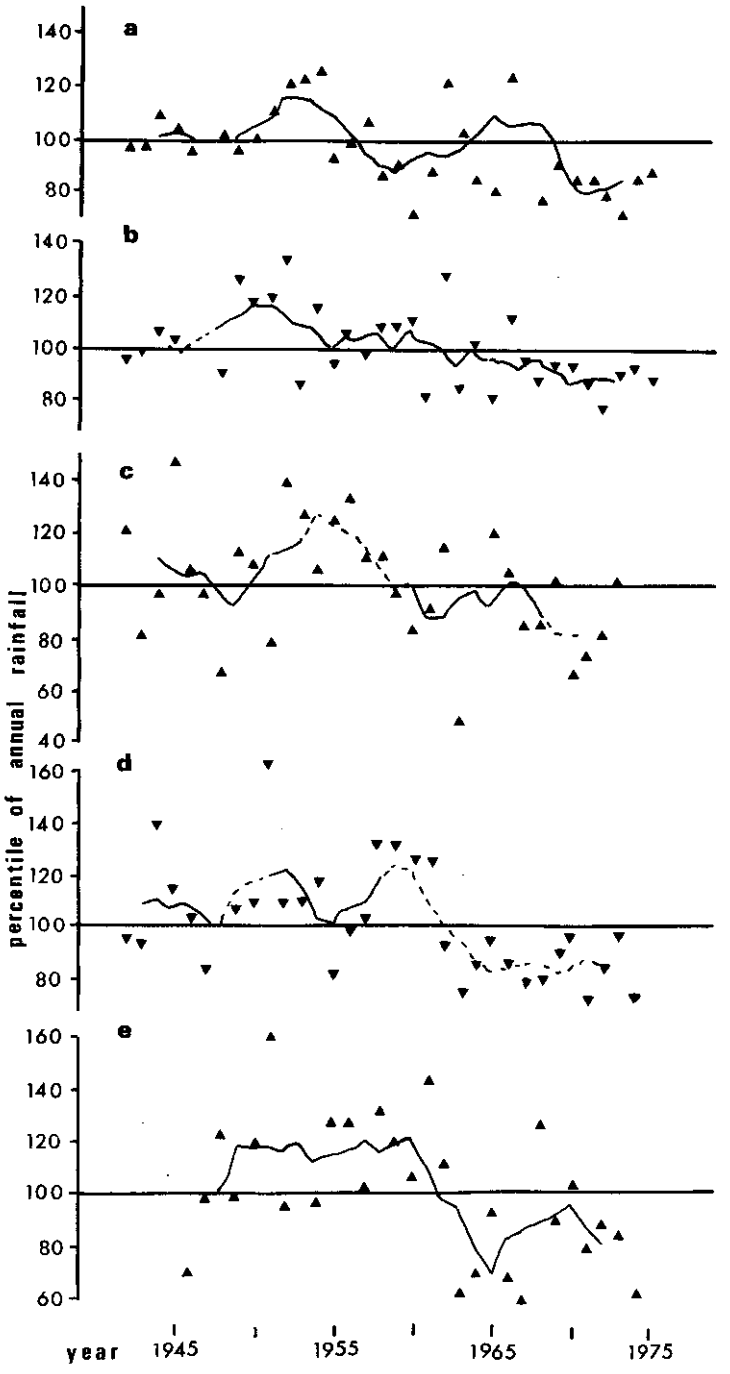

Figure 2 Plots of 5-year running means of annual rainfall for five locations in western Darfur (a, Kas, $\bar{x}$ = 560 mm: b, Garsila, $\bar{x}$ = 673 mm: c, Kubbum, $\bar{x}$ = 675 mm: d, Guldo, $\bar{x}$ = 646 mm: e, Nyertete, $\bar{x}$ = 847 mm: all for 1943–75 except Nyertete 1948–75)

LITTLE GREBE *Poliocephalus ruficollis* Present on the brick ponds at Zalingei, November 1976 to February 1977 and again in October 1977. Probably resident and certainly a winter breeder as young birds accompanied two adults throughout December 1976 and January 1977. Winter breeding recorded at Umm Ruaba in Kordofan (Hogg 1958).

BUFF-BACKED HERON *Bubulcus ibis* Summer breeding visitor, as noted by Lynes. First large flocks (50-100 birds) noted at Nyertete, 22 June. By no means all birds breed and where nesting in company with Abdim's Stork and Sacred Ibis (mainly in *Balanites aegyptiaca* and occasional *Adansonia digitata*), the breeding season was slightly later, from mid-July. Occasional birds may pass the winter in Darfur, some being recorded at Umm Badr (14°15'N) on the Darfur/Kordofan border in January 1955 (Mackenzie 1955).

GREY HERON *Ardea cinerea* Common winter visitor. A few stayed through the rainy season but were not observed to breed although breeding in the rains has been noted in Kordofan (Hogg, pers. comm.).

BLACK-HEADED HERON *Ardea melanocephala* Lynes could not estimate its status but it is now definitely a common resident throughout western Darfur, breeding in the early rains. Several nests were being constructed in fan palms *Borassus aethiopum* in Kabar village 30 April 1977. A colony of 140 pairs in company with Sacred Ibis (31 pairs) and Abdim's Stork (5 pairs) started building operations, all in *A. albida* in early May in Zalingei. Young herons hatched from about 28 June, adults quit the nesting colony in late September and the last young left the nests 16 October 1977. July breeding is recorded for the species along the Nile (Hogg 1950).

GOLIATH HERON *Ardea goliath* One record 5 km west of Zalingei, 27 October 1977. Not recorded by Lynes but apparently fairly common in south-east Darfur (Madden 1934). In western Darfur probably a vagrant at the extreme northern edge of its range.

HAMERKOP *Scopus umbretta* Probably less common than previously as only three records: two birds on 15 November 1976, one on 17 November 1976 at Amballa and one on 19 January 1977 at Zalingei. No signs of nests and may possibly be a non-breeding visitor. Madden (1934) has one record.

BLACK STORK *Ciconia nigra* One in Zalingei in latter part of January and early February 1977. Probably uncommon palaearctic winter visitor or passage migrant to and through the alluvial valleys in addition to the winter visitors to Jebel Marra noted by Lynes.

ABDIM'S STORK *Ciconia abdimii* The earliest of the intra-African migrants in Darfur. Common throughout by mid-April, well before the normal rains begin. Breeds commonly in towns and villages, most often in *Balanites aegyptiaca*, at least as far north as El Fasher and Kebkabiya. Most clutches set by end of May and few birds seen after 19 October 1977.

It also appears to be an early arrival farther east being recorded at Bara before 2 May, Shendi on 16 May but nesting slightly later, in June. Departure from Khartoum 10-20 October but still at Sodiri on 13 November (Hogg, pers. comm.).

SADDLE-BILL STORK *Ephippiorhynchus senegalensis* Although not recorded by Lynes this unmistakable stork is widespread and not uncommon, probably resident and breeding (during the rains), in Darfur in suitable habitats.

MARABOU STORK *Leptoptilos crumeniferus* Two sightings: three birds on 17 November 1976 south of Kabar and one bird on 26 January 1977 at Zalingei confirming its vagrant status noted by Lynes.

SACRED IBIS *Threskiornis aethiopicus* Generally a summer breeding visitor throughout the province but with small numbers (scattered groups of 1-3 birds) overwintering where there is permanent water. Visitors arrive later than Abdim's Stork and about the same time as the Buff-backed Heron. On the other hand they apparently stay later in Darfur than either of these two species and were still present in numbers at the end of October 1977 in and around Zalingei.

HADADA *Hagedashia hagedash* One seen and several heard calling at Kabar, 26 May 1977, probably confirm it as an occasional vagrant, as noted by Lynes.

KNOB-BILLED GOOSE *Sarkidiornis melanotus* The status appears to have changed from summer passage migrant to common rainy season visitor with some birds breeding. First birds were noted on 7 June and then in numbers from 30 June. Several pairs had nests in hollow *A. albida* trees on the flood plain of the 'Azum 5 km north-east of Zalingei: the one nest examined had five eggs (two of which measured 56.9 x 38.5 mm and 54.3 x 38.5 mm and weighed 48.6 and 45.8 g respectively) on 1 August and two additional eggs two days later.

VULTURES All species appear to have undergone a drastic reduction in numbers throughout most of Darfur. I have records of: one Nubian Vulture *Torgos tracheliotus* which had got itself partially trapped in a small acacia bush 20 km west of Zalingei in the late evening 19 November 1976; one Egyptian Vulture *Neophron percnopterus* overflying Zalingei on 18 December 1976; one Hooded Vulture *Aegypius monachus* at Kebkabiya about mid-day on 3 June 1977; two Hooded Vultures roosting in Zalingei town on 12 August 1977; and two groups of the brown phase of the White-backed Vulture *Gyps bengalensis*, one of seven birds on the ground 17 km east of Zalingei and one of five birds on the ground 12 km east of Kas, both on 7 September 1977 towards the end of the rains.

No vultures were ever present at Zalingei slaughter house throughout late 1976 and the whole of 1977 nor were any seen at the several weekly village slaughterings visited. Seven Egyptian Vultures were noted at El Fasher town midden on 1 November 1977.

BATELEUR *Terothopius ecaudatus* Fairly common in the south of the province in the Buram and Tullus areas. Never seen north of Nyala or in western Darfur and its range is probably being compressed towards the south.

FISH EAGLE *Haliaetus vocifer* Status has changed since 1920. From being an occasional summer visitor or migrant it is now a fairly common resident in suitable localities. Several were present at Lake Kundi in Southern District throughout the winter and there were four distinct breeding territories at Lake Kili. A single bird was seen most days at Zalingei brick ponds throughout January and February 1977.

BLACK KITE *Milvus migrans* Lyne's general remarks are endorsed. Large concourses, of several thousands, arrived in Zalingei on almost exactly the same dates as in 1920 - 26 June, 27 June, 1 July, 10 July 1977. A slightly earlier passage was recorded in Nyertete on 20 June. Several hundreds of birds stayed in Zalingei throughout July and August, and an estimated three thousand in Nyala.

GREY KESTREL *Falco ardosiaceus* Resident in small numbers throughout the year at least as far north as Zalingei where a pair roosted throughout the winter 1976-77 in the lower town at the confluence of the Wadi Aribo and the 'Azum. Numbers augmented in the rains by visitors.

FOX KESTREL *Falco alopex* Resident and late dry/early rains season breeder. A pair at Jebel Galabat were feeding fledged young, 8 July 1977.

SECRETARY BIRD *Sagittarius serpentarius* While being the national emblem of the modern Sudan and enjoying complete (and undoubtedly real) protection, the Secretary Bird remains uncommon to rare. Eight records, all of single birds except one: 22 April, 2 November, 17 November (of one and of two birds on recently burnt areas) 1976, 10 January, 1 May, 1 July and 12 August 1977. Probably resident and not just an off-season visitor as considered by Lynes.

SCALY FRANCOLIN *Francolinus squamatus* Present in the "gallery forests" (Wickens 1977) on Jebel Marra. Lynes did not visit these areas - at least not according to his itinerary - and it is possible that further exploration would reveal other forest species on Jebel Marra. Recorded from Jebel Marra by Cave and Macdonald (1955) but otherwise noted in the Sudan only from Equatoria Province.

STONE PARTRIDGE *Ptilopachus petrosus* Much reduced: resident in a scattered and irregular distribution, no longer common throughout as heretofore. A family group of 10-12 birds was seen in a typical habitat of laterised soils south of Kabar although the birds were actually foraging in a clump of bamboo. A second record was of several groups in a burnt out plantation of *Cupressus* above Golol on Jebel Marra at about 2,000 m.

GUINEAFOWL *Numida meleagris* Much reduced in populated areas and in the vicinity of main towns. Still very common in remote areas and particularly in the south where access by vehicles is difficult or impossible during the rains breeding season.

CROWNED CRANE *Balearica pavonina* If there are, as Lynes indicated, only a small number of resident Cranes in Western Darfur, then there must be considerable seasonal movements. Two flocks of several hundred birds were seen on the 'Azum between Amballa and Mongororo on 29 December 1976. In Southern Darfur there is a more or less permanent winter population of several hundred at Lake Kundi.

ARABIAN BUSTARD *Otis arabs* and DENHAM'S BUSTARD *Neotis denhami* Common in Lynes' time, the resident population of the Arabian Bustard is probably extinct or nearly so. The seasonal movement of a probably more southerly population continues, in seemingly greatly reduced numbers. Sixteen birds (groups of 5, 1, 1, 8, 1) were noted flying south on 17 November 1976, one bird having been noted earlier on 28 October; all of these were south of Kabar. Although the northward passage was waited for in 1977 only three birds were noted on 24 June, flying strongly towards the north 15 km west of Nyertete.

I had no sightings of Denham's Bustard although I was presented with one shot in mid-December 1976. Formerly scarce, it is probably almost extinct in Darfur.

Birds of both species, presumably residents were present in Sodiri in Kordofan in November to February and between Jebel Meidob and 'Atrun (Bir Natron) in Northern Darfur in December-January in the period 1938/39 (P. Hogg, pers. comm.).

BLACK-WINGED STILT *Himantopus himantopus* A much more common winter visitor than suggested by Lynes, and not at all local, occurring along the length of the 'Azum from Zalingei to at least Amballa. Earliest records were on 29 October 1976 at Amballa and 28 October 1977 at Zalingei. Latest record was 11 February 1977.

EGYPTIAN PLOVER *Pluvianus aegyptius* A few noted on 22 August 1977 at Zalingei. However, it was common on the 'Azum at Amballa throughout the winter of 1976-77; a resident breeding population is probably established in the far west of Darfur. Perhaps these are an offshoot colony from the Bahr el 'Arab population which was quite conspicuous in March 1974 (Field 1974).

SPECKLED PIGEON *Columba guinea* Common resident in towns and in country throughout, breeding occurring in most months. Particularly common in areas of the Fan Palm *Borassus aethiopum* in which several nests were found, thus confirming the preference indicated by Harwin (1963) in Nigeria. At least in the Sudano-Sahelian zone the Speckled Pigeon has an apparent affinity with this palm as a nest site.

GREEN PIGEON *Treror waalia* Common where there are wild fig trees, to which it is apparently confined having not made any transition to cultivated fruits.

BROWN PARROT *Poicephalus meyeri* Very common, particularly in the *A. albida* areas as far west as Amballa. Two pairs feeding young in nests, end of January 1977.

RED-HEADED LOVEBIRD *Agapornis pullaris* Not recorded by Lynes. Fairly common along the whole of the Sudan/Chad boundary in Western Darfur, particularly from November to February. Recorded on the Wadi Barei at 13°00'N 23°00'E; probably representing a northward extension of its range.

GREY PLANTAIN-EATER *Crinifer zonurus* Has probably benefitted from man's activities and has spread everywhere that mangoes and guavas grow; can be considered abundant. Diet not confined to fruit trees, however, as leaves and winged termites found in the stomach of one bird.

BROAD-BILLED ROLLER *Eurystomus glaucurus* Common summer visitor in the *A. albida* zone. Probably more plentiful and widespread than in Lynes' time. Very active. Several breeding pairs in Zalingei throughout July and August.

ABYSSINIAN GROUND HORNBILL *Bucorvus abyssinicus* Although found in various habitats is much more common in the *Acacia albida* alluvial zones than elsewhere. Normally in pairs with one young, identification being based on facial colours and casque characteristics. Congregations of six or more foraging birds were generally seen in the late afternoon or evening. Nests are probably mainly in hollow *A. albida*. One 1-week-old nestling was being fed by both parents on 28 July 1977. The booming call is not strictly confined to the breeding season - recorded 2 February, 8 March, 22 April, 24 May, 7 July and then almost continuously through July and August, almost all calls being noted before or around dawn. Calling was again heard 13-19 October.

BLACK-BREASTED BARBET *Lybius rolleti* General status given by Lynes confirmed in the northern savanna-like extensions. Has now successfully colonised the Eucalyptus plantations at Nyertete from where it probably forages out to mango and guava orchards.

BLACK-HEADED GONOLEK *Laniarius barbarus* and CRESTED HELMET SHRIKE *Prionops cristata* Both shrikes are common residents but subject to local movements. They move out of the *A. albida* zone in the rainy season when the trees are leafless.

The Gonolek has successfully colonised the *Eucalyptus* plantations in the Nyertete area.

YELLOW-BILLED OXPECKER *Buphagus africanus* Is now resident throughout most of Darfur as far north as Zalingei. Several records in Zalingei for December 1976/January 1977 and March/April 1977.

PIED CROW *Corvus albus* Observations largely confirm those of Lynes - the Pied Crow is still a winter visitor throughout most of the province. First arrived in the Zalingei area, 28 October 1976, a large number of birds remaining until well into the next rainy season, last recorded 23 July 1977. First arrivals in the following year after the rains, 14 October 1977. Nyala is evidently large enough to provide an attraction for Pied Crows even during the rains: several large flocks each of over 100 birds inhabited Nyala throughout July-August rains of 1977.

Most birds were associated with human activity, foraging usually in pairs. Only three breeding records, each of a single nest, noted in 1977. One successful brood in an *Acacia albida* in Zalingei town in early June, another in a *Khaya senegalensis* 5 km west of Nyertete raised a brood in late June/early July, and one in a baobab *Adansonia digitata* 3 km north of Nyala airfield was in the process of being built in early June but whether a brood was reared is not known.

FAN-TAILED RAVEN *Rhinocorax rhipidurus* The 1920 status is largely confirmed. Common at Dereisa gorge in addition to Jebel Marra. The slaughter slabs in the towns and villages have become important food sources. At Zalingei slaughterhouse the first birds usually appeared just after first light; if these birds roosted on Jebel Marra, over 100 km north-east, they would have had to travel during darkness.

PIAPIAC *Ptilostomus afer* Has apparently extended its range. Mackworth-Praed & Grant (1960) give its distribution as southern Sudan, associated with the Fan Palm *Borassus aethiopum* and subject to erratic seasonal movements. It is now resident in Darfur as far north as Kas and Garsila, where in both villages there is suitable habitat in the form of *B. aethiopum* groves and ample food supplies from insects disturbed by the large numbers of domestic animals. It is probably extending its range still farther northwards: recorded at Zalingei (12°54'N), early March and mid-April 1977 and at Nyertete (12°58'N) June 1977. Its presence in Zalingei may be a result of movement along corridors of suitable habitat, relicts of former savanna and gallery forest conditions (Wickens 1977).

The Corvidae in Darfur have been treated in detail elsewhere (Wilson 1981).

WHITE-CROWNED CLIFF-CHAT *Thamnolea coronata* Occurs on the isolated volcanic plug of Jebel Galabat 30 km west of Zalingei as well as on Jebel Marra where Lynes found it. A pair were feeding young at a nest on J. Galabat on 8 July 1977. Probably also occurs on the hills and crags of the Dereisa gorge.

DISCUSSION AND CONCLUSIONS

It is possible that Darfur in the late 1970s was at the end of a gradual decline in rainfall over a 50-year period, just as it was in the early 1920s. Climatic change, however, has had little effect on vegetation in the alluvial valleys of the Wadi 'Azum and its major tributaries. Thus, while climatic change can explain some of the changes in bird distribution and movement it does not explain them all.

Of those species which have been affected beneficially by man's activities the Black Kite and the Pied Crow probably provide the best examples. The Black-headed Heron also appears to have adapted successfully to human influences and in fact a measure of commensalism would explain its presence as a breeding bird in Zalingei and Kabar. Other birds which have benefitted from man's activities are the Sacred Ibis, the Saddle-billed Stork and the Fish Eagle: increases in water surface areas from irrigation schemes often coupled with the planting of trees, which provide nesting sites, are undoubtedly beneficial to these species.

The relatively high density of the Ground Hornbill is also related to human activity but in a rather anomalous way. The even-aged stands of *Acacia albida* date from the period when western Darfur was a battleground between the Sultan and his sedentary cultivators on the one hand and the Arab pastoralists on the other. In Lynes' time - Ground Hornbills were present but apparently not in considerable numbers - these trees would be about 25 years old and not yet mature. In the mid-1970s the remaining stands are comprised of mature and over-mature trees, many of them hollow. These provide nesting sites for this hornbill (and others) and have probably resulted in a rapid increase in population over the last 30 years or so. With increasing destruction of these trees it is likely that the Ground Hornbill population will decline in the near future. A decline of other species, for example the shrikes, the parrots, the Broad-billed Roller and the Knob-billed Goose, which make use of the ample dry season cover and/or nesting holes provided by *Acacia albida*, may also be expected.

The direct effects of man's activities are most in evidence in the game birds, the vultures and the Ostrich. Ducks, geese, Guineafowl and the Stone Partridge have all suffered from the increased mobility of people and the general availability of firearms. The bustards are in real danger of extinction although the smaller ones are still relatively numerous. The most spectacular crash in the bird populations of Darfur (and of the Sudan in general) has certainly been in the case of vultures. Many former members of the Sudanese Civil Service and other long time inhabitants of the country have remarked on it (P. Hogg, pers. comm.; A. Pettit, pers. comm.). The reason is perhaps obvious and provides an excellent example (chemical control of tsetse flies is another) of the consequences of the application of control measures to one species without thought to the effects on others. Reduction in vulture populations can almost certainly be related to the indiscriminate use of strychnine to poison hyaenas. In Darfur this was done on an enormous scale as can be gathered from government archives for 1947-52 for Southern Darfur district which record almost 700 hyaenas and almost as many jackals poisoned (and carcasses noted!) during the period (Wilson 1979). This continues, as it does in Mali where vultures are also uncommon (pers. obs.). On the other hand where poisoning is not practised and where hyaenas are still common, as in the case of Ethiopia, vultures are still among the most obvious birds and in fact make up more

than 90 per cent of the raptor biomass.

The commonness of the Ostrich has probably always been rather relative but they have undoubtedly suffered in numbers from egg-taking and shooting for plumes. It has been pointed out to me by the late L. H. Brown that in areas where Ostriches are fairly numerous, as in the Nairobi National Park, over half the eggs laid are never incubated and thus a harvest of kinds might be possible.

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