

MOREL

THE SAHEL ZONE AS AN ENVIRONMENT FOR PALAEARCTIC MIGRANTS

The aim of this note is not to answer all the questions raised by the wintering of palaeartic migrants in the semi-arid zone immediately south of the Sahara, but simply to define the problem, suggest some lines of research, and give some preliminary answers. Some of the data to be presented have been published (Morel & Bourlière 1962, Morel & Roux 1966, Morel 1968), and some are the result of recent unpublished work carried out at Richard-Toll, Senegal.

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THE APPARENT PARADOX

Moreau (1966) rightly pointed out that many more birds winter just to the south of the Sahara than at more southerly latitudes where conditions seem more favourable. The paradox must of course be more apparent than real; it should serve, however, to stimulate one to find out how the semi-arid zone can provide food for such a vast influx of birds. I shall deal here only with the area which I know well from 20 years' residence, the lower Senegal Valley. In this part of West Africa the vegetation zones are very compressed, so that although Senegal extends over only 450 km from north to south one passes from the Sahel zone in the north to the Guinea Zone in the south; hence useful comparisons can be made over short distances.

The general conclusions which we have reached are as follows:

(1) It is precisely because the area is arid, with a single rainy season, that migrants can winter there in such numbers. The abrupt alternation of dry and wet season results in a sharp seasonal increase in plants and invertebrates. This increase cannot be fully exploited by the resident birds alone, whose populations are adjusted to the period when food is scarcest.

(2) The regularity of the rainy season is important. Clearly, if the migrants which leave the Palaearctic in autumn could not count on finding suitable conditions south of the Sahara, the whole system would be upset. In fact, there is a remarkable synchronisation between the end of the northern summer period and the end of the wet season in the Sahel Zone.

(3) The absence of potential competitors is another important factor. The Ethiopian members of the Muscicapidae and Anatidae belong to different genera from the Palaearctic species, and are in general less numerous. There is an almost complete absence of resident members of the Charadriidae in West Africa.

Some comments are needed in amplification of the above points. It will be apparent that many problems still remain.

WATER-BIRDS

"Moreau's paradox" refers particularly to the land-birds, but water-birds are faced with a similar general problem. Many observers have commented on the enormous numbers of birds in the families Ardeidae, Anatidae and Charadriidae wintering in certain parts of the Sahel Zone. In West Africa, the greatest numbers are found in the basins of the Senegal and Niger. These two rivers are characterised by a single spectacular flood-period each year, beginning, in the case of the Senegal, at the end of July and transforming into a rich marshland thousands of hectares which at the beginning of the month were desiccated earth. The rise in river level, of up to 4 m at Richard-Toll, is brought about by the abundant rains which fall in the area of the headwaters. Earlier, the beginning of the local rains, about mid-July, produces a great number of small pools and some larger ones of up to a hectare, suitable for the first of the migrants.

Some of the vegetation which is brought on by the rains has time to produce seeds before it is flooded, thus producing a food supply for the ducks and those waders which take seeds. In the swamps a true marsh vegetation develops which also produces a food supply, especially seeds of *Nymphaea* and aquatic invertebrates. Fishes reproduce in the wet season, and the flooded areas are very rich in small fry. When it retreats, the flood water leaves behind a great network of shallow pools and channels in which many fishes are trapped. It has been calculated that in the Senegal delta, with a surface area of about 146,000 ha, at least 30,000 tons of fish are eaten annually by cormorants, herons, pelicans and other water-birds, without provoking any complaint from the local fishermen (Reizer 1971).

Although the smaller pools dry up in late December or even earlier, the larger expanses of flood water last longer and afford suitable habitat for water-birds throughout the winter.

The population of Palaearctic ducks and waders wintering in the Senegal delta is most impressive: c. 200,000 Garganey *Anas querquedula*, Pintail *A. acuta* and Shoveler *A. clypeata*; several hundred thousand Ruffs *Philomachus pugnax*; some tens of thousands of Black-tailed Godwits *Limosa limosa*, not to mention the vast mass of *Tringa* species. By contrast, the Ethiopian ducks (*Plectrophorus*, *Sarkidiornis*, *Alopochen*, *Dendrocygna*) amount to only a few tens of thousands (Morel & Roux, in preparation); moreover they belong to entirely different genera from the Palaearctic migrants. As for the waders, they are almost absent as breeding birds. Among the less abundant sorts of water-birds, e.g. *Gallinula*, a similar absence of competition may also be noted: in Senegal the European race *G. c. chloropus* is found, the Ethiopian race *meridionalis* being absent.

In the Ardeidae, however, the resident and migrant populations of four species occur together (*Ardea purpurea*, *Nycticorax nycticorax*, *Ardeola ralloides* and *Egretta garzetta*). Without being able to distinguish the two populations (a few ringing returns are the only proof of occurrence of Palaearctic birds among them) one cannot assess their relative numbers, nor to what extent they mix.

LAND-BIRDS

The autumn migration of land-birds takes place under conditions comparable to those obtaining for the water-birds. Reaching tropical latitudes they find green vegetation brought on by the monsoon. Depending on the year the growth of grasses begins between the end of July and mid-August, or exceptionally not until September. The trees, however, are in new leaf from June. In unusually dry years conditions are less favourable and Palaearctic migrants may suffer mortality, but the extent to which this occurs is unknown.

In regard to the wintering of land-birds in the Sahel Zone, I wish to draw attention to the following points which may help to clarify the problem or emphasise the gaps in our knowledge.

(1) The Sahel Zone does not provide winter quarters for all the migrant populations which reach it in autumn. Many passerines, e.g. *Sylvia borin*, *Phylloscopus trochilus*, *Hippolais polyglotta*, *Ficedula hypoleuca*, *Muscicapa striata*, *Oriolus oriolus*, *Emberiza hortulana*) stay in it for several weeks and then move further south. Only part of the population of *Luscinia megarhynchos* remains. *Cuculus canorus*, *Coracias garrulus* and *Merops apiaster* are birds of passage. Of the hirundines, only *Riparia riparia* winters in Senegal, where it is confined to areas of permanent water. The flycatchers are of special significance, for no African species is found in the north of Senegal and the Palaearctic species do not winter there either. This indicates that the country does not provide the necessary ecological niche, or that food is not abundant enough.

(2) It is true that the savannas of the Sahel Zone support more Palaearctic land-birds than the Sudan Zone to the south, where primary productivity is higher. We have noted this on a number of expeditions to different areas, including eastern Senegal at 15° 30' N, only 200 km south of Richard-Toll (Morel & Roux 1966). The difference is detectable over even shorter distances, for in about 20 km one can pass from one vegetation zone to the other. Thus I estimated the density of passerine migrants in the thorn-bush (Morel 1968) as about 2/ha, and as less than 1/ha 20 km to the south. In all cases, it seems that *Acacia*, *Balanites* and *Zizyphus* are the types of vegetation most preferred by Palaearctic passerines (especially Muscicapidae, *Anthus*, *Lanius senator*).

(3) The primary productivity of the Sahel Zone, with its sparse thorny bushes, is certainly lower than that of areas with a higher rainfall. Nevertheless, the "thorn belt"

is less poor than it appears superficially, and in the dry season there are trees at every stage of leaf, flower and fruit production. The following trees have evergreen or semi-evergreen foliage: *Boscia senegalensis*, *Guiera senegalensis*, *Balanites aegyptiaca*, *Acacia raddiana*, *A. senegal*, *Salvadora persica*, *Zizyphus mauritiaca*. The following trees flower during the period when migrants are wintering: *Guiera senegalensis*, *Combretum aculeatum*, *Balanites aegyptiaca*, *Boscia senegalensis*, *Cadaba farinosa*, *Adenium obesum*, *Maerua angolensis*, *Acacia seyal*. The following produce fruits during this period: *Commiphora africana*, *Grewia bicolor*, *Combretum aculeatum* and *C. glutinosum*, *Balanites aegyptiaca*, *Zizyphus mauritiaca*, *Cadaba farinosa*, *Maerua angolensis*, *Salvadora persica*, *Boscia senegalensis*. Only the fruits of *Grewia*, *Balanites*, *Zizyphus*, *Maerua*, *Salvadora* and *Boscia* are eaten by passerines, but the fruits that are not eaten, the flowers and the foliage must harbour a considerable insect fauna, though there are no quantitative data.

(4) Another indication that insects are available in spring is the fact that several Ethiopian species breed at this time, as Moreau (1950) noted: *Caprimulgus climacurus*, *Vanellus tectus*, *Cursorius temminckii*, *Ptilopachus petrosus*, *Anthreptes platyura*, *Sylvietta brachyura*, *Prinia clamans*, *Eremomela icteropygialis*. The species concerned are sparsely distributed and never common, except perhaps *Caprimulgus climacurus*. Three frugivorous species also breed in the spring: *Poicephalus senegalus*, *Psittacula krameri* and *Colius macrourus*.

(5) In bushy savanna passerines are very sparsely distributed. In February and March, when conditions seem really severe (the last of the marshes dry up, the heat is excessive, some trees lose their leaves), the density does not exceed two birds of wheatear or warbler size per hectare. But in riverine *Acacia* woodland densities of 18–20/ha (mainly of warblers) may be maintained. Being evergreen, and often with an undergrowth, this is an important refuge for migrants except those which are restricted to open country; it occupies vast areas in the Senegal valley.

(6) In areas of bushy savanna which we have studied the only resident passerines ecologically comparable to the Palaearctic sylvine warblers are *Eremomela icteropygialis*, *Prinia clamans* and *Camaroptera brachyura*, the density of each of which is much less than one individual per hectare. The fact that the first two of these breed when the palaearctic migrants are present suggests that they are not competing for the same resources. There is no Ethiopian *Lanius* or *Oenanthe* in bushy savanna. In riverine *Acacia nilotica* forests the situation is similar. By contrast, in the south of Senegal at 14° N a number of Ethiopian muscivores are common (*Camaroptera*, *Prinia erythroptera*, *Terpsiphone*, *Batis senegalensis*, *Hyliota flavigaster*, *Eremomela pusilla*, etc.). In all forest areas Palaearctic migrants tend to prefer clearings which are avoided by the resident forest species.

(7) Moreau (pers. comm.) pointed out that the high temperatures which are usual from March onwards should reduce the energy requirements of migrants at the time when they need to lay down fat reserves for migration.

SUGGESTIONS FOR RESEARCH

Although conditions for Palaearctic migrants wintering in the Sahel Zone are not as inimical as they appear at first sight, a great deal remains to be found out about their ecology. The following are some suggested lines of research.

It would be practicable to establish the relationship between the population level of certain migrant species (for example, the Whitethroat *Sylvia communis*, whose numbers have recently declined) and conditions on their wintering grounds (availability of fruit etc., meteorological conditions at the time of arrival and departure). Certain species could be censused in a number of well-defined habitat types. The food of selected migrants could be studied in detail (it is known that the Ruff and Black-tailed Godwit take very different food in Africa, including rice, from that taken on the breeding grounds).

Competition between Ethiopian and Palaearctic species has received little attention; but it seems likely that when food resources are low species with similar requirements may compete. The possibility needs to be investigated.

From about the end of November, when the grass has withered, there is a total absence of dew in the north of the Sahel Zone. How the Quail *Coturnix coturnix* (a granivore) obtains the water which it needs is an unsolved problem. Some birds which cannot make long flights to the widely scattered water sources must obtain the water they need from fruits or insects. In addition to the problem of water balance, the physiology of birds under different heat conditions should be investigated.

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