

Distribution and Ecology of Palearctic Birds of Prey Wintering in West and Central Africa

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ABSTRACT

The abundance, seasonal distribution, habitat and ecological requirements of 21 Falconiforms, migrants from western to far eastern Europe or North-West Africa and wintering south of the Sahara, from Mauritania to Gabon and Tchad, are summarised. The influence of drought, overgrazing, deforestation, heavy use of pesticides and other changes of their wintering conditions during the last two decades is analysed and compared to their known situation in European breeding grounds. The most affected species are the two harriers (Montagu's and Pallid) and the two gregarious small falcons (Red-footed and Lesser Kestrel) which are mostly dependent upon the concentrations of locusts in the Sahelian savannas. The ecological segregation and lack of significant competition with African resident species are also emphasised.

INTRODUCTION

Palearctic raptors are well-known on their European breeding grounds. Many studies have attempted to monitor their migration through the Mediterranean area, but their crossing of the Sahara and distribution on Afro-tropical wintering grounds are still poorly documented. The importance of adult and immature survival rates outside the breeding season on the dynamic of long-lived species and the decrease of some migrants, not fully explained by the deterioration of their breeding conditions, strongly emphasise the need to study the distribution, ecology and mortality rates of these migrants on their wintering grounds and during their migration, at least south of the Mediterranean.

During the last 20 years, most African countries and habitats of wintering raptors have changed so dramatically (even far more than their European breeding habitats) that we must search in Africa for at least a partial explanation of their population fluctuations. Up to now, it is surprising to see how few studies have been published on Palearctic migrants even in the best known areas (East and South Africa), where so many papers are devoted to Ethiopian species.

I give here a summary of mostly personal data already dispersed through several publications in French (Thiollay, 1973 to 1985) and augmented by occasional observations and unpublished reports in recent years. It is not intended to be a definitive statement but a guideline for future researches.

STUDY AREA AND METHODS

I spent six full years in West Africa (from 1967 to 1973), studying mainly the ecology of savanna birds of prey and the migrations of African species between the coast and the desert. Then, between 1975 and 1984, I returned six times to spend a total of 12 months.

Most records come from nearly every part of Ivory Coast, Mali, Upper Volta (now Burkina Faso) and Niger. Moreover, I have repeatedly censused birds of prey in Senegal, Ghana, Benin, Nigeria, Cameroun and Chad, as well as to a lesser extent in Mauritania, Liberia, Togo and Gabon. Data obtained during more than ten months of intensive studies in Morocco, Algeria, Tunisia, Uganda and Kenya will be briefly referred to but not included in this analysis.

STUDY AREA

Most of West Africa lies below 500 m and mountains exceeding 1,000 m are very isolated (mainly in south-western Cameroun and northern Chad). From north to south, the vegetation is progressively taller and denser as the mean rainfall increases. This gradient is divided into four latitudinal zones, each one usually sub-divided into a northern and a southern zone (Fig. 1). Brief descriptions and latitudinal limits apply to Central West Africa. The corresponding zones are narrower and more northern in the western part and reach much lower latitudes in the east.

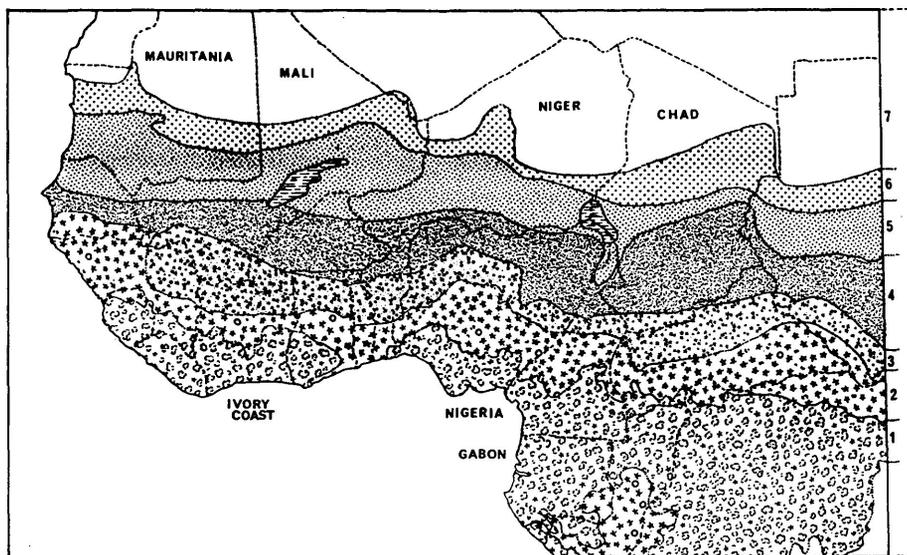


Figure 1. The main vegetation belts of West Africa: 1 = Rain forest; 2 = Southern Guinea; 3 = Northern Guinea; 4 = Sudan; 5 = Southern Sahel; 6 = Northern Sahel; 7 = desert.

1. - **The Sahel Zone** (500-600 km wide) has a long, severe dry season from October to June. The woody vegetation is dominated by *Acacia*, *Balanites*, *Ziziphus*, *Commiphora* and, locally, by the large baobab tree (*Adansonia*) or the Hyphaene palm. Rainfall increases from about 100 mm in the steppes of the desert fringe (17-21°N) to 600 mm in the southern acacia savannas (14-17°N). Cultivation is restricted to some valleys that can be irrigated. Fires are very rare.
2. - **The Sudan Zone** (400-600 km wide) has a longer rainy season (May to October) and is naturally covered by a dry but rather dense savanna woodland, usually 4-10 m high (*Cassia*, *Entada*, *Anogeissus*, *Monotes*, *Burkea*, *Diospyros*, *Combretum*, *Bombax*, *Tamarindus*, *Sterculia* ...). During the dry season, most trees are leafless and bush fires are frequent. The northern

area, around 11-14°N, receives 650-1,050 mm of rain while the southern one (9°30'-11°N) has a higher rainfall (1,000-1,200 mm) and consequently a higher grass cover (up to 90% and 1.5 m of *Andropogon*, *Hyparrhenia*, *Schizachyrium*, *Pennisetum*...). The human population is much higher than in the Sahel, and sedentary. Large areas are densely cultivated, with only scattered large trees (*Butyrospermum*, *Parkia*, *Adansonia*) in the fields or around the villages.

3. - **The Guinea Zone** is narrower (180-300 km wide, between 6°30' and 9°30') and wetter (1,150-1,400 mm of rain) with a shorter dry season of 3-4 months (mainly December to February). The taller and more continuous woodland is dominated by *Lophira*, *Daniella*, *Isobertlinia* etc. in the north and *Piliostigma*, *Cussonia*, *Crossopteryx*, and *Borassus Palm* in the south. The grass cover (*Hyparrhenia*, *Loudetia*, etc.), taller (up to 1.8 m) and denser (100%) than in the Sudan Zone, is nearly completely burnt every year. Numerous evergreen gallery forests line every watercourse.

The human population remains rather low in some areas (northern Ivory Coast and Benin), but is now very dense in most others (central Ivory Coast, Ghana, Nigeria), where the natural habitats have nearly disappeared.

4. - **The Rain Forest Zone**, now much fragmented by cultivation and completely logged outside a few reserves, extends along the coast from Sierra Leone to southern Cameroun and Gabon, except in the Dahomey Gap where the Guinean savanna reaches the coast. It is up to 200-300 km wide, reaching 8°N and receives from 1,400-1,600 mm of rain in the north to 1,800-2,200 mm in the south in one long and one shorter wet season.
5. - **The Inundation Zone** of the Niger, in central Mali, extending over nearly 40,000 km² across the north Sudan and south Sahel zones, is extremely important for wintering raptors. The flood begins in June in the south, reaches Mopti in November and finally Niamey in March, leaving rich grasslands and many pools when retreating. The shallow Chad Basin probably plays a similar role with its widely changing water levels, both between seasons and years.

METHODS

All birds of prey were counted along roads and tracks, always by two persons driving slowly and often stopping, during the daily period of maximum activity for raptors (07.30-12.00 and 15.00-17.30) and only in fine, calm and clear weather, outside towns and big villages (Thiollay 1978b). A total of over 105,000 Falconiforms have thus been recorded on more than 130,000 km of roadside counts throughout West Africa and in every month.

The true proportion of birds detected by such a survey differs widely between one species and another and also between habitat types. However, the results have proved a reliable way to compare the abundance of a given species or the composition of a whole population between different seasons.

Vegetation structure and relative abundance of grasshoppers were measured along each daily itinerary to correlate habitat suitability and prey density with raptor distribution (see Thiollay 1978b).

SPECIES ACCOUNTS

These condensed results are drawn from the synthesis of Thiollay (1977b and 128 references therein), then from subsequent unpublished observations and additional publications (Thiollay 1975, 1977a, 1978a and b, 1982) as well as the main countries' checklists: Mauritania (Gee 1984), Gambia (Gore 1981), Mali (Lamarche 1980), Ivory Coast (Thiollay 1985), Togo (Cheke & Walsh 1980), Nigeria (Elgood 1981), Cameroun (Louette 1981), Chad (Salvan 1967-68).

Griffon Vulture *Gyps fulvus fulvus*

Several records in Mauritania, Lower Senegal valley and Air mountains confirm that some of the Spanish birds which cross the Gibraltar straits regularly reach the southern edge of the Sahara.

Egyptian Vulture *Neophron percnopterus percnopterus*

A few hundred pairs breed in West Africa, mainly in western and central Mali, as well as northern Niger and Chad. This population is more than tripled from October to March by northern migrants which preferably concentrate in the Inundation Zone and along the Niger valley (14° to 17°N). Very few birds stray south of the Sahel.

Pallid Harrier *Circus macrourus*

Winters mainly in the southern Sahel (up to 17°30N), extending south with decreasing frequency to northern Guinea savannas. It is increasingly frequent from west (Senegal) to east (Chad) as reflected by the increasing ratio *C. macrourus/C. pygargus* (0.13 to 0.41). Widespread and usually seen in drier and less wooded areas than the Montagu's (dry fields, short grass savannas, steppes). In Chad, the latter remains commoner than *macrourus* in the wooded south (Thiollay 1975), but the former is far more abundant in the drier Sahel (Salvan 1968) and may even be found alone in arid zones (Newby 1979).

Montagu's Harrier *Circus pygargus*

Seen from 6° to 17°N, with a maximum abundance in the Inundation Zone of the Niger, it is much more common and widespread than the Pallid Harrier throughout West Africa. It prefers humid grasslands, ricefields and edges of drying pools. Night roosts of up to 50-60 birds were not rare in patches of tall grass and reed beds.

Hen Harrier *Circus cyaneus*

Only recorded from Mauritania (Gee 1984).

Marsh Harrier *Circus aeruginosus aeruginosus*

Although strictly associated with marshes, lakes, lagoons, ricefields and flooded grasslands, it is distributed throughout the study area from Mauritania (Banc d'Arguin) to Cameroun and Chad, and from the coast to the Sahel. Common from early September to late April.

Short-toed Eagle *Circaetus gallicus*

Less abundant than, but well segregated from (Fig. 3), its African counterpart, *Circaetus beaudouini*, this is a mainly Sahelian species whose density index is 10 times higher between 14° and 17°N than from 14° to 12°N (never seen south of the Sudan zone). Hunts in any dry area.

European Sparrowhawk *Accipiter nisus*

Lamarche (1980) cited several observations and one dead specimen in Sahelian Mali from August to December. Once collected in Chad (Salvan 1968).

Levant Sparrowhawk *Accipiter brevipes*

Only identified twice in Niger, its extreme western limit (Thiollay 1977b).

Long-legged Buzzard *Buteo rufinus*

Uncommon but widespread in the Sahel zone from northern Senegal and southern Mauritania to northern Nigeria and central Chad. Most birds are probably from the eastern subspecies *B.r. rufinus*, but the North African race *B.r. cirtensis* has been collected in Senegal and may breed in northern Mauritania and northern Chad. A bird of dry open areas.

Common or Steppe Buzzard *Buteo buteo*

Very low and scattered wintering population in open woodlands of coastal countries from southern Senegal to Ghana and Nigeria. Recorded passing though Mauritania (dying birds grounded by sandwinds during autumn migration; Gee 1984). Both races (see Morel & Browne 1981), *B.b. vulpinus* and *B.b. intermedius*, have been identified.

Booted Eagle *Hieraaetus pennatus*

Widely distributed through the Sahelo-Sudanian belt from Mauritania and Senegal to northern Nigeria and Chad and south to northern Ivory Coast and Ghana. Always found in wooded savanna, in fields with large trees, near pools and in narrow galleries along rivers.

Steppe Eagle *Aquila nipalensis*

Several records of immatures in northern Cameroun (Thiollay 1978a) are the westernmost for this species in Africa. Identification confirmed by U. Sorenson from a photograph.

Lesser Spotted Eagle *Aquila pomarina* and Greater Spotted Eagle *Aquila clanga*

Quite numerous in the low inundation plains of northern Cameroun and southern Chad (the former more than the latter), but only rare vagrants westward (to Niger and Mali).

Black Kite *Milvus migrans migrans*

The Palearctic population is widespread from December to February in all the coastal countries from Senegal to southern Nigeria, but they have also been identified far inland, notably in Mali, where they seem more numerous from September to November and in March-April. However, their status is not fully documented, few birds being positively identified among the much more abundant *M.m. parasitus*.

Honey Buzzard *Pernis apivorus*

This species winters mainly in the equatorial rainforest. It is common in southern Cameroun and Gabon, but decidedly less so in the Upper Guinea forest zone (Southern Ghana, Ivory Coast and Liberia), although still widespread. Some also winter in the gallery forests and surrounding savanna woodlands of the Guinea zone but at this latitude are more frequent during autumn and spring migration. Very few, usually single birds, are seen in the Sahel and even Sudan zones at the migration periods. Thus most birds probably cross both the desert and the wide stretches of savanna south of it very quickly without stopping more than for the night and no doubt pass from their breeding grounds to the African rainforest belt without eating. Roosting migrants in Europe and north Africa as well have never been seen hunting or casting pellets (numerous pers. obs. in France, Spain and Tunisia).

I saw a few individuals in the canopy of small patches or narrow galleries of natural rainforest, but never inside dense large tracts of primary forest. Rather they are seen along verges, open secondary forest, second growth, forest roads, plantations and around clearings. They feed on bees' nests as in Europe (Thiollay 1975b).

Osprey *Pandion haliaetus haliaetus*

Commonly found throughout West Africa from coastal lagoons to large rivers and inland lakes or pools. Equally abundant at every latitude on large bodies of water.

Saker Falcon *Falco cherrug cherrug*

Rare, occasionally seen in the Sahelian belt of the five countries from Senegal to Chad, from August to April. Mainly around inundation zones, rivers and large pools.

Peregrine Falcon *Falco peregrinus calidus*

Some large pale Palearctic migrants can be seen from October to March all along the coast (lagoons, mangroves, estuaries) from Mauritania to Gabon, but also inland near large lakes and inundation zones. Every open, large wetland with a good population of wintering waders, ducks, terns etc. is likely to have at least one wintering Peregrine. The European race *F.p. peregrinus* is only suspected (cited by Gore 1981).

Hobby *Falco subbuteo*

Despite a rather large European population, the Hobby is comparatively rare in West Africa. Individuals have occasionally been recorded from a few localities in most coastal countries from Senegal to Cameroun. In the Sahel and Sudan zones of these states and in Mali it is only known as a passage migrant. From 9°-10°N southward, it overwinters locally (at least from Ivory Coast to Togo and Cameroun). The main wintering grounds of the species probably extend into the lower Guinea rainforest zone and across the equatorial belt from Zaire to South-West Africa (Curry-Lindahl 1981).

Red-footed Falcon *Falco vespertinus*

This gregarious species is believed to pass in autumn and early winter through East Africa down

to South West Africa (Curry-Lindahl 1981), and then to proceed toward the north through Central and West Africa (Cameroun and Nigeria, February to April). However, occasional sightings are also made from September to January in Mauritania, Mali (Lamarche 1980), Nigeria (Elgood 1981) and Chad (Salvan 1968). The large flocks of hundreds or even thousands of birds formerly recorded in Nigeria have no longer been seen recently. On the western limit of the "loop-migration" (Ivory Coast-Mali), only rare groups of 2 to 10 birds have been recorded in the last 20 years.

Lesser Kestrel *Falco naumanni*

This other social falcon is very widespread from the Guinea savanna to the Sahel, but mostly local, in loose groups (5-100 birds) on open habitats with short grass cover and a high density of grasshoppers, its preferred food. Smaller concentrations (1-4 birds) may also be encountered almost everywhere but only during short periods as they move much more freely between suboptimal patches. In our area, this species' distribution extends between 8° and 17°N from Senegal to Chad, with peak numbers in the Sahel (Fig. 2). Huge migrations of thousands of birds (possibly mixed with *F. tinnunculus*) have been recorded in both spring and autumn in Senegal (Morel and Roux 1966), Mali (Lamarche 1980), Niger (Heu 1961) and Chad (Salvan 1968).

Kestrel *Falco tinnunculus tinnunculus*

The Palearctic subspecies is much more abundant and widespread throughout West Africa than the African form *F. t. rufescens*. Locally it reaches the coastal savannas and desert edge. Although mostly solitary, it tends to concentrate in the most suitable areas (burnt wooded savannas, some fields, drying grasslands of the humid areas The wintering population is more scattered and apparently more stable than that of the Lesser Kestrel, with which it often coexists.

GENERAL ECOLOGY OF THE MIGRANTS

1. FOOD RESOURCES AND ACCESSIBILITY

Along the latitudinal gradient, there are two opposing general trends (see Thiollay 1976 and 1978b for further details and references);

- In the *southern savannas*, the comparatively short dry season (December to February) is a period of relatively high food availability : bush fires destroy the dense dry grass cover which is quickly replaced by a short green regrowth where the remaining prey (arthropods, reptiles, mammals ...) are conspicuous. Newly burnt savannas are much appreciated hunting habitats of nearly all the European raptors. Fires themselves flush a large number of insects which attract many raptors including kites, buzzards and small falcons. At the same time, the oil palm fruits ripen in the gallery forests and are an important food for the Black Kite. Then the first rains in March-April trigger the swarming of ants and termite alates, a super-abundant and energy-rich food supply, much sought after by most raptor species. That is why so many migrants, mostly African, concentrate on the southern savannas during the dry season, which is also the breeding season of local raptors. From May to September, at the height of the rainy season, the over-frequent rains and tall grass prevent these species from exploiting the abundant but largely inaccessible biomass.
- In the *northern savannas* on the contrary (Sahel), the dry season is much longer and more severe. When the Palearctic birds arrive south of the Sahara from August to October, they meet optimal conditions at the end of the rainy season (maximum food supply, moderate grass cover, green woodlands). However the situation will continuously deteriorate with the advancing dry season throughout their stay. When they leave, between March and May, the Sahel is experiencing its hottest and driest season with its lowest level of food abundance.

Besides the already cited palm fruits and termite swarms, the bulk of the food of the most numerous migrants in terrestrial habitats (small *Falco* and *Circus*) are the grasshoppers, particularly the large migratory locusts (*Schistocerca* and *Locusta*), but also many other non-migratory insects, some reaching high densities during the rains in both natural grasslands and cultivated fields in the Sudano-Sahelian zone. After a sharp decline, these become scarce

from January to June but at the same time the fires and subsequent regrowth make them more abundant or more available in the southern savannas (Table 1).

Lizards and small rodents are usually more marginal prey except for rodent specialists during local rat pullulations in the Sahel. Snakes and Monitor Lizards (*Varanus*) are important for the Short-toed Eagle, fish for the Osprey and bee or wasp nests for the Honey Buzzard. Birds are the dominant food items for the large falcons and the Booted Eagle, as well as secondary prey for several other species, notably harriers. The breeding colonies of granivorous birds, mostly *Quelea quelea*, are exploited by many predators including European *Milvus*, *Circus*, *Buteo* and *Falco* on their arrival in September.

Table 1. Mean seasonal fluctuations of the availability index of grasshoppers in open grasslands of West Africa = mean number flushed/100 m (see Thiollay 1978b) combining both abundance, size and conspicuousness. The broken arrow symbolizes the seasonal southward shift of the migrants.

ZONES	Sep. -Oct.	Nov. -Dec.	Jan. -Feb.	Mar. -Apr.
S. GUINEA	13	13	30	25
N. GUINEA	12	14	12	13
S. SUDAN	13	23	9	11
N. SUDAN	68	71	5	7
S. SAHEL	34	21	1	2
N. SAHEL	83	9	0.1	0.1

2. HABITATS AND RECENT CHANGES

The key habitats for migrants are not only those where most of them concentrate during winter, but also those used for pre-migratory fattening in spring. They have all changed dramatically, mainly during the last 20 years under tremendous human pressure. However the results differ between the vegetation zones as far as the survival rate of the migrants is concerned.

- Forest Zone

The primary forest itself was probably not used by Palearctic migrants. It is now turned into very fragmented secondary forest, large clearings and plantations which seem to be a preferred habitat for the birds traditionally wintering in the rainforest zone (Honey Buzzard). This large-scale destruction also allows some birds which usually winter in the Guinean savanna to enter the forest zone (records of Common Buzzards, Hobby, Kestrel). Nevertheless the heavy use of pesticides and hunting pressure in this densely populated area may well counterbalance the benefit of habitat extension.

- Guinea Zone

Although European migrants tend to use the burnt and least densely wooded savannas, they do not seem to have benefited from extensive clearing and cultivation of the natural woodlands even if some of them (kestrels, harriers) readily hunt in cultivated areas. This doubt stems from the higher density and diversity of European migrants occurring in the natural *Borassus* palm savanna of Lamto (central Ivory Coast) than in the surrounding, now very degraded, grasslands.

- *Sudan Zone*

Here again, human population growth and the subsequent increase of cultivated areas have deeply modified large expanses of the former dry woodlands. Overgrazing by increasing numbers of cattle and extensive firewood-cutting for burgeoning towns are additional destructive factors. Most Palearctic raptors of this zone (harriers, kestrels, Booted Eagle) often hunt in cultivated, overcut or grazed lands, when large isolated trees remain. Yet these degraded habitats are likely to be suboptimal because sample counts of grasshoppers, lizards and rodents give lower prey densities than in the natural woodlands. Hunting pressure and pesticides use are additional factors of mortality. Large trees, dense woods and gallery forests along rivers are shelters much used by both prey and raptors : these are often cut, disturbed by livestock or impoverished by pesticide spraying against Tsetse Fly.

- *Sahelian Zone*

This is both a key area for wintering migrants and the most drastically affected region. It must be emphasized that the well-publicised desertisation is a result, not of a natural worsening of climate but of human impact upon a vulnerable ecosystem, only worsened by a temporary drought (Le Houerou & Gillet 1986). The human population is now far above the carrying capacity of most areas and prevents any recovery of the vegetation and of the seed stock, which has proved possible, even with low rainfall, under total protection. The very dry years were mainly 1973 and 1983-4, but intervening better rainy seasons have not much improved the situation. Such cyclic droughts have already occurred (1911-16, 1940-46) without any lasting ecological disaster. The main reason is the excessive human demographic growth and consequent increase in livestock numbers (four-fold between World War II and 1968). The result is a dramatic overgrazing, spread all over the area by the widespread digging of wells. Slow-growing trees are cut on a large scale both for cattle and firewood and entire acacia woodlands have been wiped out by the lowering of the water table, much aggravated by digging of wells and water run-off on bare soil. Extension of bad cultivation practices on unsuitable lands favours wind erosion, removal of upper soft layers and huge dust- or sandstorms, now a common feature of the dry season. The desert encroachment of the arid zone is about 1% annually and the woody cover has receded by over 1% annually since 1950 (Le Houerou & Gillet 1986).

The three main consequences are : 1) the considerable impoverishment of the grassland fauna, 2) the disappearance of most acacia forests which were another important hunting ground as well as shelter, and 3) the degradation of wetlands (drying, trampling and overgrazing) which supported high prey densities and thus a high concentration of Palearctic raptors. Not only their dry season survival rate may have been reduced but the necessary pre-migratory fattening during the critical February-April period may be more and more difficult, thus potentially increasing the mortality rate during migration.

3. LATITUDINAL DISTRIBUTION

In both spring and early autumn, I have seen most European species in the southern Sahara from Mauritania to northern Niger (Thiollay 1973 and unpubl. obs), so it is likely that the Sahara can be crossed everywhere by migrants.

The absolute and relative abundance of Palearctic migrants is maximum in the Sahel, with a marked peak in the Inundation Zone of the Niger, and quickly decreases toward the south (Table 2 and Fig. 2). Few species reach the coast, mainly *Pandion*, *Milvus*, *Pernis*, *C. aeruginosus* and more occasionally *B. buteo* and *F. tinnunculus*. Among the 17 main species, 11 are most abundant in the Sahel, 3 in the Guinea or forest zones (Hobby, Steppe and Honey Buzzards) and 3 are spread everywhere with no clear gradient of abundance (Osprey, Black Kite and Peregrine Falcon). Yet few of the Sahelian species enter the subdesert zone to the north and then only along the riparian woodlands (Kestrel and Short-toed Eagle).

Although not definitely confirmed, it seems that several species tend to stay on arrival in northern savannas, then to move slowly southward from November to January, where they only begin to reach their peak numbers (harriers, falcons and maybe kites, in Ivory Coast for instance). Such a seasonal shift has already been cited or suspected for other migrants (Curry-Lindahl 1981) and is similar to that of African migrants although on a smaller scale. However it is a partial alternative to

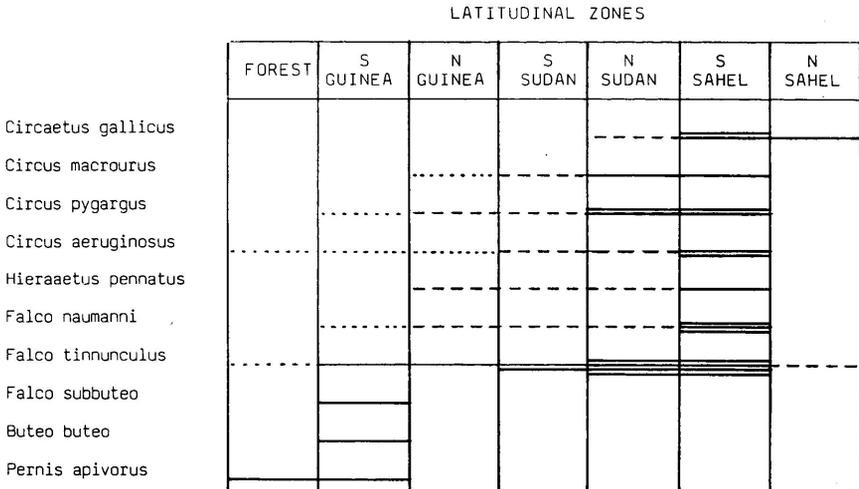
avoiding the poor wintering conditions of the Sahel, since only a fraction of the individuals are involved and many remain in the Sahel throughout the dry season. A westward shift between autumn and spring has already been mentioned for the Red-footed Falcon and might be investigated for other species.

Table 2. Latitudinal distribution and relative density of Palearctic raptors along 9,825 km of intensive roadside counts in selected contrasting habitats from December to March 1969-1970 (i.e. before the drought).

AREA	HABITAT	Mean number of individuals per 100 km	Percentage of the total raptor population
South Guinea zone (Ivory Coast) 6°-7°N	Pristine savanna (Lamto reserve)	3	2
	much disturbed savanna	1	3
North Guinea zone (Ivory Coast) 8°-10°N	natural savanna woodland (Comoé National Park)	3	8
	grazed or partly cultivated savanna	6	14
Sudan zone (Burkina Faso) 11°-13°N	Arly and 'W' National Parks	13	23
	degraded savanna	7	26
Sahel zone (Mali and northern Senegal) 14°30'-17°N	arid grasslands	20	33
	Acacia woodlands near marshes or river	57	57
Sahel wetlands (Mali and northern Senegal) 13°30' -16°30'N	Inundation zone of the Niger	314	59
	ricefields	620	73

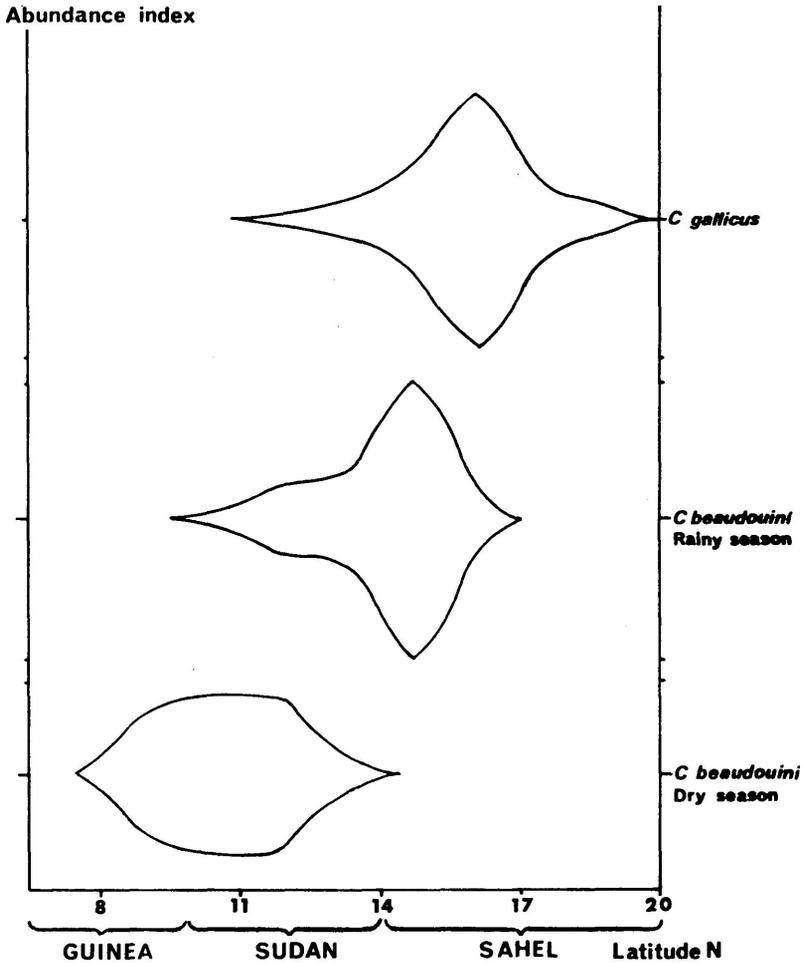
Figure 2. Latitudinal distribution of the main Palearctic migrants in Ivory Coast, Burkina Faso, Mali and Niger. Highest monthly index of abundance from November to February (mean number of individuals/100 km of roadside counts). dotted line = < 0.1; dashed line = 0.2-0.4; single line = 0.5-0.8; 2 lines = 1-2; 3 lines = 3-4; 4 lines = 5-7.

Sample size = 1,138 birds on 37,023 km of standardized roadside counts.



A significant proportion of most populations remain in Africa during the wet season. These non-breeding birds are found in every species, including kestrels, but are proportionally more numerous in large species such as the Short-toed Eagle, which breeds at an older age. There is also a northward shift of the distribution of some of these "summering" birds (Thiollay 1978b). For instance, from the total counts along the north-south gradient in June-July, there is a higher proportion of *Pernis apivorus* in the Guinea zone and of *Circaetus gallicus* in the northern Sahel during the dry season. At that time I have also seen several times birds in obviously adult plumage (i.e. male Marsh Harriers in Mali) but suspected breeding cases have never been confirmed.

Figure 3. Latitudinal segregation between European and Beaudouin's Snake Eagles, *Circaetus (gallicus) gallicus* and *Circaetus (g.) beaudouini*.



4. ECOLOGICAL RELATIONSHIPS WITH AFRICAN SPECIES

Among the Palearctic migrants, we have;

- Abundant species with no West African counterpart : harriers (*Circus*), Honey Buzzard (*Pernis*) and Osprey (*Pandion*).
- Uncommon but widespread species with an ecologically similar African equivalent : Booted Eagle vs Wahlberg's Eagle (*Aquila wahlbergi*), Steppe Buzzard vs Red-tailed Buzzard (*Buteo auguralis*), Saker vs Lanner Falcon (*Falco biarmicus*), Hobby vs African Hobby (*Falco cuvieri*), Lesser Kestrel and Red-footed Falcon vs Swallow-tailed Kite (*Chelictinia riocourii*). - Rare species at the limit of their range meeting much commoner African fellow congeners : Griffon Vulture (*Gyps*), sparrowhawks (*Accipiter*) and large eagles (*Aquila*).
- Five common species with an African conspecific breeding population : *Neophron percnopterus*, *Circaetus gallicus*, *Milvus migrans*, *Falco peregrinus* and *F. tinnunculus*.

It is possible for some species to compare the overall population sizes of the Palearctic wintering migrants and their resident West African counterparts (Table 3 and Thiollay 1976 and 1978b). Migrants may be either far outnumbered by African residents (Black Kite, Steppe vs Red-tailed Buzzard, Saker vs Lanner Falcon) or more abundant (Kestrel, Lesser Kestrel, Egyptian Vulture) or roughly of the same order of abundance (Short-toed Eagle, Peregrine Falcon).

Table 3. Estimated number of migrants actually seen crossing the Mediterranean straits of Gibraltar in autumn (late July to mid-November 1972-1974) and Messina (Cap Bon, Tunisia) in spring (March to early June 1974-1975). See Thiollay 1977c.

Most figures are minimum numbers and several (*Circus*, *Pandion*, *Falco*) are far below actual populations, which are little concentrated through the straits.

<i>Gyps fulvus</i>	= 600
<i>Neophron percnopterus</i>	= 6,620
<i>Circus cyaneus</i>	= 165
<i>Circus macrourus</i>	= 50
<i>Circus pygargus</i>	= 2,520
<i>Circus aeruginosus</i>	= 1,200
<i>Circaetus gallicus</i>	= 12,400
<i>Accipiter nisus</i>	= 1,270
<i>Accipiter brevipes</i>	= 4
<i>Accipiter gentilis</i>	= 30
<i>Buteo rufinus</i>	= 200
<i>Buteo buteo</i>	= 7,800
<i>Hieraetus pennatus</i>	= 19,450
<i>Aquila pomarina/nipalensis</i>	= 150
<i>Milvus milvus</i>	= 220
<i>Milvus migrans</i>	= 74,000
<i>Pernis apivorus</i>	= 142,000
<i>Pandion haliaetus</i>	= 110
<i>Falco cherrug</i>	= 25
<i>Falco peregrinus</i>	= 55
<i>Falco subbuteo</i>	= 420
<i>Falco columbarius</i>	= 70
<i>Falco vespertinus</i>	= 200
<i>Falco naumanni/tinnunculus</i>	= 5,500

The most important factor is that for every species there is a strong ecological segregation between the Palearctic population and its Ethiopian representative. Even when there is locally some overlap on super-abundant food supplies, the two populations are as a whole well separated at least by habitat and/or the dry season distribution. Examples of habitat segregation include:

- The European Black Kite mostly associated with lakes, ricefields, lagoons ... when the African *parasitus* is mainly a bird of savannas, towns etc.
- The Palearctic *Aquila* in Cameroun-Chad are closely associated with the proximity of pools, rivers and inundatable grasslands, whereas African *Aquila* are birds of dry savannas and woodlands.
- The African populations of Egyptian Vulture, Peregrine Falcon and Kestrel remain mostly in the neighbourhood of their breeding cliffs during the dry season, when their Palearctic conspecifics mainly occupy lakesides, wetlands and open grasslands where abundant prey are concentrating.

As a general rule, Palearctic migrants tend to use temporary habitats which cannot be fully exploited the year round by local species : seasonally flooded grasslands, drying pools, recently burnt savannas, nearly bare fields and flat lateritic plateaux (bowals), secondary growth and plantations in the forest zone, etc. (see Table 2). Thus they mostly avoid coexistence with local residents and interspecific competition is much reduced. The migrants may also actively avoid competition : for instance, Ospreys are obviously rare on stretches of rivers with a high density of African Fish Eagle *Haliaeetus vocifer*, a strong territorial competitor and parasite.

Many African raptors undertake important north-south migrations, concentrating in the Guinea zone during the dry season and going back to the Sahel during the wet season. Each species has its own pattern (timing, distribution) of migration (Thiollay 1978b). As a general rule, when Palearctic birds arrive in West Africa they meet the African migrants and coexist with them for a short time on super-abundant food (grasshoppers, young birds, caterpillars). Then the latter shift southwards, the former remaining in the northern areas which they leave before the return of the African migrants following the first rains (see Fig. 3).

CONCLUSION

Two main processes of habitat destruction, a result of human population growth rate, threaten both the resident and wintering raptor populations.

- 1) In the southern savannas - by far the most populated - the natural vegetation is destroyed to increase the cultivated areas and intensify agricultural practices. Hunting pressure is heavy, including raptors being killed as pests or for food. The use of pesticides is increasing on farmlands as well as on marshes (mosquitos), rivers (Black Flies) and gallery forests (Tsetse Flies). Repeated bush fires, often off season, also impoverish the remaining patches of natural savanna.
- 2) In the Sahel, the woody vegetation is fast disappearing through overgrazing, firewood-cutting and lowering of the water table, and continuing human pressure prevents its regeneration as well as maintenance of the former grass cover. The general decrease of prey availability in such severely degraded habitats is worsened by the impressive and widespread use of the most dangerous pesticides against locusts and even granivorous birds. In Mali alone, in 1986, no less than 11 planes and 2 helicopters were permanently at work during 3 months and huge numbers of raptors, storks, bustards and many other species were killed (unpubl. reports). From previous experience, such heavily sprayed areas remain almost devoid of large birds for at least several months.

Except perhaps in the forest zone, the wintering conditions of most raptors are likely to be worsened dramatically throughout their range either by extensive clearing for cultivation or by man-made desertisation. Another limiting factor may be the inability to accumulate enough fat reserves before the spring departure leading to a higher mortality rate during migration.

The species most obviously affected, i.e. for which a marked decrease has been reported both on their European breeding grounds and on their spring migration in Tunisia (Thiollay 1977c) and in West Africa, are the Pallid and Montagu's Harriers, Red-footed Falcon and Lesser Kestrel, all predators of locusts in the dry savanna belt. The Kestrel, more widespread and generalist, may be less affected.

Three other species are decreasing in Europe (Egyptian Vulture, Black Kite and Hobby) but their situation in Africa offers no clear explanation for this trend. Three species have not declined and may even be slightly increasing both in Europe and West Africa (Honey Buzzard, Marsh

Harrier and Osprey). The status of the other species is not sufficiently documented or has not changed on a sufficiently large scale to assess their population trends.

So long as it is not possible to reduce the main threat (human population growth and its consequences), alternative partial solutions would be :

- a) to set aside large protected areas in order to allow natural regeneration of the woody vegetation and associated fauna,
- b) to limit indiscriminate spraying operations against locusts with pesticides now prohibited in developed countries, particularly in non-cultivated areas,
- c) to control the widespread shooting of large birds, even in countries where any hunting is supposed to be closed.

Much remains to be studied on how the foraging success, energy balance and survival rate of wintering raptors in Africa are affected by habitat changes, how much they are contaminated by pesticides and how a system of reserves may efficiently protect a significant portion of their populations. The Inundation Zone of the Niger, the Lake Chad Basin and other Sahelian wetlands (lower Senegal River, northern Burkina Faso, Nigeria and Cameroun) are focal areas and may be essential for the conservation of some species.

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