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Diurnal raptors populations in the coastal forest zone of Côte d'Ivoire

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Abstract

Diurnal raptors populations were studied in four protected areas (Monogaga and Dassioko Classified Forests, Azagny and Banco National Parks) of the coastal forest area of Côte d'Ivoire, between December 2004 and January 2006, in order to collect reliable data which give a clear picture of raptors populations in the studied area. The methods of survey along transect by foots in different habitats and seasons constituted the essential of the methodology adopted in this study. Results showed that despite of the numerous threats, the sampling sites possess again an important raptors population (60.29 % of raptors species normally found in the area). In total, 16 diurnal raptors species on these 12 Residents, two Intra-African migrant and two Palearctic migrant, with seasonals totals numbers varying from 4 to 52 according to the sites, were censused. One or two species are more abundant and dominate widely the populations of each site.

Keywords: Diurnal, Raptors populations, coastal forest, Côte d'Ivoire.

Introduction

Diurnal raptors populations in Côte d'Ivoire that were particularly studied in the 1970s (mainly those in the Lamto region) (Thiollay, 1970, 1971, 1973, 1975a, 1975b, 1975c, 1976a, 1976b and 1978) have not been the subject of any in-depth scientific study since that period (Ahon, 2010). Although some raptor-related data

are available (obtained through ad hoc observations by a few researchers or during Rapid Assessment Programs), these only mention the specific richness of the rare sites inventoried (Ahon, 2010). Thus, there is a lack of updated data on raptors populations. However, it is known that in West Africa, raptors populations and particularly vultures have experienced a dramatic decline over the last three decades (Rondeau & Thiollay, 2004; Thiollay, 2006 and 2007). With regard to raptors in general, it has been reported that almost all raptors species recorded in unprotected areas of Côte d'Ivoire have also been encountered in protected areas, particularly in national parks (Thiollay, 1975c). Unfortunately, nowadays, these protected areas that used to represent refuge sites (where the naturalist could still study the settlement of primitive habitats) for wildlife in general and raptors in particular, also suffer from intense poaching (Kone, 2004) and illegal deforestation. As a result of these activities, the large fauna has been greatly reduced and continues to decline over the years (Thiollay, 1975c). However, the number of large mammals has an influence on the density and diversity of raptors. It therefore appears necessary to consider a study to evaluate the population of diurnal raptors in order to have a clear idea of their population in Côte d'Ivoire. This study, carried out between December 2004 and January 2006, was carried out in four sites (representative of the coastal forest area), namely the classified forests of Monogaga and Dassioko, and the national parks of Azagny and Banco. The general objective of this study was to identify the population of diurnal raptors in the study sites. The specific objectives were to determine the diversity and abundance of diurnal raptor species in the study area and to estimate the seasonal variation in the density of each of these species at each study site.

Materials and methods

Description of study sites

The four study sites are located in the area of evergreen dense humid forest in southern Côte d'Ivoire (Figure 1), in the Grand Domaine Guinéen (Guillaumet & Adjanohoun 1971). The Monogaga Classified Forest (MCF, 4°48'N, 6°26'W) has a surface area of 39,828 ha, and an average annual rainfall of 1178 mm. The vegetation belongs to the fundamental type of *Eremospatha macrocarpa* and *Dyospiros mannii* (Aké-Assi 1997). The relief is quite undulating with altitudes of 24-131 m. Two permanent rivers form the natural limits of the forest: the Nonoua in the north and the Brimay in the west. The fauna is typical of the forests of the Guinean block (Sodefor, 2001). The Dassioko Classified Forest (DFC, 5°3'N, 5°52'W) has a surface area of 12,540 ha and an average annual rainfall of l400 mm. Its vegetation is *Eremospatha macrocarpa* and *Diospyros mannii* (Ake-Assi, 1997). The relief is rugged with altitudes of 10-80 m. The hydrographic network is dominated by two coastal rivers: the Dagbe and the Kloukoleu. Its fauna of large mammals is typical of the forests of the Guinean block. It is still relatively intact and all species are probably still present (Sodefor, 2002). Azagny NP (ANP, 5º10'N, 4º50'W), located in the Sub-Prefecture of Grand-Lahou, has an area of 19,400 ha (Coulibaly, 1992, Oipr, 2006a). A Wetland of International Importance (Ramsar site) and Important Bird Area, the Azagny NP is one of the Bird Endemism Areas of the Upper Guinean Forest. The average annual rainfall is between 1500 and 2000 mm. Its vegetation consists of forest formations (coastal and dry land), swamp forests, coastal thickets, swamps, lagoon savannahs and mangrove swamps. The Azagny NP has a low relief, formed by plateaus with an altitude of between 40 and 100 m. The hydrographic network is represented by the Bandama River, the Ebrie Lagoon and the Azagny Canal. The Banco National Park (BNP, 5°23'N, 4°3'W) is an exceptional case of protected forest located in the heart of the district of Abidjan with an area of 3,474 ha (OIPR, 2006b). The average annual rainfall is 2 000 mm. The forest is one of the last remnants of psammohygrophic forest. Dominant or common species include *Turraeanthus africanus*, *Lophira alata*, *Parkia bicolor*, *Piptadeniastrum africanum* and *Heisteria parviflora*. Its relief is represented by very marked slopes. The Banco River constitutes the main part of its hydrographic network. Its original fauna of great diversity has almost disappeared under the effect of poaching. The climate of the region is sub-equatorial (Eldin, 1971) with four seasons: two dry seasons (large dry season LDS from December to March and small dry season SDS from August to September) and two rainy seasons (large rainy season LRS from April to July and small rainy saeson SRS from October to November). The harmattan only appears for a few days, in early and/or late January.

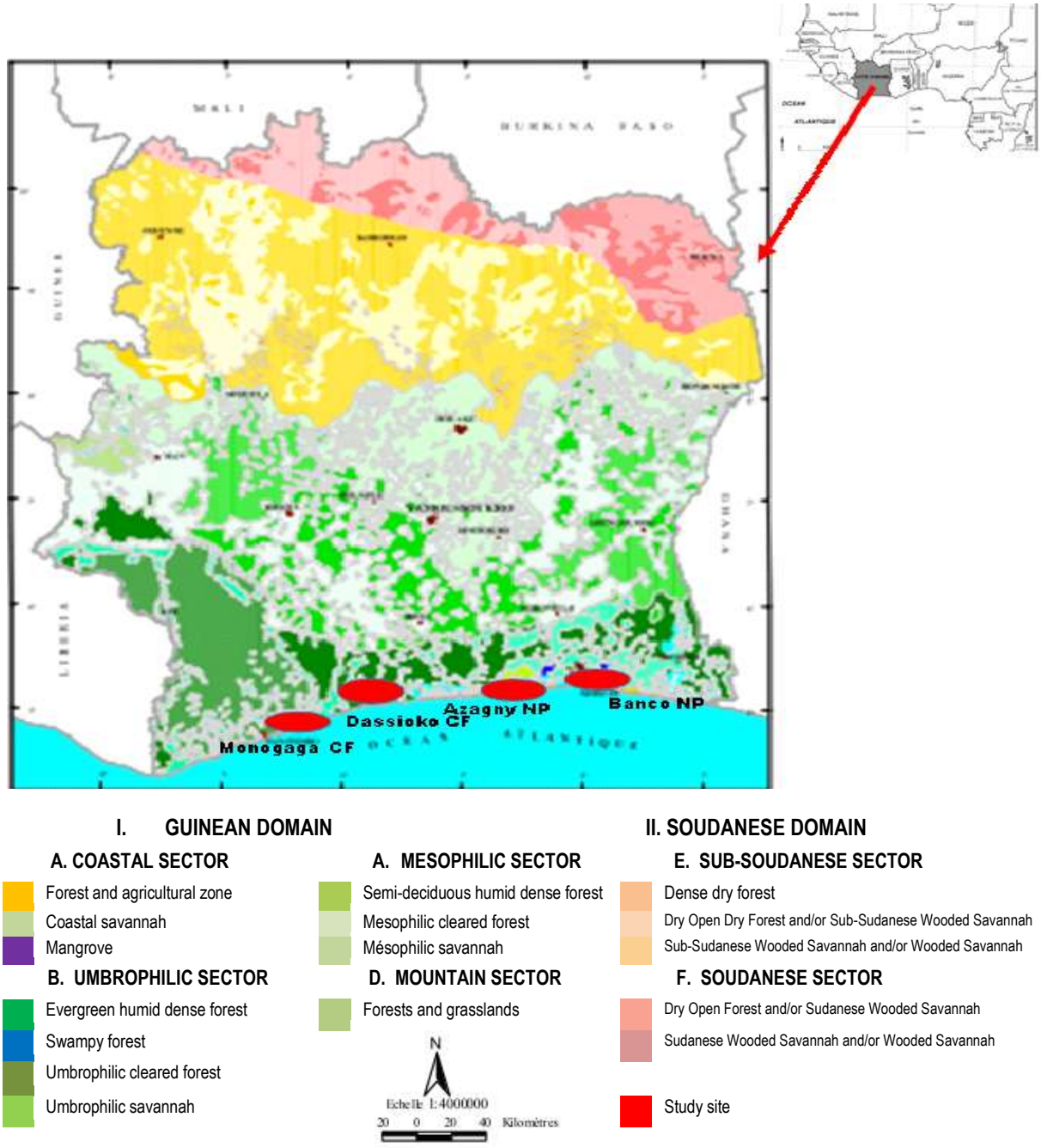

Figure 1: Map of major plant formations in Côte d'Ivoire showing study sites (Brou, 2005 modified)

Methods of Data collection and analysis

The censuses were based on the systematic and exclusive counting of all identified diurnal raptors, spotted by sight or hearing along 16 linear transects (i.e. 4 / site) of 4 km each, four times during the annual seasons. These transects have been previously described and geo-located using a Global Positionning System (GPS Garmin 60 CSx). The main methodology adopted was a slow walk along each 4 km linear transect (sample route). These routes were walked twice (outward and return) in good weather (avoid overcast sky, threat of rain, high wind, etc.). Frequent stops were observed, during which the sky was regularly scanned with a pair of binoculars (Bushnell, 10 x 40) in order to identify, through visual or auditory observations, any species of raptors flying over the site as they passed by. The tops, branches and foliage of large trees were frequently scanned with a telescope (Opticron ES 80 Gasd HDF Zoom). A camera (Panasonic Lumix DMC-FZ38 12mp 18x) was used to take pictures of a few specimens of raptors observed on sight. These observations were

made during the hours when the majority of raptors are active, i.e., in the morning from 09:00 to 12:00 and in the afternoon from 14:00 to 17:00, i.e., 6 hours of effective daily observation on each transect per season and per study site. A total of 384 h of effective observations over 64 days (16 days per site) were allocated to monitoring these raptors. The birds spotted were noted on a form previously drawn up for this purpose. Thus, for each given species, only the greatest number of individuals observed during the outward and return transect was retained. All data were recorded in Microsoft excel sheet. These data collected in the field made it possible to calculate the various parameters related to the notion of specific richness, cumulative number, frequency, relative abundance, kilometer index of abundance (KIA) and Shannon diversity Index (H') of raptors for each site using R software version 2.8.0. Mean relative densities (mean KIA per 4 km) of raptor species by study site and season were also calculated. The systematics, nomenclature and biogeographical status of the species inventoried are taken from Borrow & Demey (2001 and 2004).

Results and discussion

Diversity and relative abundance of diurnal raptors in study area

Sixteen (16) species of diurnal raptors (DR), including 12 resident, two intra-African and two Palaearctic migratory species, were recorded in all four sites (Table 1). Figure 2 presents photographs of a few species of diurnal raptors observed in the Study Area. The distribution of these species in the different sites is as follows: 13 in the ANP, 8 in the BNP, 6 in each of the two classified forests (DCF and MCF). In the MCF, Palm-nut Vulture *Gypohierax angolensis* and Black Kite *Milvus migrans* are the most abundant with relative frequencies of 37.5% and 35.94% respectively. The African Cuckoo Hawk *Aviceda cuculoides* and the Grey Kestrel *Falco ardosiaceus* with a relative frequency of 1.56% each, are the least represented at this site. In the CDF, as in the CSF, Black Kite *Milvus migrans* and Palm-nut Vulture *Gypohierax angolensis* are the most abundant with relative frequencies of 43.53% and 22.35% respectively. African Fish Eagle *Haliaeetus vocifer* with a relative frequency of 1.18% is the least abundant species. In the ANP, the Black Kite *Milvus migrans* is the most abundant species with a relative frequency of 40.53%. The Black-shouldered Kite *Elanus caeruleus* with a relative frequency of 0.71% represents the least abundant species. In terms of BNP, the Black Kite *Milvus migrans* with a relative frequency of 47.06% also represents the most abundant species while the least abundant is represented by the African Goshawk *Accipiter tachiro* with a relative frequency of 1.96%. One or two species are more abundant and largely dominate the stand at each site (Table 1). The Black Kite *Milvus migrans* still represents one of these dominant species and the other is the Palm-nut Vulture *Gypohierax angolensis* at the site where it occurs.

Of the four study sites, the highest diversity index for diurnal raptors is 2.85 in Azagny NP. Nevertheless, these raptors are more evenly distributed in Dassioko classified forest with an equitability index of 0.75.

Table 1: Biogeographic status and relative abundance of species recorded at the study sites

Bs	Scientific name	Commun name	MCF		DCF		ANP		BNP	
			CE	Fr (%)	CE	Fr (%)	CE	Fr (%)	CU	Fr (%)
	Pandionidae									
P	*Pandion haliaetus*	Osprey			1	1.18	13	9.29		
	Accipitridae									
R	*Aviceda cuculoides*	African Cuckoo Hawk	1	1.56						
R	*Elanus caeruleus*	Black-shouldered Kite					1	0.71	4	7.84
M	*Milvus migrans*	Black Kite	23	35.94	37	43.53	57	40.71	24	47.06
R	*Haliaeetus vocifer*	African Fish Eagle	4	6.25	6	7.1	3	2.14		
R	*Gypohierax angolensis*	Palm-nut Vulture	24	37.5	19	22.35	10	7.14		
R	*Polyboroides typus*	African Harrier Hawk	11	17.19	16	18.82	22	15.71	3	5.88
R	*Accipiter tachiro*	African Goshawk							1	1.96
R	*Accipiter badius*	Shikra					4	2.86	5	9.81
R	*Accipiter erythropus*	Red-thighed Sparrowhawk					2	1.43		
R	*Kaupifalco monogrammicus*	Lizard Buzzard					4	2.86		
R/M	*Buteo auguralis*	Red-necked Buzzard					6	4.29	2	3.92
	Falconidae									
R	*Falco ardosiaceus*	Grey Kestrel	1	1.56			7	5	3	5.88
R	*Falco cuvierii*	African Hobby			6	7.1				
R	*Falco biarmicus*	Lanner Falcon					7	5	9	17.65
R/P	*Falco peregrinus*	Peregrine Falcon					4	2.86		
Species numbers			**6**		**6**		**13**		**8**	
Species populations			**64**		**85**		**140**		**51**	
Shannon diversity index (H')			**1.94**		**2.07**		**2.85**		**2.35**	
Equitability			**0.75**		**0.8**		**0.75**		**0.78**	

MCF: Monogaga Classified Forest; DCF: Dassioko Classified Forest; ANP: Azagny National Park; BNP: Banco National Park; Bs: Biogeographic status; R: Resident species; M: Intra-African migratory species; P: Palearctic migratory species; ECU: Cumulative numbers; Fr (%): Relative frequency

Figure 2: Photographs of a few species of diurnal raptors observed in the Study Area

Comparison of mean relative densities of each species (mean KIA per 4 km) across study sites and seasons

The highest average relative density is 7.25 and corresponds to that of *Milvus migrans* in large dry season in the Azagny NP (Table 2). In the majority of species, more than half of their densities are zero. With the exception of *Milvus migrans*, the seasonal relative densities of each of the other species vary very little within sites.

Table 2: Mean relative densities (mean KIA per 4 km) of raptor species by study sites and seasons

	MLD	MLR	MSD	MSR	DLD	DLR	DSD	DSR	ALD	ALR	ASD	ASR	BLD	BLR	BSD	BSR
Pandion haliaetus	0	0	0	0	0	0	0	0,25 ± 0,5	1 ± 2	0,25 ± 0,5	0,75 ± 1,5	1,25 ± 2,5	0	0	0	0
Aviceda cuculoides	0	0	0	0,25 ± 0,5	0	0	0	0	0	0	0	0	0	0	0	0
Elanus caeruleus	0	0	0	0	0	0	0	0	0	0	0	0,25 ± 0,5	0,5 ± 1	0	0	0,5 ± 1
Milvus migrans	3,75 ± 2,36	0,5 ± 1	0	1,5 ± 1,29	5,5 ± 3,79	0	1,25 ± 2,5	2,5 ± 3,79	7,25 ± 4,57	1,25 ± 1,5	3 ± 2,16	2,75 ± 2,5	3,5 ± 2,38	1,5 ± 1,91	0	1 ± 1,15
Haliaeetus vocifer	0,25 ± 0,5	0,25 ± 0,5	0,25 ± 0,5	0,25 ± 0,5	0,25 ± 0,5	0,25 ± 0,5	0,5 ± 1	0,75 ± 1,5	0,75 ± 1,5	0,25 ± 0,5	0	0,25 ± 0,5	0	0	0	0
Gypohierax angolensis	2 ± 2,83	1,25 ± 0,96	1 ± 1,15	1,75 ± 1,71	1 ± 1,15	1 ± 1,15	1,25 ± 1,5	1,5 ± 1,29	0,75 ± 0,96	0,75 ± 0,96	0,5 ± 1	0,5 ± 1	0	0	0	0
Polyboroides typus	0,5 ± 1	0,75 ± 0,96	0,75 ± 0,96	0,75 ± 0,96	0,75 ± 0,96	1 ± 1,15	1 ± 1,15	1,25 ± 0,96	1,25 ± 0,96	1,5 ± 1	1,25 ± 0,96	1,5 ± 1	0	0,25 ± 0,5	0,25 ± 0,5	0,25 ± 0,5
Accipiter tachiro	0	0	0	0	0	0	0	0	0	0	0,25 ± 0,5	0	0	0	0	0,25 ± 0,5
Accipiter badius	0	0	0	0	0	0	0	0	0,25 ± 0,5	0,5 ± 1	0	0,25 ± 0,5	0,25 ± 0,5	0,25 ± 0,5	0	0,75 ± 0,96
Accipiter erythropus	0	0	0	0	0	0	0	0	0	0	0,25 ± 0,5	0,25 ± 0,5	0	0	0	0
Kaupifalco monogrammicus	0	0	0	0	0	0	0	0	0,25 ± 0,5	0,25 ± 0,5	0	0,5 ± 0,58	0	0	0	0
Buteo auguralis	0	0	0	0	0	0	0	0	1 ± 1,15	0	0	0,5 ± 1	0	0	0	0,5 ± 1
Falco ardosiaceus	0	0,25 ± 0,5	0	0,25 ± 0,25	0	0	0	0	0,5 ± 0,58	0,5 ± 0,58	0,25 ± 0,5	0,5 ± 0,58	0	0,25 ± 0,5	0,25 ± 0,5	0,25 ± 0,5
Falco cuvierii	0	0	0	0	0,5 ± 1	0,5 ± 1	0	0,5 ± 1	0	0	0	0	0	0	0	0
Falco biarmicus	0	0	0	0	0	0	0	0	0,5 ± 1	0,5 ± 1	0	0,75 ± 1,5	0	0,75 ± 1,5	0,5 ± 1	0,5 ± 1
Falco peregrinus	0	0	0	0	0	0	0	0	0	0,5 ± 1	0	0,5 ± 1	0	0	0	0

MLD: Monogaga Large Dry season; MLR: Monogaga Large Rainy season; MSD: Monogaga Small Dry season; MSR: Monogaga Small Rainy season; DLD: Dassioko Large Dry season; DLR: Dassioko Large Rainy season; DSD: Dassioko Small Dry season; DSR: Dassioko Small Rainy season; ALD : Azagny Large Dry season; ALR: Azagny Large Rainy season; ASD: Azagny Small Dry season; ASR: Monogaga Small Rainy season; BLD: Banco Large Dry season; BLR: Banco Large Rainy season; BSD: Banco Small Dry season; BSR: Banco Small Rainy season

Discussion

Sixteen (60.29%) of the 28 diurnal raptors species normally found in the study area (Borrow and Demey, 2001) were identified. This population is composed of 75 % sedentary species. The results of this study indicate that one or two species (depending on the season) are more abundant and largely dominate the seasonal raptor population at the various sites. This is comparable to the results of Thiollay (1975c). Indeed, the weather, the duration of field visits and the habitat covered are important factors in raptor monitoring (Buij, 2008) and this is particularly true for raptor habitats (Thiollay, 1975). Also, since monitoring has been carried out in habitats with different visibility, it is difficult to draw such certain conclusions on the relative abundance of species. Nevertheless, this study provides a clear and fairly representative picture of the current stands of this group of birds in this area of the country. The method of study adopted made it possible to take into account not only resident species but also migratory species (intra-African and palearctic) whose abundance varies enormously according to the seasons (Thiollay, 1978). Interpretation of such results requires a good knowledge of birds of prey, as they are only really comparable between environments with similar physiognomy (Thiollay, 1970). Thus, they are comparable from one site and season to another, since they were obtained under the same study conditions (same observer, same schedules, same transects, etc.). However, because of differences in interspecific behaviour, they rarely reflect the true diversity, relative abundance and density of all community components. With this in mind, it should be mentioned that a species not observed does not necessarily mean its absence from the site. In fact, the difficulties of detecting raptors in tropical environments and especially in dense forest areas, take away much of the significance of these different indices (Thiollay, 1975c). Nevertheless, since all species are about equally likely to be seen or heard, the proportions obtained seem to be fairly representative. With regard to the specific variability in raptor species at the sites, in comparison with the results of the work of other authors in the forest area of Côte d'Ivoire, the numbers of raptor species of 6, 13 and 8 recorded during this study in the two classified forests (FCM and FCD), PNA and PNB, respectively, appear to be low. Indeed, probably related to the disappearance or absence of large ungulates due largely to poaching in most of the protected areas of Côte d'Ivoire (Kone, 2004), several ecological niches are vacant. Thus, the fragmentation of almost all forests in general, and those of Côte d'Ivoire in particular, would be a particularly significant threat to large bird species, whose pairs require large areas of intact forest for hunting and breeding (Birdlife International, 2004).

However, with the exception of the findings of Gasthore and *al*. (1995), Yaokokoré (2001) and Lachenaud (2006b) respectively in Taï NP (16 species), Béki CF (15 species) and in BNP and Anguédou CF (18 species), the results of this study seem to be close (in terms of the number of species recorded) to those obtained by some authors such as : Thiollay (1975c, 1985b and 1985c) in Taï NP (10 and 11 species respectively), Demey and Fishpool (1994) in Yapo-Abbé CF (14 species), Yaokokoré (2001) in Bossématié CF (11 species), Demey et Rainey (2005) in Haute Dodo CF (8 species) and Cavally CF (5 species), Gasthore et *al*. (1995) in the MFC (4 species), in the Classified Forest of Mopri (14 species), Lachenaud (2006a) in the Sassandra region (13 species). The greater number of species (13) obtained at the ANP could be due in particular to the diversification and specialisation of ecological niches (diet and microclimate) subdividing the exploitation of the environment. Among the sites sampled, the ANP site contains the most biotopes, each with its own specific fauna, which seems to be very useful for a large number of raptor species. In fact, swampy forest formations and mangroves representing two thirds of the ANP's vegetation cover (Lauginie et *al*. 1996, OIPR 2006a), i.e. about 12.934 ha, would seem to be very advantageous to raptors in the face of poaching.

These habitats would undoubtedly be refuges for most species because they are difficult to access for the majority of poachers. In addition, it should be noted that 12 species of raptors, each with different ranges (known in Côte d'Ivoire), largely covering the study sites, were not observed during this study. These include seven sedentary species (the Bat Hawk *Macheiramphus alcinus andersoni*, the Congo Serpent Eagle *Dryotriorchis spectabilis*, the Black Sparrowhawk *Accipiter melanoleucus temmincki*, the Long-tailed Hawk *Urotriorchis macrourus*, the Long-crested Eagle *Lophaetus occipitalis*, Cassin's Hawk Eagle *Spizaetus africanus* and the Crowned Eagle *Stephanoetus coronatus*) and five Palearctic migratory species (Eurasian Marsh Harrier *Circus aeroginosus*, European Honey Buzzard *Pernis apivoris*, Common Kestrel *Falco tinnunculus rufescens*, Lesser Kestrel *Falco naumanni* and Eurasian Hobby *Falco subbuteo*). Indeed, the many threats (poaching, habitat destruction, etc.) to which the raptors are exposed, on the one hand, and on the other hand, the ecology and biology of each of these species (habitat, reproduction, feeding and territorial defence behaviour, way of exploiting the environment, etc.) could justify their absence from this population. With regard to strictly forest species, it is more than possible that the deforestation and poaching observed in almost all forest areas of Côte d'Ivoire, particularly in the sampled sites, are not conducive to their presence. Indeed, although forest destruction does not strictly speaking create savannah (secondary afforestation and plantations are very different), it favours the extension of savannah species and reduces the distribution of birds specific to forest undergrowth such as *Dryotriorchis spectabilis*, *Urotriorchis macrourus macrourus*, *Stenophanoetus coronatus*, etc., which are less plastic and highly specialised and adapt poorly to the new environmental conditions (Thiollay, 1975a). Also, with the disappearance of the large fauna, most eagles, which are generally large, are the target of poachers, for whom a

bird of this size "is better off in a cartridge" (Thiollay 1971). The absence of certain falcon species could be justified, no doubt, by the fact that the open environments that represent their preferred habitats have not been sufficiently explored in this study. Also, it would be difficult to observe the Bat Hawk *Macheiramphus alcinus* according to the inventory methodology used in this study (where the observation work ended at 5 p.m.), since it is a species with a twilight lifestyle (Thiollay 1971, 1975a, 1975c, 1985b; Brown and *al*., 1982; Borrow and Demey, 2001 and 2004; Rondeau et *al.*, 2005).

With the exception of raptors in the Lamto Reserve (Thiollay, 1975a and 1975b), Taï NP (Thiollay, 1985a) and the Guinea-Conakry forest zone (Rondeau et *al*., 2005), we are not aware of any other studies on the density and relative abundance of tropical raptors that would allow comparison with the data collected during this study. It is known that the Lamto Reserve has a climate with very attenuated contrasts (the importance of rainfall and its distribution during the year, the relative stability of temperature and the high degree of atmospheric humidity, etc.). This makes it much more akin to the forest than to the Sudanese savannah (Thiollay, 1971). However, its geographical location and the interweaving of so many different biotopes do not offer a real possibility to make a comparison of its density and abundance of raptors with that of the sampled sites (located in the coastal forest zone in the domain of the evergreen rain forest). As for the Taï NP site, whose biotope appears to be sufficiently homogeneous and located in the same area (evergreen rainforest) as the sampled sites, it would be interesting to compare the density of its raptor population with the results obtained during this study. However, the methodology used in Taï NP (Thiollay, 1985d) appears to be different from that used in this study, in that during the sampling in Taï, most of the trips were made by vehicle, whereas ours were made only on foot. Also for the data of Rondeau et *al*. (2005), monitoring was essentially carried out in vehicles. This makes any comparison with the results of this study out of the question. Thus, the only possibility open to us is to compare the results of the study sites with each other and to be able to interpret them. The KIA, which is proportional to raptor density (Thiollay, 1975c), is particularly noteworthy and differs relatively from one species to another depending on the season. For these different associations, the highest KIA (7.25 ± 4.57) was obtained in large dry saeson in the Azagny NP and represents the density of *Milvus migrans*. As a migratory species, *Milvus migrans* is a species with social and gregarious behaviours that congregate in a given place and time of year, making them more visible. The dry season clearly appears here as the most favourable season of the annual cycle of this species due to its higher density. It is known that the amount and annual distribution of rainfall seems to control the fluctuations of raptor stands, if not directly, at least through the consequences on the general climate and the evolution of the fauna and vegetation (Thiollay, 1976b). The rainfall regime, spread out over a large part of the year, is favourable to the fauna as a whole. Indeed, the so-called dry season is short and is never completely devoid of rainfall. Thus, the raptors do not experience a long period of famine which can considerably limit their numbers. According to Thiollay (1971), it appears that man, through his multiple activities (hunting by all possible means, illegal clearing, bush fires, uncontrolled and intensive fishing practised most often with non-conventional equipment and methods, etc.) remains the main limiting factor.

Conclusion

The study showed that at the raptor populations level, the sampled sites still have a relatively large raptor stand in that they contain more than 60% of the diurnal raptor species normally found in the area. Populations of the diurnal raptors of these sites vary both by site and season. Thus, for each site sampled, one or two species (depending on the season) are more abundant and largely dominate seasonal population. Also, among the sites, Azagny NP has a more diverse raptor population with the most evenly distributed species. Overall, the results of this study showed that despite the numerous threats (poaching, illegal clearing, pollution, etc.) to which the sites are exposed, they still have a large population of raptors. This implies that appropriate conservation actions and adequate measures need to be taken in the sites in order to save the biodiversity survivors in general, and this population of raptors in particular.

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