



Original Research Article

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Birds diversity of the Bouafle Classified Forest (Central-western of Côte d'Ivoire)

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ABSTRACT

Deforestation leads to the fragmentation of original forests into several forest portions. Indeed, the fragmentation of forests is one of the major threats to biodiversity. This study aims for the first time to determine birds diversity in the Bouafle Classified Forest (BCF) for the assessment of its state of conservation. The ornithological data were collected using listening points, Japanese net capture and recapture and fixed-term census along the linear transects with five-minute stopping points on the stations listening. These methods allowed us to identify 150 species of birds from 50 families of 18 orders. Three of these species are on the IUCN Red List of Threatened Species. The BCF is dominated by 82% resident species and 37,33 % open species. This site hosts two species endemic to the Sudano-Guinean savannah biomes and 31 other species, from the Guinean-Congolese forests.

Introduction

The alteration of natural ecosystems is the greatest threat to biodiversity (Meffe and Carroll, 1994; N'Da et al., 2008; Murhabale et al., 2020). It can lead to the fragmentation of forest habitats in favour of forest fragments (Saunders et al., 1991). This phenomenon can be observed worldwide, especially in tropical forests (Vallan, 1999). Tropical rainforests, which are home to the largest known diversity of plant and animal species (Puig, 2001 ; Teyssèdre, 2004), declined considerably during the 20th century (Lévêque, 1994). In Côte d'Ivoire, biodiversity is characterised by significant richness and diversity (Halle and Bruzon, 2006). However, this developing country is faced with an unprecedented reduction in its forest area

(Mayaux et al., 2003; Brou et al., 2005; Koné et al., 2014) which promises serious consequences both ecologically and economically. This decline in vegetation cover is the result of a development choice based on agriculture (Konan, 2009). Unfortunately, the galloping degradation of the natural environment has led to the disappearance of thousands of hectares of forest with the result that many animal species have become extinct (N'Da et al., 2008).

It is estimated that a few thousand hectares of forests that have not yet been exploited are confined to Classified Forests, Forest Reserves and National Parks (N'Da et al., 2008; Kouakou et al., 2015). Unfortunately, these protected areas are themselves under severe attack, mostly

through the development of agricultural activities (N'Da et al., 2008; Bitty et al., 2013). This state of affairs is strongly observed in the Bouafle Classified Forest (FCB). Faced with the rather gloomy consequences of deforestation and forest degradation, there is a growing conviction that the situation must no longer be allowed to continue, so we must react.

The collection and analysis of scientific information in a timely manner is essential for interventions in the sustainable management of natural resources, particularly avifauna resources. Moreover, there are several reasons why birds are so often used as a model in the study of ecosystems. Indeed, birds use a wide variety of natural habitats and are therefore directly affected by ecosystem disturbances. They therefore act as bio-indicators of the state of conservation and functioning of ecosystems, landscape modification and climate change (Bibby et al., 1992; Demey and Rainey, 2005; Gottschalk et al., 2007). Their mobility enables them to react instantaneously to any change in the environment. The objective of this study is to determine, for the first time, birds diversity of this Classified Forest in order to assess its conservation status.

Materials and methods

Materials

A GPS (Global Positioning System) navigator was used to record geographical coordinates, plot routes and mark the various observation points. The birds were observed using a pair of binoculars (Bushnell, 10 × 50 mm), a headlamp and a torch (Garrity) for lighting the tracks and trails. As for identification, it was carried out using identification guides (Borrow and Demey, 2001). The bird songs are from the Chappuis (2000). These songs were broadcast using a compact disc player (MDM-14 marker and baffles (Sony)). The recording equipment consisted of a digital camera (Panasonic Lumix DMC-TZ 61) for taking pictures, ornithological data sheets to determine the avifaunal population of each study site and a dictaphone (Sony; Cassette; TCM-150) connected to a micro-directional recorder for recording vocalisations. For the capture and recapture of bird species, two mist nets of 12 m (12 x 2. 5 m, 16 mm mesh size) were used.

Methods

Description of study site

The BCF is located in the central-western part of Côte d'Ivoire in the mesophilic forests (Guillaumet and Adjanohoun, 1971; Monnier, 1983), about 30 km from the town of Daloa and 50 km from the town of Bouaflé. It covers an area of 20,350 ha and is bounded by longitudes 6°02' and 6°13' West and latitudes 6°42' and 6°52' North. Administratively, this forest is located between the regions of Marahoué and Haut-Sassandra, 20% of its surface belongs to the department of Daloa and 80% to the department of Bouafle. It is bordered in its northern part by the Daloa-Bouaflé road and the Marahoué National Park, to the east and south-east by the Sub-prefecture of Bonon, to the south-west by the Sub-prefectures of Zaguiéta and to the west by the Sub-prefectures of Gadouan and Gonaté (Fig. 1). The climate is of the sub-equatorial Attiéén type according to Eldin (1971). Over the year, its average temperature is 25.9°C. The average annual rainfall is 1301 mm. The vegetation of the FCB belongs to the semi-deciduous dense forest zone (Guillaumet and Adjanohoun, 1971). Some of the biotopes found in the CBF are shown in Fig. 2, while its fauna is not well known because it has not been the subject of any serious study before the present study.

Data collection and analysis

The study was carried out from February 2019 to May 2020. The BCF was subdivided into three sample sites in addition to the outlying area. This subdivision was made on the basis of the presence or absence of wetlands, the heterogeneity of the vegetation and the degree of anthropisation (the intensity or extent of human activities) of the environment. The methods used are respectively the listening point method (Bibby et al., 1992; Bibby et al., 2000; Yaokokoré-Béibro et al., 2015; Zean et al., 2018), capture and recapture with mist nets (Bennun et al, 2004), time-limited census along line transects (Yaokokoré-Béibro, 2001; Issiaka, 2002 and 2011) with five-minute stopping points at listening stations (Zean et al., 2018). In fact, the fixed listening point method and the mist net capture and recapture method (excluding transects) were used for a whole day between 06 : 30 and 18 : 30 (i.e. 12 h of daily observation per study site).

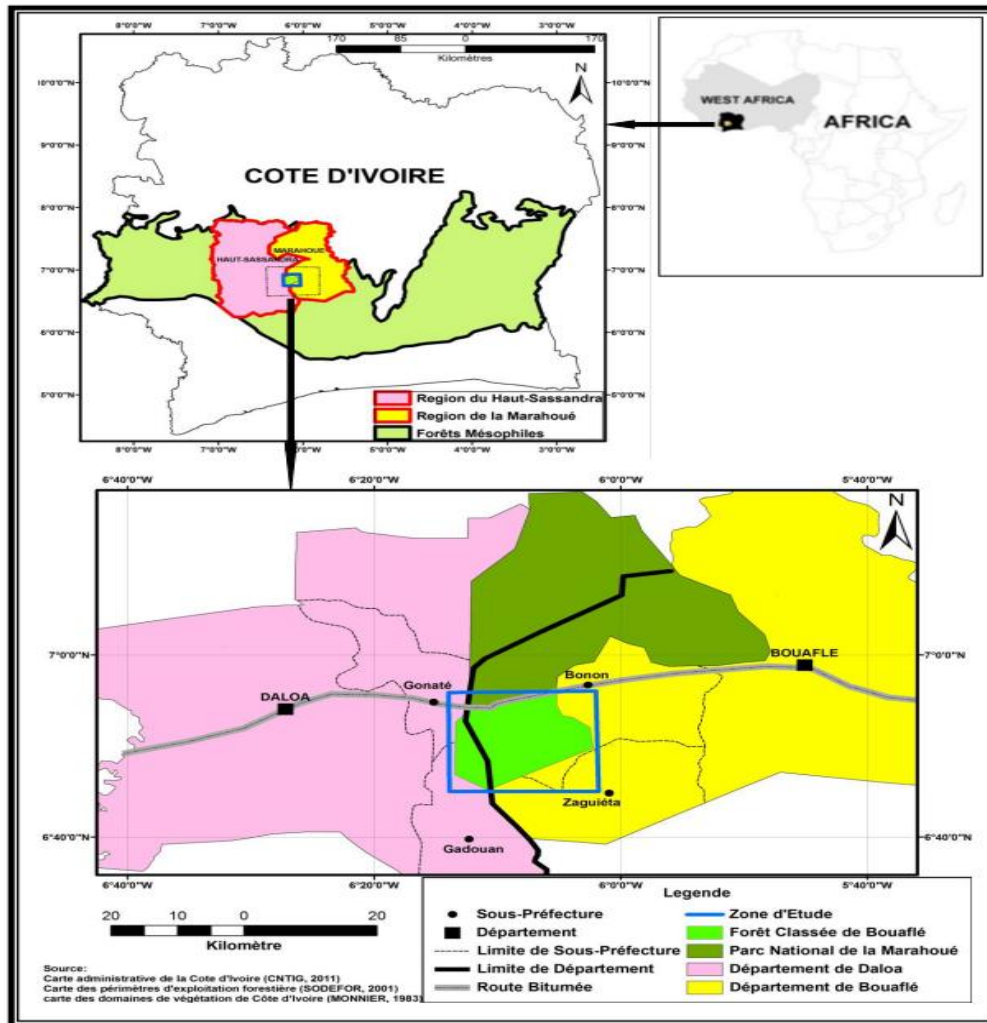


Fig. 1: Map of the location of the BCF in Côte d'Ivoire.

Daytime observations (from 06 : 30 to 10 : 30 in the morning and in the afternoon from 15 : 30 to 18 : 30), were carried out on each sample route of each sample site. The inventories were based on a systematic count of all bird species identified, spotted by sight or heard along the four transects of 2 km each, during a slow (0.5 to 1 km/h) and silent walk. Five listening and observation stations, 500 m apart, were set up on each transect to avoid double counting of individuals during sampling and at least 50 m from the edges to obtain better results (Delahaye, 2006; Loubégnon, 2007). These routes were made on the outward and return journey by favourable meteorology (uncovered sky, absence of heavy rain). For nocturnal observations, inventories were carried out on the sample routes used for sampling diurnal species. Three listening stations (1 km apart) were set up on each 1 km transect. The main methodology was the

vocalization replay technique. The songs of all nocturnal bird species such as Nighthawks, some lapwings and birds of prey likely to be encountered in the site were reviewed (10 in total). The birds' songs were broadcast using a compact disc player. The vocalisation of a given species was listened to for 1 minute, followed by a 1-minute wait before moving on to another species. Observations were made during the full moon, from 19:00 to 23:00 on the outward journey and from 04:00 to 06:00 on the return journey. For each of the species listed, the preferred habitat was indicated (FF: highly dependent on forests; F: general forest generalist; F: open habitat; E: forest species; E: forest species; F: forest species; E: forest species; F: forest species; E: forest species; F: forest species; F: forest species; E: forest species: wetland) and conservation status are from IUCN (2020), the migratory or biogeographical status (resident,

intra-African migratory or palearctic migratory) according to de Borrow and Demey (2001) and the indications concerning the biomes (Guinean-Congolese forest (GC), Sudano-Guinean savannah (SG)) are from Stattersfield et al. (1998) and Fishpool and Evans (2001). It should be noted that in order to standardise the names of the birds

recorded in the different tables, reference has been made to the nomenclature, taxonomy and order of Borrow and Demey (2001). The nomenclature, taxonomy and order of species were established according to the Handbook of the Birds of the World and Bird Life International as published by Lepage (2017).



Fig. 2: Partial views of some habitats of the BCF.

Results

Avifauna richness

In total, 150 bird species belonging to 50 families and 18 orders (Table 1) were inventoried in the different habitats of the BCF. This forest is home to 19.79% of Côte d'Ivoire's avifauna. Non-passeriformes are the most important with 86 species (57.33%) from 27 families. Within this

group, the orders of Charadriiformes, Coraciiformes and Piciformes are the most diverse, with three families each. Next come the orders Bucerotiformes, Galliformes, Pelecaniformes and Strigiformes with two families each. With 62.96% of the families of the non-Passeriformes, these seven orders are the most important on this site. Passeriformes represent 37.04% of the settlement. The most diverse family in terms of number of species is the Accipitridae family with 14 species.

The family Ploceidae is the second most diverse family with 13 species followed by the families Ardeidae and Cuculidae with eight species each. Then come the families of Lybiidae and

Pycnonotidae with seven species. These families alone account for 38% of the species richness. Fig. 3 shows some of the species inventoried in the BCF.

Table 1. List of bird species recorded in the BCF.

NE	Scientific name	Common name	SC	Bio	HP	SB	RR
GALLIFORMES							
NUMIDIDAE (1)							
1	<i>Numida meleagris</i> (Linnaeus, 1758)	Helmeted Guinea fowl	LC		f	R	
PHASIANIDAE (2)							
2	<i>Peliperdix lathamii</i> (Hartlaub, 1854)	Latham's Forest Francolin	LC	GC	FF	R	
3	<i>Pternistis bicalcaratus</i> (Linnaeus, 1766)	Double-spurred Francolin	LC		f	R	
ANSERIFORMES							
ANATIDAE (1)							
4	<i>Dendrocygna viduata</i> (Linnaeus, 1766)	White-faced Whistling Duck	LC		Ea	R	
COLUMBIFORMES							
COLUMBIDAE (5)							
5	<i>Treron calvus</i> (Temminck, 1811)	African Green Pigeon	LC		F	R	
6	<i>Turtur brehmeri</i> (Hartlaub, 1865)	Blue-headed Wood Dove	LC	GC	F	R	
7	<i>Turtur tympanistria</i> (Temminck, 1809)	Tambourine Dove	LC		F	R	
8	<i>Turtur afer</i> (Linnaeus, 1766)	Blue-spotted Wood Dove	LC		f	R	
9	<i>Streptopelia semitorquata</i> (Rüppell, 1837)	Red-eyed Dove	LC		f	R	
CAPRIMULGIFORMES							
CAPRIMULGIDAE (3)							
10	<i>Caprimulgus longipennis</i> (Shaw, 1796)	Standard-winged Nightjar	LC		f	M	
11	<i>Caprimulgus europaeus</i> (Linnaeus, 1758)	European Nightjar	LC		f	P	
12	<i>Caprimulgus tristigma</i> (Rüppell, 1840)	Freckled Nightjar	LC		f	R	
CUCULIFORMES							
CUCULIDAE (8)							
13	<i>Cuculus solitarius</i> (Stephens, 1815)	Red-chested Cuckoo	LC		FF	M	
14	<i>Cuculus clamosus</i> (Latham, 1802)	Black Cuckoo	LC		FF	M	
15	<i>Chrysococcyx cupreus</i> (Shaw, 1792)	African Emerald Cuckoo	LC		F	R	
16	<i>Chrysococcyx klaas</i> (Stephens, 1815)	Klaas's Cuckoo	LC		f	R/M	
17	<i>Chrysococcyx caprius</i> (Boddaert, 1783)	Didric Cuckoo	LC		f	R/M	
18	<i>Ceuthmochares aereus</i> (Vieillot, 1817)	Yellow bill	LC		f	R	
19	<i>Centropus grillii</i> (Hartlaub, 1861)	Black Coucal	LC		f	M/R	
20	<i>Centropus senegalensis</i> (Linnaeus, 1766)	Senegal Coucal	LC		f	R	
GRUIFORMES							
RALLIDAE (4)							
21	<i>Zapornia flavirostra</i> (Swainson, 1837)	Black Crake	LC		Ea	R	
22	<i>Porphyrio alleni</i> (Thomson, 1842)	Allen's Gallinule	LC		Ea	R	
23	<i>Porphyrio porphyrio</i> (Linnaeus, 1758)	Purple Swampphen	LC		Ea	R/M	
24	<i>Gallinula chloropus</i> (Linnaeus, 1758)	Common Moorhen	LC		Ea	R	
MUSOPHAGIFORMES							
MUSOPHAGIDAE (3)							
25	<i>Corythaëola cristata</i> (Vieillot, 1816)	Great Blue Turaco	LC		FF	R	
26	<i>Tauraco persa</i> (Linnaeus, 1758)	Green Turaco	LC	GC	FF	R	
27	<i>Crinifer piscator</i> (Boddaert, 1783)	Western Grey Plantain-eater	LC		f	R	
PELECANIFORMES							
ARDEIDAE (8)							
28	<i>Ixobrychus minutus</i> (Linnaeus, 1766)	Little Bittern	LC		Ea	P	
29	<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	Black-crowned Night Heron	LC		Ea	R	
30	<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle Egret	LC		Ea	R/M	
31	<i>Butorides striata</i> (Linnaeus, 1758)	Green-backed Heron	LC		Ea	R	

Table 1 (Continued)...

NE	Scientific name	Common name	SC	Bio	HP	SB	RR
32	<i>Egretta garzetta</i> (Linnaeus, 1766)	Little Egret	LC		Ea	R	
33	<i>Egretta intermedia</i> (Wagler, 1829)	Intermediate Egret	LC		Ea	R	
34	<i>Egretta alba</i> (Linnaeus, 1758)	Great Egret	LC		Ea	R	
35	<i>Ardea cinerea</i> (Linnaeus, 1758)	Grey Heron	LC		Ea	R/P	
	SCOPIDAE (1)						
36	<i>Scopus umbretta</i> (Gmelin, 1789)	Hamerkop	LC		Ea	R	
	SULIFORMES						
	PHALACROCORACIDAE (1)						
37	<i>Microcarbo africanus</i> (Gmelin, 1789)	Great Cormorant	LC		Ea	R	
	CHARADRIIFORMES						
	CHARADRIIDAE (2)						
38	<i>Vanellus senegallus</i> (Linnaeus, 1766)	African Wattled Lapwing	LC		Ea	R	
39	<i>Vanellus albiceps</i> (Gould, 1834)	White-headed Lapwing	LC		Ea	M	
	JACANIDAE (1)						
40	<i>Actophilornis africanus</i> (Gmelin, 1789)	African Jacana	LC		Ea	R	
	SCOLOPACIDAE (2)						
41	<i>Tringa glareola</i> (Linnaeus, 1758)	Wood Sandpiper	LC		Ea	P	
42	<i>Actitis hypoleucos</i> (Linnaeus, 1758)	Common Sandpiper	LC		Ea	P	
	STRIGIFORMES						
	TYTONIDAE (1)						
43	<i>Tyto alba</i> (Scopoli, 1769)	Barn Owl	LC		f	R	
	STRIGIDAE (3)						
44	<i>Ptilopsis leucotis</i> (Temminck, 1820)	White-faced Owl	LC		f	R	
45	<i>Jubula lettii</i> (Büttikofer, 1889)	Maned Owl	DD	GC	FF	R	
46	<i>Strix woodfordii</i> (Smith, 1834)	African Wood Owl	LC		F	R	
	ACCIPITRIFORMES						
	ACCIPITRIDAE (14)						
47	<i>Pernis apivorus</i> (Linnaeus, 1758)	European Honey Buzzard	LC		f	P	
48	<i>Macheiramphus alcinus</i> (Westermann, 1851)	Bat Hawk	LC		F	R	
49	<i>Elanus caeruleus</i> (Desfontaines, 1789)	Black-shouldered Kite	LC		f	R	
50	<i>Milvus migrans</i> (Boddaert, 1783)	Black Kite	LC		f	M	
51	<i>Gypohierax angolensis</i> (Gmelin, 1788)	Palm-nut Vulture	LC		F	R	
52	<i>Polyboroides typus</i> (Smith, 1829)	African Harrier Hawk	LC		F	R	
53	<i>Circus macrourus</i> (Gmelin, 1770)	Pallid Harrier	NT		f	P	
54	<i>Micronisus gabar</i> (Daudin, 1800)	Gabar Goshawk	LC		f	R	
55	<i>Accipiter tachiro</i> (Daudin, 1800)	African Goshawk	LC		FF	R	
56	<i>Accipiter badius</i> (Gmelin, 1788)	Shikra	LC		f	R	
57	<i>Kaupifalco monogrammicus</i> (Temminck, 1824)	Lizard Buzzard	LC		f	R	
58	<i>Buteo auguralis</i> (Salvadori, 1865)	Red-necked Buzzard	LC		f	R/M	
59	<i>Aquila rapax</i> (Temminck, 1828)	Tawny Eagle	LC		f	R	
60	<i>Hieraaetus ayresii</i> (Gurney, 1862)	Ayres's Hawk Eagle	LC		FF	R	
	BUCEROTIFORMES						
	BUCEROTIDAE (4)						
61	<i>Lophoceros semifasciatus</i> (Hartlaub, 1855)	African Pied Hornbill	LC	GC	F	R	
62	<i>Lophoceros nasutus</i> (Linnaeus, 1766)	African Grey Hornbill	LC		f	R	
63	<i>Bycanistes fistulator</i> (Cassin, 1852)	Piping Hornbill	LC	GC	f	R	
	UPUPIDAE (1)						
64	<i>Upupa epops</i> (Linnaeus, 1758)	Hoopoe	LC		f	M/P	
	CORACIIFORMES						
	MEROPIDAE (2)						
65	<i>Merops albicollis</i> (Vieillot, 1817)	White-throated Bee-eater	LC		f	M	
66	<i>Merops apiaster</i> (Linnaeus, 1758)	European Bee-eater	LC		f	P	

Table 1 (Continued)...

NE	Scientific name	Common name	SC	Bio	HP	SB	RR
	CORACIIDAE (3)						
67	<i>Coracias cyanogaster</i> (Cuvier, 1817)	Blue-bellied Roller	LC	SG	f		R
68	<i>Eurystomus gularis</i> (Vieillot, 1819)	Blue-throated Roller	LC	GC	F		R
69	<i>Eurystomus glaucurus</i> (Müller, 1776)	Broad-billed Roller	LC		f		R/M
	ALCEDINIDAE (4)						
70	<i>Halcyon senegalensis</i> (Linnaeus, 1766)	Woodland Kingfisher	LC		f		R
71	<i>Ispidina pictus</i> (Boddaert, 1783)	African Pygmy Kingfisher	LC		f		R
72	<i>Corythornis leucogaster</i> (Fraser, 1843)	White-bellied Kingfisher	LC	GC	f		R
73	<i>Corythornis cristatus</i> (Pallas, 1764)	Malachite Kingfisher	LC		Ea		R
	PICIFORMES						
	LYBIIDAE (7)						
74	<i>Gymnobucco calvus</i> (Lafresnaye, 1841)	Naked-faced Barbet	LC	GC	F		R
75	<i>Pogoniulus scolopaceus</i> (Bonaparte, 1850)	Speckled Tinkerbird	LC	GC	F		R
76	<i>Pogoniulus subsulphureus</i> (Fraser, 1843)	Yellow-throated Tinkerbird	LC	GC	FF		R
77	<i>Pogoniulus bilineatus</i> (Sundevall, 1850)	Yellow-rumped Tinkerbird	LC		F		R
78	<i>Tricholaema hirsuta</i> (Swainson, 1821)	Hairy-breasted Barbet	LC	GC	F		R
79	<i>Lybius vieilloti</i> (Leach, 1815)	Vieillot's Barbet	LC		f		R
80	<i>Pogonornis bidentatus</i> (Shaw, 1798)	Double-toothed Barbet	LC		f		R
	INDICATORIDAE (1)						
81	<i>Indicator indicator</i> (Sparman, 1777)	Greater Honeyguide	LC		f		R
	PICIDAE (1)						
82	<i>Dendropicos pyrrhogaster</i> (Malherbe, 1845)	Fire-bellied Woodpecker	LC	GC	F		R
	FALCONIFORMES						
	FALCONIDAE (2)						
83	<i>Falco ardosiaceus</i> (Vieillot, 1823)	Grey Kestrel	LC		f		R
84	<i>Falco biarmicus</i> (Temminck, 1825)	Lanner Falcon	LC		f		R
	PSITTACIFORMES						
	PSITTACIDAE (2)						
85	<i>Psittacus timneh</i> (Fraser, 1844)	Grey Parrot	EN		FF		R
86	<i>Poicephalus gulielmi</i> (Jardine, 1849)	Red-fronted Parrot	LC		FF		R
	PASSERIFORMES						
	ORIOOLIDAE (1)						
87	<i>Oriolus brachyrhynchus</i> (Swainson, 1837)	Western Black-headed Oriole	LC	GC	F		R
	CAMPEPHAGIDAE (2)						
88	<i>Cebilepyris pectoralis</i> (Temminck, 1824)	White-breasted Cuckoo-shrike	LC		f		R
89	<i>Cyanograucalus azureus</i> (Cassin, 1852)	Blue Cuckoo-shrike	LC	GC	FF		R
	VANGIDAE (1)						
90	<i>Dyaphorophyia castanea</i> (Fraser, 1843)	Chestnut Wattle-eye	LC	GC	FF		R
	PLATYSTEIRIDAE (1)						
91	<i>Platysteira cyanea</i> (Müller, 1776)	Common Wattle-eye	LC		f		R
	MALACONOTIDAE (2)						
92	<i>Tchagra australis</i> (Smith, 1836)	Brown-crowned Tchagra	LC		F		R
93	<i>Tchagra senegalus</i> (Linnaeus, 1766)	Black-crowned Tchagra	LC		f		R
	DICRURIDAE (2)						
94	<i>Dicrurus adsimilis</i> (Bechstein, 1794)	Fork-tailed Drongo	LC		F		R
95	<i>Dicrurus modestus</i> (Hartlaub, 1849)	Velvet-mantled Drongo	LC		F		R
	MONARCHIDAE (1)						
96	<i>Terpsiphone rufiventer</i> (Müller, 1776)	Red-bellied Paradise Flycatcher	LC	GC	F		R
	LANIIDAE (1)						
97	<i>Lanius collaris</i> (Linnaeus, 1766)	Common Fiscal	LC		f		R
	CORVIDAE (1)						
98	<i>Corvus albus</i> (Müller, 1776)	Pied Crow	LC		f		R

Table 1 (Continued)...

NE	Scientific name	Common name	SC	Bio	HP	SB	RR
	MACROSPHENIDAE (1)						
99	<i>Sylvietta virens</i> (Cassin, 1859)	Green Crombec	LC	GC	F	R	
	CISTICOLIDAE (9)						
100	<i>Camaroptera brachyura</i> (Vieillot, 1820)	Grey-backed Camaroptera	LC		f	R	
101	<i>Camaroptera chloronota</i> (Reichenow, 1895)	Olive-green Camaroptera	LC	GC	FF	R	
102	<i>Cisticola erythrops</i> (Hartlaub, 1857)	Red-faced Cisticola	LC		f	R	
103	<i>Cisticola cantans</i> (Heuglin, 1869)	Singing Cisticola	LC		f	R	
104	<i>Cisticola lateralis</i> (Fraser, 1843)	Whistling Cisticola	LC		f	R	
105	<i>Cisticola galactotes</i> (Temminck, 1821)	Winding Cisticola	LC		f	R	
106	<i>Cisticola brachypterus</i> (Sharpe, 1870)	Short-winged Cisticola	LC		f	R	
107	<i>Prinia subflava</i> (Gmelin, 1789)	Tawny-flanked Prinia	LC		f	R	
	HIRUNDINIDAE (2)						
108	<i>Cecropis abyssinica</i> (Guérin-Méneville, 1843)	Lesser Striped Swallow	LC		f	R	
109	<i>Hirundo rustica</i> (Linnaeus, 1758)	Barn Swallow	LC		f	P	
	PYCNONOTIDAE (7)						
110	<i>Stelgidillas gracilirostris</i> (Strickland, 1844)	Slender-billed Greenbul	LC		FF	R	
111	<i>Bleda canicapillus</i> (Hartlaub, 1854)	Grey-headed Bristlebill	LC	GC	FF	R	
112	<i>Thescelocichla leucopleura</i> (Cassin, 1856)	Swamp Palm Bulbul	LC	GC	F	R	
113	<i>Chlorocichla simplex</i> (Hartlaub, 1855)	Simple Leaflove	LC	GC	F	R	
114	<i>Eurillas latirostris</i> (Strickland, 1844)	Yellow-whiskered Greenbul	LC		F	R	
115	<i>Eurillas virens</i> (Cassin, 1858)	Little Greenbul	LC		F	R	
116	<i>Pycnonotus barbatus</i> (Desfontaine, 1789)	Common Bulbul	LC		f	R	
	SCOTOCERCIDAE (1)						
117	<i>Hylia prasina</i> (Cassin, 1855)	Green Hylia	LC	GC	f	R	
	STURNIDAE (2)						
118	<i>Onychognathus fulgidus</i> (Hartlaub, 1849)	Forest Chestnut-winged Starling	LC	GC	F	R	
119	<i>Lamprotornis splendidus</i> (Vieillot, 1822)	Splendid Glossy Starling	LC		F	R	
	MUSCICAPIDAE (2)						
120	<i>Melaenornis annamarulae</i> (Forbes-Watson, 1970)	Nimba Flycatcher	VU	GC	FF	R	RR
121	<i>Saxicola rubetra</i> (Linnaeus, 1758)	African [Common] Stonechat	LC		f	P	
	NECTARINIIDAE (6)						
122	<i>Hedydipna collaris</i> (Vieillot, 1819)	Collared Sunbird	LC		f	R	
123	<i>Cyanomitra olivacea</i> (Smith, 1840)	Olive Sunbird	LC		FF	R	
124	<i>Chalcomitra adelberti</i> (Gervais, 1833)	Buff-throated Sunbird	LC	GC	F	R	
125	<i>Cinnyris chloropygius</i> (Jardine, 1842)	Olive-bellied Sunbird	LC		f	R	
126	<i>Cinnyris coccinigastrus</i> (Latham, 1801)	Splendid Sunbird	LC	SG	f	R	
127	<i>Cinnyris cupreus</i> (Shaw, 1811)	Copper Sunbird	LC		f	R	
	PLOCEIDAE (13)						
128	<i>Amblyospiza albifrons</i> (Vigors, 1831)	Grosbeak Weaver	LC		f	R	
129	<i>Quelea erythrops</i> (Hartlaub, 1848)	Red-headed Quelea	LC		f	R/M	
130	<i>Quelea quelea</i> (Linnaeus, 1758)	Red-billed Quelea	LC		f	O	
131	<i>Euplectes hordeaceus</i> (Linnaeus, 1758)	Black-winged Red Bishop	LC		f	R	
132	<i>Euplectes macroura</i> (Gmelin, 1789)	Yellow-mantled Widowbird	LC		f	R	
133	<i>Ploceus nigricollis</i> (Vieillot, 1805)	Black-necked Weaver	LC		f	R	
134	<i>Ploceus cucullatus</i> (Müller, 1776)	Village Weaver	LC		f	R	
135	<i>Ploceus tricolor</i> (Hartlaub, 1854)	Yellow-mantled Weaver	LC	GC	FF	R	
136	<i>Ploceus superciliosus</i> (Shelley, 1873)	Compact Weaver	LC		f	R	
137	<i>Ploceus albinucha</i> (Barboza du Bocage, 1876)	Maxwell's Black Weaver	LC		FF	R	
138	<i>Ploceus nigerrimus</i> (Vieillot, 1819)	Vieillot's Black Weaver	LC	GC	f	R	
139	<i>Malimbus nitens</i> (Gray, 1831)	Blue-billed Malimbe	LC	GC	F	R	
140	<i>Malimbus rubricollis</i> (Swainson, 1838)	Red-headed Malimbe	LC	GC	f	R	

Table 1 (Continued)...

NE	Scientific name	Common name	SC	Bio	HP	SB	RR
	ESTRILDIDAE (5)						
141	<i>Lagonosticta rubricata</i> (Lichtenstein, 1823)	Blue-billed Firefinch	LC		F	R	
142	<i>Spermophaga haematina</i> (Vieillot, 1805)	Western Bluebill	LC	GC	f	R	
143	<i>Estrilda melpoda</i> (Vieillot, 1817)	Orange-cheeked Waxbill	LC		f	R	
144	<i>Spermestes cucullatus</i> (Swainson, 1837)	Bronze Mannikin	LC		f	R	
145	<i>Spermestes bicolor</i> (Fraser, 1843)	Black-and-white Mannikin	LC		f	R	
	VIDUIDAE (3)						
146	<i>Vidua macroura</i> (Pallas, 1764)	Pin-tailed Whydah	LC		f	R	
	PASSERIDAE (1)						
147	<i>Passer griseus</i> (Vieillot, 1817)	Northern Grey-headed Sparrow	LC		f	R	
	MOTACILLIDAE (3)						
148	<i>Anthus trivialis</i> (Linnaeus, 1758)	Tree Pipit	LC		f	P	
149	<i>Anthus leucophrys</i> (Vieillot, 1818)	Plain-backed Pipit	LC		f	R	
	FRINGILLIDAE (1)						
150	<i>Crithagra mozambicus</i> (Müller, 1776)	Yellow-fronted Canary	LC		f	R	

Bio: Biome; **DD:** Data Deficient ; **Ea:** Wetland; **EN:** Endangered; **F:** General forest specialist; **f:** Open environment; **FF:** Forest specialist; **BCF:** Bouaflé Classified Forest ; **Fr:** Relative frequency ; **GC :** Guinean-Congolese forest biome species; **HP:** Preferred habitat; **LC:** Least concern; **M:** Intra-African migratory; **NE:** Species serial number; **NT:** Near threatened; **P:** Palearctic migratory; **R:** Resident; **Re:** Regular ; **RR:** Restricted distribution; **SB:** Biogeographic status; **SC :** Conservation status; **SG:** Sudano-Guinean savannah biome species; **VU:** Vulnerable.

Characterisation of the population

In terms of preferred habitats, the CBF has 56 species (37.33%) in open habitats (F), 43 species (28.67%) general forest specialists (F), 28 species (18.67%) forest specialists (FF) and 23 species (15.33%) in wetlands (E). The birds of the BCF are of different bio-geographical origins, but are predominantly *Resident*, with 123 species (82%). Ten species (6.67%) are Intra-African migratory (M) and six (6.67%) species are Palearctic migratory (P). Ten species (6.67%) have a mixed status (7 R/M; 1 R/P; 1 M/R) and one species (0.66%) is casual (O). Only one species (0.66%) is casual in BCF.

Species of conservation interest

According to the IUCN status, three species on the Red List of Threatened Species have been observed there. These are a species close to threatened or *Near threatened* (NT) the Pallid Harrier *Circus marourus* (Gmelin, 1770), a *Vulnerable* species (VU) the Nimba Flycatcher *Melaenornis annamarulae* (Forbes-Watson, 1970) and an *Endangered* species (EN) the Grey Parrot *Psittacus timneh* (Fraser, 1844). Scientific *Data deficient* (DD) for the Maned Owl *Jubula lettii*. The other species are of *Least Concern* (LC). The BCF is home to two bird species

belonging to the Sudano-Guinean savannah biomes, 31 species from the Guinean-Congolese forest biomes and one *Restricted – range* species.

Discussion

The BCF is rich and diverse with 150 species. This number of species could be explained by the combination of the sampling techniques used during this study (observation, listening to cries and songs, capture and recapture with mist nets and the vocalization replay technique). These observations are also made by Yaokokoré-Beibro (2010) during studies of avifaunal diversity in the Besso classified forest in south-eastern Côte d'Ivoire. For a shorter period, the N'ganda N'ganda Classified Forest (Kouadio et al., 2014), the Téné Classified Forest (Yaokokoré-Béibro et al., 2015) and the Haut Bandama Flora and Fauna Reserve (Ahon et al., 2020) contain 132, 93 and 178 bird species respectively. The latter share 82, 64 and 86 species with BCF, respectively. This homogeneity between the Classified Forests in terms of species richness reflects the state of degradation of most protected areas in Côte d'Ivoire. The predominance of open habitat species (37.33%) highlights the state of degradation of the BCF. Indeed, this forest relic is fragmented throughout the year mainly by anthropogenic activities such as logging and

intensive and extensive agriculture, thus simultaneously reducing forest cover and nesting sites for forest specialist bird species. The presence of the Pallid Harrier *Circus marourus* (Gmelin, 1770), the Nimba Flycatcher *Melaenornis annamarulae* (Forbes-Watson, 1970) and the Grey

Parrot *Psittacus timneh* (Fraser, 1844), whose protection is of global interest (IUCN, 2020), 31 species endemic to the Guinean-Congolese forest biomes, and two species that belong to the Sudano-Guinean savannah show that BCF in full degradation deserves special attention.



Fig. 3: Some bird species encountered in the BCF.

Strictly forest species whose range covers the study area according to Borrow and Demey (2001) could not be observed. For example, these are the Western Bronze-naped Pigeon *Columba iriditorques*, Black-throated Coucal *Centropus leucogaster*, Yellow-billed Turaco *Tauraco macrorhynchus*, Congo Serpent Eagle *Dryotriorchis spectabilis*, Red-thighed Sparrowhawk *Accipiter erythropus*, of Cassin's Hawk Eagle *Spizaetus africanus*, Black Dwarf Hornbill *Horizoceros hartlaubi*, Red-billed Dwarf Hornbill *Lophoceros camurus*, Black-and-w-casqued Hornbill *Bycanistes subcylindricus* and Yellow-spotted Barbet *Buccanodon duchailui*. Their absence could be attributed mainly to man-made activities. Generally speaking, deforestation therefore leads to the disappearance of more specialised forest species, leaving the place to generalist species that are better adapted to the unfavourable conditions of the environment, but up to a certain tolerance limit where these generalist species would start to disappear progressively. Thus, forest unit managers should integrate the ecological monitoring of wild fauna into their management plans for sustainable ecosystem management.

Conclusion

A study of the avifaunal population of the classified forest of Bouaflé has revealed that it is rich and diversified with 150 species from 48 families and 18 orders. This diversity is related to the ecological structure of the different habitats. This study has made it possible to improve knowledge of the general state of conservation of this forest relic. However, the greater representation of species from open environments and the presence of threatened species leaves us somewhat perplexed. In fact, together with the local populations, the Société de Développement des Forêts (SODEFOR), which is responsible for managing this forest, must undertake large-scale actions to preserve this heritage. It is therefore recommended that additional studies be carried out on the effects of reforestation on birds and other wildlife groups (mammals, reptiles, amphibians, insects, and fish) for a better understanding of the biodiversity of this forest. These data will be made available to forest managers so that the wildlife component can be better taken into account in the management plan. In this context, raising the awareness and

training of local populations will be an asset for the sustainable management of the forest's natural resources.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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