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(RESEARCH ARTICLE)

ACTIVITY BUDGET AND INTERACTIONS WITH HUMANS OF THE CATTLE EGRET, BUBULCUS IBIS, ON AN URBAN CAMPUS IN ABIDJAN (CÔTE D'IVOIRE)

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ABSTRACT

Urbanization pushes some birds to change their behavior to live in cities, but these changes remain poorly documented in tropical Africa. To fill this gap, we studied the activity budget of the Cattle Egret *Bubulcus ibis* on the campus of Université Félix Houphouët-Boigny (UFHB, Abidjan, Côte d'Ivoire) in November and December 2020. We first located the birds during walking surveys (351 detections). We then recorded their activity every 10 minutes at two sites (624 scans, 103.8 h of observation). Finally, we recorded their interactions by ad libitum observation (677 records). The egrets used mainly lawns (56.7% of detections), then waste dumps (27.6%) and bushes (15.7%). They stayed on the ground in 70.5% of scans. Feeding took about half of the scans (50.3%), ahead of movement (22.3%), resting (14.6%) and preening (8.0%). It peaked in the morning and in the afternoon. The activity budget changed with the site. On the lawns of site A, the egrets walked to search for prey. Near the food market and the waste dumps (site B), they pecked at food scraps, moved less and rested more. Site B also had the most interactions with humans (266 against 41). The egrets ate from plates and bathed in dishwater. These contacts create a potential health risk, which we did not test. We therefore recommend stronger hygiene in eating areas and a study of the health status of this population.

Keywords: Activity budget; Cattle Egret; *Bubulcus ibis*; Urban ecology; Human–wildlife interactions; Côte d'Ivoire

1 INTRODUCTION

Urbanization is one of the greatest pressures on global biodiversity. It transforms and fragments natural habitats [1, 2]. Cities cover about 3% of the land surface [3]. The share of the world population living in cities rose from 10% in 1900 to 50% around 2000, and the United Nations expects 66% in 2050 [4]. In tropical regions, this growth is fast and poorly controlled [5]. Urbanization changes biotic conditions (predation, food) and abiotic conditions (habitat, microclimate) [6]. Light, noise and chemical pollution make these changes worse [7, 8].

Faced with these pressures, some species disappear or leave the city. Others persist [9, 10]. Shochat *et al.* [6] call them "urban adapters" and "urban exploiters". They often change their behavior to survive in these sometimes hostile environments [11].

Birds are well represented in cities, from low-density districts to highly urbanized areas [8]. Their species richness often decreases, while the numbers of a few species increase [9]. These birds provide services: pollination, seed dispersal and insect control [12, 13]. But they can also disturb residents through noise, droppings and the risk of zoonoses [14, 15]. This coexistence is often conflictual [16].

The activity budget is the share of time an animal devotes to each activity during the day [17]. It shows how the animal manages its time and energy [18]. Combined with the study of interactions with humans, it helps to guide conservation strategies [16].

In Africa, few studies of this type exist in urban areas [19]. In Côte d'Ivoire, most ornithological work concerns protected areas [20–24]. A few recent studies deal with cities [25–27]. They mostly describe the richness and abundance of birds. The way of life of these birds and the risks linked to their presence are rarely examined.

The Cattle Egret *Bubulcus ibis* is a good model for this question. This species of Indo-African origin has colonized almost all continents in recent decades [28]. It is gregarious and uses meadows, lawns and even rubbish dumps [29, 30]. It associates with livestock and farm machinery to catch prey [31]. Its urban colonies are sometimes seen as a nuisance and may be persecuted [30].

The main objective of this study is to establish the activity budget of the Cattle Egret on the campus of Université Félix Houphouët-Boigny (UFHB, Abidjan). It has three specific objectives: (1) to identify the habitats used by the species; (2) to determine its activity budget by time of day and by site; (3) to describe interactions among egrets and with humans. We expected that: (i) lawns, rich in prey, would be the most used habitat; (ii) feeding would dominate the budget; (iii) the budget would differ between a lawn site and a site rich in human food scraps; (iv) contacts with humans would be more frequent near eating places.

2 MATERIALS AND METHODS

2.1 Study site

The study took place on the UFHB campus, in the Cocody district, east of Abidjan (5°20′33.9″ N; 3°59′13.7″ W). The campus covers about 200 ha. It is bounded to the north by François Mitterrand Boulevard, to the south by France Boulevard, to the west by the Cocody University Hospital and to the east by the Riviera 2 district (Figure 1).

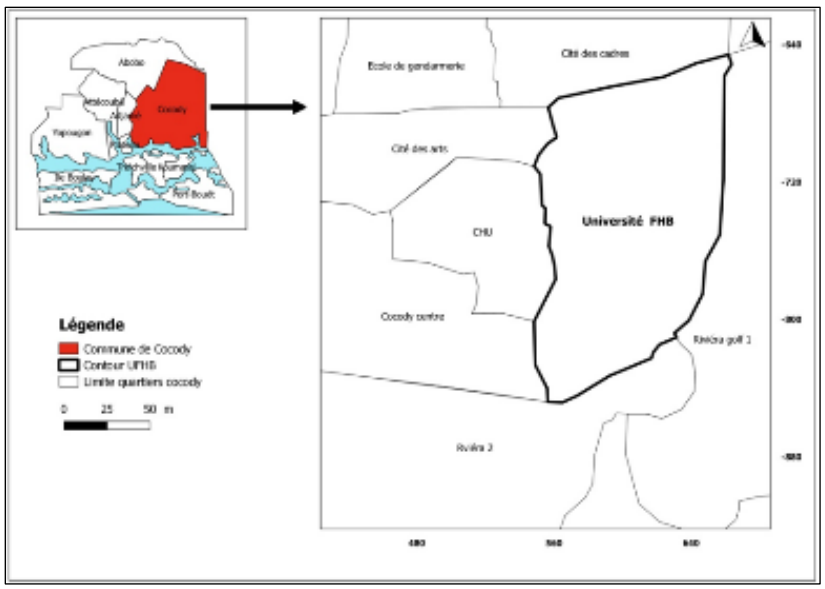


Figure 1: Location of Université Félix Houphouët-Boigny (UFHB) in the city of Abidjan.

The climate is subequatorial, with four seasons [32]. The long rainy season runs from March to July. The short dry season runs from August to September. The short rainy season covers October and November. The long dry season runs from December to February. In 2020, the mean monthly temperature ranged from 25.6 to 29.4 °C. Annual rainfall reached about 1,500 mm, with a maximum of 386 mm in June (CLIMATE-DATA.ORG).

The vegetation includes wooded areas: the Centre National de Floristique (445 plant species) [33], the forest relic in front of the UFR Biosciences and the undergrowth near the "Les Palmiers" restaurant. It also includes lawns, bushes and

cultivated plots. The fauna includes rodents [33], insects and earthworms [34]. The most frequent birds are the Pied Crow *Corvus albus*, the Black Kite *Milvus migrans* and the Cattle Egret [35]. Besides teaching, research and administration, the campus hosts restaurants, shops and cultural events. These activities produce a lot of food scraps.

2.2 Study species

The Cattle Egret *Bubulcus ibis* (Linnaeus, 1758) belongs to the order Pelecaniformes and the family Ardeidae. It is a small, stocky heron, 50 to 56 cm long, with a wingspan of 90 to 96 cm and a mass of 300 to 400 g [36]. The two sexes look alike. The plumage changes with season and age [37, 38]. The diet is mainly insectivorous [39, 40]. The species is classified as Least Concern on the IUCN Red List [41].

We follow the IOC nomenclature here. Depending on the source, the species is also named *Ardea ibis*, and the western and eastern forms are sometimes separated into two species.

2.3 Data collection

Fieldwork lasted 21 days, between 20 October and 19 December 2020. It had three parts: 6 days of spatial surveys, 5 days of preliminary observations and 10 days of behavioral records (from 1 November to 19 December). The preliminary observations were used to test observation techniques and to build the behavioral repertoire.

2.4 Walking surveys

To locate the egrets, we walked across the campus for 6 days. Each day had three surveys: morning (6:30–10:20), midday (10:30–14:20) and afternoon (14:30–18:20). We looked for direct signs (birds seen) and indirect signs (calls). Each occupied place was georeferenced with a Garmin GPS (GPSmap 76Cx). We also described the vegetation type and the human activity. Points were mapped with Google Earth Pro.

2.5 Choice of groups and sites

The Cattle Egret is used to human presence, so no habituation phase was needed. The species forms flocks of at least 10 individuals [29]. We followed groups of at least 10 individuals, including at least one adult. The birds were not marked. Two sites were chosen according to the frequency of observations during the surveys and to their characteristics (Table 1, Figure 2).

Table 1: Characteristics of the two observation sites.

Site	Coordinates	Zone	Vegetation	Human establishments	Human activities
A	5°21′ N; 3°59′ W	Built-up	Lawns	Teaching buildings, sports fields, paved tracks	Administration, sports, gardening, vehicle and pedestrian traffic
B	5°20′ N; 3°59′ W	Non-built	Bushes, trees, banana plants, cultivated plots	Food market, waste dump	Food trade

2.6 Scan sampling

Behavioral records lasted 10 days, from about 6:00 to 18:30, that is 10 to 12 h per day and 103.8 h in total. Each day, we started a few minutes after the first birds arrived at the site, or after we found a group already present. We waited 5 minutes to let the group settle. The preliminary observations tested intervals of 5, 10, 15 and 20 minutes. We kept 10 minutes, which gave 624 scans [42]. At each scan, we noted: (1) the time; (2) the activity of the majority of the group; (3) the vertical stratum occupied (ground, 1–10 m, more than 10 m), when the birds were not flying; (4) the vertical support (bare or grassy ground, human equipment, vegetation or air). Six activities were distinguished (Table 2). For analyses, the period of the day is morning (6:30–10:20), midday (10:30–14:20) or afternoon (14:30–18:20).

Table 2: Description of the sampled activities.

Activity	Sub-activity	Behavioral units
Feeding	Without foraging	The bird stays in place, pecks and swallows food.
Feeding	With foraging	The bird walks slowly over a short distance, rocks its neck and head to follow prey, and pecks to catch them.

Movement	Walking	Slow or fast steps, over short or long distances.
Movement	Flying	Movement through the air from one point to another, or hovering over the site.
Resting	–	Bird motionless, neck folded against the chest, eyes closed.
Preening	–	The bird cleans its feathers with its bill or feet.
Alert	–	Marked pause between two activities, neck raised and quivering, bird motionless and watchful.
Aggression	–	Aggressiveness, conflict, bill exchanges, chases.

2.7 Ad libitum observation

This method records events without time or target constraints [42]. We used it to record interactions that are rare or involve few individuals, which scans capture poorly. For each event, we noted the time, the behavior and its duration (smartphone stopwatch). In total, 677 records were made in 10 days. Interactions among egrets were classed as agonistic (conflicts, aggressiveness, chases) and non-agonistic. Interactions with humans were classed into five types (Table 7).

2.8 Data analysis

Each variable was expressed as a proportion, by period of the day and by site. We compared proportions with chi-square goodness-of-fit tests (hypothesis of equal proportions) and independence tests. The significance level is $\alpha = 0.05$. We report χ^2, degrees of freedom (df), sample size (N) and the P value. When expected counts were below 5, we checked the P value by permutation. Successive scans of the same group are not independent. P values are therefore indicative. Calculations were performed with Python (SciPy module).

3 RESULTS AND DISCUSSION

3.1 Use of space

3.1.1 Habitats used

The 351 detections made during the walking surveys cover the whole campus (Figure 2). Egrets were detected more often in the built-up zone than in the non-built zone. Lawns held 56.7% of detections (n = 199), waste dumps 27.6% (n = 97), and bushes, cultivated plots and wooded areas 15.7% (n = 55). These proportions differed ($\chi^2 = 93.74$; df = 2; N = 351; $P < 0.001$). Habitat use changed during the day (Table 3). Lawns dominated in the morning (78.4%) and in the afternoon (61.0%). Waste dumps dominated at midday (46.2%). This difference was clear ($\chi^2 = 64.90$; df = 4; N = 351; $P < 0.001$).

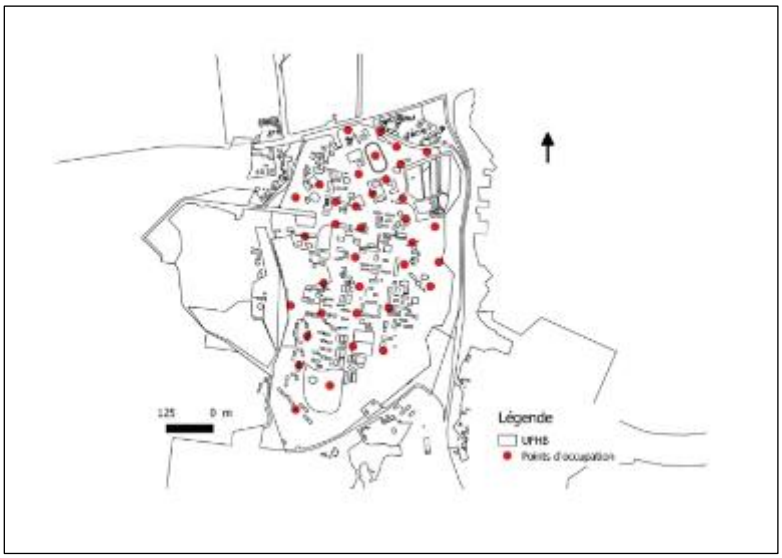


Figure 2: Spatial occupation of the Cattle Egret *Bubulcus ibis* on the UFHB campus. Red dots are the occupation points recorded during the walking surveys.

Table 3: Cattle Egret detections by habitat and period of the day, n (%).

Period	N	Lawns	Waste dumps	Bushes, crops, wooded areas
Morning	139	109 (78.4)	20 (14.4)	10 (7.2)
Midday	130	40 (30.8)	60 (46.2)	30 (23.1)
Afternoon	82	50 (61.0)	17 (20.7)	15 (18.3)
Total	351	199 (56.7)	97 (27.6)	55 (15.7)

The egrets were detected on lawns, in waste dumps and in bushes. These habitats resemble those described elsewhere in the range of the species [28, 43, 44]. Lawns were the most used. Several reasons are possible. Short grass makes prey accessible [45]. Lawns offer grasshoppers, butterflies and earthworms, usual prey of the species [43]. They are also abundant and regularly maintained by machines. Egrets willingly hunt behind tractors, which flush prey and save their energy [28, 29, 31]. Waste dumps are also known feeding sites [28, 46]. At site B, we observed that these scraps were most abundant at midday, when catering is at its peak. This is consistent with the peak of detections in waste dumps at that hour. One reservation is needed. Our detections measure an encounter frequency, not time spent. We did not measure the availability of each habitat. We therefore cannot conclude to a preference in the strict sense.

3.2 Vertical strata and supports

The egrets were at ground level in 70.5% of scans (n = 439). They were between 1 and 10 m in 11.1% of scans (n = 69) and above 10 m in 18.5% (n = 115) (χ^2 = 391.64; df = 2; N = 623; P < 0.001). The support was covered ground in 75.3% of scans with an identified support, vegetation in 16.6% and human equipment in 8.1% (χ^2 = 468.49; df = 2; N = 583; P < 0.001). Strata differed between sites (χ^2 = 97.68; df = 2; N = 618; P < 0.001; Table 4). At site A, 82.4% of scans were on the ground and only 3.3% above 10 m. At site B, 33.8% of scans were above 10 m. Human equipment was used as support in 20.2% of scans at site A, against 5.0% at site B. Vegetation support was almost absent at site A (0.9%) and frequent at site B (32.6%).

Table 4: Vertical strata occupied by site, n (%).

Stratum	Site A	Site B
Ground level	253 (82.4)	186 (59.8)
1 to 10 m	44 (14.3)	20 (6.4)
More than 10 m	10 (3.3)	105 (33.8)
Total	307	311

The egrets spent most scans on the ground. This is logical for a species that searches for prey on the ground. Upper strata are generally linked to nesting [47], and to resting or alertness in the face of predators [48]. At site B, the egrets often used plants as support. At site A, they used human equipment more. We noted few trees there and much human traffic [49]. The egrets used walls and roofs, perhaps in place of the trees they usually perch on [47]. We did not measure tree density.

3.3 Activity budget and differences between sites

Across all scans, feeding took 50.3% of observations: 32.9% with foraging and 17.5% without foraging (Table 5). Movement came next with 22.3% (walking 11.9%; flying 10.4%). Resting accounted for 14.6%, preening for 8.0% and alert plus aggression together for 4.8% (χ^2 = 220.58; df = 6; N = 624; P < 0.001).

The activity budget differed strongly between sites (χ^2 = 325.93; df = 6; N = 624; P < 0.001; Figure 3). At site A, the egrets fed only by foraging (55.4%) and moved a lot (35.8%). They rested little (3.9%). At site B, they fed mostly without foraging (34.4% against 11.0% with foraging). They moved little (9.1%). Resting (24.9%), preening (12.6%) and alert plus aggression together (7.9%) were higher there than at site A.

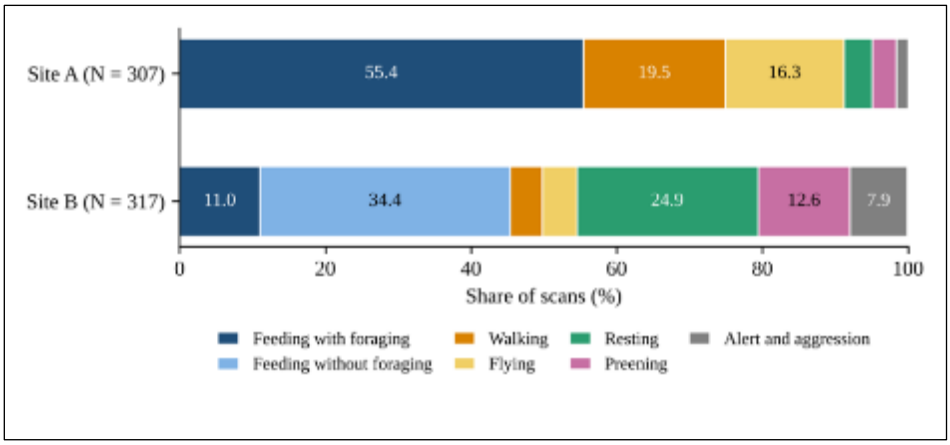


Figure 3: Activity budget of the Cattle Egret at the two sites (% of scans; site A, N = 307; site B, N = 317).

Table 5: Overall activity budget and budget by site, n (%) of scans.

Activity	Overall (N = 624)	Site A (N = 307)	Site B (N = 317)
Feeding with foraging	205 (32.9)	170 (55.4)	35 (11.0)
Feeding without foraging	109 (17.5)	0 (0.0)	109 (34.4)
Total feeding	314 (50.3)	170 (55.4)	144 (45.4)
Walking	74 (11.9)	60 (19.5)	14 (4.4)
Flying	65 (10.4)	50 (16.3)	15 (4.7)
Total movement	139 (22.3)	110 (35.8)	29 (9.1)
Resting	91 (14.6)	12 (3.9)	79 (24.9)
Preening	50 (8.0)	10 (3.3)	40 (12.6)
Alert and aggression	30 (4.8)	5 (1.6)	25 (7.9)

Feeding took about half of the scans, and movement 22%. Ojija [50] found a feeding time roughly equal to movement time. Birds must feed often to meet their energy needs [51]. In our case, movement is lower, and this comes mainly from site B. There, the egrets pecked at food scraps without moving. This feeding mode needs no search or capture of prey, so no neck and head movements [52]. At site A, the food is made of insects and worms that must be searched for and caught in the grass. Foraging is the only feeding mode there, with a lot of walking and flying. We can assume that human food reduces search effort. However, we did not measure energy expenditure.

The activity budget differs clearly between sites. At site A, resting is very low (3.9%). Egrets prefer to rest in trees taller than 10 m [47, 48], but such trees are rare at this site. At site B, resting is higher (24.9%). Trees there could also give shelter from diurnal raptors such as the Black Kite. These explanations remain hypotheses. The two sites differ in resources, trees and level of disturbance. With only two unreplicated sites, we cannot separate the effect of each factor.

3.4 Daily rhythm

The activity budget varied with the period ($\chi^2 = 215.68$; df = 12; N = 571; $P < 0.001$; Table 6, Figure 4). Feeding showed two peaks: 54.8% in the morning and 53.7% in the afternoon. It dropped at midday (47.5%). Foraging dominated in the morning (50.3%) and in the afternoon (44.4%). At midday, feeding without foraging dominated (41.1%). Movement fell from 31.7% in the morning to 6.3% at midday, then rose again to 27.1% in the afternoon. Resting (27.2%) and preening (15.2%) peaked at midday. Alert and aggression stayed low (1.5 to 5.1%).

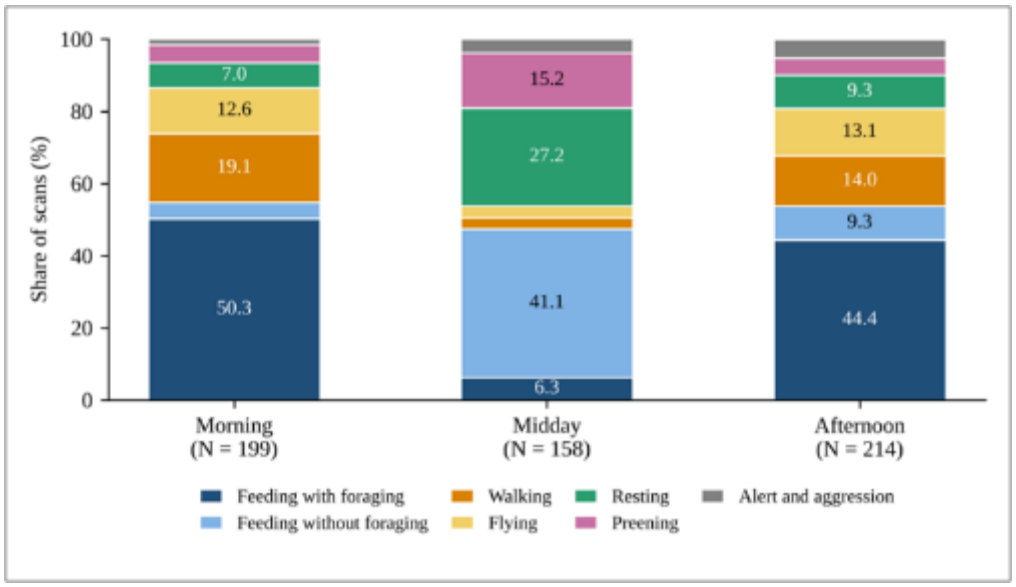


Figure 4: Activity budget of the Cattle Egret by period of the day (% of scans; morning, N = 199; midday, N = 158; afternoon, N = 214).

Table 6: Activity budget by period of the day, % of scans.

Activity	Morning (N = 199)	Midday (N = 158)	Afternoon (N = 214)
Feeding with foraging	50.3	6.3	44.4
Feeding without foraging	4.5	41.1	9.3
Total feeding	54.8	47.5	53.7
Walking	19.1	3.2	14.0
Flying	12.6	3.2	13.1
Total movement	31.7	6.3	27.1
Resting	7.0	27.2	9.3
Preening	5.0	15.2	4.7
Alert and aggression	1.5	3.8	5.1

Feeding has two peaks, one in the morning and one in the afternoon, and drops at midday. This pattern is described in the species by Siegfried [39], Brown *et al.* [53] and Ojija [50]. Egrets would avoid midday heat by resting in the shade [50]. Our data go in this direction: resting and preening are highest at midday. We did not measure temperature. Feeding nevertheless stays high at midday (47.5%). It changes form: foraging drops and feeding without foraging dominates. This coincides with the arrival of human food scraps at site B.

3.5 Interactions among egrets

We recorded 370 interactions among egrets. Agonistic interactions dominated: 295 (79.7%) against 75 non-agonistic interactions (20.3%) (χ^2 = 130.81; df = 1; N = 370; P < 0.001). All agonistic interactions lasted less than one minute. Among non-agonistic interactions, 28 lasted 1 to 10 minutes and 47 lasted more than 10 minutes. Agonistic interactions dominate (79.7%) and are short. They could come from competition for food. Tractors make prey available and attract high densities of egrets [28]. We saw these conflicts near tractors and at site B at midday. We did not quantify this. Human crowds could also make the birds more aggressive. *Ad libitum* observation favors visible, short events. The percentages therefore show the composition of the recorded interactions, not their real rate.

3.6 Interactions with humans and health risk

We recorded 307 interactions between egrets and humans, of five types (Table 7, Figure 5). Three types are indirect contacts (73.0% of interactions): feeding in restaurant plates and bins (45.0%), entering dishwater or hand-washing

water (24.8%) and feeding behind tractors (3.3%). Two types are disturbances by humans (27.0%). Voluntary disturbance (12.7%) occurs when a person chases the birds with a gesture. They then fly off fast and far. Involuntary disturbance (14.3%) occurs when a person passes near the group without a gesture. The birds then take an alert posture or move away with small steps, faster as the distance decreases. These five types were not equally frequent ($\chi^2 = 155.17$; df = 4; N = 307; P < 0.001).

Site B had 266 interactions (86.6%), against 41 (13.4%) at site A ($\chi^2 = 164.90$; df = 1; P < 0.001), with a similar observation effort (317 and 307 scans). The type of interaction depended on the site ($\chi^2 = 141.91$; df = 4; N = 307; P < 0.001 by permutation). At site B, 80.5% of interactions (214 of 266) were contacts with human food scraps. At site A, indirect contacts were limited to feeding behind tractors (n = 10). Disturbances were more numerous in absolute terms at site B (52) than at site A (31). But they made up 75.6% of the interactions at site A, against 19.5% at site B.



Figure 5: Examples of indirect contacts between Cattle Egrets and humans on the UFHB campus: (a) egret near a bag of produce and discarded bananas; (b) egret with its bill in a bucket; (c) egret perched on dish basins.

Table 7: Interactions between egrets and humans by site, n.

Type of interaction	Site A	Site B	Total	%
Feeding in plates and bins	0	138	138	45.0
Entering dishwater and hand-washing water	0	76	76	24.8
Feeding behind tractors	10	0	10	3.3
Voluntary disturbance	12	27	39	12.7
Involuntary disturbance	19	25	44	14.3
Total	41	266	307	100

Indirect contacts make up 73.0% of interactions with humans. Almost all are at site B, near eating places. We saw egrets climb on tables, eat from plates and bathe in dishwater. The Cattle Egret can carry several pathogens: West Nile virus [54, 55], bacteria of the genus *Chlamydia* [56, 57], Newcastle disease virus [57] and haemosporidians [58]. It also carries ectoparasites [59, 60]. Cases of transmission to humans are rare [57]. But many contacts between humans and wildlife increase exposure to zoonoses [61]. Droppings and feathers left in plates or water could therefore expose consumers. We did not sample birds or food. The risk remains potential.

Disturbance by humans makes up 27.0% of interactions. A disturbance stops the current activity. The bird resumes it a few minutes, or even a few hours, later [49]. It could therefore reduce foraging efficiency. We did not study reproduction, and we cannot say anything about its effect on chicks.

4 CONCLUSION

On the UFHB campus, the Cattle Egret divides its time according to the resources of each site, and its contacts with human food scraps create a potential health risk. Feeding takes about half of the scans and shows two peaks, in the morning and in the afternoon. On lawns, the egrets search for prey by walking. Near eating places and waste dumps, they peck at scraps, move less and rest more. Contacts with humans are mostly indirect (73.0%) and concentrated at site B. We recommend stronger hygiene in shops and eating places (closed bins, protected food and dishwater). The aim is to limit contacts between birds and food.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

This study was observational. The birds were observed from a distance and were not captured, marked, handled or otherwise manipulated.

REFERENCES

[1] Marzluff JM. Worldwide urbanization and its effects on birds. In: Marzluff JM, Bowman R, Donnelly R (eds) Avian Ecology and Conservation in an Urbanizing World. Springer, Boston, pp 19–47; 2001.

[2] McKinney ML. Urbanization, biodiversity, and conservation. BioScience. 2002;52(10):883–90.

[3] Aronson MFJ, La Sorte FA, Nilon CH, Katti M, Goddard MA, Lepczyk CA, et al. A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. Proc R Soc B. 2014;281:20133330.

[4] United Nations. World urbanization prospects: the 2014 revision. United Nations, New York; 2014.

[5] UNEP-WCMC. L'État de la biodiversité en Afrique : examen à mi-parcours des progrès réalisés vers l'atteinte des Objectifs d'Aichi. UNEP-WCMC, Cambridge, 112 p; 2016.

[6] Shochat E, Warren PS, Faeth SH, McIntyre NE, Hope D. From patterns to emerging processes in mechanistic urban ecology. Trends Ecol Evol. 2006;21(4):186–91.

[7] Longcore T. Sensory ecology: night lights alter reproductive behavior of blue tits. Curr Biol. 2010;20(22):R893–R895.

[8] Demeyrier V. Habitats urbanisés : des pièges écologiques potentiels pour les oiseaux sauvages ? Thèse de doctorat, Montpellier SupAgro, 198 p; 2016.

[9] Clergeau P, Croci S, Jokimäki J, Kaisanlahti-Jokimäki M-L, Dinetti M. Avifauna homogenisation by urbanisation: analysis at different European latitudes. Biol Conserv. 2006;127:336–44.

[10] Adams CE, Lindsey KJ. Anthropogenic ecosystems: the influence of people on urban wildlife populations. In: Urban Ecology. Oxford University Press, pp 116–128; 2011.

[11] Isaksson C. Urbanization, oxidative stress and inflammation: a question of evolving, acclimatizing or coping with urban environmental stress. Funct Ecol. 2015;29(7):913–23.

[12] Whelan CJ, Sekercioglu CH, Wenny DG. Why birds matter: from economic ornithology to ecosystem services. J Ornithol. 2015;156:222–38.

[13] BirdLife International. L'État des oiseaux de l'Afrique 2017 : indicateurs pour notre environnement en mutation. Partenariat africain de BirdLife International, Nairobi, 46 p; 2018.

[14] Clergeau P, Erstinlingot D, Chaperon J, Lerat C. Difficultés de cohabitation entre l'homme et l'animal : le cas des concentrations d'oiseaux en site urbain. Natures Sciences Sociétés. 1996;4(2):102–15.

[15] Parodi AL, Pilet C. Animaux de la ville et santé publique. Bull Acad Natl Méd. 2002;186(2):541–68.

[16] Berthier A. Oiseaux urbains ? Les conditions d'une cohabitation humains-animaux dans le Grand Paris. Thèse de doctorat en Géographie, Université Paris 1 Panthéon-Sorbonne, Paris, 437 p; 2019.

[17] Jaman MF, Huffman MA. Enclosure environment affects the activity budget of captive Japanese macaques (Macaca fuscata). Am J Primatol. 2008;70(12):1133–44.

[18] Defler TR. The time budget of a group of wild woolly monkeys (Lagothrix lagotricha). Int J Primatol. 1995;16(1):107–20.

[19] Lee ATK, Ottosson U, Jackson C, Shema S, Reynolds C. Urban areas have lower species richness, but maintain functional diversity: insights from the African Bird Atlas Project. Ostrich. 2021;92(1):1–15. https://doi.org/10.2989/00306525.2021.1902876

[20] Thiollay JM. L'avifaune de la région de Lamto (moyenne Côte d'Ivoire). Ann Univ Abidjan, Sér E, Écologie. 1971;4:4–132.

[21] Lachenaud O. Les oiseaux de la région de Sassandra, Côte d'Ivoire. Malimbus. 2005;28:18–34.

[22] Yaokokoré-Béibro KH. Diversité avifaunique de la forêt classée de la Besso, Sud-est de la Côte d'Ivoire. Sci Nat. 2010;7(2):207–19.

[23] Yaokokoré-Béibro KH, Kouadio KP, Assa ES, Konan ME, Odoukpé KSG. Diversité des oiseaux du sous-bois du Parc National du Banco, Abidjan (Côte d'Ivoire). Rev Ivoir Sci Technol. 2014;24:196–212.

[24] Okon MO, Konan EM, Kouadio KP, Yaokokoré-Béibro KH. Diversité et distribution des Touracos (Musophagidae) dans quelques milieux naturels du Centre et du Sud-est de la Côte d'Ivoire. Int J Biol Chem Sci. 2018;12(4):1851–64.

[25] Yaokokoré-Béibro KH, Koné SY, Odoukpé SGK, Guèye FM. Avifaune d'un milieu marécageux urbain dans la commune de Cocody (Abidjan, Côte d'Ivoire). Int J Innov Sci Res. 2015;8(1):1–10.

[26] Zean GM, Ahon DB, Koffi BJ-C. Peuplement avifaunique du Campus Universitaire Jean Lorougnon Guédé, Daloa et sa périphérie (Centre-Ouest de la Côte d'Ivoire). Int J Biol Chem Sci. 2018;12(6):2503–18.

[27] Niamien CJM, Konan EM, Odoukpé KSG, Yaokokoré-Béibro KH, N'Goran KE. Premières données sur les variations saisonnières de la communauté d'oiseaux du barrage urbain de Koko (Korhogo, Côte d'Ivoire). J Anim Plant Sci. 2019:6926–39.

[28] Franchimont J. Les causes de l'expansion géographique mondiale du Héron garde-bœufs (Bubulcus ibis L.). Cah Ethol Appl. 1986;6(4):373–88.

[29] Del Hoyo J, Elliott A, Sargatal J. Handbook of the Birds of the World, vol 1: Ostrich to Ducks. Lynx Edicions, Barcelona; 1992.

[30] Kushlan JA, Hancock JA. The Herons. Oxford University Press, Oxford, 454 p; 2005.

[31] Seedikkoya K, Azeez PA, Shukkur EAA. Cattle Egret Bubulcus ibis habitat use and association with cattle. Forktail. 2005;21:174–6.

[32] Eldin M. Le climat. In: Le milieu naturel de Côte d'Ivoire. ORSTOM, Paris, pp 73–108; 1971.

[33] Kouamé APS. Diversité végétale et estimation de la biomasse dans l'arboretum du Centre National de Floristique (Abidjan, Côte d'Ivoire). Mémoire de DEA d'Écologie tropicale, UFR Biosciences, Université Félix Houphouët-Boigny, 66 p; 2012.

[34] Kassi N'J. Étude descriptive de quelques angiospermes ligneuses ivoiriennes du jardin botanique du Centre National de Floristique de l'Université de Cocody-Abidjan. Mémoire de DEA de Botanique, UFR Biosciences, Université de Cocody-Abidjan, 93 p; 2001.

[35] Kpangui KB. Apport des systèmes d'information géographique à l'étude de la diversité spécifique de l'arboretum du Centre National de Floristique de l'Université de Cocody-Abidjan. Mémoire de DEA d'Écologie tropicale, 62 p; 2009.

[36] Duquet M, Maurin H. Inventaire de la faune de France : vertébrés et principaux invertébrés. Nathan et Muséum national d'Histoire naturelle, Paris; 1992.

[37] Siegfried WR. Plumage and moult of the Cattle Egret. Ostrich. 1971a;42:153–64.

[38] Krebs EA, Hunte W, Green DJ. Plume variation, breeding performance and extra-pair copulations in the Cattle Egret. Behaviour. 2004;141(4):479–99.

[39] Siegfried WR. The food of the Cattle Egret. J Appl Ecol. 1971b;8:447–68.

[40] Bredin D. Le régime alimentaire du Héron garde-bœufs à la limite de son expansion géographique. Rev Ecol (Terre Vie). 1984;39:431–45.

[41] BirdLife International. Bubulcus ibis (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019; 2019. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22697109A155477521

[42] Altmann J. Observational study of behaviour: sampling methods. Behaviour. 1974;49(3–4):227–67.

[43] Bredin D. Contribution à l'étude écologique d'Ardeola ibis : Héron garde-bœufs de Camargue. Thèse de doctorat, Université Paul Sabatier, Toulouse III, 315 p; 1983.

[44] Beaudoin JC. Dispersion inter-nuptiale du Héron garde-bœufs Bubulcus ibis en Maine-et-Loire. Crex. 2015;13:59–64.

[45] Pierron V. Pelouses et coteaux secs… Paysages, biodiversité et pastoralisme. Les cahiers techniques, Conservatoires Rhône-Alpes des espaces naturels, 40 p; 2012.

[46] Boukhemza M, Doumandji S, Voisin C, Voisin JF. Disponibilités des ressources alimentaires et leur utilisation par le Héron garde-bœufs Bubulcus ibis en Kabylie, Algérie. Rev Ecol (Terre Vie). 2000;55:361–81.

[47] Hafner H. À propos d'une population de Hérons garde-bœufs Ardeola ibis en Camargue. Alauda. 1980;38(4):249–54.

[48] Siegfried WR. Habitat and the modern range expansion of the Cattle Egret. Wading Birds, Res Rep Natl Audubon Soc. 1978;7:315–24.

[49] Le Corre N. Le dérangement de l'avifaune : état des lieux d'une problématique devenue incontournable sur les espaces naturels protégés de Bretagne. Actes du colloque international pluridisciplinaire « Le littoral : subir, dire, agir », Lille, 13 p; 2008.

[50] Ojija F. Ecology and influence of age and habitat on the diurnal activity patterns of Cattle Egret (Bubulcus ibis). Int J Sci Technol Res. 2015;4(12):107–11.

[51] Bonter DN, Zuckerberg B, Sedgwick CW, Hochachka WM. Daily foraging patterns in free-living birds: exploring the predation–starvation trade-off. Proc R Soc B. 2013;280:20123087. https://doi.org/10.1098/rspb.2012.3087

[52] Selmane A. Structure et étude écologique du Héron garde-bœufs (Bubulcus ibis) dans la région de Tébessa (Est algérien). Magistère de Biologie, Université Larbi Tébessi, Tébessa, 145 p; 2012.

[53] Brown LH, Urban EK, Newman K. The Birds of Africa, vol I. Academic Press, London; 1982.

[54] Doctrinal D. Analyse épidémiologique spatiale et temporelle des zoonoses émergentes. Exemple : modèle de propagation de la fièvre du Nil occidental. Thèse de doctorat vétérinaire, École Vétérinaire de Lyon, 98 p; 2004.

[55] Doctrinal D, Bicout D, Gauthier-Clerc M, Artois M, Sandez A, Sabatier P. Rôle des oiseaux dans l'écologie de la fièvre du Nil occidental : exemple du Héron garde-bœufs en Camargue. Environ Risques Santé. 2005;4(2):101–8.

[56] El-Jakee J, Oman KM, Ezzelden AN, Ali AH, Mostafa RE. Chlamydia species in free-living cattle egret (Bubulcus ibis) and hoopoe (Upupa epops) in Egypt. Int J Vet Sci Med. 2014;2:1–6.

[57] Phouratsamay A. Précision du statut sanitaire des hérons garde-bœufs (Bubulcus ibis) présents dans le sud-ouest de la France en 2016 et 2017 vis-à-vis de virus de l'influenza aviaire, de virus de la maladie de Newcastle, de Mycoplasma gallisepticum et de Chlamydia spp. Thèse de doctorat vétérinaire, École Nationale Vétérinaire de Toulouse, 111 p; 2018.

[58] Villar Couto CM, Cumming GS, Lacorte GA, Congrains C, Izbicki R, Braga EM, et al. Avian haemosporidians in the cattle egret (Bubulcus ibis) from central-western and southern Africa: High diversity and prevalence. PLoS ONE. 2019;14(2):e0212425. https://doi.org/10.1371/journal.pone.0212425

[59] Abdessamed A. Identification des ectoparasites chez le Héron garde-bœufs Bubulcus ibis dans deux sites d'Oum-El-Bouaghi. Magistère de Biologie, Université L'arbi Ben M'hidi, Oum El Bouaghi, Algérie, 95 p; 2014.

[60] Kisasa KR, Bansomire C, Malekani D. Ectoparasites (Phthiraptera) de quelques oiseaux de Kinshasa. Malimbus. 2020;42:1–6.

[61] Mackenstedt U, Jenkins D, Romig T. The role of wildlife in the transmission of parasitic zoonoses in peri-urban and urban areas. Int J Parasitol Parasites Wildl. 2015;4(1):71–9. https://doi.org/10.1016/j.ijppaw.2015.01.006