World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Perception of the local population of the forest relics and agrosystems of the regions of Haut-Sassandra and Marahoue on the Avifauna (Centre-West, Cote d'Ivoire)

Gninin té Maxime ZEAN *, Dibié Bernard AHON, Okon Modeste OKON and Béné Jean-Claude KOFFI

Department of Biodiversity and Sustainable Conservation of Ecosystems, Faculty of Biodiversity and sustainable ecosystem management, Jean Lorougnon GUEDE University, Cote d'Ivoire.

World Journal of Advanced Research and Reviews, 2025, 25(03), 1493-1505

Publication history: Received on 18 January 2025; revised on 20 March 2025; accepted on 22 March 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.25.3.0655

Abstract

Man is an essential link in the modification of landscapes. Over the centuries, man has shaped his environment through the use of land and natural resources. All these practices have led, in one way or another, to the erosion of wildlife resources. In order to reverse this trend, it is vital to understand how birdlife is perceived by people living near forest relics and agrosystems in the Haut-Sassandra and Marahoué regions. To achieve this, the methodology employed involved individual and group interviews using structured questionnaires. A total of 69 peoples from Bété (22 individuals) and Baoulé (47 individuals) ethnic groups were interviewed. The study revealed that birdlife is used for a variety of purposes, including food (86.97%), commercial (27.54%), magico-religious (7.24%) and medicinal (7.24%). Mann Whitney test revealed that the use of species did not depend on ethnicity ($p = 0.97$). Skin and meat were the most commonly used organs in the medicinal category (VUx = 3). Our studies showed that organ use did not vary according to the ethnicity ($p = 0.179$), sex ($p = 0.240$) or age ($p = 0.513$) of the respondent. In addition, the value of the respondent's diversity of use index was low (UD = 0.43 < 0.5). This means that the vast majority of respondents have little knowledge of the different uses made of birds. This knowledge is well distributed among respondents (EU = 0.93 > 0,5). This study has thus generated useful information that could opinion for decision-making in favour of the community conservation biodiversity of forest fragments.

Keywords: Avifauna; Forest Relics; Ethno-Ornithological Knowledge; Côte d'Ivoire; Wilderness

1. Introduction

The growing poverty of the populations living near forest relics is forcing them to exert strong pressure on natural resources. While the populations of Western countries pollute the environment with greenhouse gases, those of the tropics, and Africa in particular, degrade it through deforestation [1], the abusive use of fertilisers (herbicides and pesticides) in agrosystems [2] and poaching in protected areas. This pressure on forests and soils could ultimately lead to the disappearance of certain animal and plant species, resulting in a loss of biodiversity [1]. Birds are no exception. Indeed, they are increasingly sought after as a source of animal protein by local populations, due to the fact that the fauna of large mammals is almost totally eradicated outside national parks [3]. The process of combating the destruction of biodiversity is therefore of the utmost importance in ensuring that it is properly managed to ensure the well-being of present and future generations.

In Côte d'Ivoire, people value bird resources in different ways : spiritually, economically, aesthetically, culturally and scientifically [4 ; 5]. Conflicts between people and wildlife, particularly those involving birds, exist in all regions of the country [6]. Birds are perceived as devastators of cereal crops, hampering farmers' ability to improve their yields [7 ; 8]. However, bird life is important for a number of ecological, economic, social and cultural reasons [9 ; 10]. Today, this

* Corresponding author: Gninin té Maxime ZEAN

situation poses a real conservation problem. Uncontrolled harvesting of avifauna is leading to the displacement or even extinction of certain species [11]. Birds are trapped and shot in the forest relics and agrosystems of Côte d'Ivoire in general and in the Haut-Sassandra and Marahoué regions in particular. Local perception is an essential approach for studying biodiversity and ecosystem degradation [12 ; 5 ; 9]. It also guarantees local acceptance of development perspectives and strategies. The existing ethno-ornithological study in the Marahoué region [9] focuses on knowledge of habits and customs with a view to understanding the role of birds in the education of children among the Gouro people.

The aim of this study is to find out how people living near forest relics and agrosystems in the Haut-Sassandra and Marahoué regions perceive birdlife, according to socio-cultural group, age and sex, with a view to reducing pressure on birds and their ecosystems.

2. Materials and methods

2.1. Study site

The study was carried out in central-western Côte d'Ivoire, in three forest relics in the Haut-Sassandra and Marahoué regions (RHSM). These were the classified forest of Tos (FCT) in the Marahoué region, the classified forest of Bouaflé (FCB) straddling the Marahoué and Haut-Sassandra regions and the village forest of Gbétitapéa (FVG) in the Haut-Sassandra region (Figure 1).

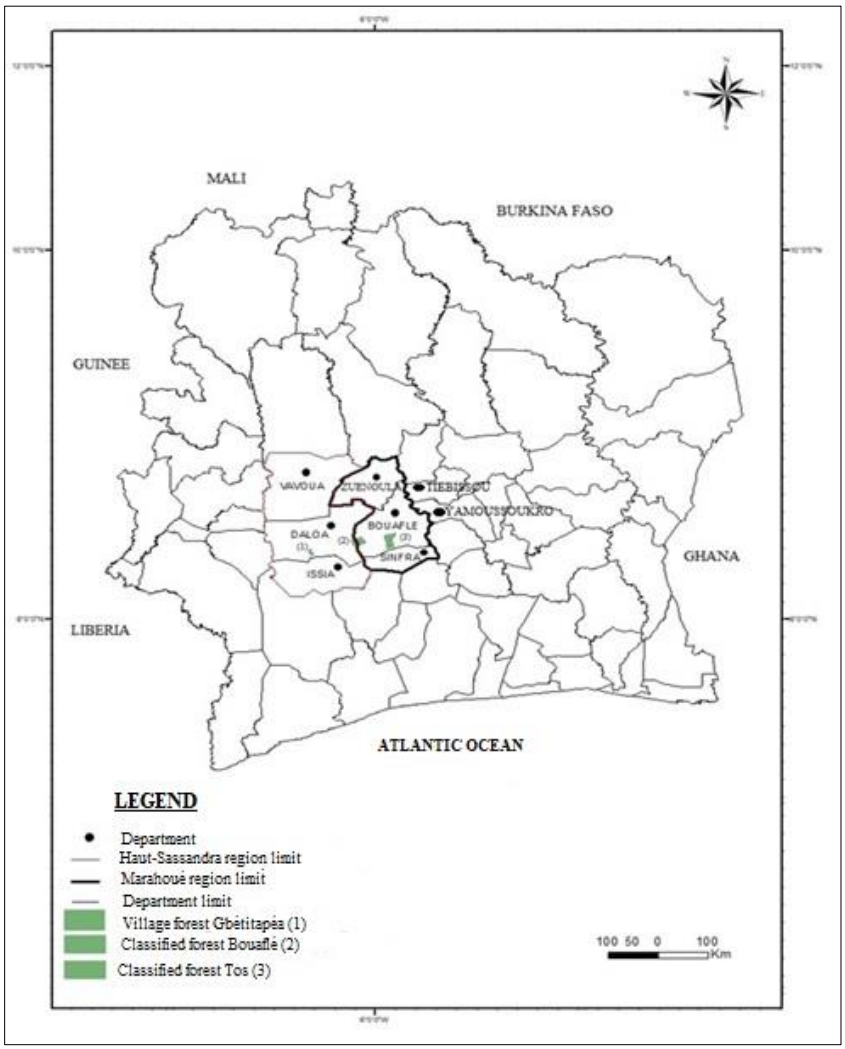

Figure 1 Map of study areas and sites

The Haut-Sassandra region has a humid tropical climate and is characterised by two seasons of unequal length. Average annual rainfall is between 1,200 mm and 1,600 mm [13 ; 14 ; 15 ; 16]. Hydrographically, the region is under the influence of the Sassandra River and its tributaries (Lobo and Davo) and the Buyo dam lake. The shape of the region is monotonous and the landscape is made up of vast, gently undulating peneplains. The Haut-Sassandra region has favourable natural conditions for agricultural development. As a result, the region has many assets, not only for food production, but also for its tourism potential.

As for the Marahoué region, its vegetation comprises semi-deciduous dense rainforest and mosaics of forest and savannah, characteristic of the 'V baoulé' [17 ; 18]. Wooded savannah predominates in open landscapes [19]. The relief of the region is relatively flat, consisting of low plateaux with a few low-lying areas and hills with an average altitude of 260 m. The climate is Baoulean and characterised by two seasons. The dry season runs from november to March and the rainy season begins in April and ends in october [20]. The region is drained by the red Bandama river, which acts as a natural border to the east, then the Marahoué river, which crosses most of the study area, and the Baha, Ouréné, Bôlè, Zabré, Bouré, Dromonyi, Houda and Tenére rivers. The topography of the study area is relatively flat. It is made up of low plateaux with a few shallows and hills with an average altitude of 260 m.

2.2. Methods

2.2.1. Data collection

Data collection took place from 10 april to 22 may 2020. Contacts were made with local people (the chiefdom, women and young people [21] in order to identify the various resource persons [22]). In order to collect reliable information, the minimum age for a respondent was 18. According to Côte d'Ivoire legislation, this age corresponds to the physical and cultural maturity required for a person to answer questions. Age was classified according to [23]. A distinction was made between young people (aged 18 to 40), the 'young-old' (aged 40 to 50) and the 'old-old' (aged over 50). The localities were chosen on the basis of their accessibility, their proximity to the forests and their particularity in terms of the presence of socio-cultural groups.

The data was collected on the basis of individual and group interviews administered using structured questionnaires. The main data collected concerned the socio-professional characteristics of the respondents, the use of birds, the use of different bird organs, threats and hunting and capture pressures. This is often preceded by the identification of birds using an identification guide [24] by the people surveyed.

This sampling involved five villages:

In the Tos Classified Forest (FCT), the survey was carried out in the villages of Nangrékro and Akoviébo. The composition of the people interviewed was as follows : 10 farmers, two hunters, two traders and one student.

- Within the Bouaflé Classified Forest (FCB), the survey was carried out in the Kouassi-Abékro camp and in the SODEFOR camp.
- The peoples interviewed were made up of : 23 farmers, four hunters, four traders, one village authority (Nangrékro village chief), one farmer and one civil servant (forestry officer).
- In the Village Forest, the village of Gbétitapéa was surveyed. Nine farmers, four schoolchildren, two hunters, two shopkeepers, two housewives and a village authority (chief of the village of Gbétitapéa) were interviewed.

A total of 69 peoples were randomly surveyed in the five localities (Nangrékro, Akoviébo, Kouassi-Abékro, SODEFOR camp and Gbétitapéa). Two socio-cultural groups characterise these villages. These are the 'Baoulé' and the 'Bété'.

The main points of the questionnaire concerned

- general knowledge of game birds (vernacular and/or local names, current availability) ;
- the different ways in which wild birds are used by local populations (medicinal, commercial, cultural, ornamental, decorative, food, etc.) ;
- the organs (feather, bone, egg, skull, skeleton, leg, claw, blood, live specimen, etc.) used by local people ;
- the use values per organ of the species : these were assessed using an organ use score.

The assessment grid used is : 3 = organ heavily used; 2 = organ moderately used; 1 = organ lightly used. This scale is left to the discretion of the respondents.

2.2.2. Data processing

The information sought concerned the socio-professional characteristics of the respondents and the different uses made of the birds. The following ethno-ornithological indices were then calculated.

- ✓ *Frequency of citation (FC)*

The frequency with which a usage category is cited is expressed as follows :

$$FC = 100 * \frac{n}{N}$$

FC : frequency of quotation; n: number of people who gave a positive response (Yes) for the usage category; N: total number of people interviewed. It measures the diversity of uses by the population and varies from 0 to 100. A value of 0 indicates that the use category is not used and 100 indicates that birds are used extensively in the use category [25].

- ✓ *Usage value (VUx)*

The use values of each organ were calculated. After processing the ethno-ornithological survey forms, an Excel spreadsheet database was created. The use value of the organs and certain parts was calculated for each category [26].

$$VUx = \frac{\sum_1^p Si}{N}$$

Vux : is the use value of birds for a given category ; N : is the number of respondents for a use category ; Si : is the use score attributed by respondents. The advantage of the use value is that it can be used to determine in a meaningful way which bird organ has a high use value for the local community [27 ; 28].

The data were grouped by age class and assessed using the Kruskal-Wallis test (1-criterion ANOVA, with a probability of 5%) under STATISTICA 7.1 software to compare differences in knowledge or use of organs between villages. Non-parametric Mann-Whitney tests were also used to compare differences in species use by ethnic group and gender.

- ✓ *Diversity of Use Index (UD)*

The diversity of use index (UD) from [29] is the ratio of the number of uses reported by category (food, medicinal, etc.) (Ucx) to the total number for all use categories (Uct).

$$UD = Ucx/Uct$$

This index measures the importance of the use categories and indicates how they contribute to the total use value [29]. Its value varies between 0 and 1. It is low if UD < 0.5 and high if UD > 0.5.

- ✓ *Equitable use (EU)*

The value of the equitability of uses (EU) is the value of the diversity of uses (UD) divided by the value of the maximum diversity (UDmax) [29].

$$EU = \frac{UD}{UDmax}$$

This index measures the degree of homogeneity of knowledge about use categories [29]. The equitability of use index lies between 0 and 1. If EU < 0.5, then information on birdlife is not equitably distributed among the respondents. If EU = 0.5, then equitability is average. If EU > 0.5, the information is well distributed among the respondents.

3. Results

3.1. Local nomenclature for a number of bird species in the study area

The local name of a bird species around the sites varies from one socio-cultural group to another. Table 1 shows the local designations of some bird species given by the ethnic groups surveyed (Bété and Baoulé).

Table 1 Local designations of some 'game' bird species by the ethnic groups surveyed (Baoulé and Bété)

	Species		
Ethnic group	**Common name**	**Scientific name**	**Local name**
Bété	Senegal Coucal	*Centropus senegalensis*	*Zouzou*
	African Pied Hornbill	*Lophoceros semifasciatus*	*Copéhi*
	White-faced Whistling Duck	*Dendrocygna viduata*	*Labou*
	Black-shouldered Kite	*Milvus aegyptius*	*Tchètchè*
	Village Weaver	*Ploceus cucullatus*	*Tazra*
	Pied Crow	*Corvus albus*	*Kamlan*
	Barn Owl	*Tyto alba*	*Gbizi*
	Double-spurred Spurfowl	*Pternistis bicalcaratus*	*Ziawonlon*
	Timneh Parrot	*Psittacus timneh*	*Sla*
	Red-eyed Dove	*Streptopelia semitorquata*	*Biossou*
Baoulé	Senegal Coucal	*Centropus senegalensis*	*Blékou*
	African Pied Hornbill	*Lophoceros semifasciatus*	*Aviéman*
	White-faced Whistling Duck	*Dendrocygna viduata*	*Laboulabou*
	Black-shouldered Kite	*Milvus aegyptius*	*Asri*
	Village Weaver	*Ploceus cucullatus*	*N'djôlè*
	Pied Crow	*Corvus albus*	*Abédékouassi*
	Barn Owl	*Tyto alba*	*Akpatoué*
	Double-spurred Spurfowl	*Pternistis bicalcaratus*	*Ahokô*
	Timneh Parrot	*Psittacus timneh*	*Akô*
	Red-eyed Dove	*Streptopelia semitorquata*	*Okômô*

3.2. Forms of use of birds by local populations

The populations surveyed appreciate biological resources in different ways. The peoples surveyed listed four uses for birds. These were sale in the form of bushmeat, consumption in the form of bushmeat, medicinal use and magico-religious use. Table 2 shows the different proportions of respondents from the Bété and Baoulé ethnic groups in each of these areas of use. Examination of this table shows that food use was mentioned most by all respondents (86.97%), followed by sale (27.54%). Medicine and magico-religious use were mentioned less frequently, with proportions of 7.24% each. Among the Baoulé ethnic group, birds are hunted primarily for consumption (86.36%). However, they are little used for magico-religious practices (9.09%). As for the Bété ethnic group, food use was mentioned in the majority of cases (87.23%), while medicine was mentioned only slightly (2.13%). The Mann Whitney test shows that the use of species does not depend on ethnicity ($p = 0.97$). In other words, there were no significant differences between the two ethnic groups in the areas of use of bird species. The parts most frequently mentioned by respondents were skin and meat (66.67%), eggs (55.07%) and the whole animal (42.03%). However, organs such as the head, feathers and legs were mentioned less frequently by respondents, with citation values of 20.29%, 18.84% and 18.84% respectively (Figure 2).

Table 2 Frequency of citing areas of use by ethnic group, Bété (N = 22 individuals) ; Baoulé (N = 47 individuals)

Use	Proportion of respondents (%)	Bété (%)	Baoulé (%)
Commercial	27.54	18.18	31.91
Food	86.97	86.36	87.23
Magico-religious	7.24	9.09	6.38
Medicinal	7.24	18.18	2.13

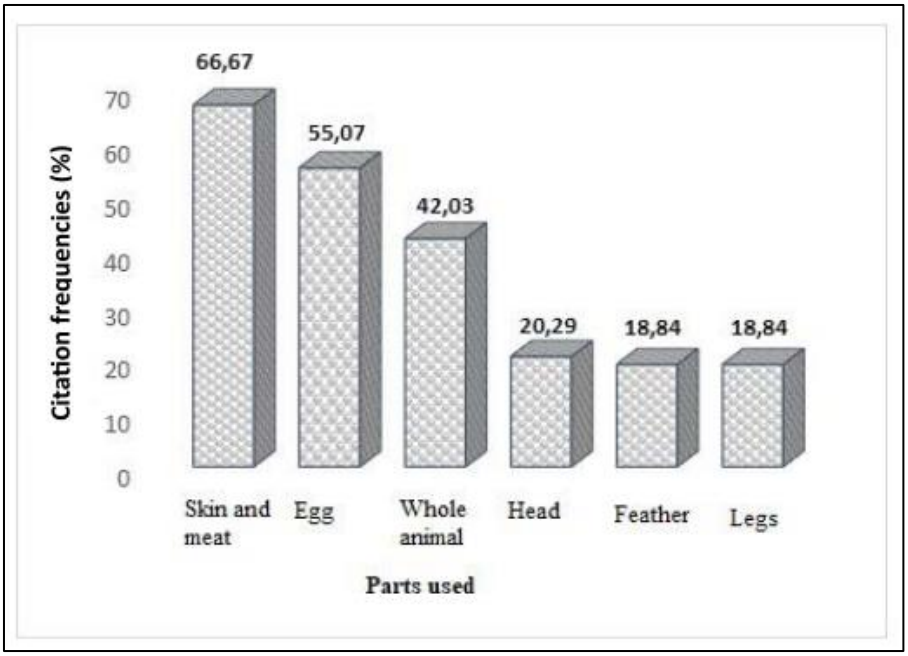

Figure 2 Parts used and frequency of use

3.3. Breakdown of respondents by age, sex and occupation

69 peoples surveyed were unevenly distributed according to socio-professional characteristics (Table 3). In terms of age, the majority (49.27%) were aged between 18 and 40. In terms of gender, men (71.01%) were more likely to be interviewed, and in terms of socio-professional category, farmers (60.87%) were more likely to be involved.

Table 3 Socio-professional characteristics of respondents

Respondents	Staff	Frequency (%)
18 years ≤ X ≤ 40 years	34	49.27
40 years < X ≤ 50 years	21	30.43
X > 50 years	14	20.29
Men	49	71.01
Women	20	28.98
Farmers	45	60.87
Hunters	8	11.59
Others *	16	27.54

* **:** Shopkeepers, civil servants, village authorities, farmers, schoolchildren and housewives

3.4. Ethno-ornithological use values for the four use categories

Table 4 shows the ethno-ornithological use values within four use categories (commercial, food, magico-religious and medicinal). Organs with higher use values are considered to be highly used. Analysis of Table 4 shows that skin and meat are the most widely used organs in the medicinal, food and magico-religious categories. In the commercial and magico-religious category, it is the whole animal that is used the most.

Table 4 Ethno-ornithological use values of bird species within four use categories

	Ethno-ornithological use values			
Parts of the bird	Commercial	Food	Magico-religious	Medicinal
Skin + meat	1	2	2	3
Eggs	1.07	1.13	0.5	0
Whole animal	2.12	1.26	2	2
Head	0.07	1	1.5	1
Feathers	1	0	1	2
Legs	2	1	0	1

3.5. Ethno-ornithological use values by gender

Table 5 shows the ethno-ornithological use values according to the sex of the surveys. Analysis of Table 5 shows that skin and meat are the most popular with men, followed by the whole animal, then the head and eggs. For women, skin and meat are also the most popular, followed by feathers and legs, then heads and whole animals. The Mann Whitney test carried out on the gender of the respondents revealed that there was no significant difference between the ethno-ornithological use values according to the gender of the respondents ($p = 0.240$).

Table 5 Use values of bird species by sex of respondents

	Ethno-ornithological use values	
Parts of the bird	Men	Women
Skin + meat	3.22	2.29
Eggs	1.17	1
Whole animal	1.27	1.29
Head	1.2	1.33
Feathers	1.09	2
Legs	1	2

3.6. Ethno-ornithological use values by ethnic group

Table 6 shows the use values of bird species by ethnic group. The organ use values generally show that, whatever the ethnic group, skin and meat are the most commonly used, followed by the whole animal and eggs. The results of the Mann Whitney test on the use of species by the ethnic groups investigated indicate that there is no significant difference between the use values by ethnic group ($p = 0.179$).

Table 6 Use of organs by the Baoulé and Bété ethnic groups

	Ethno-ornithological use values	
Parts of the bird	Baoulé	Bété
Skin + meat	1.82	2.43
Eggs	1.03	1.37
Whole animal	1.29	1.17
Head	1	1.1
Feathers	1	1.14
Legs	1	1.08

3.7. Ethno-ornithological use values by age group

Table 7 shows organ usage by age group. Analysis of this table shows that, whatever the age group, organs such as skin and meat are widely used. Eggs and whole animals, on the other hand, are second most popular with young people. Whole animals, legs, heads and feathers are used more by adults and the elderly, who possess ancestral medicinal and magical knowledge. The results of the Kruskal-Wallis test carried out according to the age of the respondents reveal that the ethno-ornithological use value does not vary significantly according to the age of the respondents ($p = 0.513$).

Table 7 Organ use values by age group of respondents

	Ethno-ornithological use values		
Parts of the bird	Young	Adult	Old
Skin + meat	1.76	1.82	2.87
Eggs	1.58	1	1.12
Whole animal	1.54	1.1	1
Head	1.11	1	1.33
Feathers	1	1	1.33
Legs	1	1.33	1

3.8. Distribution of endogenous knowledge about birds

Table 8 presents the use, diversity and equitability values for the different forms of avifauna use in the study area. Of the four forms of use, food and magico-religious forms have the highest diversity of use (UD) value (0.39). They contribute little to the local use of birds (UD < 0.5). Furthermore, the highest equitability value (1) was obtained for food and magico-religious forms, indicating that knowledge of the food and magico-religious properties of birds is well distributed within the survey population.

The value of the respondent's total diversity index (UD = 0.43 < 0.5) is low. This means that the vast majority of respondents have a poorly diversified knowledge of the different uses made of birds. This low level of knowledge is well distributed among the respondents (EU = 0.93 > 0.5). Furthermore, when we consider the respondents by sex and ethnic group, we see that women and the Bété group have more knowledge about birds, with index values of diversity of use of 0.52 and 0.54 respectively (EU > 0.5). The diversity value for the respondent is low and practically the same for all age groups. In addition, the calculated equitability index shows that information about birds is well perceived according to the gender, ethnic group and age of the respondents studied (Table 9).

Table 8 Values of use, diversity and equitability

Types of use	**Vu_x**	**UD**	EU
Commercial	0.55	0.28	0.72
Food	0.5	0.39	1
Magico-religious	0.5	0.39	1
Medicinal	0.43	0.22	0.56

Vux : Use values ; UD : Diversity use values ; EU: Equitability use values

Table 9 Values of use, diversity and equitability of people's knowledge of birds

Types of use	**Vu_x**	**UD**	EU
Total	1.38	0.43	0.93
Men	1.49	0.47	0.9
Women	1.65	0.52	1
Baoulé	1.19	0.46	0.85
Bété	1.38	0.54	1
Young	1.33	0.33	0.92
Adult	1.2	0.3	0.83
Old	1.44	0.36	1

Vux : Use values ; UD : Diversity use values ; EU: Equitability use values

4. Discussion

Studies carried out in West Africa [5 ; 30 ; 31 ; 10] have demonstrated the need to take local perceptions into account when implementing ecosystem restoration and managements techniques. From a methodological point of view, it must be acknowledged that the information gathered on ethno-ornithological knowledge during this study depends mainly on the mood of the respondents and does not always represent true knowledge about birds. While it is easy to understand that information that is repeated is often true, the same cannot be said for information that is not held by all respondents. The attribution of scores to uses and translators were also weak points in this work. The ethno-ornithological characterisation revealed that birds are used by local populations in four different ways, namely for food, trade, magico-religious purposes and medicinal purposes. Food use was cited most often by respondents. It was observed that the use of species does not depend on ethnicity ($p = 0.97$). In fact, birds are harvested essentially for food when local human populations need animal protein in regions where livestock farming is underdeveloped or poor. Calculating the value of use and diversity of use nevertheless showed that knowledge was well distributed among the respondents. These results are similar to those described by [32 ; 33 ; 34 ; 3], which show that the use of wildlife as a main source of protein by people living near classified forests and wildlife reserves is very intense. In Africa, wild animals are traded and used in ceremonies to cure certain diseases or in rituals practised by initiates. In the parts of the study area investigated, certain organs can be combined for various uses. This is particularly true of feathers and eggs, which are used to cure epilepsy. The data from our studies corroborate those of authors such as [35 ; 36 ; 37], who have revealed that bird organs confer many magical powers on local populations and therefore occupy an important cultural position within communities. These results were also supported by [10] at Burhinyi (Itombwe, South Kivu, DR Congo). It was revealed that six taxa (Eagle, Owl, Raven, Mountain Buzzard, Mountain Gonolek and Ruwenzori Touraco) cited by the respondents were used to treat four diseases and also to embellish the hats worn by village chiefs during customary ceremonies. Four bird organs (heart, claw, feathers and head) used during ceremonies and for healing were mentioned by the respondents [10]. The value of the respondent's total diversity index ($UD = 0.43 < 0.5$) is low. This means that the vast majority of respondents have a poorly diversified knowledge of the different uses made of birds. This low level of knowledge is well distributed among the respondents ($UE = 0.9 > 0.5$). The diversity of uses reflects the importance of birds for the socio-cultural groups studied [38]. In southern Benin [3] showed that all the organs of

five species of game birds (widow egret *Dendrocygna viduata*, great egret *Ardea alba*, slaty egret *Egretta ardesiaca*, Allen's scrub *Porphyrio alleni* and sultana scrub *Porphyrio porphyrio*) were used in traditional pharmacopoeia. Similarly, the work of [39], [40] and [10] clearly demonstrates the multiple roles played by birds in African and Amerindian societies. In addition, all the bird organs are used for cultural practices by the ethnic groups studied. Our studies have shown that organ use does not vary according to the ethnic group, sex or age of the respondent. This result can be explained by the dissimilar cultural values, the proximity of the ethnic groups surveyed, and the specific needs of the local population [37]. Our results differ from those of [41 ; 3 ; 25] who showed that ethno-ornithological knowledge of wildlife varies in Benin according to sex, ethnic group and age. In other words, the results of these authors showed that there is a significant difference in the level of knowledge of uses according to the socio-cultural groups of the respondents. The whole animal, legs, head and feathers are used more by adults and the elderly. The higher diversity noted among older people could be explained by the fact that knowledge is acquired and accumulated over the years [42]. Our results also confirm the conclusions of authors such as [43 ; 44] who have stated that the level of valuation of endogenous knowledge increases with age. Many other authors have agreed and shown that this knowledge is often only held by people aged 50 and over [45 ; 46]. This means that birds are not widely known by all social classes. The difference between these results could be due to the different socio-economic and cultural uses of species within communities. All this suggests that there is strong pressure on bird species that are already scarce [47 ; 10]. However, according to [48], when the use value of a species that is not very abundant is high, this reflects strong pressure on that species. Thus, the importance attached to a species does not depend on its availability but on its capacity to satisfy the needs of populations in the various categories of use [3].

5. Conclusion

Ethno-ornithological surveys of people living near forest relics and agrosystems in the Haut-Sassandra and Marahoué regions enabled 69 peoples from two ethnic groups to be surveyed, namely Bété (22 individuals) and Baoulé (47 individuals). The study also revealed that birdlife is used for a variety of purposes, including food (86.97%), commercial (27.54%), magico-religious (7.24%) and medicinal (7.24%). Mann Whitney test revealed that the use of species did not depend on ethnicity ($p = 0.97$). Skin and meat were the most commonly used organs in the medicinal category ($VUx = 3$). Our studies showed that organ use did not vary according to the ethnicity ($p = 0.179$), sex ($p = 0.240$) or age ($p = 0.513$) of the respondent. In addition, the value of the respondent's diversity of use index was low ($UD = 0.43 < 0.5$). This means that the vast majority of respondents have little knowledge of the different uses made of birds. This low level of knowledge is well distributed among the respondents ($EU= 0.93 > 0.5$).

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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