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Assessment of the Population, Feeding Habits and Threats of Turaco species in the Bali Ngemba Forest Reserve in Northwest Cameroon

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ABSTRACT

Population and feeding habit data is vital in conservation and wildlife management in protected areas. However, this data is still non-existent for turacos in the Bali Ngemba Forest Reserve. Data on size, density, relative abundance, food trees, and threats of turacos were obtained by prolonged observations through distance sampling by the line transect method. Three species of turacos (Turaco persa, Turaco bannermani and Corythaeola cristata) were recorded with an estimated population of 373 individuals. Turaco persa was the most populated with an estimate of 223 individuals and a calculated density of 0.2 individuals/ hectare. Turaco bannermani was the second most populated with an estimated population of 91 individuals and a density of 0.08 individuals / hectare whereas Corythaeola cristata was the least populated with 56 individuals and a density of 0.052 individuals/ hectare. Popular food trees recorded were Prunus africana, Pseudospondias macrocarpa, Ficus asperifolia, Ficus otteniifolia, Ficus thonningii and Pittosporium manni. The major threats of turacos were farming, logging, firewood collection, grazing, and bushfires. Three turaco species persist in the reserve with a small population size that is greatly impacted by human activities. To conserve these species, human interference in the reserve should be effectively monitored, and controlled and local communities empowered.

Keywords: turaco, Bali Ngemba Forest Reserve, population, feeding habits, threats

INTRODUCTION

Birds perform many services that help in the sustenance of the ecosystem. The birds of an ecosystem serve important ecological services as seed dispersers, pollinators, transfer of nutrient between oceanic and terrestrial ecosystems, and predators of agricultural pests (Collar *et al.* 2007). Birds also represent important characters in myths

and fables, representing gods or acting as messengers and augurs (Mynott 2009). The avifauna of an ecosystem are considered indicators of species richness and biological diversity (Fleishman *et al*. 2005), and also indicators of conditions and qualities of habitats (Canterbury *et al*. 2000; Venier and Pearce, 2004; Bhattacharya *et al*. 2009). However, most bird species are experiencing a decline in their population due to habitat loss and overexploitation (Barlow *et al.* 2006). About 95% of threatened birds worldwide suffer severe impacts as a result of habitat loss, whereas 71% are associated with various forms of use by humans (Sodhi *et al*. 2011). The population decline of many bird species has also been influenced directly or indirectly by anthropic actions (Alves *et al.* 2013).
Information on the population, feeding habits, and threat factors are essential in conservation planning and wildlife management. Population data makes it possible to predict the long-term probability of a species persisting in a given patch of habitat (McGowan *et al*. 2017). Feeding habit has a direct impact on the better chances of survival and continuance of turaco species. Thus, feeding habits implicate fitness, survival, and better chances of reproduction. This study is therefore quintessential in providing knowledge about population indices, feeding habits, and threats of turaco species in the Bali Ngemba Forest Reserve.

Turacos are one of the most colorful birds. They have erectile crests and short rounded wings. They are found in a variety of habitats only in South Sahara Africa (Borrow and Demey, 2001). They are 23 species of Turacos in one family (*Musophagidae*) and 5 genera - *Corythaeola, Corythaixoides, Crinifer, Tauraco,* and *Musophaga* (Grimes 1987). Turacos' are principally frugivorous which makes them good plant distributors and seed dispersers. Turacos have been used by humans for culture, feeding, pet, communication, and decoration of homes (Deikumah 2006; Yeboah *et al*. 2006, Anousta 2014 and Mfombo 2018).

Bali Ngemba Forest Reserve forms part of the Bamenda Highlands in northwest Cameroon. It is the largest and only officially protected block of forest below 2000 m altitude (Harvey *et al*. 2004). In the Bamenda Highlands, endemic bird species richness is higher than in any other part of Cameroon (Smith *et al*. 2000). However, most of the mountain ecosystem is threatened with habitat loss and degradation. It is under serious threat from forest clearance for agriculture, grazing, firewood, and timber, with birds surviving in forest fragments in imminent danger of extinction. Most ornithological research in the Bamenda highlands has been focused on the Kilum-Ijim forest on Mount Oku (Dowsett-Lemaire and Dowsett, 1998; McKay and Coulthard, 2000; Forboseh and Ikfuingei, 2001; and Forboseh *et al*. 2003). The only study conducted on the population of turacos has also been in the Kilum-Ijim forest where *Tauraco bannermani* was assessed with an estimated population in the range of 2,500 to 9,999 individuals (Forboseh and Ikfuingei, 2001). To our knowledge, there has been no other attempt to assess the turacos' population in other forest patches in the Bamenda Highlands and no study has focused on all three sympatric turaco species present in this area. It is in this line that this study was carried out to assess not only the population of turacos but also their feeding habits and the current threats to their survival.

MATERIALS AND METHODS

2.1 Study area

2.1.1 Location and Population

This study was conducted in the Bali-Ngemba Forest Reserve located between longitudes 10°02' and 10°05' E and latitudes 05°47' and 05°49'N. The reserve is bordered by the local communities of Bali, Mbu-Baforchu and Pinyin. Entry into the reserve is only through Mantum and Pinyin. There is no access through Mbu-Baforchu because of the abrupt escarpment. In Pinyin, the reserve can be accessed through the quarters of Mamben and Buchi. The reserve was officially designated a protected area in 1953 covering an area of about 1147 ha. It is approximately 16.5 kilometers southwest of Bamenda (capital of the North West Region of Cameroon).

2.1.2 Climate, Topography and Vegetation

The biophysical environment of the area is described by its characteristics climate, relief, vegetation types and hydrology. Annual rainfall in this area is slightly lower than 2000 mm/year and is mainly distributed from May to September, with two very rainy months (June and July). The climate is that of the tropical rain forest type which is warm to hot during the dry season and warm to cold during the rainy season. The area has two major seasons; a longer rainy season which ranges from mid-March to mid-November and a short dry season from mid-November to mid-March. The area is subjected to an average temperature throughout the year between 25 ° C and 28°C. The topography is undulating and mountainous and is not easily accessible because of the abrupt escarpment of the landscape. The common vegetation type of the forest is a continuous band of submontane and montane forests (Njabo and Languy, 2000). The forest structure is characterized by five distinctive vegetation types: a natural mosaic forest (775 ha), a highly degraded natural forest (151ha), an artificial forest planted with *Eucalyptus sp* and some local species (98 ha), an artificial forest featuring only *Eucalyptus sp* (13 ha) and grassland savannah (110 ha) (Tetsekoua 2000). A set of streams cascade down the mountainside and fall downstream of the reserve to form river Nki. The map of the study area is presented in Figure 1.

2.2 Methodology

Turaco census was carried out using the distance sampling method by line transect, which is recommended for estimating the population of a species (Buckland *et al*. 2001). It also provides fair estimates of species abundance (Azhar *et al.* 2008). To maximize sampling efficiency, we used the stratified random sampling design, where the reserve was categorized into habitat types A, B, and C. Habitat A consisted of a natural mosaic forest dominated by *cola* sp, *Pterygota macrocarpa, Macaranga spinosa,* and *Pycnanthus angolensis* and is slightly degraded with the herbaceous strata dominated by *Asystasia* sp*.* Habitat B was a highly degraded forest dominated by *Syzygium staudtii, Trema guinneensis,* and *Croton macrostachyus* and grassland savanna characterized by steep and gentle slopes while habitat C was an artificial forest planted with eucalyptus species mixed with some local species like *Harungana madagascariensis* and *Macaranga spinosa* with the herbaceous stratum dominated by *Afromomum* sp and is highly degraded characterized by farm bush, fallow land; Perennial crops, orchards, and groves. Habitat A had a total of 4 transect lines while habitats B and C had 2 transect lines each. All transects were approximately 1 km in length and adjacent transects were at least 200 m apart and parallel to avoid double counting (Terry and Murray, 2012).

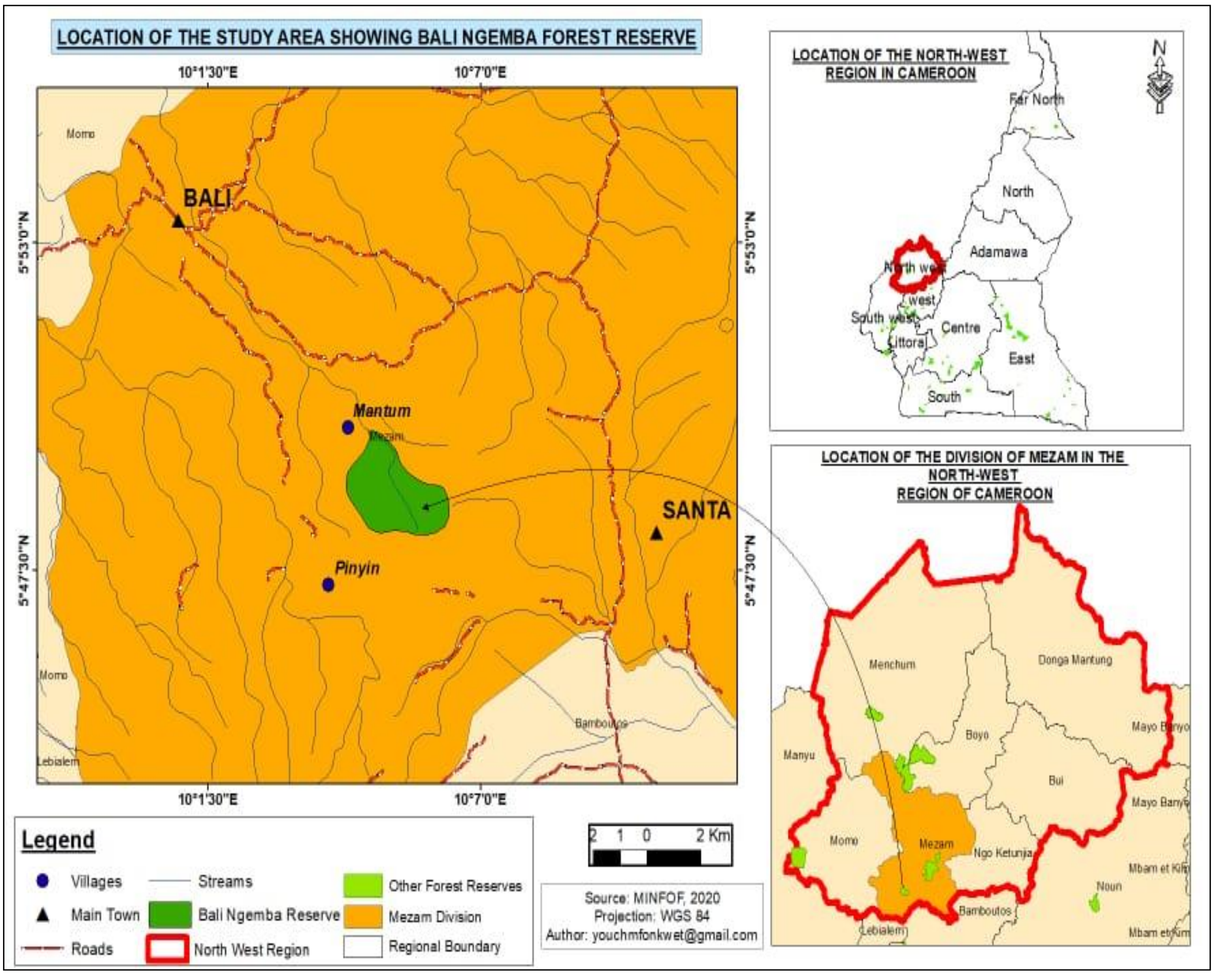

Figure 1: Location map of the study area

The geographical positions of the start and end points of each transect were recorded with a Garmin GPS. We performed turaco census for 3 months of dry and 3 months of wet seasons, visiting each transect once every month. We performed all visits during morning hours (between 06:00 to 09:00GMT+1) and afternoon hours (between 14:00 to 17:00GMT+1) because most avian species are feeding actively in the morning and afternoon (Sutherland 2000). Thus, a high probability of detecting turacos during these times. Transects were walked at a fairly constant speed while observing on either side and recording any turaco contact with a close concentration on the trees' canopy. There was a silent movement to minimize disturbances. The number of counts recorded through sight or sound was taken as the species abundance. Any turaco that was seen flying into or over the line transect areas were not recorded as their inclusion tends to inflate density estimates (Buckland *et al*. 2001) while Birds flying out of transect areas were only recorded when their point of origin was identified and estimated. While trading the line transects, we took note of turacos' food types (plant species) and habitat threats. Where we couldn't identify the plants in situ, pictures of the plants with fruits and leaves were taken for off-field identification.

2.3 Data Analysis

We used the Distance software version 6.2 release 1 and the conventional distance sampling (CDS) as an analysis engine (Buckland *et al*. 2001; Thomas *et al*. 2010) to estimate the population size and density of the turaco species recorded. We also used the goodness-of-fit chi-square test in SPSS version 20.0 to test for possible variation in turaco abundances with habitat types, seasons, time blocks, and the local communities.

RESULTS AND DISCUSSION:

3.1 Population Size, Density and Abundance of Turaco species recorded

In this study, we recorded three species of turacos in the Bali Ngemba Forest Reserve. These species include the great blue turaco (*Corythaeola cristata)*, bannerman's turaco *(Tauraco bannermani)*, and green turaco *(Tauraco persa*), which corroborate those reported by Tetsekoua, 2000. The combined estimated population of all three turaco species was 373 individuals. *Tauraco persa* was the most populated with an estimate of 223 individuals and a calculated density of 0.2 individuals/hectare. *Tauraco bannermani* was the second most populated with an estimated population of 91 individuals and a density of 0.08 individuals/hectare and *Corythaeola cristata* was the least populated with 56 individuals and a density of 0.052 individuals/hectare (Table 1). This indicates a small population size and density of all three turaco species in the Bali Ngemba Forest Reserve. This was probably due to habitat loss and human pressure. Sodhi et al. 2011 hypothesized that species usually suffer severe impacts as a result of habitat loss and various forms of uses by humans. However, population size can also be influenced by predation, intra and inter-specific competition, parasites, weather, and diseases (Asokan *et al*. 2010). These species are thus vulnerable to extinction. Small populations are vulnerable to extinction as a result of random changes in population size over time due to random variation in individual survival and reproductive success (Frankham *et al*. 2002).

Turaco abundance varied among seasons (X^2 = 14.876, df = 1, p<0.05) and was higher in the wet season (68.1%) than in the dry season (31.9%) (Figure 2). This is probably due to little forest disturbance and more food availability in the wet season than in the dry season. Yeboah *et al*. 2006 also attributed seasonal differences in turacos to food availability in one season than the other. The forest was highly disturbed in the dry season with bushfires, farming, logging, and grazing activities. Most plant species were not fruiting in the dry season and turacos might have moved right deep into the forest in search of food and shelter. Turacos show some seasonal movements in search of food as they are mainly frugivorous, feeding on plant parts such as fruits, leaves, berries, and flowers (Dowsett-Lemaire, 1990).

Table 1: Estimated population of turaco species derived from the distance package

Species	Density/ha	95% CI	n	N
Tauraco persa	0.20	0.13 – 0.29	45	223
Tauraco bannermani	0.08	0.064 – 0.099	17	91
Corythaeola cristata	0.052	0.017 – 0.16	4	59

NB: n = number of bird counts, N = estimated numbers of birds, CI = confidence interval

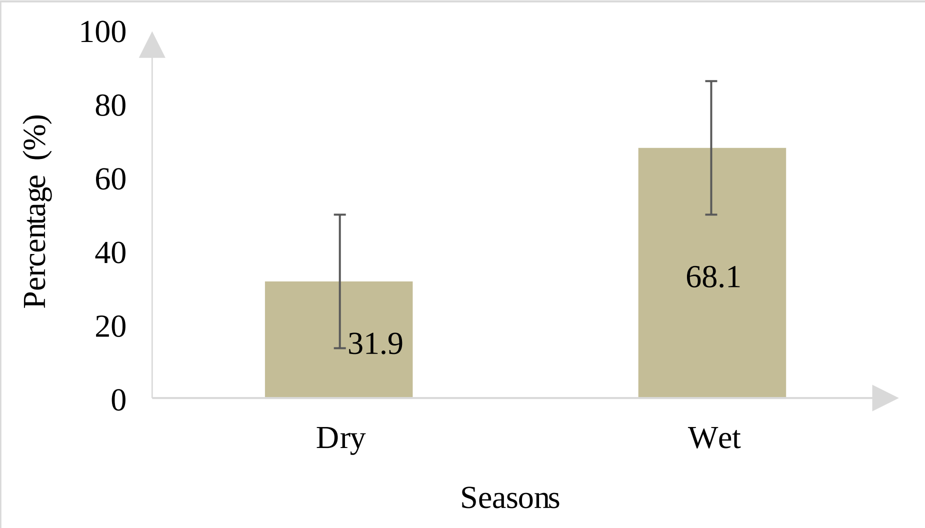

Figure 2: Seasonal turaco census in the Bali Ngemba Forest reserve

Table 2: Turaco counts in various habitat types with seasons

Seasons	Habitat type			Total
	A	B	C	
Dry	14	11	11	36
Wet	45	15	17	77
Total	59	26	28	113
Mean	37.64±1.73	13.31±0.40	14.64±0.56	63.94±1.81

Notes: A = natural mosaic forest, B = degraded forest and grassland, C = artificial forest planted with eucalyptus species and some local species

Table 3: Average number of individual turaco species recorded in the forest blocks of Pinyin and Mantum communities

Species	Forest Blocks		Total
	Mantum Forest n (%)	Pinyin Forest n (%)	
Tauraco persa	32 (39)	50 (61)	82
Tauraco bannermani	6 (26.1)	17 (73.9)	23
Corythaeola cristata	0 (0.00)	8 (100)	8
Total	38 (33.6)	75 (66.4%)	113

Table 4: Average numbers of turaco species recorded with time block.

Species	Time Block		Total
	Morning (6:00 – 9:00 GMT+1) n (%)	Afternoon (14:00 – 17:00 GMT+1) n (%)	
Tauraco persa	55 (67.1)	27 (32.9)	82
Tauraco bannermani	16 (69.6)	7 (30.4)	23
Corythaeola cristata	3 (37. 5)	5 (62.5)	8
TOTAL	74 (65.5)	39 (34.5)	113

Table 5: Individual numbers of turaco species recorded during the months of survey

Species	Months					
	December	January	February	March	April	June
Great blue	2	0	0	0	6	0
Bannerman's	2	3	4	5	9	0
Green	2	16	7	14	28	15
Mean	2.0±0.00	6.3±4.9	3.7±2.1	6.3±4.1	14.3±6.9	5.0±5.0

Turacos' census showed habitat-wise variation (X^2 = 18.177, df = 2, p<0.05), and was higher in habitat A (52.2%) than in habitat C (24.8%) and habitat B (23%) (Table 2). Terrestrial species usually seek their habitat rather than dispersing randomly (Tewodros and Afework 2013). The greater numbers of individual turaco species in habitat A may be due to its more pristine nature with a relatively rich supply of food and with a low disturbance rate as compared to the other habitat types. Species are usually confined in areas where they get their feeding and nesting sites (Brown *et al*. 2001). Bibby and Green, 1980; Berthold, 1982 and Yeboah *et al*. 2006 confirms that turacos show preferences for pristine habitat.

A significant difference in abundance was also observed among forest blocks (X^2 = 12.115, df = 1, p<0.05). More turaco numbers were recorded in the forest block at Pinyin community (66.4%) than in the forest block at Mantum community (Table 3). The forest block of the Pinyin community recorded the highest number of turacos because it looks more pristine and safer providing a safe breeding ground also with it numerous hideouts protecting the turacos. The forest at Pinyin is also located at a much higher elevation. Turaco species usually occur at the highest elevation of a forest (Dowset-Lemaire, 1990; Del Hoyo *et al*. 1997). A good size of the reserve at Mantum community is made up of artificial forest planted with eucalyptus species where logging for timber and firewood is taking place and other parts are heavily affected by agricultural activities. The disturbance coming from chainsaws and farming activities might have moved the species further into the jungle.

Turaco numbers also varied among time blocks (X^2 = 10.84, df = 1, p<0.05) and was higher in the morning (65.5%) (Table 4). They were no sampling of turacos during the midday time periods in other to maximize the detection probability of turacos. The mean monthly population of turaco species showed variation with months and was highest in April (14.3±6.9) and lowest in December (2.0±0.00) (Table 5).

3.3 Feeding requirements of turacos in the Bali Ngemba Forest Reserve

Turaco species observed fed mostly on fruits. Brosset and Fry, 1988 states that turacos are principally frugivorous. However, turaco also feeds on foliage, flowers, buds, caterpillars, moths, beetles, snails, slugs, and termites, particularly during the breeding season (Sun and Moermond, 1997). Turacos fed on the fruits of fifteen (15) plant species recorded (Table 6). The plant species were from 12 different families with the family *Moraceae* making up a majority of turacos food trees (26%). The most popular food trees of turaco species were *Prunus africana, Pseudospondias macrocarpa, Ficus asperifolia, Ficus otteniifolia*, *Ficus thonningii,* and *Pittosporium manni.* These trees were distributed throughout the whole forest in very limited numbers and no tree species were concentrated in a particular area of the habitat.

Table 6: Plant species used as food by turaco species in the Bali Ngemba Forest Reserve

Scientific name	Common name	Local name	Family
Prunus africana	African cherry	Pygeum	*Rosaceae*
Ficus thonningii	Fiddle leaf fig	Nget	*Moraceae*
Ficus asperifolia	Sandpaper plant	Tomb	*Moraceae*
Ficus otteniifolia	Strangler fig	-	*Moraceae*
Syzygium staudtii	-	-	*Myrtaceae*
Polyscias fulva	Umbrella Tree	Keghang	*Moraceae*
Canthium dunlapii	-	-	*Rubiaceae*
Cola sp	Cola nut tree	-	*Malvaceae*
Trichilia rubenscens	Red ash	-	*Meliaceae*
Pittosporium manni	Cheesewood	-	*Pittosporaceae*
Pseudospondias macrocarpa	African nut tree	-	*Anacardiaceae*
Markhamia thomatocia	-	-	*Bignonniaceae*
Gmelina arborea	Gmelina	-	*Lamiaceae*
Olea sp	Black iron wood	-	*Oleaceae*
Schefflera abyssinica	-	-	*Araliceae*

Most of the trees were not fruiting in the dry season except for *Ficus asperifolia* and *Ficus otteniifolia* which fruited throughout the seasons.

3.4 Habitat Threats Affecting Turacos and Their Habitat in the Bali Ngemba Forest Reserve

Major anthropogenic factors impacting the health of the Bali Ngemba Forest Reserve ecosystem and the survival of turacos include farming, logging, fuel wood collection, grazing, and bushfires. Farming, logging, and fuel wood collection all together contributed more than 80% impact on the forest ecosystem. Farm sizes were generally large ranging from 3 to 8 ha. Farming systems practiced include bush fallowing, slash and burn and shifting cultivation and crops cultivated were cassava, potatoes, maize, beans, cocoyam, and banana. Logging was mostly for commercial purposes through the production of planks and boards. Logging was also oriented towards the selection of specific tree species with diameters greater than 40cm. Trees were also cut down for the construction of cattle fences and bush huts. Fuel wood collection was both for household use and commercial purposes especially in the forest of Mantum community where piles of fuel woods were recorded. No signs of hunting were recorded in the forest reserve probably due to the poor nature of the reserve in terms of large mammals. The communities rely heavily on the forest reserve resources which has greatly impacted the forest habitat and the survival and reproduction of turaco species.

CONCLUSION

This study reveals that three species of turacos persist in the Bali Ngemba Forest Reserve with small population size and density. *Tauraco persa* still occurs in good numbers and was the most encountered while *Tauraco bannermani* and *Corythaeola cristata* were so rare and were most often heard than seen. Turacos in the study area fed mostly on *Ficus asperifolia, Ficus otteniifolia*, *Ficus thonningii, Prunus africana, Pseudospondias macrocarpa* and *Pittosporium manni.* The habitat of the reserve is highly threatened by farming, logging, fuel wood collection, grazing, and bushfires. Thus, affecting the survival and reproduction of turacos and many other bird species that rely on the ecosystem. A great portion of the forest reserve is lost to unsustainable agricultural practices. Most farming systems being practiced cannot maintain farmers in the same piece of land year in, year out as the fertility is lost within the first two years. As such, there is continuous encroachment into new areas within the forest resulting in deforestation and degradation. Uncontrolled harvesting and exceptionally high prices of timber and fuel wood in nearby cities may cause overexploitation leading to deforestation. Bushfires which usually result from farmers' farm or from herdsmen who burn grass fields to initiate the growth of fresh pasture for their cattle, damages the forest ecosystem when the fire burns out of control and enters the forest. Effective management measures including control of human activities, management of forest fires, and restoration of degraded forest patches are essential in improving turacos' survival and reproduction in the reserve. Further research is also needed on the impacts of human pressure on seasonal food requirements, nest-site selection, and the population size of turacos species in the Bali Ngemba Forest Reserve.

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