Sustainability and Biodiversity Conservation

Food preference and foraging ecology of the black and white Casqued Hornbill *(Bycanistes subeylindricus*) in Okomu National Park, Nigeria

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Abstract

This research study examined the diet and foraging ecology of the Black and White Casqued Hornbill (*Bycanistes subeylindricus*) in Okomu National Park. The *Bycanistes subeylindricus* is a flagship bird species, and studying the diet will help in the conservation thereby promoting ecotourism in the park. This study followed the Direct observation method, field observations were carried out with binoculars (Bushnell 75), and field surveys were conducted during the early morning or late evening when birds were actively feeding with the least disturbance. The result showed that *Bycanistes subeylindricus* consumed a variety of foods, including fruits, leaves, seeds, flowers, and insects. The results showed that six primary plant species account for most *Bycanistes subcylindrical* diet. *Ficus exasperata* had the highest frequency of 34%, followed by *Elaesis guinneensis* at 20%, and *Dacryodes gullies* at 16. The result of fruit type consumption indicates that fruit consumption was highest during the wet season 54, this is followed by dry season 41, and fruit type consumed in both seasons were the lowest 5. The Moraceae family has the most plant species with 7, and the Fabaceae family comes in second with 5 Figure 4. The family Formicate has the second-highest number of 5 insects fed upon this followed by the family Scarabaeidae with 3 species.

Keywords: Diet, Ecotourism development, Foraging ecology, Home range

Introduction

Hornbills are a group of birds found in Africa and Asia, known for their distinctive bills which are often brightly colored and sometimes have a casqued or hollow structure on the top. They are generally found in forests, woodlands, and savannas, and many species require large trees for nesting (Datta, 2008). One example of a black and white hornbill is the African pied hornbill (*Tockus fasciatus*), which is found in eastern and southern Africa. They inhabit savannas, open woodlands, and thornbush areas with scattered trees (Holbrook & Smith, 2000; Kemp, 2001). They inhabit lowland and montane forests, as well as mangroves and plantations. They are often found near water sources such as rivers and lakes. Lack and white hornbills are generally adapted to forested environments and rely on trees for nesting and roosting. They often feed on fruit, insects, and small animals, and may forage in the forest canopy or on the ground. The Black and White Casqued Hornbill (*Bycanistes subcylindricus*) is a large species of hornbill found in the forests of West and Central Africa (Kemp, 2001). They have a black body with white markings on the belly, tail, and wingtips, and a large black bill with a casqued on top. These hornbills inhabit tropical rainforests, where they can be found in the canopy and sub-canopy levels of the forest. (Holbrook & Smith, 2000). They are also known to occur in secondary forests and plantations. Black and White Casqued Hornbills are generally frugivorous, feeding on a variety of fruits, including figs and other small berries. They are also known to eat insects, small reptiles, and small mammals. Like many hornbill species, Black and White Casqued Hornbills are cavity nesters, meaning they rely on tree cavities for nesting. The female seals herself in the cavity during incubation, leaving only a small slit for the male to pass food to her and the chicks. This behavior is considered an adaptation to protect the female and chicks from predators while they are vulnerable. Overall, the Black and White Casqued Hornbill is adapted to life in the forest canopy, relying on tree cavities for nesting and feeding on a variety of fruits and insects. it's worth noting that the range of Black and White Casqued Hornbills in Nigeria is relatively limited, with the species being found primarily in the southern part of the country, including the Cross River National Park and other forested areas in the Niger Delta region (Kemp, 2001). Habitat loss and fragmentation due to deforestation and other human activities are significant threats to the species in this region. More research is needed to better understand the ecology and behavior of Black and White Casqued Hornbills across their range, including in Nigeria. The Black and White Casqued Hornbill (*Bycanistes subcylindricus*) is listed as Near Threatened on the IUCN Red List of

Threatened Species, and its population is decreasing. In Nigeria, the species is also facing threats and has a relatively small population. Habitat loss due to deforestation is one of the primary threats to the Black and White Casqued Hornbill in Nigeria, as forests are being cleared for agriculture, logging, and other forms of human development. Birdlife International (2018). The species is also sometimes hunted for its meat, and its feathers and other body parts are used in traditional medicine and cultural practices. (Short & Horne, 2001). Efforts are being made to conserve the Black and White Hornbill in Nigeria and other parts of its range. Some protected areas, such as Cross River National Park in Nigeria, provide habitat for the species and other wildlife. Community-based conservation initiatives are also being developed to promote sustainable use of forest resources and reduce hunting and other threats to the species. The Black and White Casqued Hornbill (*Bycanistes subcylindricus*) is listed as Near Threatened on the IUCN Red List of Threatened Species, and its population is decreasing at Birdlife International (2018). In Nigeria, the species is also facing threats and has a relatively small population. Habitat loss due to deforestation is one of the primary threats to the Black and White Casqued Hornbill in Nigeria, as forests are being cleared for agriculture, logging, and other forms of human development. The species is also sometimes hunted for its meat, and its feathers and other body parts are used in traditional medicine and cultural practices. Efforts are being made to conserve the Black and White Casqued Hornbill in Nigeria and other parts of its range. Some protected areas, such as Cross River National Park in Nigeria, provide habitat for the species and other wildlife. Community-based conservation initiatives are also being developed to promote the sustainable use of forest resources and reduce hunting and other threats to the species (Leighton, 2014). More research is needed to better understand the distribution, abundance, and ecology of Black and White Casqued Hornbills in Nigeria and other parts of its range, to inform conservation actions and ensure the long-term survival of the species. The study of the diet of the Black and White Casqued Hornbill in Nigeria could potentially promote tourism in the country by providing valuable information about the species and its role in the ecosystem. Here are a few ways in which this could be the case: Ecotourism opportunities: Ecotourism is a type of tourism that focuses on natural environments and conservation efforts. If the study of the Black and White Hornbill's diet shows that the species is an important seed disperser for certain plant species or plays a critical role in maintaining forest biodiversity, this information could be used to create ecotourism opportunities that highlight the importance of the species and its habitat. This could include guided tours, birdwatching activities,

and educational programs that showcase the unique ecology of the region. Conservation education: Understanding the diet of the Black and White Casqued Hornbill could also be used to educate tourists and local communities about the importance of conservation. By highlighting the role of the hornbill in seed dispersal or forest regeneration, for example, visitors may be more motivated to support conservation efforts aimed at protecting the species and its habitat (Ahmad, 2013). This could include financial support for conservation organizations or participation in community-based conservation initiatives. Cultural tourism: The Black and White Casqued Hornbill is also an important cultural symbol in many parts of Nigeria, and its feathers and other body parts are sometimes used in traditional ceremonies and rituals (Kemp, 2001). By studying the diet of the species and its ecological importance, tourism programs could be developed that showcase the cultural significance of the hornbill, providing visitors with a unique cultural experience. Overall, by providing valuable information about the Black and White Casqued Hornbill and its role in the ecosystem, the study of the species' diet could potentially promote tourism in Nigeria, while also supporting conservation efforts and cultural preservation.

Material and methods

Study area

Okomu National Park is a protected area located in the Ovia South-West Local Government Area of Edo State, Nigeria. The park was established in 1935 and covers an area of about 1,082 square kilometres. Okomu National Park is home to a wide variety of flora and fauna, including several endangered species such as the white-throated guenon, chimpanzees, and forest elephants. The coordinates park are approximately 6.5371° N, 5.8099° E. The Park covers an area of approximately 1,082 square kilometres (418 square miles), (Adeyemi & Adeyemi, 2016) (Fig. 1). And is one of the largest protected areas in the country NCF (Nigerian Conservation Foundation, 2014). It is home to a diverse range of wildlife and plant species, including several endangered species, and is an important conservation area in Nigeria. The park is also known for its diverse birdlife, with over 150 species recorded. Okomu National Park is home to a wide variety of tree species, many of which are endemic to the West African region. Some notable tree species found in the park include *Khaya senegalensis*, *Chlorophora excels*, *Milicia excels*, *Hevea brasiliensis*, *Lovoa trichilioides*, *Lophira alata*, *Dacryodes edulis*, *Milicia regia*, *Triplochiton scleroxylon*, *Entandrophragma cylindricum*, (Oates et al., 2004). These tree species are important for the ecological balance of the park and provide habitats for many animal species. Some of them are also commercially valuable and are used for timber and non-timber forest products. The Park faces

several challenges that threaten its long-term conservation and sustainability. Some of these challenges include Poaching and illegal wildlife trade: Poaching and illegal trade of wildlife products, such as ivory and *bushmeat*, are major threats to the survival of endangered species such as the forest elephant and chimpanzee. Deforestation and habitat loss: The park is surrounded by communities that engage in subsistence farming, logging, and other land-use changes, leading to deforestation and habitat loss. Encroachment and land-use conflicts: There have been cases of encroachment into the park by farmers and other land users, leading to conflicts over land use and resource allocation (World Wildlife Fund, 2021). Addressing these challenges requires a multi-stakeholder approach, including better law enforcement to combat poaching and illegal trade, improved land-use planning and community engagement, adequate funding and capacity building for park management, and efforts to address climate change impacts. (Vliet & Nasi, 2008).

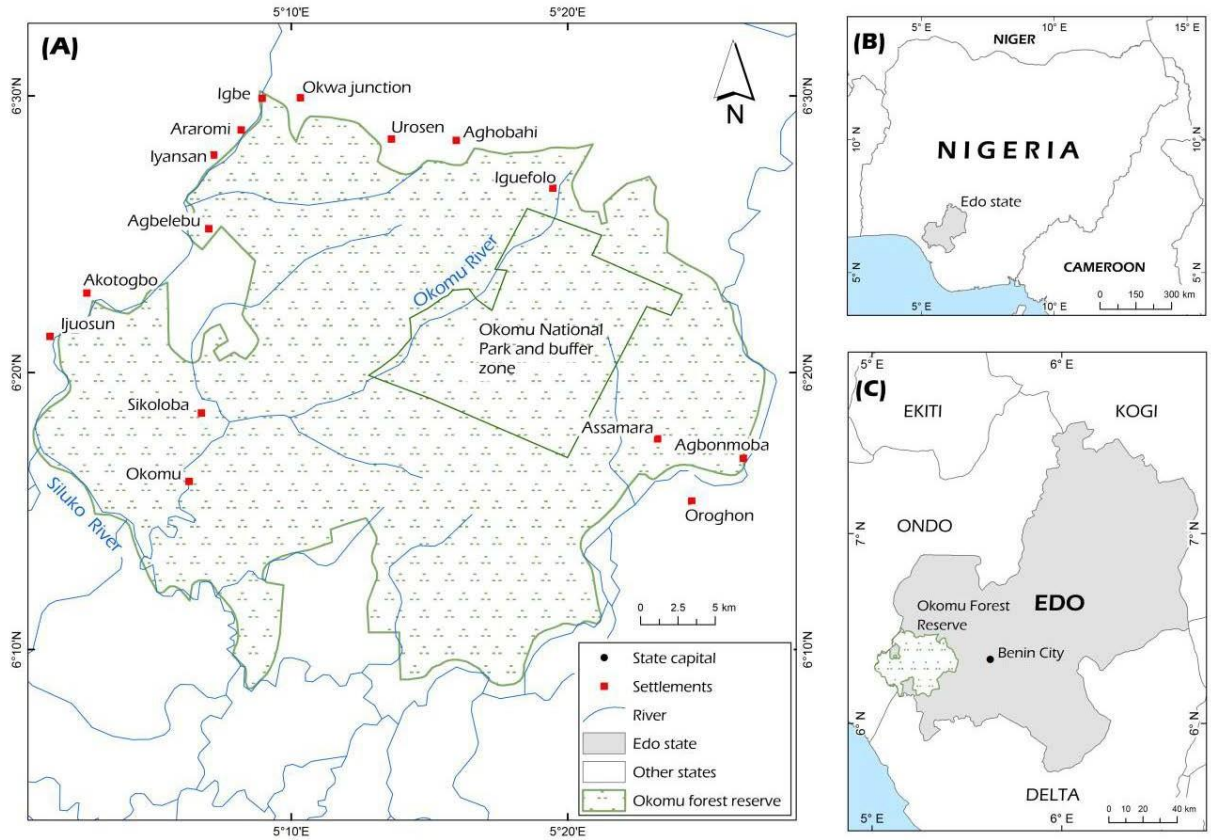

Figure 1. Map of the study area source: (AIGBE and Ayuk, 2021)

Data Collection

The study area was divided into three compartments according to land use types: mature forest, logged area, and farmlands. The data collection on the diet and feeding ecology of Black and White Casqued Hornbill was made on 12 pairs ranging in size from 1 to 3 individuals over a continuous

period of 12 months (January-December 2016). The Direct Observation method as described by Okosodo et al. (2016), was used for this study. Field studies were carried out in 2022 for 12 months which include both seasons of the year. Whenever it was deemed necessary, field observations with binoculars (Bushnell 75) were conducted during the early morning or late evening when birds were actively feeding with the least amount of disturbance. It was frequently possible to have some birds in view at all times when following individual pairs for periods ranging from 2 to 5 hours, but it was uncommon to see the entire group of birds together. Each time a visit was made, observations were made regarding the foraging area, the technique of feeding used, the feeding session, the number of birds, the type of meals, and any interactions with other bird species. The bird's feeding habits over various seasons were investigated. Due to the height of the nests above the ground and the size of the trees, no pellets were inspected.

Statistical analysis

Data collected from the observations were explored with descriptive statistics. The computer PAST Model version 3 was used to analyze bird species diversity, the generalized linear model, and SHE analysis.

Results

The result showed that *Bycanistes subeylindricus* consumed a variety of foods, including fruits, leaves, seeds, flowers, and insects. The results showed that six primary plant species account for the majority of *Bycanistes subeylindricus'* diet. *Ficus exasperata* had the highest frequency of 34%, followed by *Elaesis guinneensis* at 20%, *Dacryodes edullies* 16% , (Fig. 2), The result of fruit type consumption indicates that fruit consumption was highest during the wet season 54, this is followed by dry season 41, and fruit type consumed in both seasons was the lowest 5 (Fig. 3), The *Moraceae* family has the most plant species with 7, and the *Fabaceae* family comes in second with 5 (Fig. 4), The family *Formicidae* has the second-highest number of 5 insects fed upon this followed by the family *Scarabaeidae* with 3 species (Fig. 5). Major insects consumed by Black and White *casqued hornbill* are of four species. *Macrotermes bellicosus*, has the highest frequency of observation (13), while *Rhychophorus ferrugineus* is second with 7 (Fig. 6), The result of habitat utilization indicates that the core forest has the highest of 54%, this is followed by farmland (plantations) at 30% and secondary forest 16% (Fig. 7).

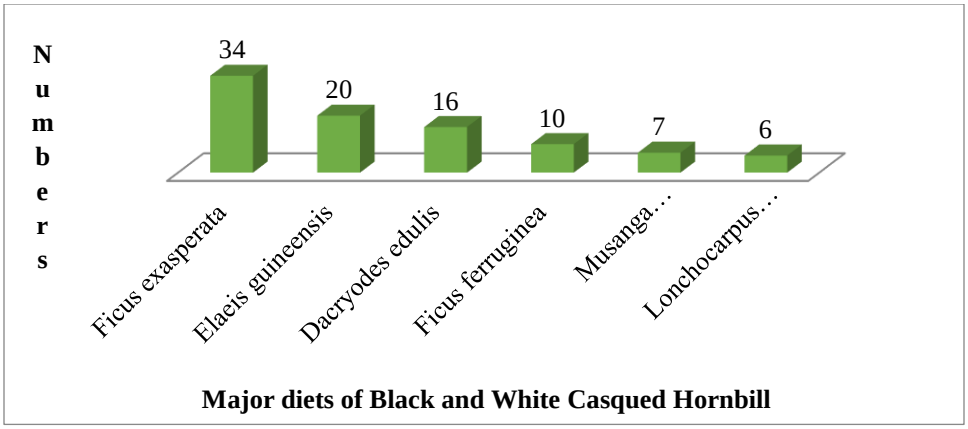

Figure 2: Major diet of Black and White Casqued Hornbill

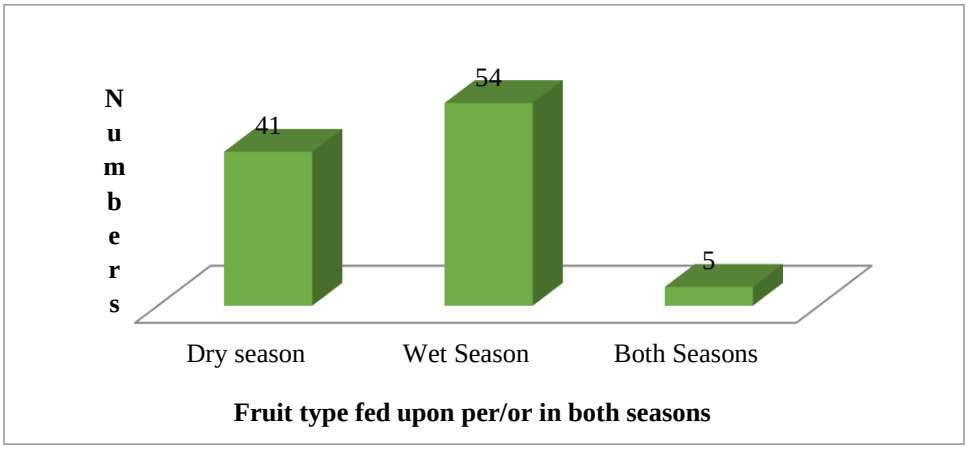

Figure 3. Fruit type consumed per season/or in both seasons of the year

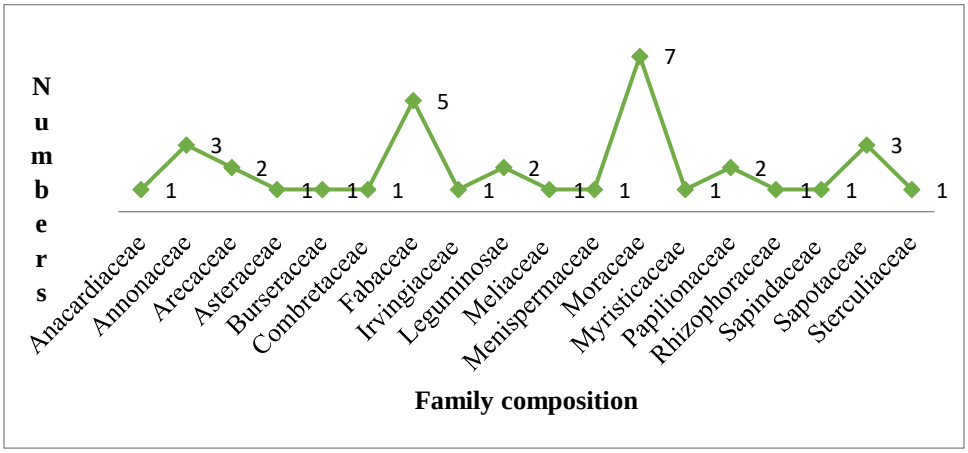

Figure 4. Family composition of plant species consumed in the study area

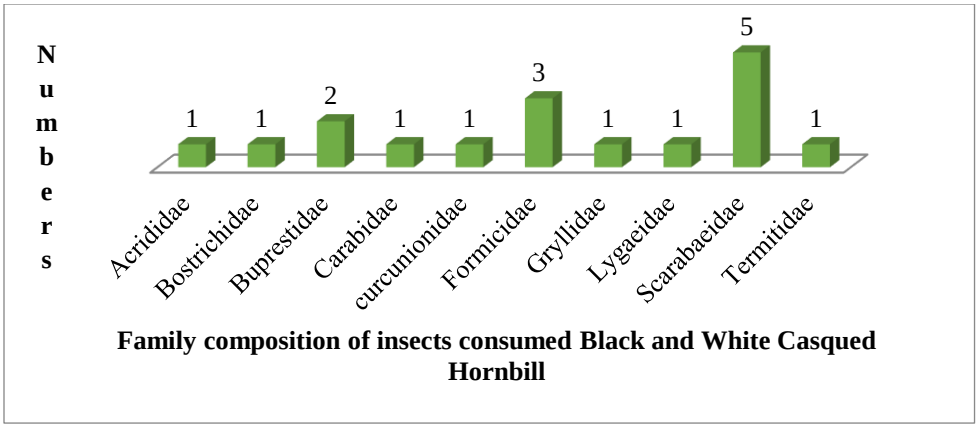

Figure 5. Family composition of insect species consumed in the study area

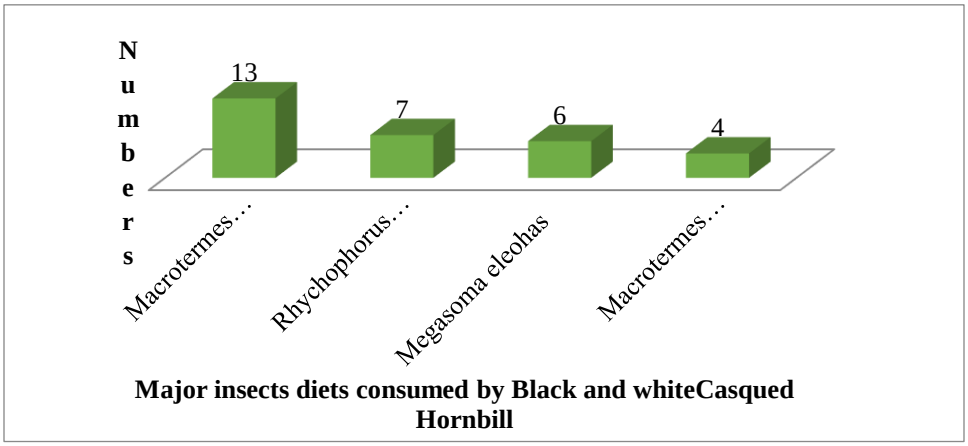

Figure 6. Major insects consumed in the study area

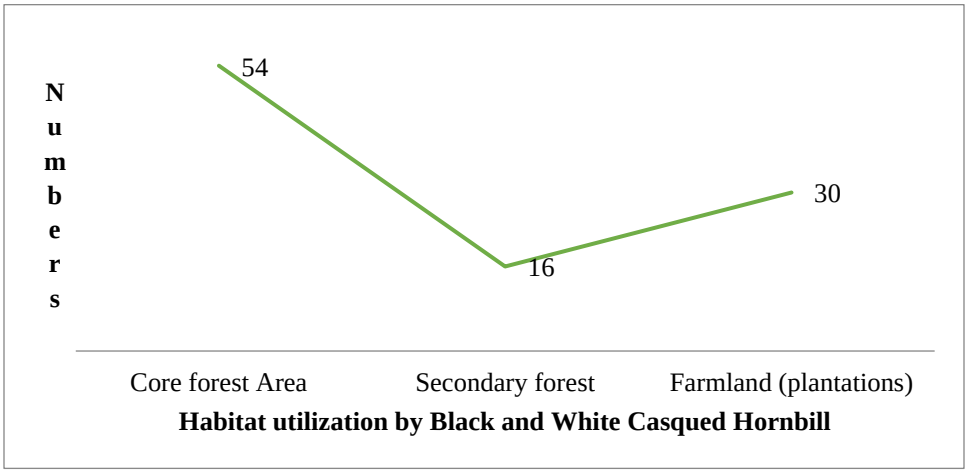

Figure 7. Habitat Utilization by Black and White Casqued Hornbill

Discussion

Bycanistes subeylindricus, are omnivorous birds that feed on a variety of foods including fruits, insects, small animals, and occasionally small reptiles or amphibians. The result of the research study indicates that Black and White *Casqued Hornbills* feed on a variety of fruits, leaves, flowers, and insects. This finding is supported by Short and Home (2001), who reported that their diet primarily consists of fruits, with figs being a particular favorite. They also consume a variety of other fruits, such as berries and nuts. Insects, especially beetles and ants, make up a significant part of their diet as well. This is also similar to Kemp (2001), who reported Black and white Casqued Hornbills will occasionally hunt for small animals, such as lizards and frogs, but this makes up a relatively small part of their diet. They have also been known to feed on eggs and chicks of other birds. Black and white Casqued hornbills consume a variety of fruits from different families of trees. However, from the field result, one of their favorite fruit types is *ficus exasperata*, which is part of the *Moraceae* family of trees. This finding is supported by Kemp and Boesman (2020), who reported that the *Moraceae* family is a diverse group of trees and includes many species that are important food sources for wildlife. Ficus species, in particular, are a common food source for many bird and mammal species, including *hornbills*. It is also similar to Short and Horne (consume fruits from other tree families such as the *Arecaceae*, *Lauraceae*, *Myrtaceae*, and *Annonaceae*. These families include a wide range of trees that produce edible fruits that are important food sources for many animal species. Black and white *Casqued Hornbills* are *omnivorous* birds that feed on a variety of foods, including insects. They consume a wide range of insect species, but some of the major insect groups that are consumed by these birds include beetles, ants, and termites. This result agrees with Kemp and Boesman (2020). Who reported that beetles are a particularly important food source for black and white hornbills. They consume a variety of beetle species, including *weevils*, *longhorn beetles*, and *scarab beetles*. Ants are also a significant part of their diet, with *hornbills* feeding on both flying and crawling ants. Termites are another important food source, with *hornbills* consuming both worker and soldier termites. This finding is also similar to Short and Horne (2001). Who reported that in addition to these insect groups, black and white *Casqued Hornbills* also feed on a variety of other insects such as *grasshoppers*, *crickets*, *caterpillars*, and *mantises*. They are opportunistic feeders and will consume whatever insects are available in their habitat. The researchers observed that the Black and White *Hornbill* use a unique feeding method that involves catching and manipulating their

prey using their large bills. This observation is similar to Short and Horne (2001), who reported that When feeding on fruits, black and white hornbills use their bills to pluck the fruit from the tree or bush. They then *swallow* the fruit whole or break it into smaller pieces using their bills before swallowing. Insects are caught by the *hornbills* using a technique known as "gaping." The birds open their bills wide and use them to catch flying insects, such as bees or butterflies, or to scoop up crawling insects, such as ants or termites. It also agrees with Teo (2017), who reported that when hunting for small animals, such as lizards or rodents, black and white *hornbills* use their bills to grab and manipulate their prey. They will use their bills to crush the prey or to pull it apart into smaller pieces before swallowing. They are also known for their ability to catch and eat flying insects while in flight. They use their bills to catch insects such as dragonflies and moths, and they are known to be skilled at catching insects in mid-air The researchers discovered that the Black and White used a sizable home range inside a national park and relied on tall, emergent trees for food. According to this finding, which is comparable to one made by Leighton (2014), movement across *hornbill* species was hierarchical and followed body size. Throughout the mating season, the species made use of 18 different nest tree species, representing at least 12 families. This discovery echoes that of Kemp (2001), who noted that nest selection can take place at any time of the year in territorial pairs but often happens at the start of the mating season in non-territorial species. Also, Ahmad (2013), stated that at least 18 families of trees were employed by the 43 different types of nesting trees used by the *Sumatra hornbills*.

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Appendix 1. Fruits fed upon in both seasons of the year

Name Tree Species	Family	Parts Utilized	Season	Observations%
Afzelia africana	Fabaceae	Seeds	Dry season	2
Albizia ferruginea	Asteraceae	Seeds	Dry season	1
Blighia sapida	Sapindaceae	Fruits and seeds	Wet season	2
Bosqueiaangolensis	Moraceae	Seeds	Wet season	1
Brachystegia eurycoma	Fabaceae	Seeds	Dry season	3
Brachystegia nigerica	Fabaceae	Seeds	Dry season	2
Chrysophylllum albidum	Sapotaceae	Fruits	Wet season	3
Chrysophyllum delevoyi	Sapotaceae	Fruits	Dry season	3
Chrysopyllum africana	Sapotaceae	Fruits	Wet season	2
Cissampelosmu cronata	Menispermaceae	Seeds	Dry season	2
Cleistopholis patens	Annonaceae	Seeds	Wet season	2
Cola ginganta	Sterculiaceae	Seeds	Dry season	3
Dacryodes edulis	*Burseraceae*	Fruits	Wet season	16
Daniellia ogea	Fabaceae	Seeds	Dry season	2
Elaeis guineensis	Arecaceae	Fruits	Both seasons	20
Erythrophleumsuaveolens	Leguminosae	Seeds	Dry season	1
Ficus exasperata	Moraceae	Fruits	Wet season	34
Ficus ferruginea	Moraceae	Fruits	Wet season	10
Ficus glumosa	Moraceae	Fruits	Wet season	3
Ficus sur	Moraceae	Fruits	Wet season	2
Guareacedrata	Meliaceae	Seeds	Dry season	1
Hymenoste giaafzelii	Leguminosae	Seeds	Dry season	2
Irvingia grandifolia	Irvingiaceae	Fresh Fruits	Wet season	2
Lonchocarpus griffonianus	Fabaceae	Fresh pods and seeds	Both seasons	6
Monodora tenuifolia	Annonaceae	Seeds	Wet season	1
Musanga cecropioides	Moraceae	Seeds	Wet season	7
Myrianthus arboreus	Moraceae	Riped Fruits	Wet season	1
Polyalthia suaveolens	Annonaceae	fruits	Wet season	2
Pterocarpu ssoyauxii	Papilionaceae	Fresh fruits	Dry season	2
Pterocarpu sosun	Papilionaceae	Fresh seeds	Wet season	1
Pycnanthu sangolensis	Myristicaceae	Seeds	Dry season	3
Rattan zakeri	Arecaceae	Fruits	Wet season	2
Rothmannia hispida	Rhizophoraceae	Fruits	Dry season	2
Spondia mombin	Anacardiaceae	Fresh fruits	Wet season	2
Stercullia coriata	Sterculiaceae	Fruits	Wet season	1
Tetrapleura tetaptera	Combretaceae	Fresh fruits	Dry season	2