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Local community perceptions on the conservation of hornbill (Family Bucerotidae) in West Kalimantan, Indonesia

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Abstract. *Kurniawan FH, Rahmansyah R, Rahman A, Hardiyanti, Kurniawan J, Putra ID, Hadiprakarsa Y. 2024. Local community perceptions on the conservation of hornbill (Family Bucerotidae) in West Kalimantan, Indonesia. Biodiversitas 25: 1702-1710.* Effective wildlife conservation strategies must consider local community perceptions to develop effective actions. This study explored community attitudes toward hornbill conservation in West Kalimantan, Indonesia. Between November 2018 and August 2019, we interviewed 513 respondents in ten villages in Kapuas Hulu District, West Kalimantan Province, Indonesia. We collected data on respondent's demographics, socioeconomic status, human-forest interactions, animal hunting trends, knowledge of hornbill, hornbill hunting, and hornbill-cultural knowledge. Most respondents were Dayak, relying on the forest for farming and harvesting for subsistence and commercial purposes. Seven out of eight Kalimantan hornbill species are targeted for hunting, with Helmeted hornbills being the most targeted species (80%) in the past five years. In addition, 12% of respondents reported hunting hornbills for food. Our result suggests that hunting is related to socioeconomic conditions, given that a significant proportion of respondents had no steady income (56%) and limited economic resources as farmers (38%), and a significant portion was unemployed (46%). A decline in the cultural value of hornbills was also recorded, with 61% of respondents did not know about it. The respondents who know, generally only understand the hornbill utilization in the traditional ornament matter and lost the sacred value. Additionally, in this study, cultural narratives were successfully recorded by some older respondents who were aware of the cultural value of hornbills from age >55 years old (27%). Hornbill ecotourism is suggested to enhance and fortify the socioeconomic well-being of sustainable conservation practices and mitigate the unsustainable use of hornbill. To enhance public awareness, we suggest conducting conservation education activities and awareness campaigns targeted at individuals within the age <35 years old, where a majority of respondents at these ages (45%) are unaware of the cultural value of hornbills. A community-based hornbill monitoring program is also recommended to raise public awareness, although funding for this aspect is currently very limited.

Keywords: Conservation perception, cultural values, Helmeted hornbill, Kapuas Hulu, traditional knowledge

INTRODUCTION

Indonesia, with its extensive tropical forests, is important for global hornbill conservation since the country has 13 species of hornbills, of which three are endemic (Kinnaird and O'Brien 2007; Poonswad et al. 2013a). All Indonesian hornbills have been protected since the Dutch colonial era through the Dierencershermin Ordonnantie 1931 No. 134 (Staatsblad van Nederlandsch-Indie 1931). Currently, the hornbills are protected by the Indonesian Government through the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.106 of 2018 concerning the Second Amendment on the Regulation of the Minister of Environment and Forestry Number 20 of 2018 about Protected Species of Plants and Animals (KLHK 2018).

In the social, cultural, and political context, hornbills have important meanings for the people of Indonesia. Among several regions in Indonesia, Kalimantan (Indonesian Borneo) shows the strongest cultural and political ties between humans and hornbills (Philovenny and Mohd-Azlan 2023). The Dayak tribe, the major indigenous community group on the island (Suswandari et al. 2022), share a strong cultural connection with hornbills, considering them as symbols of honor, bravery, and spirituality (Furness 1902). Several traditional practices in Dayak communities, such as tattoos, dances, and rituals, resemble the form and movements of hornbill (Hose and Shelford 1906; Wisjayanti and Astuti 2020). Hornbills are also featured in political symbols, like the Helmeted hornbill *Rhinoplax vigil* Pennant 1781, being the mascot of West Kalimantan Province, Indonesia.

Although certain subtribes within the Dayak communities historically hold cultural values against the hunting of hornbills (Bennett et al. 1997), these big birds now face a severe threat, especially the Helmeted hornbill, due to extensive illegal hunting driven by the demand for their valuable beaks, known as *red ivory* from all types of individuals, male, female, and/or juvenile (Hatten et al. 2022; Ouitavon et al. 2022). It has been noted that the

casques of Helmeted hornbills are used as souvenirs, with their final trade destination being China, and these casques serve as a form of investment indicating social status (Phassaraudomsak et al. 2019). This has led to the Helmeted hornbill being critically endangered, putting it on the verge of extinction (Beastall et al. 2016). Paradoxically, Kalimantan, particularly West Kalimantan Province, has become a major hub for hornbill hunting and trade (Phassaraudomsak et al. 2019). The significant scale of hunting is evident in a large number of Helmeted hornbills illegally traded, such as the estimated 6,000 killed in West Kalimantan in 2013 alone (Hadiprakarsa et al. 2013; Collar 2015). Recent events, including the seizure by the airport and quarantine authority in Semarang, secured a total of 23 red ivory items in February 2021 (Perdana 2021), indicating that hunting activities persist, raising concerns about the survival of hornbills on an island that holds them in high cultural regard. A study on the other Bornean hornbill species, like Rhinoceros hornbill *Buceros rhinoceros* Linnaeus 1758, showed an alarming sign of population decline due to their use as traditional ornaments (Bennett et al. 1997).

The continuous illegal hunting and trading not only affect the fate of the hornbill's population into extinction but also might lead to disturbances in ecosystem balance (Ardiantiono et al. 2020: Kaur et al. 2020). It is known that hornbills consume a variety of fruits in tropical forests to meet their energy needs (Kinnaird and O'Brien 2007). Simultaneously, the seeds of the fruits they consume are dispersed over a wide area during their daily movement, reaching 25 km per day (Naniwadekar et al. 2019). At least 80% of the seeds they consume can be dispersed over distances exceeding 500 meters from the parent tree (Holbrook and Smith 2000), and have a survival probability of over 76.9%, considering no seed predation events by rodents (Kitammura et al. 2004; Velho and Isvaran 2009). The loss of hornbills would result in reduced seed dispersal, especially for medium to large-sized seeds preferred by hornbills. Only certain animals, including hornbills, are capable of dispersing these seeds (Kitammura et al. 2004). Studies have shown that the decline in hornbill populations leads to a reduction of the naturally dispersed seeds in the forest (Naniwadekar et al. 2015).

Understanding community attitudes towards hornbill conservation is crucial (Niemiec et al. 2021; Jomes et al. 2023), as community knowledge and involvement play a vital role in conservation efforts (Abram et al. 2015). This study aims to explore community perspectives on hornbill conservation in West Kalimantan, Indonesia. This study not only contributes to the knowledge and implies hornbill conservation action plans (Jain et al. 2018), but also confirms our findings regarding hornbill hunting in 2013 (Hadiprakarsa et al. 2013).

MATERIALS AND METHODS

Study period and area

The perception survey was conducted from November 2018 and August 2019, simultaneously with the hornbill population and occupancy surveys in Kapuas Hulu District (2,998,400 ha). A grid-based survey design with a grid size of 13.9×13.9 km was used to select survey locations in the remaining forested areas, totaling 2,235,037 ha. Ten adjacent grids were randomly selected where human settlements were present. The survey area included 8 sub-districts and 10 settlements (Figure 1). Two settlements were identified as part of the buffer zone of Betung Kerihun National Park (BKNP) and Danau Sentarum National Park (DSNP).

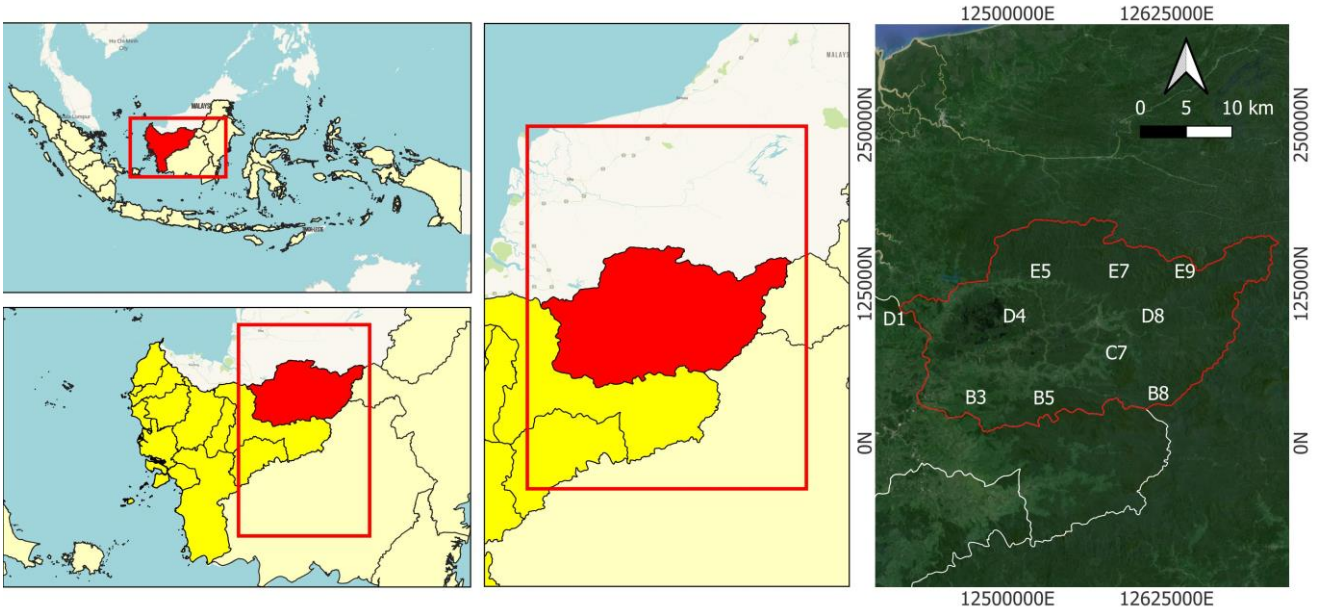

Figure 1. Map of study area showing grids for perception survey in Kapuas Hulu District, West Kalimantan, Indonesia. Note: grids in Danau Sentarum National Park included: B3: Parang, B5: Segitak, B8: Rantau Bumbun, C7: Nanga Raun, D1: Langau, D4: Meliau; grids in Betung Kerihun National Park included: D8: Kareho, E5: Batu Lintang, E7: Tanjung Lasa, E9: Bungan Jaya

Data collection procedures

Hornbill species studied

All of eight Kalimantan hornbill species were included in this study. The species were White-crowned hornbill *Berenicornis comatus* Raffles 1822, Rhinoceros hornbill *Buceros rhinoceros* Linnaeus 1758, Helmeted hornbill *Rhinoplax vigil* Pennant 1781, Bushy-crested hornbill *Anorrhinus galeritus* Temminck 1831, Black hornbill *Anthracoceros malayanus* Raffles 1822, Oriental-pied hornbill *Anthracoceros albirostris* Shaw 1808, Wrinkled hornbill *Rhabdotorrhinus corugatus* Temminck 1832, and Wreathed hornbill *Rhyticeros undulatus* Shaw 1812.

Survey design and analysis

This study used a quantitative approach based on the recommendation by Mack et al. (2005), with the objective of confirming the hornbill hunting in the last decade, especially the Helmeted hornbill in west Kalimantan (Beastall et al. 2016). The survey involved administering a questionnaire consisting of 63 interconnected close-ended questions with a combination of open-ended questions about cultural stories to randomly selected respondents. The questionnaire covered seven aspects i.e., respondents' demography (ethnicity, gender, age, education level), socioeconomic conditions, human-forest interactions, animal hunting trend, general knowledge of hornbill, hornbill-hunting knowledge and hornbill-cultural knowledge. The reliability of the respondents was assessed by requesting wildlife pictures from within and outside the study area. Respondents who selected wildlife species that did not exist in the study area were subsequently excluded. Documentation of the bill, feathers, or other hornbill organs that have been fashioned as ornaments is undertaken, where feasible, as evidence of the utilization of these birds in societal contexts.

The sample size for the interviews was determined to have a maximum error tolerance of 5% of the population in the survey locations, based on the formula by Sevilla et al. (1984). This resulted in a minimum of 376 participants, an average of 32 respondents per location. The collection and survey data management used the KoboToolbox application (Philovenny and Mohd-Azlan 2023). The KoboToolbox application consists of a computer server component installed at http://kf.pemantau.id and the KoboCollect Android application. We analyze the data descriptively. All data were tabulated and then generated to describe the variation condition of the community in the scope of six aspects using pivot table, a tool in Microsoft Office Excel.

Ethics statement and respondent reliability

All respondents involved in this study were informed about the purpose of the interviews and assured that their data would be analyzed anonymously. All hornbill organ documentations were taken by enumerator, under the permission of the owner.

RESULTS AND DISCUSSION

Our data collection exceeded the minimum required sample size, with a total of 513 participants. It should be noted that three villages, namely Lauk Rugun (31 respondents), Meliau (25 respondents), and Salin (10 respondents), did not meet the desired number of respondents per location. However, we still included the data from these three villages, considering that the populations there are more than 10 individuals (Abram et al. 2015), with the average number of respondents across all ten villages remaining at 42.75 individuals, which exceeds the minimum required number

Respondent demography

As expected, the majority of respondents (84%) belonged to the Dayak tribe, consisting of 13 sub-tribes, i.e., Ahe, Bukat, Embaloh, Iban, Kalis, Kantuk, Orung Daan, Pangin, Punan, Suruk, Taman, Ot Danum, and Ulu Sungai. Meanwhile, Malays and other ethnic groups (Javanese, etc.) accounted for 16% of the total population. Gender representation was balanced, with 38% women and 62% men. Most participants (91%) had resided in the data collection area for over 10 years, with a small portion residing for 5 to 10 years (5%) and less than 5 years (4%). The age distribution exhibited a relatively even pattern, with 20% falling within the 10-24 years old, 29% for 25-34 years old, 19% in the 35-44 years old, 12% in the 45-55 years old, and 20% over 55 years old. In terms of education, the majority had completed primary school only (31%), followed by those without formal education (29%), while respondents with junior high school and senior high school education accounted for 18% each. Those with higher education qualifications comprised only 5% of the respondents.

Socioeconomic conditions

The survey revealed that a considerable number of respondents belonged to communities characterized by economic instability, indicated by restricted occupations and limited income. A significant portion of respondents did not have specific work and/or did not work (46%), while the rest worked as farmers (38%), while the minority was an officer or private employees (8%) and a merchant (4%). It must be noted that 12% of respondents were identified as students, so we excluded the specific question about the salary in this occupation due to not yet being part of the workforce. Regarding income, more than half of the respondents (56%) have uncertain income, followed by respondents with incomes ranging between 500,000 to 5,000,000 IDR per month (44%) (1 USD=15480,40 IDR). In contrast, only 1% of the respondents reported a monthly income exceeding 5,000,000 IDR, with the majority earning less than this threshold.

Human-forest interaction

Among all the respondents, 60% (n=308) admitted that they often go to the forest, consisting of 65% men and 35% women. Respondents from the Dayak tribe were the ethnic group that often enters the forest (91%), but a small number of Malay ethnic (9%) also enter the forest. If further examined, respondents who often go to the forest claimed to have a profession as farmers, with a significant majority 57% being engaged in this activity. However, a concerning finding emerged as 24% of the respondents admitted to participating in hunting, which poses a substantial threat to hornbill conservation efforts. Based on the intensity, most (46%) respondents admitted that they do not have a certain time to go to the forest, and only 30% of the respondents admitted that they go to the forest every day. Based on their purpose, apart from farming, as many as 24% of the respondents go to the forest for hunting, and some collect wood and non-timber forest products, such as honey, medicinal plants, and rattan. Based on the measurement of the respondents' confidence level in animal identification, 95% (n=295) of the respondents who stated they frequently going to the forest gave quite convincing answers, while the remaining 5% gave dubious answers because they had seen bison, birds of paradise, and tigers in the forest. Therefore, further analysis was conducted only on the 295 respondents.

Animal hunting trend

Most of the respondents who carried out hunting activities while going to the forest (74%) felt a change in getting the prey. Almost of these respondents (n=73), as many as 94% of them feel the changes, mainly in the increase of difficulties in finding animals to hunt, even the rest (6%) believe that many of the prey are extinct. As many as 85% of the respondents stated that the change occurred due to the high intensity of hunting both from their own village and from outside the village. As many as 48% of the respondents felt that such changes have occurred in the last five years, while 41% feel that it has been quite a while, more than 5 years ago. As a result of this change, 29% of hunter respondents took longer periods in finding their prey and most respondents (69%) would hunt further into the forest. However, with the trend of hunting animals becoming increasingly difficult, half of the respondents (57%) admitted that many villagers/hamlets stopped or reduced their hunting activities, while the other (43%) did not see any change in the number of people hunting or the intensity of hunting in the village/hamlet.

Knowledge of hornbill

Most respondents (93%) had knowledge of hornbills, while the rest who did not know generally originated from ethnic Malay or other than Dayak. Basic knowledge of hornbill is fairly evenly distributed across all age groups of respondents. General knowledge (58%) is due to the attractive shape and color of the hornbill beak, and 27% of respondents remember it because of the hornbill's large-sized body. Of the eight Kalimantan hornbill species, all of them could be recognized by 477 respondents who knew hornbills. Rhinoceros hornbill was the most recognized species (22%), followed by Black hornbill (17%) and Helmeted hornbill (14%). The Wreathed hornbill and other hornbills were recognized by a few respondents.

Among the 513 respondents interviewed, the majority (86%) had no knowledge regarding the fauna symbols or mascots of West Kalimantan Province. Unfortunately, we found misconceptions among the remaining respondents (n=70) who claimed to know the mascot of West Kalimantan. Most of these respondents (75%) identified the Rhinoceros hornbill as the mascot, while the remaining 25% chose the Helmeted hornbill as the right answer.

Hornbill-hunting knowledge

As many as 56% of the respondents who had basic knowledge of hornbills also knew about hornbill hunting. However, only 9% of them knew that hunting was still happening at the time of the survey, and most of the respondents could not remember when they knew the hunting was happening. Interestingly, 57% of the respondents admitted that hunting is carried out by their own residents, while 36% of the respondents knew that the hunters come from outside the village/hamlet.

As many as 47% of the respondents stated that hornbill hunting occurred within the last five years, 41% of respondents knew that hunting had occurred more than five years ago, while the rest had only learned about it in the last 1 year (11%), even up to the last month. Based on the information provided by 89% of the respondents, hornbill hunting is carried out using rifles known as *lantak*, some also use other hunting tools such as air rifles, traps, and sumpit (traditional weapon of Dayak).

If studied further, five species of hornbills in Kalimantan were targeted for hornbill hunting in the study sites, i.e., Helmeted, Rhinoceros, Black, Wreathed, and Bushy-crested hornbills. However, it must be noted that outside the study sites, we also found two hornbill species being hunted, including Oriental Pied (Figure 2A) and the endangered Wrinkled hornbill (Figure 2B). We recorded these findings while conducting community assistance in the same district of Kapuas Hulu during the same period as well. Thus, except for the White-crowned hornbill, the other seven species were hunted during the study period.

Most of the respondents (80%) stated that the Helmeted hornbill is the most hunted species. The majority of respondents (82%) stated that hornbills were hunted for sale (mainly head trading), 13% of respondents stated that the other hornbill species were for consumption, and 2% for pets. The species that were most consumed were the Rhinoceros hornbill, followed by the Black and Wreathed Hornbill. We also collected a picture of a Black hornbill just hunted by the local community for consumption as evidence of this statement (Figure 3A). After being eaten, the head and/or feathers were usually kept and preserved to later be used as an ornament to complement traditional clothing (Figure 3B).

According to 70% of the respondents, the head is the most valuable part of the hornbill, especially for the Helmeted hornbill. Generally, 40% of the respondents did not know the selling price of red ivory, other respondents (30%) who knew said the price is above 5,000,000 IDR per head, and other prices vary from 500,000 to 4,000,000 IDR per head.

For trading the hornbill head, as much as 26% of the respondents said it was taken to Putussibau (capital of Kapuas Hulu District), 26% of the respondents said someone would come to the village to collect, even 2% of respondents admitted that there was a host in their village. However, almost all respondents (99%) did not know where the head of the Helmeted hornbill they hunted would be taken or sold.

Hornbill-cultural knowledge

The cultural value of hornbills is an essential aspect of our study. Surprisingly, only a small portion of the respondents (39%) were aware of the cultural significance of hornbills, while the majority (61%) either didn't know or even believed that hornbills have no value. Notably, among the unaware respondents of the hornbill's cultural value (n=311), the majority (80%) belonged to the Dayak tribe, which is known for considering the hornbill a sacred bird. On the other hand, among the respondents who were aware (n=202), 77% regarded hornbills solely as ornamental additions to traditional attire and dances, while the remaining respondents acknowledged the cultural and spiritual significance associated with hornbills. Examining the age groups, respondents who were unaware of the cultural value of the hornbill were predominantly within the age range of 10-24 years (18%) and 25-34 years (27%). On the other hand, respondents who were knowledgeable about the cultural value of the hornbill were most commonly found in the age range of 35-44 years old (24%) and over 55 years (27%). The ornamental uses of hornbills include enhancing the visual appeal of ceremonial clothing and traditional ornaments (Figures 4A-B). Furthermore, we also encountered instances where parts of the hornbill's body were openly traded during an event in the KapuasHulu District (Figure 4C). We also elaborated on the narratives obtained from the community during the interviews.

A closing open-ended question in our interview sessions was provided to delve deeper into the cultural value of hornbills. This information was sourced from respondents aged 35-44 years and >55 years who indicated awareness of the cultural value of hornbills. We then cross-checked the similarity of cultural information across ethnic groups as elaborated below.

In several Dayak sub-tribes like the Punan, Iban, Taman, Pangin Orung Daan, and Ulu Sungai Dayak, various body parts of the hornbill are used as mediums for traditional medicine by the *manang* (shamans or folk healers). Dance performances among the Punan, Taman, Iban, Pangin Orung Daan Dayak, and other sub-tribes often feature hornbill body parts, primarily those of the Rhinoceros hornbill. The commonly used body parts include the head and tail feathers. In the case of the hornbill head, it is frequently positioned as a crown, as observed in the Dayak Orung Daan sub-tribe. On the other hand, hornbill tail feathers are not only used as decorative elements like a crown but also as an attribute for dance performances, as indicated by the respondents from the Iban, Pangin, Orung Daan, Kantu', and Punan tribes.

The explanation regarding the cultural-ornamental value of hornbills stands in stark contrast to the perspectives of respondents who were able to recount the cultural-spiritual significance of hornbills. A minority of the respondents (23%, n=202) expressed spiritual beliefs associated with hornbills, regarding them as sacred birds and prohibited from being killed, ancestral figures, bird commanders, and good signs during forest journeys. Within the Iban Dayak, the hornbill is revered as a sacred bird known as *panglima burong* (the bird commander), believed to possess supernatural powers. For this tribe, the hornbill is regarded as a significant omen during forest journeys, and hunting hornbills is forbidden due to their sacred value and their role as ancestral beings aiding humans. The Orung Daan and Taman Dayak refer to the hornbill's tail as *mamasih*, a term reserved for those who have performed the ritual of *mengayau* (cutting off the human head). These indicate that the hornbill serves as a sign or symbol for individuals with courage. For the Ot Danum and Punan Dayak, the hornbill, particularly the Rhinoceros hornbill, holds ancestral significance. The Ulu Sungai Dayak believe that hunting Rhinoceros and Helmeted hornbills brings bad luck or disaster. Interestingly, certain individuals from Orung Daan and Pangin also view the hornbill as a symbol of social status, exclusively reserved for royal descendants or individuals of importance. Consequently, the hornbill is utilized as an ornament in ceremonies like *sangkai pulut*-a welcoming ceremony for guests of high social standing. It is noteworthy that there are varying opinions on the use of hornbill parts in these ceremonies, even within the same ethnic group. Some respondents still endorse the use of hornbill organs, while others propose the use of *kayu pelaik* (*Alstonia* spp., Apocynaceae) as a main material to make hornbill statues, considering the hunting of hornbills to be prohibited due to their sacred status. However, we did not find any text that documented these spiritual values in all locations, such beliefs are verbally transmitted across generations.

Nevertheless, these findings demonstrate that the spiritual value of hornbills is not entirely lost in society, as evidenced by recorded sacred narratives. However, these narratives were only obtained from a small subset of respondents, typically older individuals (>35 years), while younger respondents below this age could not recount the sacred values associated with hornbills. Meanwhile, hunting stands in stark contrast to these findings. It should also be noted that our research did not encompass validation regarding whether respondents have engaged in hunting or not; rather, it only asks whether respondents have witnessed hunting or not, considering that such information is quite sensitive within the community and poses risks when inquired about. As far as our speculation goes, it appears that older generations still comprehend the spiritual value of hornbills. In contrast, hunting activities carried out by younger generations are the result of cultural degradation.

Figure 2. Evidence of hornbill species that were not mentioned as hunting targets in the study sites but were found to be hunted based on our investigation during community assistance in the same area and periods. A. Wrinkled hornbill with two heads of Black hornbill; B. Three heads of Oriental-pied hornbill

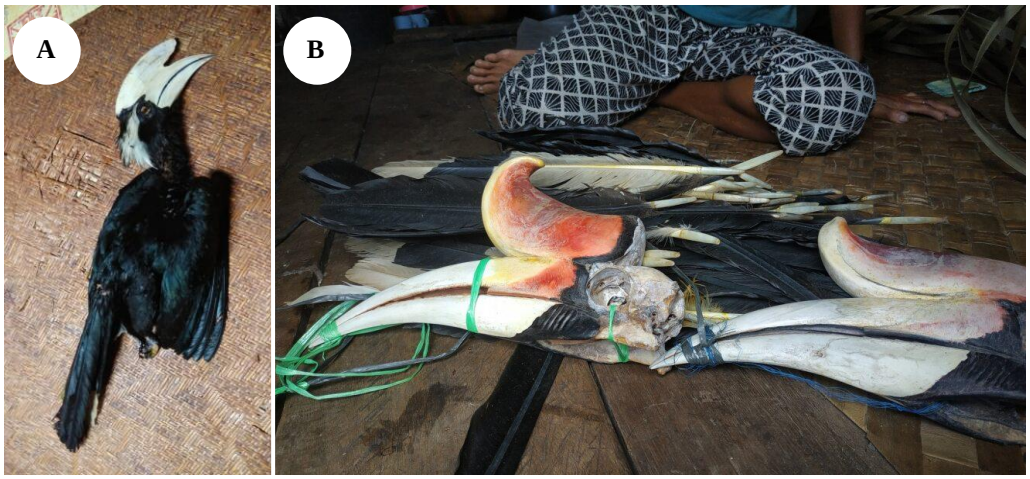

Figure 3. Evidence of hornbill hunting event. A. Black hornbill just hunted for food by the local community; B. Heads and feathers of Rhinoceros hornbill as collections for ornament purposes

Figure 4. Hornbill as ornamental complements. A. Rhinoceros hornbill; B. Black hornbills; C. Rhinoceros hornbills were openly traded at cultural event in Kapuas Hulu

Discussion

The strong presence of the Dayak tribe engaged in farming activities, as indicated by the frequency and purpose of their visits to the forest (Goh 2020), has fostered a profound connection between the Dayak community and their natural environment (Fahrianoor et al. 2013). Not only in West Kalimantan, farming is also common for Dayak people on the other side of Kalimantan (Mardiyaningsih et al. 2018; Suswandari et al. 2022). Through their practice of shifting cultivation and the opening up of forest areas for farming, the Dayak community has had significant interaction with the forest (Murhaini and Achmadi 2021; Usop and Rajiani 2021). This regular and long-term interaction has allowed them to develop a deep familiarity with the forest and wildlife, including the hornbill (Franco and Minggu 2019).

Within the cultural context of the Dayak community, the hornbill holds high sacred cultural esteem and has been a source of inspiration for various traditional rituals and customs (Hasegawa 2018; Haviluddin et al. 2023; Philovenny and Mohd-Azlan 2023; Sahertian 2021), whereas we found contrary results. An ancient manuscript about Dayak narrates in an extreme manner that the feathers or head of the hornbill can only be utilized as battle attire when the user has performed a ritual of decapitating another person called *mengayau* (Furness 1902), and it was still shown in a small number by Orung Daan and Taman Dayak in this study. Furthermore, the manuscript elucidates that ornaments from the hornbill are believed to afford protection to the user's posterior body during warfare in the past (Furness 1902). On the other hand, we unveiled the diminishing cultural significance of hornbills among the respondents, as the majority of them exhibited limited awareness, primarily perceiving hornbills solely for their ornamental value and the hornbill being hunted. The reduction of hornbill cultural value coincided with the presence of misconceptions surrounding the mascot of West Kalimantan Province. Almost all respondents argued that the Rhinoceros hornbill is the fauna symbol. According to the Decree of the Minister of Home Affairs No.48 of 1989 and No. 522.53-958 of 2010, which determines the flora and fauna for the provincial identity, the official identity of West Kalimantan Province consists of the Helmeted hornbill and Tengkawang *Shorea stenoptera* Burck. This decision was further reinforced by the Decree of the Governor of West Kalimantan No. 257 of 1992, which officially established the flora and fauna identity of the province.

Given the general condition that community traditions are generally rarely explored (Perez et al. 2016), the lack of written records and the influence of globalization, which facilitates easier access to information, can contribute to the diminishing cultural significance of important species such as the hornbills (Dorji 2009; Riza et al. 2019). The current process of globalization has been favored and accelerated by the rapid evolution of the Internet (Combi 2016). This undoubtedly impacts the indigenous culture held by the communities. However, with appropriate guidance and support, this can actually be turned into an opportunity, as seen in China (Xiaochun 2016). The presence of technological globalization allows for more practical cultural documentation (Perez et al. 2016) and addresses the current lack of traditional documentation.

The hunting of hornbills, as in this study, is driven by various factors, including sale, traditional ornamentation and even for consumption purposes. It is important to note that such occurrences are not limited to the Indonesian Borneo (Kalimantan) side but have also persisted in Malaysia, specifically in Sabah and Sarawak, for an extended period (Bennett et al. 1997). In addition, the extraction of wildlife for consumption not only contributes to modern extinctions (Bayley et al. 2022), but also has broader implications for climate change (Machovina et al. 2015). In fact, the Dayak people have a long-standing tradition of animal hunting for daily necessities of protein (Mardiyaningsih et al. 2018; Sari et al. 2019). However, they also have historically adhered to strict customary regulations that prohibit hunting sacred animals, like hornbills and orangutans, for food, and some subtribes continue to uphold these values (Hose 1929; Leo et al. 2022). Our finding indicates a shift in the sacred values associated with hornbills, leaving behind only their ornamental value.

The hornbill hunting in the study area is also in line with suboptimal socioeconomic conditions, which are proved by the limited community occupation. This means the current intent of hunting activity extends beyond just fulfilling daily needs for consumption; it also includes the sale of hornbill parts, both as standalone items and ornamental additions. It is common for biodiversity conservation challenges, including hornbill conservation, to be situated within communities with limited economic resources (Roe and Elliott 2005). Considering the high value placed on hornbill casques, it is understandable that people hunt them (Collar 2015). However, it is important to emphasize that hunting, despite being an alternative economic source, is not sustainable and poses a risk of extinction (Borgerson et al. 2019). The illegal trade in hornbills, particularly Helmeted hornbills, aligns with previous data (Collar 2015; Phassaraudomsak et al. 2019), confirming a significant trade in early 2013 (Hadiprakarsa et al. 2013). The current demand, particularly in China, has significantly contributed to this illegal trade of red ivory (Phassaraudomsak et al. 2019). Market trends indicate that red ivory can command prices up to five times higher than on the top of black market in China as carvings, with values ranging from approximately US$4 to US$8 per gram or fetching up to 1,000 USD for a single casque (Nijman et al. 2022; Phassaraudomsak et al. 2019), as our finding ranged the price from hunters were between 33.27-332.73 USD for a single casque.

A holistic approach, as recommended by Poonswad et al. (2013b), is vital to address the crisis. First of all, adequate investigation of hornbill extraction by the local community is required. This approach should particularly focus on the Helmeted hornbill, without overlooking other hornbill species. Then, understanding the consumption rate of hornbills by the community, as well as their use in traditional attire, is needed as it is not covered in this study yet and is recommended by Bennett et al. (1997). This

approach may focus on the Rhinoceros and Black hornbill extraction. Additionally, thorough documentation of the cultural value associated with hornbills is crucial, considering the oral traditions in these communities, particularly in the local communities with an age class of more than 55 years old. To promote conservation, cultural understanding, and accurate knowledge dissemination, enhanced education and awareness programs are imperative. This activity can be conducted with community members in the age range of 10 to 34 years, as shown by almost all of our respondents in this age class who were not aware of the hornbill's cultural significance. Regarding the suboptimal socioeconomic conditions and limited job opportunities, creating alternative economic sources through ecotourism that is centered on hornbill observation is suggested. Establishing such economic opportunities may encourage a shift from hunting to conserving the hornbill, as successfully seen in Thailand and India (Datta et al. 2018; Poonswad 2012; Poonswad et al. 2013a).

In conclusion, the surveyed communities in Kalimantan, predominantly belonging to the Dayak tribe, displayed varying levels of awareness and knowledge about hornbill hunting. Socioeconomic conditions were characterized by limited resources and occupational restrictions, leading to unstable income and a need for targeted interventions for sustainable livelihoods. Forest visits were primarily for farming, but hunting activities posed a threat to hornbill conservation efforts. Respondents experienced difficulty in finding prey due to high hunting intensity, resulting in longer searches and venturing further into the forest. Knowledge about hornbills varied, with recognition of their distinctive beak shape and color, but limited understanding of specific species. Cultural significance and awareness of official symbols were also lacking among respondents. A total of seven out of eight Kalimantan Hornbill species were being hunted by the local community, mainly for trading and consumption. The existence of hornbill hunting within the Dayak community is possible due to the reduction of the hornbill's cultural value, where its sacred significance is gradually being forgotten, leaving only its ornamental value, along with limited availability of income options to the community.

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