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continued on the back inside cover

Cover: Tamil Lacewing *Cethosia nietneri* with colour pencils and watercolours for the background; detailing with fine liners by Elakshi Mahika Molur.

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ARTICLE

Culture and provisioning: the case of Human-Long-tailed Macaque *Macaca fascicularis* (Raffles, 1821) interactions in Sumile, Butuan City, Philippines

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Abstract: Understanding human-macaque interactions is crucial for species conservation and management. Hence, this study investigated the Human-Long-tailed Macaque *Macaca fascicularis* (Raffles 1821) interactions in Sumile, Butuan City from July 2022 to April 2023 through one-on-one interviews. A total of 271 randomly selected respondents were surveyed to determine their demographic and socioeconomic profiles. Their knowledge, attitudes, and perceptions of human-macaque interactions such as provisioning, regulation measures, and associated factors were also determined. Most of them were aware of the cultural importance of macaques (86.35%). The majority were not aware of the ecological (73.43%) and socioeconomic importance of macaques (52.03%), as well as RA 9147 or Wildlife Act (61.26%). Most residents provisioned macaques (99.26%). Macaque behaviors were household food foraging (94.84%), crop foraging (31.78%), trash consumption (69.37%), and trash dropping (30.63%). Most residents did nothing to food foraging in households (53.51%) or crop foraging (58.30%) while some resorted to throwing hard objects, hand clapping, or dog chasing. Educational attainment was the most common factor significantly associated with residents' knowledge. Length of residency and educational attainment were significantly associated with provisioning frequency while length of residency and occupation were associated with the prohibition of provisioning to avoid negative human-macaque interaction. This study implies that cultural factors influence rampant macaque provisioning. If uncontrolled, provisioning may lead to economic and health losses and negative attitudes toward macaques and conservation efforts. The top three human-macaque regulation measures suggested by most residents were government action, effective waste disposal, and increasing the food base in the forest. Researchers further recommend local conservation area establishment; culture-sensitive and controlled provisioning; and community-based conservation. This also entails educating the public on the adverse impacts of uncontrolled provisioning. Furthermore, periodic monitoring of macaque populations and conservation management strategies that balance ecological, socio-economic, and cultural considerations for human-macaque co-existence is necessary.

Keywords: Conservation, crop foraging, cultural belief, Elijan Park, foraging behavior, local communities, management, monkey feeding, perceptions, regulation measures.

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Author contributions: FHL, DSA & SLP conceptualized & designed the research, wrote the paper, reviewed, edited, and approved the submission of the final paper. FHL & DSA performed the surveys and field work activities and analysed the data.

Filipino abstract: See end of this article.

Acknowledgements: We express our gratitude to the local government officials of Sumile who allowed us to conduct the surveys in their communities. We are also grateful for the assistance and significant information from the Elijan Park caretakers and the local government head. Most of all, we highly appreciated the contribution of the mentors and the advisory committee of Fritche H. Lapore and Debbie S. Aseñas as this paper is part of their undergraduate thesis.

INTRODUCTION

Long-tailed Macaques *Macaca fascicularis* (Raffles, 1821) are found across southeastern Asia (Eudey et al. 2020) and are now classified as 'Endangered' due to habitat destruction and exploitation (Hansen et al. 2022). One of the 10 subspecies of *M. fascicularis* is found in the Philippines, which is *M. fascicularis philippinensis* (Grunstra et al. 2023), specifically known as the Philippine Long-tailed Macaque. Macaques often share space and food with humans which is an important aspect of the human-primate interface (Fuentes et al. 2007). The adaptability, flexibility, and synanthropic nature of Long-tailed Macaques enable them to inhabit diverse habitats including anthropogenic areas (Gumert et al. 2011), and consume various foods including human food (Sha & Hanya 2013). The macaque's adaptability to human-modified landscapes, their crop-foraging behavior, and the complex cultural and religious associations have made them particularly challenging for wildlife managers. The Long-tailed Macaques are often subject to culling despite being recently elevated to Endangered status on the IUCN Red list due to negative human-macaque interactions (Gamalo et al. 2023). The endemic Toque Macaque *Macaca sinica* in Sri Lanka is considered both endangered and nuisance species in certain habitats due to increased interactions with humans and crop foraging (Jayapali et al. 2023). In Nepal, negative Human-Rhesus Macaques *Macaca mulatta* interactions resulted from expanding monocultures, forest fragmentation, and habitat degradation (Koirala et al. 2021).

Long-tailed Macaques are frequently observed in roadsides, temples, towns, tourist sites, and agricultural areas (Muroyama & Eudey 2004; Lee & Priston 2005; Gumert et al. 2011). In these human-dominated areas, macaques are often provisioned by humans. Multiple factors contribute to macaque provisioning. Sengupta & Radhakrishna (2018) found that human attitudes significantly influence the degree of human-primate interaction. Their study highlighted the cyclical pattern where macaques are attracted to areas with food provided by humans, who in turn are motivated to feed them due to their behavior. Research in China and India showed that macaque provisioning was mainly due to concerns about wildlife food scarcity, desire for close observation, cultural factors, and religious beliefs (Zhao 2005; Sengupta & Radhakrishna 2018, 2020).

Macaque provisioning is prevalent in anthropogenic areas of the Philippines, including parks and human settlements adjacent to forests. Food provisioning was observed to be common in Puerto Princesa Subterranean River National Park in Palawan (Gamalo et al. 2019), and Subic Bay. In Butuan City, particularly in Barangay Sumile, food provisioning for the Philippine Long-tailed Macaques is frequently observed. These macaques inhabit Elijan Park in proximity to human settlement. Elijan Park is governed by a quasi-religious organization, the Knights of Rizal Agricultural Endeavor Foundation Incorporated (KRAEFI), and was established by tribal chieftain or Datu Santiago B. Ecleo, Sr. (Dominador Paglinawan pers. comm. 20.i.2022). The majority of residents in Sumile are affiliated with the KRAEFI organization. Most residents perceived macaque provisioning as an act of benevolence. KRAEFI members typically provide corn, bananas, and other human food items to macaques inside and outside the park boundaries. Elijan Park caretakers were also observed permitting tourists to provision the macaques.

Food provisioning can aid macaque survival (Kurita 2014). Macaques may consume human food during periods of natural food shortages to supplement their diet (McKinney 2010) which could similarly benefit macaques in Sumile during a food crisis. Food provisioning may also have negative consequences such as the attenuation of macaque natural survival instinct (Dubois & Fraser 2013), increased risks of human-macaque infectious disease transmission (Chapman et al. 2005), restriction of ecological functions, e.g., seed dispersal capabilities (Sengupta 2015), alterations in habitat use (Sengupta & Radhakrishna 2018), changes in macaque behavior (Hsu & Kao 2009) and abrupt increase in reproduction and population size (Sengupta & Radhakrishna 2020).

Macaques adapt to provisioning, and subsequently exhibit a preference for and actively seek human-provided food (Lee & Priston 2005). This often leads to an overabundance of macaques in human settlements, resulting in negative human-macaque interaction (Sengupta & Radhakrishna 2020) such as foraging in kitchens or refuse containers (Unwin & Smith 2010) and consuming crops (Agyei et al. 2019; Li & von Essen 2021). Crop and refuse foraging are linked to food provisioning issues in Puerto Princesa Subterranean River National Park, Palawan (Gamalo et al. 2019). Similarly, in Sumile, macaques forage in households, nearby farms, and refuse disposal sites. These are perceived as a consequence of macaque adaptation to provisioning.

Without regulation, provisioning in Sumile could lead to an overabundance of macaques and negative human-macaque interactions, fostering negative perceptions among residents (Muroyama & Eudey 2004; Matheson et al. 2006; Kuswanda & Hutapea 2023), and hindering conservation efforts. Identifying sociocultural predictors

of human-macaque interactions is crucial for developing adaptive conservation plans for Long-tailed Macaques in Sumile (Humle & Hill 2016). Education programs, targeted behavior management, and consideration of cultural contexts are crucial components of such plans.

Therefore, the study aimed to assess the socioeconomic and cultural background of the respondents; knowledge of macaque significance and relevant legislation; perceptions and attitudes toward macaque provisioning and other human-macaque interactions, management measures, and conservation strategies; and associated socio-economic factors. This research aimed to prove if all Sumile residents engaged in provisioning and whether educational attainment, length of residency, and income negatively correlated with the provisioning frequency and positively correlated with its prohibition as a management measure alongside cultural factors. Studies like this are important, particularly in areas where sociocultural factors play a complex and important role in shaping human-macaque interactions. According to Priston & Mclennan (2012) and Dacks et al. (2019), it is essential to incorporate sociocultural indicators, alongside ecological ones for developing holistic conservation strategies in human-dominated landscapes where macaques reside. The findings will furnish critical information to aid policymakers in developing adaptive management measures and conservation interventions that respect cultural and socio-economic values. This research can guide information, education, and communication initiatives in Sumile, particularly concerning the ecological significance of macaques, protective laws, specific threats, and the importance of human-macaque co-existence. Additionally, it will provide baseline data for future studies on human-macaque interactions and related primate behavior.

METHODS

Study site

Sumile is located in Butuan City, Agusan del Norte, Mindanao Island, Philippines, at 8.826°N, 125.626°E with an elevation of 116.3 m (381.6 ft) (Image 2). It was declared as "barangay" on 30 May 30 1986, under Ordinance No. 450–85. It has a population of 2,271, which comprises 0.64% of Butuan's total population. Its population has increased by 585 individuals from 1,814 in 1990 to 2,399 in 2020.

One subspecies, *Macaca fascicularis philippensis* (Grunstra et al. 2023) is endemic to the Philippine archipelago and also inhabits Sumile, Butuan City, particularly in Elijan Park, known as the KRAEFI-Sumile Botanical & Zoological Garden (Image 1). Elijan Park is named after the first settlers in the area "Elijan" — individuals residing near the site since the 1960s (Dominador Paglinawan pers. comm. 20.i.2022). The macaque population is estimated at approximately 500 and is divided into three troops according to park caretakers. The Knights of Rizal Agricultural Endeavor Foundation, Inc. (KRAEFI) organization currently manages Elijan Park (Dominador Paglinawan pers. comm. 20.i.2022). Numerous tourists visit Elijan Park primarily due to the presence of macaques. The tourists do not pay entrance fees as the local government still complies with the necessary documents to officially designate the park as tourism destination (Dominador Paglinawan pers. comm. 20.i.2022).

Elijan Park was part of the extensive forest in Sumile during the 1970s (Dominador Paglinawan pers. comm. 20.i.2022). This park consists of primary and secondary forests with 28 species. The botanical garden is dominated by *Gmelina arborea*, followed by *Swietenia macrophylla, Artocarpus blancoi*, and *Shorea contorta* (Glenn Mary Daulat in litt. 20 June 2022). In 2016, the DENR-Caraga also established a dipterocarp (White Lauan) plantation in the area. Sumile has 10 Puroks. Puroks 1,2, & 3, being the closest to Elijan Park, were selected for this research.

Image 1. KRAEFI-SUMILE Botanical & Zoological Garden (Elijan Park). © Fritche Lapore.

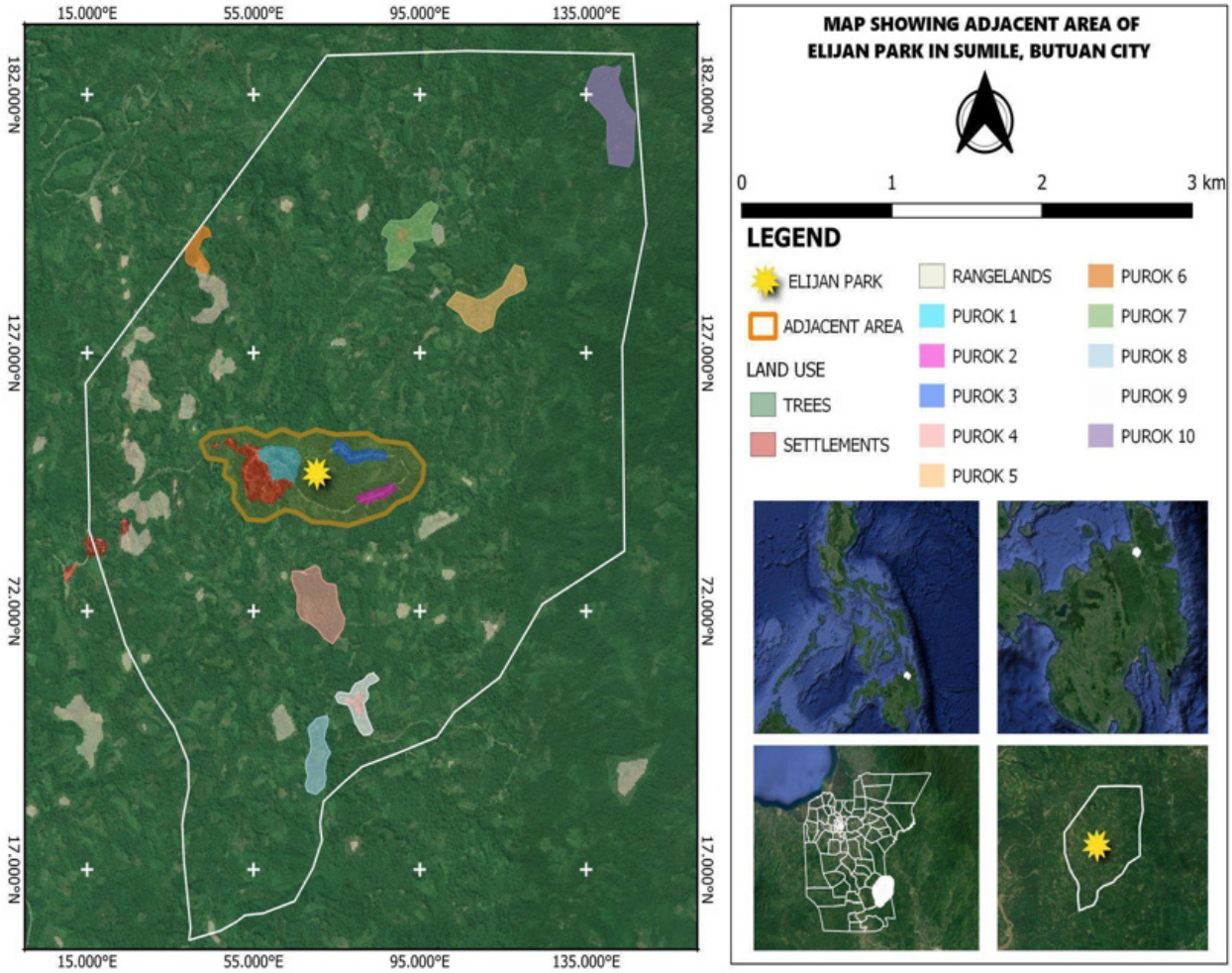

Image 2. Map of Sumile showing Elijan Park and its adjacent areas (four smaller pictures on the lower right show the location of Elijan Park in the Philippines, Mindanao Island, Caraga, and Sumile perspectives). Source: Butuan City Local Government Unit.

Study design, questionnaire, and research ethics

The researchers secured research authorization from Sumile Local Government, KRAEFI, and the City Environment and Natural Resources Office (CENRO-Butuan) prior to initiating the study. A preliminary site visit was conducted for area familiarization, followed by a pilot test of the questionnaire with 15 respondents to gather feedback for revisions. The questions underwent review and validation by subject matter experts. Subsequently, the actual surveys were conducted in three Puroks (Purok 1,2 & 3) of Barangay Sumile, involving 271 randomly selected respondents: 82 in Purok 1, 96 in Purok 2, and 93 in Purok 3. Although the questionnaire was in English, it was translated into Visayan. During one-on-one interviews, respondents provided socio-demographic and economic information (first part of the questionnaire), including gender, civil status, age, length of residency, religion, ethnicity, household size, education, KRAEFI membership, occupation, and income (Appendix 1). The second part of the questionnaire assessed knowledge of macaque importance and conservation legislation and examined perceptions and attitudes toward provisioning, other human-macaque interactions, management, and conservation measures.

Data analysis

Data were organized, coded, and analyzed utilizing descriptive and inferential statistics from jamovi version 2.3.28. Frequencies and percentages were calculated. The results are subsequently presented using tables, graphs, and qualitative descriptions. The chi-square test of association was used to determine the socioeconomic factors linked to knowledge (RA 9147 and importance of macaques — ecological, socio-economic, and cultural), attitudes (provisioning frequency, and deterrent actions to household food and crop foraging), and

perceptions (potential management strategies such as the prohibition of provisioning, translocation, and dog patrolling) of the respondents. All reported statistical tests were conducted at a 95% confidence level.

RESULTS

Demographic and socio-economic profile of respondents

The majority of respondents were female (79.34%, n = 215) (Table 1) and married (80.07%, n = 217). The predominant age group was 26–45 years old (53%, n = 143), while the least represented age range was over 66 years (2%, n = 7). More than half of the participants had resided in the area for 16–35 years (57.94%, n = 157). Iglesia Filipina Independiente (IFI) was the dominant religious affiliation (83.13%, n = 225). Regarding ethnicity, only two respondents were indigenous: Higaonon (0.74%). The majority of the respondents were Bisaya (48.34%, n=131). Most households had 1–5 members (56.45%, n = 153). Nearly half of the respondents had attained Junior High School education without completion (44.28%, n = 120). In terms of organization affiliation, 87.82% of the respondents (n = 238) were members of the KRAEFI.

Nine occupations were identified in this study (Table 2), with housewives being the largest occupational group (60.53%, n = 164). The majority of respondents (83.76%, n = 227) had only one employed family member, and more than half of the respondents had no supplementary income sources (60.53%, n = 164). A small proportion of the remaining respondents earned from businesses (sari-sari store, ready-to-wear store, manicure/pedicure services) (3.69%, n = 10) and employment as government employees (8.49%, n = 18). The monthly income for most respondents (83.76%, n = 227) ranged from PHP1,000 to PHP5,000 per month. The primary sustenance came from farm produce such as vegetables, fruits, and root crops.

Knowledge of respondents: macaque importance and related legislation

Approximately 26.57% (n = 72) of respondents considered macaques ecologically significant, while the majority (73.43%, n = 199) did not (Figure 1). Of those recognizing the ecological importance of macaques, 15.87% (n = 43) identified them as seed dispersers aiding tropical forest diversity. A few respondents (2.21%, n = 6) recognized macaques as important in maintaining forest balance while 1.11% (n = 3) linked them to preserving

Table 1. Socio-demographic characteristics of the respondents in Sumile, Butuan City.

Socio-demographic characteristics	Frequency	Percentage
Sex		
Female	215	79.34
Male	56	20.66
Civil status		
Single	51	18.82
Married	217	80.07
Widowed	3	1.11
Age		
18–25	59	21.77
26–45	143	52.77
46–65	62	22.88
66 above	7	2.58
Length of residency		
1–5	8	2.95
6–15	34	12.54
16–25	74	27.31
26–35	83	30.63
36+	72	26.57
Religion		
Iglesia Filipina Independiente (IFI)	225	83.03
Roman Catholic	37	13.65
Born Again Christian	9	3.32
Ethnicity		
Higaonon	2	0.74
Masbatenio	73	26.94
Leytenio	11	4.05
Bisaya	131	48.34
Number of household members		
1–5	153	56.45
6–10	114	42.07
11–15	4	1.48
Educational attainment		
Elementary Undergraduate	22	8.12
Elementary Graduate	35	12.92
Junior High School Undergraduate	120	44.28
Junior High School Graduate	51	18.82
Senior High School Undergraduate	1	0.37
Senior High School Graduate	3	1.10
College Undergraduate	19	7.01
College Graduate	19	7.01
Vocational	1	0.37
KRAEFI membership Non-Member Member	 33 238	 12.18 87.82

forest diversity.

Most respondents (52.03%, n = 141) did not recognize macaques as socioeconomically important, whereas 47.97% (n = 130) did, primarily in relation to tourism. These respondents believed macaques could significantly boost Sumile's tourism revenue. Although Elijan Park has no mandatory entrance fee, visitors can make voluntary donations that can be utilized for park maintenance and community support. Majority of the respondents (86.35%; n = 234) regarded macaques as culturally important. Half of the respondents (51.29%, n = 139) viewed macaques as symbols of unity while 27.68% (n = 75) considered macaques sacred, and 7.38% (n = 20) believed that mistreating them could lead to negative karmic consequences.

More than half of the respondents (61.26%; n = 166) were unaware of the Wildlife Resources Conservation and Protection Act or Republic Act No. 9147, while 38.38% of the respondents (n = 104) were familiar with it. Among those aware of RA 9147, 17.71% (n = 48) identified it as wildlife protection legislation. Twenty-five respondents (9.23%) specifically mentioned macaque protection. Twenty-one respondents (7.75%) referred to it as providing wildlife handling guidelines, and 11 respondents (4.06%) recognized its role in wildlife conservation.

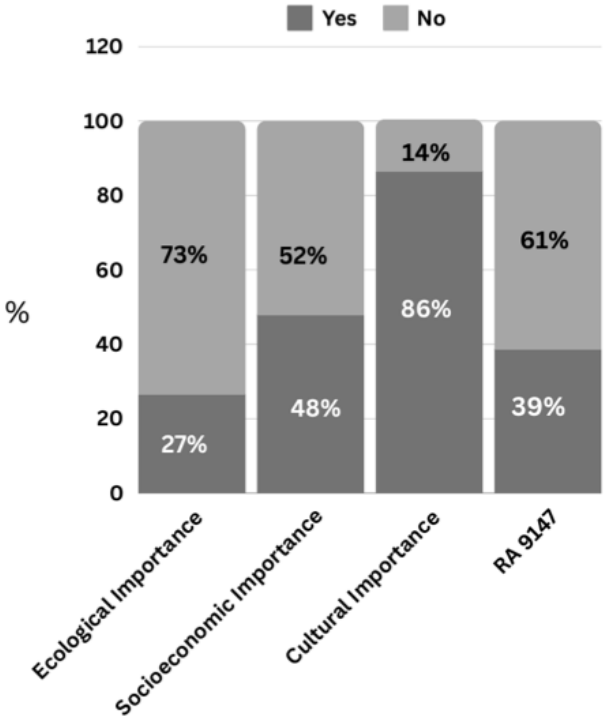

Figure 1. Knowledge of respondents on the ecological, socio-economic, and cultural importance of macaques and RA 9147 or Wildlife Resources Conservation and Protection Act in Sumile, Butuan City.

A chi-square test was employed to examine the association between socioeconomic factors and knowledge of macaque importance and RA 9147, with results in Table 3. There was a significant association between age (X^2 = 31.0, p = 0.011) and the knowledge of macaques' ecological importance. Educational attainment (X^2 = 30.0, p <0.01), income (X^2 = 13.2, p = 0.021), and occupation (X^2 = 46.6, p <0.01) were also significantly associated with this knowledge. Younger residents (18–45 years old), individuals with higher educational attainment, and those with higher monthly incomes were more likely to know the ecological significance of macaques. Local government officials and educators exhibited a higher level of knowledge concerning this information.

Significant associations with length of residency (X^2 = 14, p = 0.007), education (X^2 = 30.8, p <0.01), income (X^2 = 18.5, p = 0.002), and occupation (X^2 = 46.6, p <0.001) were also observed when respondents were asked about their knowledge of the socio-economic importance of macaques. Long-term residents, individuals who attained higher educational levels, and those with higher monthly incomes were more likely to be knowledgeable about the socioeconomic importance of macaques. Similarly, local government officials, teachers, and students were more likely to be knowledgeable about this information.

Additionally, the length of stay (X^2 = 17.2, p = 0.002) and education (X^2 = 25.2, p <0.001) were significantly linked to knowledge of macaque's cultural importance.

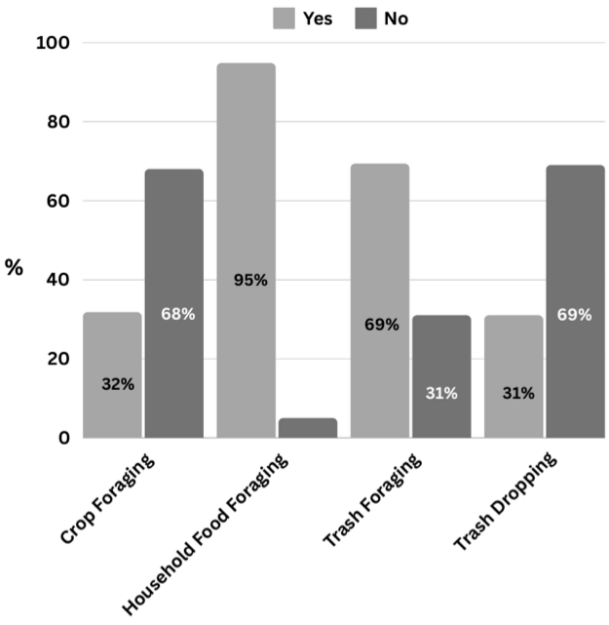

Figure 2. Observed macaque behavior in Sumile, Butuan City.

Long-term residents and individuals who attained higher educational levels demonstrated greater knowledge regarding the cultural significance of macaques. Age (X^2 = 31.0, p <0.01), length of residency in the village (X^2 = 20.4, p <0.01), educational attainment (X^2 = 44.6, p <0.01), income (X^2 = 26.3, p <0.01) and occupation (X^2 = 50.6, p <0.01) were significantly associated with knowledge of RA 9147. Individuals who were younger had a shorter-term residency, possessed higher educational attainment, and reported higher incomes demonstrated greater knowledge of RA 9147. Additionally, educators and students exhibited a higher level of familiarity with this legislation.

Perceptions and attitudes of respondents toward human-macaque interactions and management

Macaque provisioning

Nearly all respondents (99.26%, n = 269) engaged in macaque provisioning, while only two (0.74%) abstained due to perceived harm to macaques. A significant proportion of the respondents (71.59%, n = 194) provisioned macaques out of respect, 18.08% (n = 49) regarded macaque provisioning as a cultural practice, and 9.59% (n = 26) participated in macaque provisioning out of concern for macaque survival. Conversely, one respondent (0.36%) avoided provisioning to encourage natural foraging, and another respondent (0.36%) believed that provisioning does not provide macaques with a natural diet.

The five primary food items frequently provided to macaques in Sumile were Bananas *Musa acuminata*, Sweet Potatoes *Ipomoea batatas*, Corn *Zea mays*, Taro *Colocasia esculenta*, and biscuits. Bananas were the most common (35.42%, n = 96), followed by Sweet Potatoes (18.08%, n = 49), Corn (17.71%, n = 48), biscuits (17.71%, n = 48), and Taro (11.44%, n = 31). Additional foods included bread, vegetables (e.g., squash, eggplants, vegetable pear), root crops (cassava, other taro species, gabi, and ube), and fruits (cacao and jackfruit). Some respondents shared portions of their crop harvests with macaques.

More than half of the respondents 65.68% (n = 178) engaged in macaque provisioning during "community service" time in Elijan Park. Others (22.88%, n = 62) provisioned macaques upon encountering them within the village, during the recreational visits to Elijan Park (10.70%. n = 29), or deliberately prepared food for them (0.71%, n = 2). The majority of the respondents (60.15%, n = 163) provisioned macaques sometimes, while 38.38% (n = 104) always did, and 1.48% (n = 4) seldom provisioned macaques.

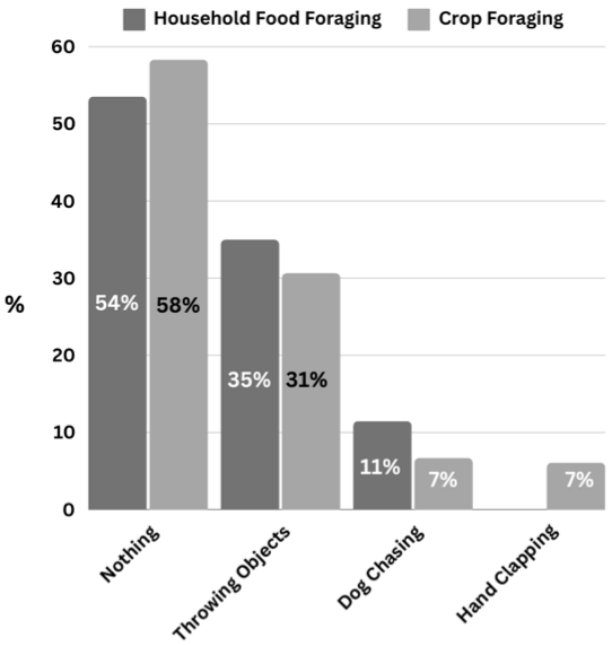

Figure 3. Deterrent actions of the respondents to household food and crop foraging by macaques in Sumile, Butuan City.

Table 2. Socio-economic characteristics of the respondents in Sumile, Butuan City.

Socio-demographic characteristics	Frequency	Percentage
Occupation of respondents		
Housewife	164	60.53
Farmer	14	5.17
Local government employees	23	8.49
Teacher	18	6.64
Engineer	2	0.74
Social Worker	1	0.37
Information technologist	1	0.37
Student	38	14.02
Businessman	10	3.69
Monthly income		
1,000–5,000	227	83.76
5,001–10,000	19	7.01
10,001–15,000 15,001–20,000 20,001–25,000 25,001–30,000	2 3 17 3	0.74 1.11 6.27 1.11

There was a significant association between age (X^2 = 25.2, p <0.001) and frequency of macaque provisioning. Other factors significantly associated included length of residency (X^2 = 42.3, p <0.001), education (X^2 = 73.6, p <0.001), and income (X^2 = 24.6, p = 0.006) (Table 3).

Table 3. Factors associated with the knowledge, attitudes, and perceptions of residents towards human-macaque interactions and management strategies in Sumile, Butuan City.

Variables knowledge	Age	Length of residency	Educational attainment	Monthly income	Occupation
RA 9147	X^2 (3, N = 271) = 31.0, **p <0.01**	X^2 (4, N = 271) = 20.4, **p <0.01**	X^2 (8, N = 271) = 44.6, **p <0.01**	X^2 (5, N = 271) = 26.3, **p <0.01**	X^2 (8, N = 271) = 50.6, **p <0.01**
Ecological importance of macaques	X^2 (3, N = 271) = 11.2, **p=0.011**.	X^2 (4, N = 271) = 6.03, p=0.197	X^2 (8, N = 271) = 30.0, **p <0.01**	X^2 (5, N = 271) = 13.2, **p=0.021**	X^2 (8, N = 271) = 46.6, **p <0.01**
Socio-economic importance of macaques	X^2 (3, N = 271) = 5.92, p=0.153	X^2 (4, N = 271) = 14, **p=0.007**	X^2 (8, N = 271) = 30.8, **p <0.001**	X^2 (5, N = 271) = 18.5, **p=0.002**	X^2 (8, N = 271) = 46.6, **p <0.001**
Cultural importance of macaques	X^2 (3, N = 271) = 5.92, p=0.115	X^2 (4, N = 271) = 17.2, **p=0.002**	X^2 (8, N = 271) = 25.2, **p=0.001**	X^2 (5, N = 271) = 7.67, p=0.176	X^2 (8, N = 271) = 10.9, p=0.208
Attitudes					
Provisioning frequency	X^2 (6, N = 271) = 25.2, **p <0.001**	X^2 (8, N = 271) = 42.3, **p <0.001**	X^2 (16, N = 271) = 73.6, **p <0.001**	X^2 (10, N = 271) = 24.6, **p=0.006**	X^2 (16, N = 271) = 21.8, p=0.148
Deterrent Action (Household Foraging)	X^2 (6, N = 271) = 25.5, **p <0.001**	X^2 (8, N = 271) = 36, **p <0.001**	X^2 (16, N = 271) = 80.7, **p <0.001**	X^2 (10, N = 271) = 38.1, **p <0.001**	X^2 (16, N = 271) = 45.7, **p <0.001**
Deterrent Action (Crop Foraging)	X^2 (9, N = 271) = 29.7, **p <0.001**	X^2 (12, N = 271) = 48.4, **p <0.001**	X^2 (24, N = 271) = 107, **p <0.001**	X^2 (15, N = 271) = 39.7, **p <0.001**	X^2 (24, N = 271) = 39.7, **p 0.015**
Perceptions					
Prohibit Provisioning	X^2 (3, N = 271) = 6.59, p=0.086	X^2 (4, N = 271) = 23.3, **p <0.001**	X^2 (8, N = 271) = 12.4, P =0.136	X^2 (5, N = 271) = 3.18, P=0.672	X^2 (8, N = 271) = 31.3, **p <0.001**
Translocation of macaques	X^2 (3, N = 271) = 7.11, p=0.068	X^2 (4, N = 271) = 4.95, p=0.292	X^2 (8, N = 271) = 25, **P 0.002**	X^2 (5, N = 271) = 15.3, **P 0.009**	X^2 (8, N = 41.5) = 19.7, **p 0.012**
Dog patrolling	X^2 (3, N = 271) = 3.94, p=0.268	X^2 (4, N = 271) = 35.3, **p <0.001**	X^2 (8, N = 271) = 25, **P 0.002**	X^2 (5, N = 271) = 16.7, **P 0.005**	X^2 (8, N = 41.5) = 28.7, **p <0.001**

Individuals aged 25–45 years, long-term residents, those with lower educational attainment, and those with higher monthly incomes exhibited increased provisioning frequency.

Other human-macaque interactions

Macaque behaviors in Sumile included crop foraging (31.78%), household food foraging (94.84%), trash foraging (69.37%), and trash dropping (30.63%) (Figure 2). Macaques were observed foraging most of their crops including Gabi *Xanthosoma sagittifolium*, Corn, Coconuts *Cocos nucifera*, Sweet Potatoes, Peanuts *Arachis hypogaea*, Chayotes *Sechium edule*, Bananas *Musa* spp., Cassava *Manihot esculenta*, and Eggplant *Solanum melongena*. All respondents (100%, n = 271) reported that macaques did not take non-food items from their households, and only one reported a monkey attack in 2013 near a stream in Sumile.

Most respondents did not intervene when macaques foraged household food (53.51%) and their crops (58.30%, n = 158). Deterrent actions in response to household food foraging included throwing hard objects e.g. slippers or stones (34.97%) and using a dog (11.44%) (Figure 3). Actions taken to deter crop foraging included throwing hard objects e.g. slippers or stones (30.62%), hand clapping (6.64%), and dog chasing (6.64%). Other preventive measures also involved closing doors and windows and installing nettings and fences.

Chi-square tests showed that age (X^2 = 25.5, p <0.001), length of residency (X^2 = 36, p <0.001), education (X^2 = 80.7, p <0.001), income (X^2 = 38.1, p=0.004), and occupation (X^2 = 45.7, p <0.001) were significantly associated with deterrent actions on household food foraging (Table 3). Younger residents (18–45 years old), long-term residents, respondents with college-level education, and those with higher incomes were more likely to ignore household food foraging. In contrast, older respondents (46–65 years old), short-term residents, individuals with lower educational attainment, and those with lower incomes demonstrated positive responses to throwing objects and allowing dogs to chase the macaques. Local government officials and teachers were more likely to disregard the food-foraging macaques, while students were more likely to throw objects and allow dogs to chase the macaques.

Similarly, for crop foraging deterrence, significant associations were found with age (X^2 = 25.2, p <0.001), length of residency (X^2 = 25.2, p <0.001), education (X^2 = 25.2, p <0.001), income (X^2 = 25.2, p <0.001) and occupation (X^2 = 25.2, p <0.001). Residents aged 26–45 years old, long-term residents (over 36 years), college graduates, and residents with higher incomes were more likely to ignore crop-foraging macaques. Older residents (46–65 years old), those with lower education levels, and those with lower incomes were more likely to throw objects to deter macaques. Local government

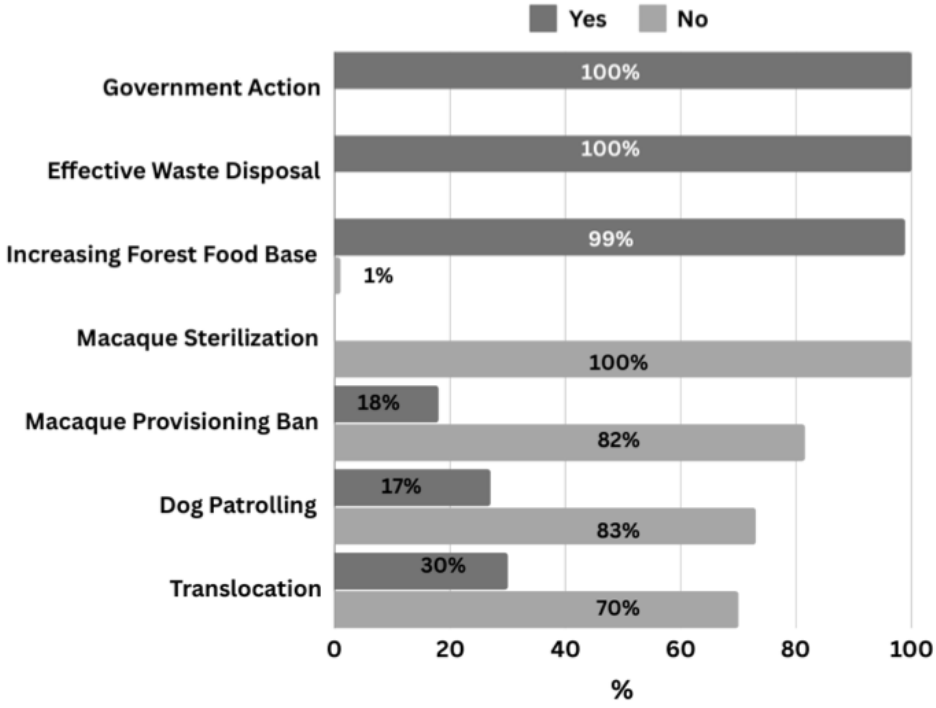

Figure 4. Measures selected by the respondents to manage human-macaque interactions in Sumile, Butuan City.

officials and teachers were more likely to disregard crop foraging, while housewives and students were more inclined to throw objects, use dogs, and hand clapping to deter macaques.

Human-macaque interaction management measures

All the respondents (100%) reported absence of management measures for negative human-macaque interactions in Sumile, allowing macaques to interact freely with humans. The three most suggested measures (Figure 4) were: (i) Government intervention to address negative human-macaque interactions (100%), with respondents emphasizing its importance for both macaques and human welfare. (ii) Effective waste disposal (100%), as macaques were seen foraging and dropping trash in the village. (iii) Increasing the food base in the forest (98.89%, n = 268), linked to observed household food foraging during food scarcity in Elijan Park. Respondents opposed measures such as sterilization (100%), culling of monkeys (100%), prohibition of monkey feeding (81.55%), patrolling by dogs (73%), and translocation (70%) due to cultural reasons.

The length of stay in the village (X^2 = 23.3, p <0.001) and occupation (X^2 = 31.3, p <0.001) are significantly associated with the respondents' perception of prohibiting macaque provisioning as a measure. Short-term residents, students, housewives, teachers, and local government officials were less likely to favor the prohibition of macaque provisioning. Perceptions of macaque translocation as a measure were significantly associated with education (X^2 = 25, p = 0.002), income (X^2 = 15.3, p = 0.009), and occupation (X^2 = 41.5, p = 0.012). Residents with lower education attainment and those with lower incomes were more in favor of translocation. Students, teachers, local government officials, and housewives were likely not in favor of translocation. Perceptions of dog patrolling as a management measure were significantly associated with the length of stay (X^2 = 35.3, p <0.001), education (X^2 = 25, p = 0.002), income (X^2 = 16.7, p = 0.005), and occupation (X^2 = 28.7, p <0.001). Short-term residents, individuals with lower educational attainment, and those with higher incomes were less likely to favor dog patrolling as a measure.

DISCUSSION

The study indicates that the majority of Sumile residents engaged in macaque provisioning which could be attributed to their reverence for macaques, cultural beliefs, and concern for macaque survival. Most of the respondents were KRAEFI members who considered macaques sacred, reflecting traditional reverence for

macaques common in southeastern Asia (Nahallage & Huffman 2013) including the Philippines.

The KRAEFI organization that governed Elijan Park encouraged weekly macaque provisioning in the park as "community service". More than half of the respondents also mentioned that most of their provisioning activity occurred during "community service" while others did so opportunistically around the village. The primary foods used for provisioning were bananas, sweet potatoes, corn, and biscuits, with some respondents preparing food specifically for macaques or sharing crop harvests.

This study did not include tourist interviews. Tourists were observed provisioning macaques when Elijan Park was open to the public, with KRAEFI and caretakers encouraging this behavior to habituate macaques to human presence and attract visitors. Frequent provisioning has resulted in the frequent observation of macaques in Elijan Park and adjacent communities, demonstrating their synanthropic behavior and adaptability to human environments and food (Gumert et al. 2011; Sha & Hanya 2013). Macaques foraging household food, crops, and refuse highlights their adaptation to human settlements in Sumile, especially during food scarcity in Elijan Park. Consistent with Suwannarong et al. (2023), cultural beliefs in Sumile prevented macaque killings, as harming them was believed to bring misfortune. The act of harming monkeys was perceived to incur misfortune. Consequently, most residents did not act against household food and crop foraging, using non-aggressive deterrents like dog chasing, throwing slippers or wood, and hand clapping.

The fear of spiritual retribution for killing macaques is the main reason for the taboo against hunting, trading, and consuming them in Sumile. Most residents fear spiritual consequences similar to those in Bali, Indonesia, where harming monkeys is believed to bring misfortune (Peterson & Riley 2017). In Sumile, locals cited instances of neighbors falling ill and dying after persecuting macaques. The residents' reverence for macaques helps protect the threatened Long-tailed Macaques from exploitation and harm.

The residents' affection and respect for macaques, demonstrated through provisioning, indicate a significant human-macaque relationship in Sumile. Many residents mistakenly view provisioning as a conservation measure, which may undermine long-term conservation efforts. Unregulated provisioning may lead to a substantial increase in the macaque population and adverse behavioral changes (Fa 1981; Newsome & Rodger 2008; Knight 2017; Sengupta & Radhakrishna 2020; Cui et al. 2021) in areas of sympatry (Dittus et al. 2019). If unchecked in Sumile, this could result in negative human-macaque interactions due to the growing macaque population's dependence on human food, similar to situations in western Sumatra, Indonesia (Ilham et al. 2017), and Hainan, China (Cui et al. 2021). Macaques in the Palawan Subterranean River National Park in the Philippines also exhibited problematic behaviors linked to widespread food provisioning (Gamalo et al. 2019). In Elijan Park, macaques displayed intraspecific conflict during provisioning. Despite prohibitions against harassing monkeys, some tourists disturb and provoke them, leading to macaque aggression, like Berman & Li's findings (2002).

Macaque adaptation to human food can reduce natural feeding and forest habitat use (O-Leary & Fa 1993; Sha & Hanya 2013; Sengupta et al. 2015; Sengupta & Radhakrishna 2018). Extensive provisioning and culturally influenced macaque tolerance in Sumile and Elijan Park may increase foraging on household food, crops, and waste. If unaddressed, these behaviors can escalate, leading to socio-economic and health issues, fostering hostility, and resulting in retaliatory actions against macaques. Negative attitudes toward macaques due to socioeconomic losses (Hill & Webber 2010) can undermine community support for conservation and human-macaque management, complicating human-wildlife interactions (Frank et al. 2019).

According to Pontzer (2023), macaques' dependence on human food and loss of natural foraging behavior can lead to health issues such as increased body size, higher stress, and alopecia in males (Maréchal et al. 2016). Physical contact during provisioning raises mutual disease transmission risks which is detrimental to macaque health and populations (Jones-Engel et al. 2005; Muehlenbein & Wallis 2014). For instance, provisioning by tourists and locals in Elijan Park and Sumile often follows bites, facilitating disease spread via fluid exchange.

In Sumile, food provisioning also leads to waste consumption and dispersion. Frequent provisioning habituates macaques to anthropogenic food sources in refuse areas (Bempah et al. 2021). The lack of proper waste receptacles exacerbates this behavior, potentially impacting human and primate health. Waste foraging can attract enteroparasites (Baloria et al. 2022), disease-carrying insects, and rodents, heightening disease transmission risks. Effective waste management and public awareness about provisioning risks and proper disposal practices can minimize refuse dispersion and reduce negative interactions.

The strong human-macaque connections in Sumile

and the potential adverse effects of uncontrolled provisioning indicate a need to balance socio-cultural and ecological factors. Completely prohibiting provisioning may not be an optimal solution, as most residents did not support measures like prohibition, sterilization, translocation, and dog patrolling for managing human-macaque interactions. A bottom-up approach involving residents, KRAEFI leaders, local government officials, and other stakeholders in management planning is recommended. Decision-making should be culture-sensitive, participatory, and community-based to develop adaptive strategies for human-macaque coexistence.

The findings show that residents' educational level and occupation were significantly associated with knowledge of the ecological, socio-economic, and cultural importance of macaques, as well as RA 9147. More positive responses were seen from individuals with higher educational attainment, local government officials, teachers, and students. Education and length of stay in the village were also significantly linked to provisioning frequency. This underscores the need for comprehensive education and social media campaigns to raise public awareness of the ecological and health implications of uncontrolled macaque provisioning. In addition to local government officials, teachers, and students, it is crucial to educate local communities, KRAEFI officials, Elijan Park caretakers, and tourists on the conservation status of Long-tailed Macaques, their threats, behavior, ecological and socio-economic services, the importance of natural foraging behavior, conservation laws like RA 9147, and macaque-friendly management strategies. Engaging local religious leaders to include conservation messages in religious teachings and promote responsible macaque interaction is also recommended.

Results indicated that lower-income residents were more likely to throw objects and let dogs chase household food and crop-foraging macaques. This suggests that economically disadvantaged communities who are reliant on subsistence, may use deterrent tactics against macaques. A study on Buton Island, Indonesia, showed that lower-income communities employed violent control methods more frequently than wealthier ones, even when crop raiding was less severe (Hardwick et al. 2017). Although most Sumile residents did not act against foraging macaques and only a few used non-aggressive deterrents, this situation could change. Disadvantaged residents might develop negative attitudes if unregulated provisioning worsens macaque foraging behavior, potentially leading to conservation issues. Thus, a holistic approach combining education, coexistence incentives, macaque-friendly deterrents, and economic support is necessary. Wildlife managers, local governments, and communities need to collaborate on context-sensitive solutions to balance macaque conservation with community well-being (Koirala et al. 2021).

Macaque conservation should prioritize habitat restoration and natural food provision through science-based and community-driven establishment of local conservation areas. Multi-sectoral participation in the planning and implementation of local conservation areas should be encouraged. Volunteer programs for habitat restoration, observation, and education may be organized. Government officials and residents should develop culture-sensitive provisioning regulations alongside habitat rehabilitation and public education. In extreme cases, like during a food crisis, controlled provisioning supervised by wildlife professionals may be necessary. Proper waste management is also crucial to prevent macaques from consuming food remnants from refuse containers and other health issues. Instead of a total provisioning ban, a gradual reduction over time could encourage natural foraging behaviors.

Regular monitoring of the macaque population in Sumile is crucial to avoid overestimating their numbers in anthropogenic areas (Kyes et al. 2011), where they are often mistakenly seen as abundant (Eudey et al. 2020). Comprehensive and extensive research on macaque behavior, habitat preference, feeding patterns, and reproduction is needed to understand human-macaque-environment dynamics. One of the limitations of this study was that females (79.34%) and housewives (60.53%) constituted the majority of respondents, primarily due to their availability during the one-on-one interview process, as most of the husbands were at work during daytime hours. Therefore, it is recommended that future studies incorporate a balanced representation of male and female respondents. Additional studies on interactions with tourists in Elijan Park and farmers in the village will offer insights for managing human-wildlife interactions, coexistence strategies, and sustainable conservation efforts.

CONCLUSIONS

The research findings indicate that rampant macaque provisioning in Sumile is influenced by cultural beliefs. The reverence for Philippine Long-tailed Macaques may contribute positively to the conservation

of this threatened species. Uncontrolled provisioning in settlements and Elijan Park may potentially lead to population increase, zoonotic disease transmission, behavioral changes, and adverse human-macaque interactions, potentially undermining conservation and coexistence goals. The regulation of provisioning requires balancing cultural and scientific considerations. Culturally sensitive, participatory, and science-based planning and management strategies are recommended to balance the ecological, socioeconomic, and cultural aspects of human-macaque-environment interactions.

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Appendix 1. Survey questionnaire.

Human and Philippine Long-tailed Macaque interaction in Sumile, Butuan City

Part 1: Sociodemographic and economic profile

Name of barangay/location: _____ Date of interview:_____
1.1. Respondent no: _____ 1.2. Gender: ( ) Male ( ) Female ( ) LGBTQ+++
1.3. Age Group: ( ) 18–26years old
( ) 27–35 ( ) 36–44 ( ) 45–53 ( ) 54–62 ( ) 63 and above

1.4. How many years have you resided in the village? _____
1.5. Religion:
( ) Roman Catholic
( ) Iglesia ni Cristo
( ) Jehovah's Witness
( ) Mormon
( ) Protestant
( ) Other: _____
( ) Muslim
( ) Seventh Day Adventist
( ) Baptist
( ) Born Again Cristian
( ) Rizalian

1.6. Civil Status: ( ) Single ( ) Married ( ) Widowed ( ) Separated ( ) Other: __
1.7. Number of Household m ember/s: _____
1.8. Highest educational attainment:
( ) No formal schooling
( ) Elementary level
( ) Elementary graduate
( ) High school level
( ) High school graduate
( ) Vocational courses
( ) College level
( ) College graduate
( ) Post graduate level
1.9 Membership in organization (if any) and role

2.0. Family monthly income:
( ) 1,000 – 5,000/mo
( ) 5,001 – 10,000/mo
( ) 10,001 – 15,000/mo
( ) 15,001 – 20,000/mo
( ) 20,001- 25,000/mo
( ) 25,001 – 30,000

2.1. Tribal/Ethnic group (if any):

2.1. Occupation of respondents:
( ) Housewife ( ) Farmer ( ) Student ( ) Teacher
( ) Local government employee ( ) Social worker ( ) Self-employed
( ) Others, specify: _____

Part 2: Knowledge of macaque importance and RA 9147

	Yes	No
Do you know about the **ecological importance** of macaques?		
If yes, what do you know about the ecological importance of macaques?		
Do you know about the **socio-economic importance** of macaques?		
If yes, what do you know about the socio-economic importance of macaques?		
Do you know about the cultural importance of macaques?		
If yes, what do you know about the cultural importance of macaques?		
Do you know about the **Wildlife Resources Conservation and Protection Act or Republic Act No. 9147**?		
If yes, what do you know about **RA 9147**?		

Part 3: Perceptions and attitudes toward human-macaque interactions and management measures

	Yes	No
Do macaques forage food in your household?		
Aside from food, what else did macaques get from your households?		
What did you do when macaques forage food in your households?		
Do macaques forage your crops?		
What crops did they forage?		
What did you do when macaques forage your crops?		
Have you observed the macaques foraging in the trash bin?		
Have you observed the macaques dropping trash in the village?		
Have you experienced hunting macaques?		
If yes, when? _____ How often?_____ How many were hunted? _____ Purpose of hunting? _____ Where? _____		
Have you experienced trading macaques?		
Yes If yes, when? _____ How often?_____ How many were sold? Price per piece _____ Purpose of trading? _____ Who bought the macaques? _____		
Have you eaten monkey meat?		
If yes, when? _____How often?_____ What does it taste like? _____		
Have you been attacked or bitten by a monkey?		
If yes, when? _____ how often? _____ where? _____		
Have you experienced provisioning macaques?		
Do you think provisioning is right?		
If yes, why?		
What type of food did you provide to macaques?		
When did you usually engage in provisioning?		
How often did you provision macaques? ___Not al all ___Seldom ___Sometimes ___Always		
Please identify the observed behavior of macaques in Sumile. (Please check any of the following macaque behavior that you observe in Sumile.) ( ) Crop foraging ( ) Household Food Foraging ( ) Foraging Trash ( ) Dropping Trash ( ) Others, specify:_____		

Were there any management measures for human-macaque interactions implemented in the area?		
If yes, can you name some?		
What do you think are the measures to manage human-macaque interactions in Sumile? (Please check any of the following that you believe is correct) ( ) Sterilization of macaques ( ) Prohibition on provisioning ( ) Culling of macaques ( ) Translocation of macaques ( ) Patrolling by dogs ( ) Effective wastage disposal ( ) Government action ( ) Increasing food base in forests for macaques		
Can you recommend other human-macaque management measures in Sumile?		

Was there any macaque conservation activity conducted in the area?			
If yes, please specify the conservation activity:			

Thank you for your participation!

Abstrak: Ang pag-unawa sa pakikipag-ugnayan ng tao at unggoy ay mahalaga para sa pangangalaga at pamamahala ng nasabing species. Samakatuwid, sinuri ng pag-aaral na ito ang mga pakikipag-ugnayan ng tao at unggoy sa Sumile, Butuan City mula Hulyo 2022 hanggang Abril 2023 sa pamamagitan ng one-on-one na panayam. May dalawang daan at pitompot isang mga respondente ang random na tinanong upang matukoy ang kanilang mga demograpikong at sosyoekonomikong katangian. Ang kanilang kaalaman, saloobin, at pang-unawa sa mga pakikipag-ugnayan ng tao at unggoy tulad ng pagpapakain sa mga unggoy, mga hakbang sa regulasyon, at mga kaugnay na kadahilanan ay tinukoy din. Karamihan sa kanila ay may kamalayan sa kultural na kahalagahan ng mga unggoy (86.35%). Gayunpaman, ang karamihan ay hindi alam ang ekolohikal (73.43%) at sosyoekonomikong kahalagahan ng mga ito (52.03%), gayundin ang RA 9147 o Wildlife Act (61.26%). Karamihan sa mga residente ay nagpakain ng mga unggoy (99.26%). Ang mga pag-uugali ng unggoy ay ang kumain ng pagkain sa bahay (94.84%), kumain ng pananim (31.78%), pagkain ng basura (69.37%), at pag-kalat ng basura (30.63%). Karamihan sa mga residente ay wala namang ginawa nang kumain ang mga unggoy ng pagkain sa mga sambahayan (53.51%) o nang kumain sila ng pananim (58.30%) habang ang ilan ay binato ang mga unggoy ng mga matigas na bagay, pumalakpak, o pinahabol nila ang unggoy sa aso. Ang antas ng edukasyon ang pinaka-karaniwang salik na may kaugnayan sa kaalaman ng mga residente. Ang haba ng paninirahan at edukasyon ay may kaugnayan sa dalas ng pagpapakain sa mga unggoy habang ang haba ng paninirahan at uri ng trabaho ay may kaugnayan sa pagbabawal ng pagpapakain bilang isang hakbang upang maiwasan ang negatibong pakikipag-ugnayan ng tao sa mga unggoy. Ipinahihiwatig ng pag-aaral na ito na ang mga pang kultura na kadahilanan ay nakakaimpluwensiya sa laganap na pagpapakain ng mga unggoy sa Sumile. Gayunman, kung hindi makontrol, ang pagpapakain ng mga unggoy ay maaaring humantong sa suliraning pang ekonomiya at kalusugan na maaring mag dudulot ng negatibong saloobin ng mga residente sa mga unggoy at sa mga pagsisikap para sa konserbasyon. Ang nangungunang tatlong hakbang sa regulasyon ng pakikipag-ugnayan ng tao sa unggoy na iminungkahi ng karamihan sa mga residente ay ang pagkilos ng pamahalaan, epektibong pag-aalis ng basura, at pagpaparami ng pagkain sa kagubatan. Inirerekomenda pa ng mga mananaliksik ang pagtatatag ng local conservation area; kontrolado na pagpapakain sa mga unggoy na may respeto sa kultura; at pamamaraan ng konserbasyon na nakabatay sa komunidad. Kasama rin dito ang pagtuturo sa publiko tungkol sa masamang epekto ng di-kinokontrol na pagpapakain sa mga unggoy. Bukod dito, kinakailangan ang regular na pagsubaybay sa populasyon ng mga unggoy at mga diskarte sa pagkonserba at pamamahala na nagbabalanse ng mga pang-ekolohikal, sosyo-ekonomiko at pangkultura na pagsasaalang-alang para sa pagpapanatili ng mapayang ugnayan ng tao at unggoy.

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