

# A Review: Human – Macaque Conflict in Sri Lanka

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## ABSTRACT

Conflicting interactions between humans and primates is a significant problem that poses a threat to the conservation of primate species diversity in habitat countries. We reviewed scientific literature on the toque macaque (*Macaca sinica*) published over the last 14 years in Sri Lanka regarding human – primates' conflicts to gain a comprehensive understanding of the current state of knowledge and to identify gaps and priorities for conservation efforts. Our review revealed an increasing trend in the number of publications over time, with a peak between 2010 and 2021. The toque macaque was the most studied species while the tufted grey langur was the least studied. Additionally, we determined which of these species of primates are most involved in conflictive interactions, which crops are most often damaged and the people's attitudes towards them. Toque macaques were the species that engaged in such interactions with humans most frequently. The increase in such interactions is being exacerbated by the destruction of forest cover and the establishing of human settlements within and around the forests where primates live. In addition, aggressive human behavior leads to conflicting interactions between primates and humans. Due to the economic damage that primates can cause local people tend to be more aggressive towards non-forest primates than forested primate species. According to the development research on human-primate conflicts, after 2005, scholars have become more interested in this topic than they were in or before 2010. Researchers' concern over human-primate disputes suggests that they may become even more prevalent in Sri Lanka in the future. Most publications focused on human-monkey interactions, with the second highest number focusing on ecology. We also found that there were few studies using molecular genetic techniques or investigating the effects of climate change. Additionally, there were limited studies on practical conservation efforts such as habitat protection and corridor establishment. Despite the wealth of literature available, our review highlights the significant gaps in knowledge and the need for applied research efforts to help protect and conserve primates and their habitats in Sri Lanka.

**Keywords:** Mitigating Interaction, Foraging on agriculture crops, Deforestation, Habitat Loss, Economic Loss, Human-Monkey Interaction, *Macaca sinica*, Folklore

**Abbreviations:** DSD—Divisional Secretariat Division | GN divisions—Grama Niladhari divisions | NHP—Non-human primate | HMC—Human Monkey Conflict | DWC—Sri Lanka's Department of Wildlife Conservation | TGL — tufted grey langur | PFL — purple-faced langur | TM — toque macaque.

## INTRODUCTION

Human-monkey conflict is a growing issue in Sri Lanka, as the expansion of human settlements has led to increased encounters between humans and macaque monkeys. Sri Lanka is home to three sub species of the

toque macaque (*Macaca sinica*), the four species of purple-faced langur (*Semnopithecus vetulus*) and the gray langur (*Semnopithecus priam thersites*), all of which are protected under Sri Lankan law. However, the rapid loss of natural habitat due to human activities has led to the displacement of these primates into urban areas, resulting in frequent conflicts between humans and monkeys. These conflicts have become a major concern for both conservationists and local communities, as they can lead to property damage, injury, and even death for both humans and monkeys. According to a study by Dittus et al. (2017), human-monkey conflict is particularly severe in urban areas where monkeys have learned to raid homes and public areas for food. The studies found that conflict between humans and macaques in Sri Lanka is driven by a number of factors, including human food availability, human attitudes towards monkeys, and the presence of natural habitats in close proximity to human settlements. Studies by Abeyesinghe et al. (2013) and Huffman et al. (2013) found that intensification of interaction with and conflict between humans and monkeys in Sri Lanka possess the threat to the spread of zoonotic diseases, as monkeys can carry pathogens that can be transmitted to humans and vice versa. Efforts to mitigate human-monkey conflict in Sri Lanka have included the implementation of education programs to teach local communities how to coexist with monkeys, as well as the use of non-lethal methods such as noise-making devices and fences to deter monkeys from entering human settlements. However, these measures have had limited success, and the issue of human-monkey conflict in Sri Lanka remains a significant challenge for conservationists, local communities, and policymakers. To protect themselves from monkeys, humans used a variety of methods or combinations thereof. The most common tactics were throwing stones, using catapults, shouting or setting off fireworks, and driving dogs to chase monkeys. Men used most of the preventive measures, while women and children used them less. About one-third of the population reported human-monkey interactions to the government (Nahallage, 2013). Wildlife conservation is an important aspect of maintaining biodiversity and ecosystem function, yet it is often perceived differently by different groups of people. Some see it as a necessary measure to protect endangered species, while others may view it as an infringement on their personal or economic interests (Dittus et al., 2019b). Research has shown that people's perceptions of wildlife conservation can be influenced by a variety of factors, including cultural background, level of education, and past experiences with wildlife (Manfredo et al., 2017; Clayton et al., 2019). For example, a study conducted in the United States found that people who identified as hunters or anglers were more likely to support wildlife conservation efforts that aligned with their own interests, such as habitat restoration for game species, but were less supportive of conservation efforts aimed at protecting non-game species (Manfredo et al., 2017). This highlights the importance of considering different stakeholder groups when designing and implementing conservation strategies. Another factor that can influence perceptions of wildlife conservation is the way in which it is communicated to the public. Research has shown that effective communication strategies can increase support for conservation efforts by making them more relevant and relatable to people's everyday lives (Clayton et al., 2019). For example, a study conducted in the United Kingdom found that using personal stories and emotional appeals in conservation messaging was more effective in eliciting support for conservation than presenting only scientific facts (Dicks et al., 2017).

## Objective

Reviewing the human macaque conflict research conducted till 2022 in Sri Lanka.

## METHODS

### Literature search strategy and selection of literature

To find papers on macaques in Sri Lanka, we used a search technique for the literature that was similar to those used in earlier studies by Pullin and Stewart (2006), Allen et al. (2013), Pant et al. (2020), Smith et al. (2020), and others. Using multiple common and scientific names for the species, we searched three online databases – Google Scholar, Scopus, and Web of Science – for articles from 2004 to 2022. When were

unable to get hard copies of publications not available online we contacted the authors or other sources to obtain them. We found 24 papers for analysis after applying these criteria (see Appendix 01). The literature study provided a thorough description of earlier investigations into the interactions between humans and primates. An examination of the relevant literature's objectives included listing, characterizing, summarizing, and explaining previous studies. It gave the we the authors who were involved in solving this conflict a theoretical foundation for their study, contributed to determining the present situation, recognized the contributions of earlier researchers, and so gave them confidence that their work was well-considered. A reference to earlier work on the topic is seen as an evaluation of that work and its assimilation into the current effort.

## ANALYSIS

We the authors looked at local 21 papers on Sri Lankan macaques. 3 papers detailing book chapters of the global perspective on HMC, noting the subjects covered in each and the year of publication. We carefully reviewed the articles to choose the six themes that, in our opinion, best captured their substance. These themes covered a variety of topics, such as the different ways that people interact with monkeys, strategies for minimizing these interactions, the uses of nonhuman primates, the use of primates in folklore and other narratives, human influence on macaque populations and their ecology, attitudes and perceptions toward monkeys, and perceived trends in crop damage and primate population size in the area. Depending on its principal focus, we allocated each publication to one or more of these topics. Where two or more themes received equal attention, we classed the publication under both themes.

### Data availability

The supplementary information files contain all the data that were generated and analyzed during the study.

## RESULTS AND DISCUSSION

### Overview of Results

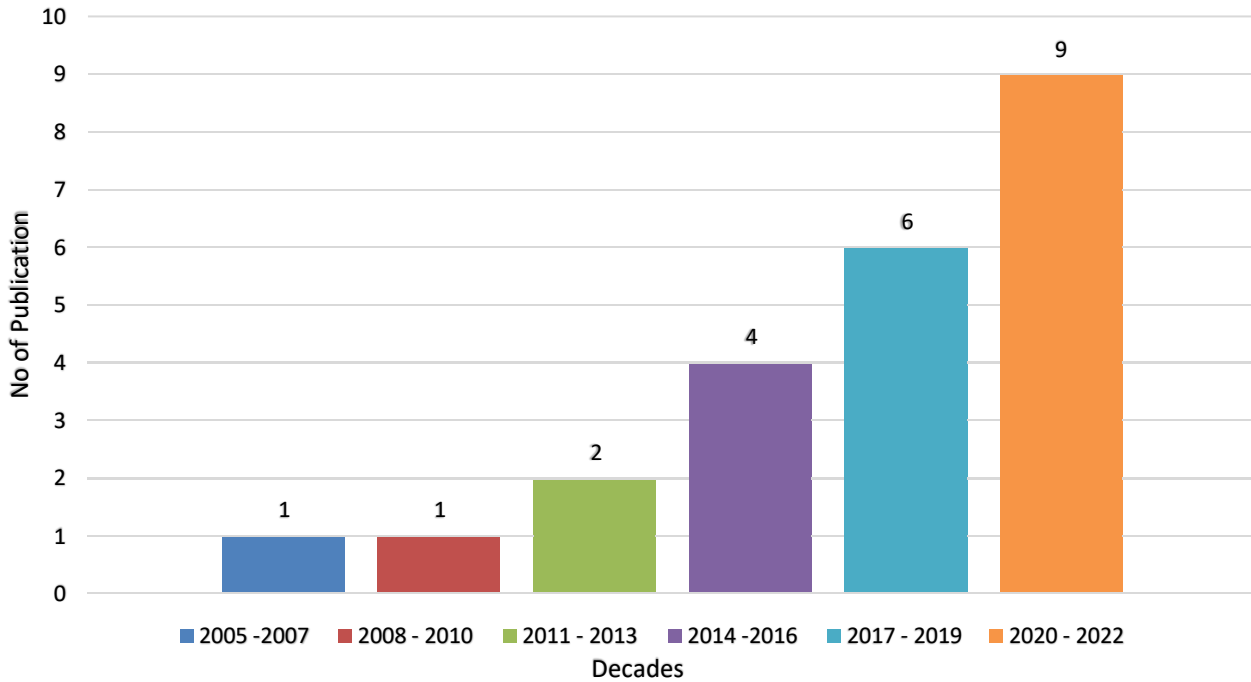
Throughout a 14-year span distinct trends can be seen in the content of publications (Figure 1). Over this time, the number of publications every 5 years rose with peaks from the years 2016 to 2022 to the present (Figure 1 – A) since this is the maximum period of publishing papers on HMC in Sri Lanka.

In 88% (N = 18) of the papers, the toque macaque was mentioned. Since the 1970s, Wolfgang Dittus has been doing research that has significantly added to our understanding of the toque macaque sub species living in the north central area of Sri Lanka and his work is one of the longest-running primatological investigations in the world. Forty eight percent (N = 13) of the 24 papers examined focused on all three species of monkeys, 7% (N = 2) concentrated on two species, and the remaining 22% (N = 6) contained only one species. Four of the six articles that covered just one species dealt with toque macaques, one with purple-faced langurs, and one with tufted grey langurs (Figure 1-B). While interest in the toque macaques has grown over the past 50 years, beginning in the 1960s, that of the tufted grey langur and purple-faced langur continues to be modest; despite the fact that at least two of these species coexist in most parts of the country (Phillips,1984; Yapa & Ratnaweera,2013; Lu et al.,2021). Only a small number of papers concentrate on multiple species at once (Figure 1 – B). While each pair of species has been represented similarly in these studies, the number of publications discussing two species indicates a tendency increased interest in them over time.

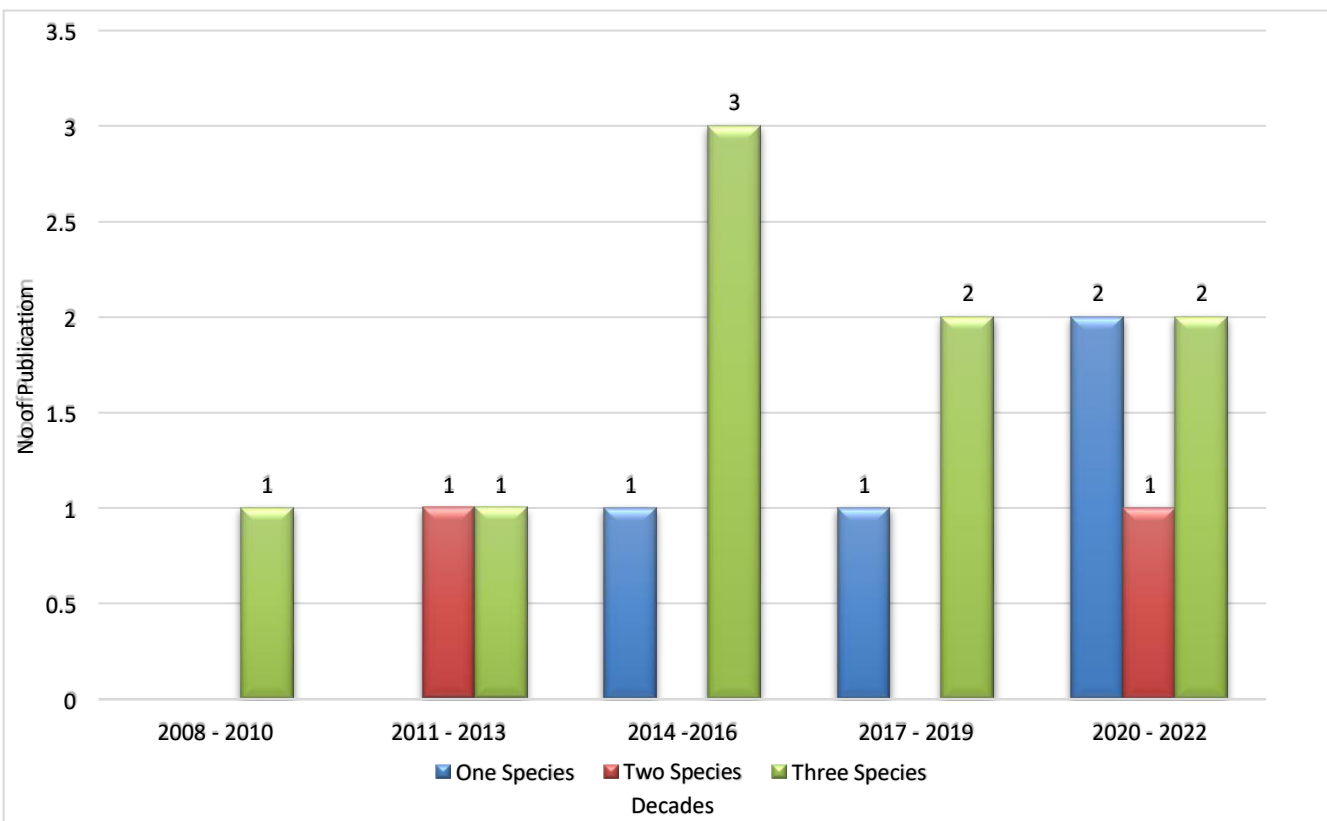
The connection between people and monkeys has become a significant issue in Sri Lanka. Several factors have exacerbated this problem like excessive deforestation and the prolonged 26 years ethnic conflict that

concluded in 2009. By 2015, these factors had an impact on the majority of the nation’s counties, and the Wildlife Conservation Service (DWC) came under political and public pressure to come up with solutions to the problem. One of the purple langurs is categorized as endangered and should be handled similarly to other national treasures and safeguarded appropriately (Dittus et al.,2008; Rudran & Cabral,2017). The ecological importance of the aforementioned features makes monkeys in Sri Lanka crucial for conservation.

a.



b.



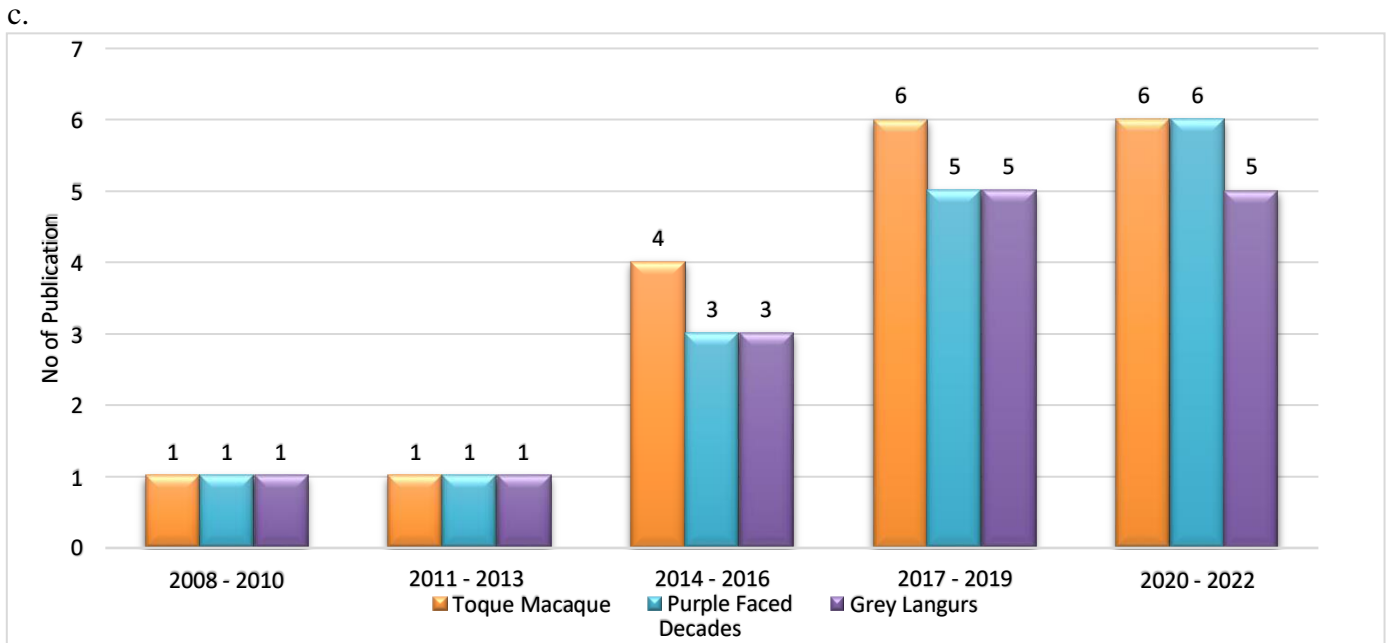


Figure 1. Trends in relative proportion of publications on the three Sri Lankan primate species between 2004 and 2022

Figure 1 shows the changes in the total number of publications on human-monkey interactions in Sri Lanka from 2004 to 2023 (figure 1 -A) followed by changes during this period in the number of species studied in articles about interactions between humans and monkeys in Sri Lanka (Figure 1 -B) and the focus of publications by primate species (Figure 1 – C).

The topics covered in published scientific research on Sri Lankan monkeys are diverse (Table 2). Sri Lankan publications on human-monkey interaction: trends in themes, 2004–2023.

Theme	No of Publications (Total N = 24)
Types of human-monkey interactions	21
Mitigation of these interaction	21
Uses for nonhuman primates	05
Primates as food, medicine, and ritual objects	04
Primates in folklore and other narrations	06
Human influence on macaque populations and their ecology	24
Attitudes towards and perceptions of monkeys	23
Perceived trends in local primate population size and amount of crop damage	23

Figure 2. The number and percentage of Sri Lankan monkey publications on various themes

The articles covered a range of subjects, including the impact of humans on macaque populations and their ecology, attitudes toward and perceptions of monkeys, perceived changes in the size of the local primate population, and agricultural harm. The representation of species in these articles varied greatly. Regarding the species pairs, the number of publications on two species throughout the categories differed, with the bulk of articles on the HMI and people’s perceptions of two kinds of monkeys focus on the toque macaque and purple-faced langur (Douglas et al.,2007, Gamage et al.,2016). (Figure1). The majority of articles on all three species (Eisenberg et al., 1972; Kumara et al., 2019; Weerasekara et al., 2019) cover their general

ecology, however some also concentrate on disease ecology (Dissanaike,1972, Dewit et al.,1991, Huffman et al.,2013). The specifics of a few of these studies are given under the topics addressed below.

### Types Of Humans – Monkey Interaction

Sri Lanka is home to five different kinds of primates (Dela, 2007; Rudran, 2007; Nahallage et al., 2008). These species include three diurnal species, the toque monkey (*Macaca sinica*), the purple-faced langur (*Semnopithecus vetulus*), the crested gray langur (*Semnopithecus priam thersites*), and the two nocturnal species of slow loris (*Loris lydekkerianus* and *Loris tardigradus*). Mihintale, an important religious center is home to all of all three diurnal species and one of the nocturnal species. Located 12 kilometers to the east of the country's ancient capital city of Anuradhapura and 221 kilometers northeast of the modern capital city of Colombo. The size of the Mihintale reserve is around 2470 acres (999.6 hectares) and it is of great historical and religious significance, making it a popular travel destination for both religious and secular travelers. Mihintale is also the oldest game reserve in the world (Mendis & Dangolla, 2017d). We may assume that there have been interactions between humans and primates for more than 2200 years, if not earlier when this area was used as the hunting grounds of kings in those days.

People's cultural background, folk beliefs, and religious views all have a significant impact on attitudes towards animals. Also, there are regional variations in attitudes (Prasad et al., 2016). Relationships between tolerance levels and human interactions with other primates are determined by the degree to which an animal obstructs human activities (Mendis & Dangolla, 2017d). The precise number of primates in an area that would result in conflict cannot be predicted, but they will exhibit hostile behavior towards humans, mostly in relation to access to human food resources, i.e., agricultural fields and tourist areas. When primates understand that attacking humans might result in a quick meal, they become emboldened. Giving food to primates is seen from their perspective as an act of subordination; if food is withheld or not supplied, they may react hostilely. In essence, by feeding primates, people teach them to be aggressive. They may also turn aggressive if they feel their offspring are threatened (Cabral De Mel, 2016).

Non-human primates may interact with humans for a variety of different reasons, resulting in conflicts of various types:

1. Living in large numbers in public spaces.
2. Aggressive behavior of some or all of the primates living in these locations, which leads to attacks/bites and harm to humans.
3. The ensuing loss of conspecifics.
4. Increasing proximity of human communities to primate habitats, and loss of natural resources, leading to foraging on agricultural crops and food in garbage dumps.
5. Introducing problem primates from conflict areas into areas with no prior history of conflict.
6. Increase in population size due to access to food source of caloric value from refuse bins and handouts from tourists; emboldening primates forage of crops, approach or entry into homes, businesses, and attach tourists.
7. The transmission of diseases that are zoonotic from non-human primates to humans and vice versa.
8. Tour guides urging passengers to feed primates to increase interaction.

Economic loss caused by damage to agriculture, infrastructure, and roofs is perhaps the most significant consequence of the human-primate interaction. The data did not allow for a quantitative assessment; however, monetary loss can lead to hostility towards primates, especially if such losses are recurrent (Prasad et al., 2016). Psychological fear of primates can be caused by human or animal injuries. Furthermore, animal behavior can be considered normative across species, causing fear in other members of that species (Cabral et al., 2018). Another concern expressed in complaint letters was of primates entering the garden and sometimes the house. Some claimed that the primates preferred to attack juveniles and females over adult

males for some unknown reason. Humans are perhaps less tolerant of primates than other animals such as birds or giant squirrels. Primates are larger and capable of creating fear and greater economic loss (Cabral et al., 2018). In the Western Province of Sri Lanka, the most common primate species is the purple langur, which is considered a pest because it destroys homes and consumes and damages some crops (Dela, 2007; Rudran, 2007). They sometimes coexist with macaques, which are more commonly found around human settlements, and are more likely to steal food from homes and attack fields than langurs, who tend to shy away more from human settlements. Compared to the arboreal and leaf-eating purple face langur, macaques are terrestrial and omnivorous, which brings them into more direct face-to-face contact with humans. Indeed, most communities are concerned about toque macaques (Cabral et al., 2018).

Toque macaque attacks on people are more common than the other two species of diurnal monkeys in Sri Lanka (Phillips, 1981; Dittus, 2013b). Although it is an endemic primate, it is classified as a species of the least concern at the national level (Weerakoon, 2012). It also does not fall under Sri Lanka's Animal and Plant Protection Ordinance (Law No. 22 of 2009). This situation seriously hinders the conservation of this species. The unfortunate situation of monkeys is caused by the fact that they are often omnivorous forest dwellers. Due to deforestation, they have lost significant amounts of their natural habitat and have become easily adapted to consuming human food that would be thrown away with the city's garbage. This behavior has led to a significant increase in the local monkey population. This is especially true near public areas where tourist sites and garbage dumps can be used as food sources (Dittus, 2012a, b, 2013b). In some of these places, macaques are considered pests. Nevertheless, the upland subspecies *M. s. opisthomelas* have a relatively restricted distribution in montane environments (Dittus, 2013b). Interactions can be categorized into crop damage, infrastructure damage, roof damage, human and animal injuries, harassment, food theft, and monkey injuries. Crop damage can be described as damage to both commercial and non-commercial crops. It is almost impossible to distinguish between commercial and non-commercial crops, as most people in the area are subsistence farmers who sell their surplus crops for income. Damage to infrastructure includes antennas, telephone lines, electrical cables pipes, light bulbs, mirrors, vehicles, appliances and more. Reports of injuries to humans and their animals by monkeys biting or scratching. Other aggressive behavior by monkeys towards humans includes stealing clothes, urinating and defecating in homes and water tanks, eating from garbage cans. Monkeys in general are referred to by others as generally being a nuisance without specifying the problem. Stealing food from homes, public places such as schools, and tourist attractions is also reported. Theft of food left to dry in the kitchen garden is also counted as food theft (Cabral et al., 2018).

### **Mitigation Interaction**

Loss of primate natural habitat as a result of numerous construction projects is one of the main reasons for the escalating adverse encounters with human primates in Sri Lanka (Nahallage et al., 2008; Cabral et al., 2018; Ditas et al., 2019). Fragmented primate habitats isolate primates into small patches of forest, increasing competition for food and space. When natural ecosystem resources are scarce, monkeys flock to villages for food, exacerbating human-primate conflicts (Dela, 2007; Rudran, 2007; Nahallage et al., 2008; Dittus, 2012, 2019; Rudran & Kotagama, 2016; Reverb 2019). Options proposed to address the situation include moving monkeys from their homes to nature reserves and national wildlife parks, reducing monkey populations through sterilization, and keeping monkeys away from one's property (Nahallage et al., 2008). Most residents of these areas practice Buddhism, a religion that emphasizes compassion for all living things. However, the Hindus, Tamil, and their beliefs similarly cherish and respect animals. These studies show people from these areas have struggled to clear bushes and protect crops from monkeys and other animals that encroached on abandoned land (Dela, 2007; Rudran, 2007; Nahallage et al., 2008; Dittus, 2012; Rudran & Kotagama, 2016). Yet it is apparent that they were not always able to follow the teachings of the ancient religious doctrines of respect for all living things when initiating the mitigation actions. A systematic plan to reduce interaction between humans and monkeys could have prevented the neglect of this beautiful tradition

of peaceful coexistence (Perera & Vandercone, 2015). Rudran et al (2021) offered strategies based on the cultural characteristics of the country and backed them up by studies and the opinions of those interviewed (Rudran et al., 2021).

### **Use Of Non-Human Primates as Pets and Performers**

In general, few people would consider research monkeys desirable as pets, but according to the selected studies, people expressed a fondness for monkeys and their playfulness and wit, even though they come to peoples' property and cause loss or damage (Nahallage et al., 2008). The people's attitudes towards monkeys are influenced by how often the animals visited one's property. People who with the fewest monkey visits did not have strong negative opinions about monkeys. Households visited daily had the highest percentage of individuals expressing a preference for monkeys (Dittus et al., 2019). Most people say they prefer purple-faced langurs as pets because they think they are more human-like than grey langurs and are better suited to captive environments. In some provinces, macaques are used profitably by people. Trained macaques are taken to neighborhoods, villages, and public places to entertain crowds. The most common performances were scenes such as visiting the in-laws on New Year's Day, standing upright on their hind legs carrying gift boxes on their heads, and being punished by the police for stealing. They were appropriately dressed. The cost is equivalent to US\$1 per performance (Nahallage, 2013).

### **Primates As Food, Medicine and Ritual Objects**

Some people have reported hunting primates for food in their respective regions, except in the northern states. Some people also hunted monkeys for their body parts used as medicine and for ritual activities. In the North West, loris tears are mixed with other ingredients and ritually applied to plates to foresee the future. In Sabaragamuwa province, the hearts of purple langur are given to pregnant women to eat. Skulls, skin, meat and bones are also used. In the Uva province, both crowned monkeys and purple langur skins are used to make drums (Nahallage and Huffman, 2013). Most information on zoonotic or other parasitic species in monkeys in Sri Lanka comes from Polonnaruwa, North Central Province, an arid lowland environment (Dewit et al., 1991; Ekanayake et al., 2006; 2007). This is Sri Lanka's first large-scale multi-site assessment of potential zoonotic species in non-human primates. The distribution of primate hosts across the country is determined by altitude and climatic conditions (Nahallage et al., 2008).

### **Primates In Folklore, Myth and Other Narrations**

There are many folk tales about monkeys. The Jataka stories revolve around the 550 rebirths of a Bodhisattva before his enlightenment as Buddha. In 22 of these tales, the Bodhisattva was born as a monkey and emphasizes the Bodhisattva's kindness, forgiveness, mutual help, intelligence, and patience through the monkey's actions in various situations. Other primate folklore also emphasizes their intelligence and curiosity. Examples include the story of a monkey who lost its tail because it was so curious, the monkey who scarred its face trying to imitate someone shaving, and the story of the famous hat seller (Nahallage and Huffman, 2013). The famous Hindu epic Ramayana highlights Hanuman, the monkey god worshiped by Hindus, as a central figure. He was the intrepid leader of a legion of monkeys who flew to Sri Lanka in search of Sita, who had been kidnapped by Sri Lanka's King Ravana (Nahallage and Huffman, 2013). Myths and beliefs about primates vary from area to area. Some believe that if you see a monkey when you leave your home, it will bring you good luck. Some people believe that if a monkey calls out in the morning just before you go to work, it will bring misfortune and you will not be able to finish your work on time. Some people believe that the right side of a langur's body is made of human flesh, so they refrain from eating them entirely or using the right side of the animal's body. Macaques were thought to have been created by the demon Wasawartha his along with wild boars to annoy the villagers (Nahallage, 2013).



## **Human influence on macaque population, ecology and HMI**

Over time, the monkey population in one research area underwent many fissions and fusions, as well as group extinctions. The group with frequent access to anthropogenic foods increased at a mean annual rate and experienced many group fissions, whereas surrounding groups with access to human food sources grew modestly (Dittus et al., 2019). The expansion of the group with regular access to anthropogenic food was particularly instructive; not only did its numbers increase, resulting in group fissions, but the land area used by this growing subpopulation expanded progressively in size, primarily through dispersal into the human-dominated landscape, though some of its newly acquired range was taken over by neighboring groups from the natural forest (Nahallage et al., 2008b). According to the overall findings of selected studies, the majority of people have a negative sentiment regarding monkeys. Because monkeys are involved in a variety of disputes, societal views against them are more unacceptable than sentiments toward other creatures, such as birds or giant squirrels (Cabral et al., 2018). Males have a more negative opinion about monkeys than females do. However, these findings contradict the findings of (Nekaris et al. 2013), who found that gender had no effect on attitudes. The studies' respondents who offered unfavorable responses when asked about their emotions toward monkeys indicated that they saw them as pests and dangerous or unsightly creatures (Cabral De Mel, 2016). The majority who had previously experienced problems with primates had substantially more negative opinions than those who had not (Cabral De Mel, 2016). The vast majority of people in Sri Lanka have never raised monkeys as pets, however, some people have in the past (Nekaris et al., 2013). The vast majority of people who had reported concerns with primates agreed that primates deserved to be protected.

Other factors that lure monkeys to neighboring human communities include inappropriate rubbish disposal, human feeding, large-scale cash crop production, and a lack of food and water in natural habitats during the dry season (Dittus et al. 2019). The connection between primates and merchants is vague and tangled. Vendors are seriously concerned about monkey numbers and their inability to regulate them (Kumara et al., 2018d). The degree of interaction between humans and various primate species determined the nature of their attitudes towards each species (Jayarathne, 2021). They also threatened vendors and pilgrims when forcibly deprived of food. However, the majority of people do not have any negative feelings toward the purple faced langur (Kumara et al., 2018). Combined with scientific data, it is important in understanding conservation efforts and human attitudes toward primates. It also gives a complete picture of one of Sri Lanka's biggest problems, the interaction between humans and monkeys (Kumara et al., 2018d).

### **Attitude towards Monkeys**

A considerable number of studies have indicated that crop foraging has become more common over time. These three species of the most important crop-robbing monkeys in Asia and Africa are macaques (*Macaca*), baboons (*Papio*), and vervet monkeys (*Cercopithecus*) (Else 1991; Hill 1997; Norton-Traves 2001; Osburn and Hill 2005; Leary 2007). This is due, in part, to sophisticated social structures, adaptability, threatening behavior, omnivorous tendencies, and the ability to move between the ground and trees (Forthman-Quick 1986; Else 1991; Hill 2000; Webber et al. 2007). According to these studies, opinions about monkeys deteriorated with age. But as people get older, their understanding of monkeys also grows (Wijethilaka et al., 2021). In contrast, older respondents knew more about monkeys than younger respondents. This may be due to many more previous experiences (Jayarathne et al., 2021). The higher the monthly household income, the more positive attitudes toward monkeys were. This may be because individuals with higher monthly incomes were able to withstand the financial losses caused by monkeys (Nahallage et al., 2008). People's occupation does not influence their attitudes toward monkeys. Farmers are expected to have fewer positive feelings toward them (Rudran et al., 2021). One study found that respondents' primary source of income and occupation did not significantly influence attitudes toward primates (Nekaris et al., 2013), while in India it did (Nautiyal et al. 2020). People who are frequently

harassed by monkeys have more negative feelings about them. These results were consistent with previous findings that people who had problems with monkeys were more likely to have negative emotions towards them (Nekaris et al., 2013). Attitudes were not affected by gender, occupation, or primary source of income in that study. However, individuals with the highest level of education were more favorable to primates than those with little or no education. Landowners who lived near jungles were most likely to have had problems with primates in the past years (Poornima et al., 2022). The number of people reporting problems with monkeys decreased as they moved further away from the forest (Nekaris et al., 2013).

### **Perceptions of wildlife conservation**

According to Dittus (2012), programs for sterilization of monkeys require a sizeable financial investment and is challenging to implement in large monkey populations. Rudran, (2021) proposed the requirement of a short-term plan and a long-term plan for the sustainable solution of the HMC to maintain the healthy co-existence of humans and monkeys. Financial compensation for crop losses and provision of financial support and technical support can be implied as short-term plans to mitigate HMC. The long-term plans help retain both humans and monkeys in coherence (Dittus et al., 2019b). It is difficult for local communities to come up with a workable solution of their own concurrence. Thus, it is necessary to cooperate among farmers and other stakeholders including local people, Farmer's societies, Government bodies like DWC, Forest Department, DS officers, researchers, students, NGOs, agricultural-related academics, and local politicians before implementing. Farmers and residents have more experience in crop raids and other nuisance effects caused by monkeys because they deal with it on a daily basis, thus if any solution needs to be developed it should take the assistance of farmers and residents (Weerasekara & Ranawana, 2017). In order to reduce the disturbance from monkeys' the public need to work with the DWC and Forest Department to improve reforestation and forest cover and improve the management of natural protected areas and forest reserves and corridors. Some restricted areas with catchment areas should be identified and fruiting trees should be cultivated for the survival of monkeys and for reducing conflicts with humans (Nahallage et al., 2008). Farmers should be encouraged to synchronize their crop cultivation properly along with the fruiting and flowering seasons in the forest. There is a need for adequate protection for perennial crops. These recommended interventions will help to protect the mutual coexistent between humans and monkeys making an effective solution for non-human primate conservation and human welfare (Kumara et al., 2019).

### **The perceived trends of local primate population size and damage to crops**

The frequency of contact between humans and primates has recently increased. Crop attacks were experienced by many and viewed as pests: thought primates were afraid of humans Many techniques were used by people to protect their crops, such as firecrackers, making loud noises, shooting guns, using traps, and throwing stones (Perera & Vandercone, 2015). Throughout the country, macaques have been regarded as agricultural pests, temple guardians, and entertainers (Nahallage, 2013; Nekaris et al., 2013). A common mode of human-ape interaction along forest cropland ecosystems, including Sri Lanka, is crop raids by primates. The lack of compensation exacerbates the economic losses farmers suffer from harvest-stealing monkeys (Perera & Vandercone, 2015). Such scenarios can make farming communities unfriendly and callous to non-human primates, and can even cause farmers to kill problem species and thwart conservation efforts (Poornima et al., 2022). To reduce this type of human-ape interaction, it is first important to understand the transient nature of crop grabbing by various primate species, as this will help develop cost-effective protection systems. For tens of thousands of years, the people of southwestern Sri Lanka have coexisted peacefully with apes (Horgan & Kudavidanage, 2020). Non-human primates were rarely mentioned as major crop pests, and the losses that occurred were often ignored (Nekaris & de Silva Wijeyratne, 2008; Nijman & Nekaris, 2010). In southwestern Sri Lanka, people have reported agricultural damage by crested macaques, and slightly more purple-faced langurs and mural lorises, which were clearly

not seen as a problem. Ground locomotion allows macaques to traverse vast open terrain (Nijman, 2021). One of the most successful measures taken so far for the control of rodents is the surrounding of cultivated fields with electric fences. Therefore, it is advisable to continue to operate the electric fence in response to all perpetrators of crop damage. The knowledge and understanding of the community to manage the conflict is minimal, so their knowledge and understanding needs to be developed. Although it is a very sensitive matter to give food to the animals on the basis of religion, it is argued by several researchers that further feeding will only bring the animals closer to the people. Therefore, the community should stop providing food (Dittus, 2020; Pemadasa, 2022). In managing the conflict, the responsible institutions and the local community should be involved, so it should be emphasized that it is essential to develop a relationship between the main parties. The crop damage caused by beetles is high in the cultivated lands spread near the forests and in those fields where the attraction of beetles is very low, crops like green chilies, fish chilies, and green cabbage can be grown (Pemadasa, 2022). Also, the trade of forest food by people should be stopped further and measures should be taken such as imposing laws, monitoring them, educating the people and the trade community, and especially launching programs for regional economic development. In taking long-term measures, especially responsible institutions should intervene and it is essential to prepare a systematic program for that (Nahallage et al., 2022). There is a high probability of managing the conflict in a sustainable manner with the implementation of the identified long-term methods and the long-term methods that can be implemented (Horgan & Kudavidanage, 2020).

## CONCLUSION

By describing how they have been dispersed in terms of their thematic focus as well as their focal species, we have given an overview of the publications on Sri Lankan monkey species over a 14-year period. This exercise showed that studies on the ecological niche overlap of sympatric species and in-depth ecological studies of particular species are underrepresented and need more investigation. It would also be beneficial to conduct long-term, landscape-level studies that add to our current knowledge, such as examining how the ecology of a particular monkey species varies in various habitats and land use types and how this information may be used to identify important places for conservation. By doing this, it is hoped that certain changes to present regulations would be possible, helping to safeguard subspecies that require it but do not yet have it. We hope that this evaluation will encourage such action. These steps, combined with the adoption of practical conservation strategies involving all pertinent stakeholders, might aid in the conservation of the primates of Sri Lanka. Despite the fact that we have concentrated on Sri Lankan monkeys in this article, the strategy we have outlined may also be used to safeguard other types of animals in other parts of the world, including under studied primates.

In Sri Lanka, interest in and research of the war involving human prisoners has grown over the past 50 years. Conflict arises for diverse reasons in forested and non-wooded regions, and locals in non-forested areas tend to be more aggressive than those in forested ones (Cabral et al., 2018), This may also have some influence on the patterns of how humans interact with primates and other animals that pose a threat to human livelihoods. In Sri Lanka, toque macaques frequently clash with people. Given that the majority of studies are carried out in regions of forest or human settlement, we recommend more investigation into how people and monkeys interact in larger cities where they are also sometimes found. More research is required to determine how the aggressive actions of the monkey lead to conflicts with people. Overall, we advise beginning to systematically create a stronger adaptation and mitigation strategy for human-monkey interactions that will aid in the conservation and of all monkey species in Sri Lanka.

## APPENDIX

### Appendix 01 – Papers reviewed in this manuscript

1. Abeyesinghe, S. M., Weerasinghe, U. M., & Dittus, W. P. (2013). Human-monkey conflict in Sri

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