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Conflict Between Himalayan Palm Civet (*Paguma larvata*) and Local Community for Food Competition in District Dir Lower, Khyber Pakhtunkhwa, Pakistan

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AR and TA designed the study. TA collected the field data. AR and TA interpreted the results. FR, GS, OS, SU and MS participated in statistically analysis. AR wrote up the paper LB revised the manuscript.

Key words
Human-wildlife conflict, Himalayan palm civet, Local community, Dir lower, Village Takoro and village Koherai Malakand

ABSTRACT

Human-wildlife conflict (HWC) has a long history, it has become a major concern for wildlife management due to its expanding magnitude and nature complexity, affecting largely local communities that nearer to forests. Therefore, the two villages of District Dir lower (village Takoro and village Koherai Malakand), the part of great Himalayas has been selected to highlight the conflict between Himalayan palm civet (*Paguma larvata*) and local community during January 2018 to end of November 2020. During current studies it was found that the problem mainly arises due to civets foraging habits, who damages and feed human cultivated fruits, stored wheat grains and attacks on their domestic poultry. The results demonstrated that the ability of civets to change their diet in response to availability of food resources, as it found the consumption of *Vitis vinifera* in bulk in the month of July and August whereas *Diospyros lotus* and *Diospyros kaki* were the most preferred diet in the month of September and October. We were informed that Civet cats were predominantly killed (N=60) in village Takoro and (N=30) in village Koherai Malakand as a result of human wildlife conflict (HWC), limited fruit availability causes Himalayan palm civet to attack domestic poultry. The three-year data show that (*Vitis vinifera*) had the highest economic loss which is $ 12,897.63 followed by domestic poultry $ 9,232.15, *Diospyros kaki* $ 7,846.21, and *Diospyros lotus* $ 3,168.66. According to respondents fruits attack (40%) and domestic poultry attack (32%), were the major root of conflict followed by agriculture damage (12%), livestock attack (10%) and human settlement (6%). This unwarranted killing must be stopped immediately, otherwise this species will become extinct.

INTRODUCTION

Human-wildlife conflict (HWC) have a long history with human-life, the earliest forms of conflict existed in the form of predation of ancient human ancestors (the Taung Child, *Australopithecus africanus*; Berger and McGraw, 2007; Lee-Thorp *et al*., 2000). Today, HWC exists in a variety of different ways and encompasses a range of taxonomic groups of species (Walpole *et al*., 2003; Okello, 2005; Baruch-Mordo *et al*., 2008; Davison *et al*., 2011; Hoffman and O'Riain, 2012). Although HWC has a long history, it has become a key problem for wildlife management due to its growing magnitude and complex nature. A variety of factors have been attributed to the rise in HWC intensity, such as the expansion of human activities into wildlife habitat, the recovery and expansion of a few wildlife population and significant environmental changes (reviewed in Treves, 2008). Previously, the human wildlife dispute was considered a rural or agricultural problem (Messmer, 2000), which primarily affects communities that live close to forests. However, with human population

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growth and the expansion of human development programs, HWC incidences are now prevalent in urban and suburban areas (Soulsbury and White, 2015).

Currently, HWC is a global issue that encompasses a wide range of events that have adverse consequences for both humans and wildlife. With its far-reaching impacts in the domains of species conservation, protected area management and sustainable livelihoods (Dickman, 2010; Bowen-Jones, 2012), it is increasingly acquiring the attention of ecologists, wildlife biologists, and wildlife managers across the globe (Messmer, 2000). Unmitigated conflict levels deplete local support for conservation (Hill *et al*., 2002) and result in to retaliatory killing of wildlife species (Inskip and Zimmerman, 2009; Mateo-Tomás *et al*., 2012), thus threatening the long-term survival of wildlife species. Decline in wildlife population levels tends to be associated with areas that show a high degree of conflict between humans and wildlife (Woodroffe *et al*., 2005; Michalski *et al*., 2006). Thus, unmitigated conflict presents a very real, perceivable threat to the long-term survival of species. It also poses a danger to human lives and is a challenge for the sustainability of human livelihoods (Rao *et al*., 2002; Gillingham and Lee, 2003; Sahoo and Mohnot, 2004). Concomitantly, resultant economic loss due to crop and livestock damage (Brara, 2013; Mackenzie and Ahabyona, 2012; Schön, 2013) and management of HWC drains the affected countries of financial and human resources (Lamarque *et al*., 2009).

Himalayan palm civet (*Paguma larvata*) (the civet), belonging to the family Viverridae is a civet species, also known as Masked Palm Civet occurs widely across South Asia, Southeast Asia, and China, and Taiwan (Torii, 2009). Its range includes northern Pakistan and Kashmir to Indochina and the Malay Peninsula, Laos, Sumatra, Borneo, Taiwan, Hainan, much of eastern and southern China, and the Andaman and Nicobar Islands (Veenakumari *et al*., 1996; Duckworth, 1998; Nowak, 1999). The average length of head and body of a civet is 50 to 76 cm in length, and the tail is between 50 and 64 cm long. The ears are approximately 4 to 6 cm long. The civet weight depends on gender and age, but adults vary between 3.6 and 5 kg (Prater, 1948). Generally, their relatively short pelage is usually gray, with some tinges of orange, buff or yellowish red. Their feet tend to be blackish with five retractable claws in each. The distal end of the tail appears to be darker than of the proximal end. They are named for their 'mask', consisting of a median white line from the top of the head to the nose, white marks extending to the base of each ear above each eye, and white marks immediately below each eye (Nowak, 1999). The dental formula is 3/3 1/1 3/4 2/2 and females have 2 pairs of mammae (DeBlase and Martin, 1981).

This species is listed as "Least Concern" in IUCN red list due to its wide distribution, presumed large population, occurrence in many protected areas, tolerance to some degree of habitat change, and because it is unlikely to decline at almost the rate required to qualify for listing in a threatened category. The major threats for the masked palm civet are continued habitat destruction and hunting for bush meat. However, it can also live in fragmented forest habitats, albeit at reduced density, and its semi-arboreal lifestyle makes it less vulnerable to hunting than ground-dwelling carnivores (Duckworth *et al*., 2008).

These civets are found in a variety of forests. They live in deciduous, evergreen and mixed deciduous forests, as well as mountainous regions (Rabinowitz, 1991; Duckworth, 1998). They are also found in tropical rain forests (Nowak, 1999) and are frequently found near human settlements (Parker, 1990). These civets are located at the top of many food chains, and thus play an integral role in predator-prey interactions and ecosystem balance (Heydon and Bulloh, 1996).

Masked palm civets are arboreal, solitary, and nocturnal (Nowak, 1999). They sleep during the day in 'day beds', which are in trees over 80% of the time. These beds are located in the top 10% of the tree (measured by height), and usually near a water source. During an average night, they are active approximately 50% of the time and can travel up to two kilometers in a single day. Increased activity is shown in warmer weather, with May having the highest activity levels and November the lowest (Rabinowitz, 1991).

Masked palm civets are hunted for their fur and for food, and some local villagers keep them as pets. They are often used as ratters, since they are extremely quick and adept at killing these nuisance rodents (Nowak, 1999). These civets often raid fruit crops when those crops are close enough to the forest (Veenakumari *et al*., 1996). They have also been known to take chickens and other poultry (Parker, 1990; Nowak, 1999). Individuals in Japan have shown a high susceptibility to canine distemper virus infections, which would taint prospective meat (Machida *et al*., 1992).

The objective of this study was to evaluate the conflict between civet and local community.

MATERIALS AND METHODS

Study area

The study was conducted in two villages (village Takoro and village Koherai Malakand) of district Dir Lower that is located in northern part of the Khyber Pakhtunkhwa province (KP) in the Hindukush range of Pakistan from January 2018 to end of November 2020

(Fig. 1). Geographically the area is bounded by Swat in the east, Bajur agency and Afghanistan in the west, district Dir Lower in the south and Chitral in the north, spanning from 34° 52 N latitude and 071°44 E longitude. The study area is part of sub-tropical dry temperate areas. However, part of the district also lies in the moist temperate area of the country (Champion *et al*., 1965; Khan *et al*., 2010). According to the district census report (1998), the total population of the area is 575,858 and lies almost in the valley besides the river Panjkora which rises high in the Hindukush at latitude 35° 45 and joins the Swat River at Sharbatayi near Chakdara at latitude 34° 40.

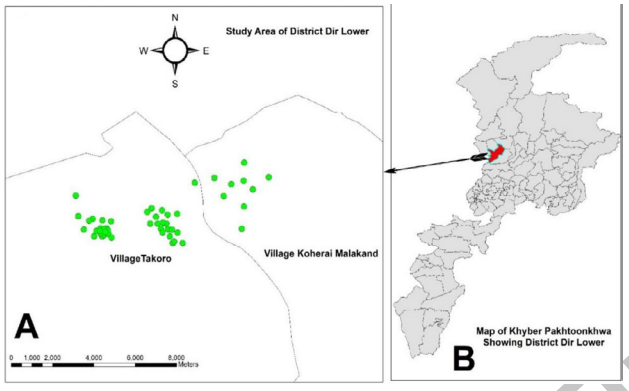

Fig. 1. Map of Khyber Pakhtoonkhwa showing the number of civet that are killed in the study area of Village Takoro and village Koherai Malakand of District Dir Lower.

Climate

The climate of the study area can be described broadly as typically continental type with four different seasons in a year; winter, summer, spring, and autumn (Wahab *et al*., 2008). Winters are relatively long and cold and severe usually in the months of December and January, the average maximum and average minimum temperature are 8.8 and -7°C. On the other hand, the average maximum and minimum temperature in summer ranges between 34.4 to 11.5°C respectively. The mean relative humidity ranges between 30 to 70%, while in the month of March average rainfall 269.6 mm has been recorded, indicating that winter season receives more rainfall as compared to other seasons. According to the meteorological station in the area, the pattern of rainfall, relative humidity and temperature increase progressively from January to June and then gradually decline up to December.

Study design

Questionnaire based surveys were conducted for the collection of data by interviewing local community (including villagers, farmers, hunters). A total of 150 questionnaires were filled out from the study areas during the survey. Interviews were conducted to cover settlements of two northern villages (Takoro and Koherai Malakand). As preliminary contacts with local interviewees indicated some importance of local land cover (such as farmland or settled areas), people were also interviewed about civet contacts in the non-cultivated dense stands, rainfed and irrigated farms and the village margins.

Field data were also collected from the selected potential sites by collecting the scats, as the civet is nocturnal and inhabits moist coniferous forests, chir pine forests or broad leaved scrub forest with a dense canopy cover and understory, direct observations of feeding or camera trapping were not feasible. All scats encountered in rainforest along trails and in the interior were examined thoroughly in the field or collected for macroscopic examination. Scats of the civet were identified based on their shape, size, and location. Civet scats are straight, cylindrical (≤ 2 cm in diameter), rounded at both ends and usually defecated as a single bolus on prominent places like fallen logs, rocks and watercourses. This defecation behavior is typical of civets.

RESULTS

We collected data from two villages (Takoro and Koherai Malakand) of District Dir Lower of the Northern areas of Pakistan from January 2018 to end of November 2020.

Food data of civet

Civet feeds on eight (8) fruits viz., date-plum (*Diospyros lotus),* persimmon (*Diospyros kaki),* fig *(Ficus carica),* ber or red date *(Ziziphus mauritiana),* mulberry black+white (*Morus nigra + alba),* grapes *(Vitis vinifera),* bakain or China berry *(Melia azedarach*). The civ*et al*so feeds on stored wheat (*Triticum asetivum)* and domestic poultry. Civ*et al*so feeds on rotten fruits and acts as a scavenger (Table I). Fruit materials were the dominant consumption year round. *Diospyros lotus* and *Diospyros kaki* were the most preferred diet in the months of September and October while in the month of January, February, March, November and December rarely consumed. *Vitis vinifera* mostly preferred in the month of July and August. *Ziziphus mauritiana is* mostly consumed in the month of July, August, September and October. In the months of April, May and June, *Morus nigra + alba*, *Ficus carica* and *Melia azedarach* were mostly attacked by the civet while *Melia azedarach* was also rarely consumed in the month of January, February, March, November and December. Rotten fruits were rarely consumed in winter months.

Table I. The table shows the availability and consumption of food by civet in two villages of District Dir Lower of KPK province in Pakistan. (✓ shows feed mostly, * shows feed rarely and × shows no attack).

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Fruits												
Diospyros lotus	*	*	*	×	×	×	×	×	✓	✓	*	*
Diospyros kaki	*	*	*	×	×	×	×	×	✓	✓	*	×
Vitis vinifera	×	×	×	×	×	×	✓	✓	×	×	×	×
Ziziphus mauritiana	×	×	×	×	×	×	✓	✓	✓	✓	×	×
Morus nigra + alba	×	×	×	✓	✓	✓	✓	✓	✓	✓	×	×
Ficus carica	×	×	×	✓	✓	✓	×	×	×	×	×	×
Melia azedarach	*	*	*	✓	✓	✓	×	×	×	×	*	*
Triticum aestivum	✓	✓	✓	*	*	*	*	*	*	*	✓	✓
Domestic poultry	✓	✓	✓	*	*	*	*	*	×	×	✓	✓
Rotten fruits	*	*	*	×	×	×	×	×	*	*	*	*
Scavengers	×	×	×	*	*	*	×	×	×	×	×	×

The stored grains of wheat were preferred as a diet in the month of November, December, January, February and March while it was rarely consumed year around. Civ*et al*so attacks on domestic poultry in the winter months of January, February, March, November and December while the Civ*et al*so acts as a scavenger.

Five species of fruits were observed, with *Vitis vinifera* the most frequent fruit consumed (Fig. 2) in the village Takoro and village koherai Malankand followed by the *Melia azedarach* and *Diospyros kaki*. The five predominant fruits found were *Vitis vinifera, Melia azedarach, Diospyros kaki, Diospyros lotus* and *Ficus carica*. Wheat was also found in the faeces by macroscopic lens.

Civet killed in different fruits and poultry attack

The civets are usually killed by shooting after stunning them with sharp light of a tourch. In the village Takoro, 19 civets were killed feeding on grapes while 11 civets were killed in the village koherai Malankand. However, 17 civets were killed while feeding on *Melia azedarach* in village Takoro and 7 killed in village koherai Malankand, also on the consumption of their native fruit *Diospyros kaki,* Fourteen civets were killed in the village Takoro and 6 killed in village Koherai Malakand. In village Takoro, 7 civets were killed at the consumption site of *Diospyros lotus,* one at *Ficus carica* and two on *Triticum aestivum* respectively while three were killed at consumption of *Diospyros lotus* two were killed at *Ficus carica* and one at wheat in village Koherai Malakand (Fig. 3).

Overall 45-60% civets were killed by the local community in village Takoro in last three years whereas 25-30% civets had been killed in village Koherai Malakand (Fig. 3) in retaliation of damage to their native fruits and domestic poultry.

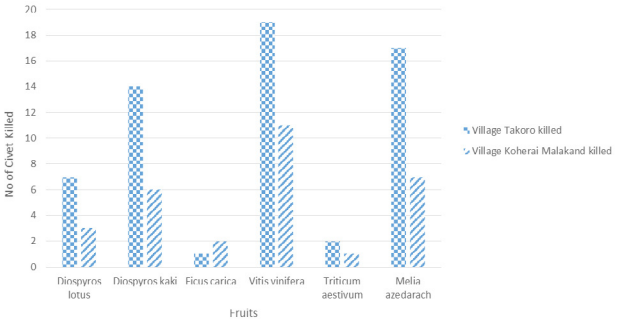

Fig. 2. The most frequent consumption of fruits and no of civets killed in the village Takoro and village koherai Malankand of District Dir Lower.

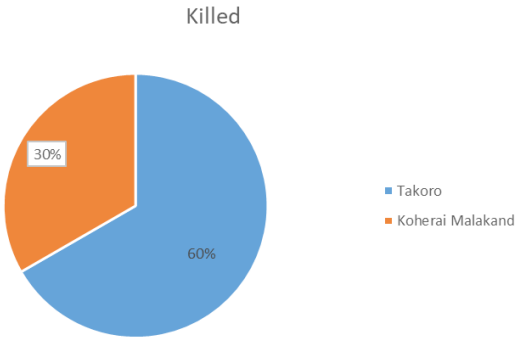

Fig. 3. Civet killed by the local community in village Takoro and village Koherai Malakand in last three years.

During the study period, incidents of domestic poultry assumed to be killed by the civet taking live chicken from unattended poultry sheds were recorded. All incidents occurred between 18 h and 19 h. In the direct sighting, only the chicken feathers were observed as the civet attacked and consumed poultry chicks. Local poultry farmers believe that the mode of attacking poultry on its head was peculiar to the civet identified as Himalaya palm civet kills. According to the farmers, domestic dogs *Canis familiaris* and stray cats *Felis catus* usually tear the bird at the site itself and carry the carcass away, while both mongoose (*Herpestes* sp.) apparently attack only chicks and not adult birds. The local farmers felt that they have never seen small Indian civet (*Viverricula indica*) in the area.

Economic loss to local community

The local community of village Takoro and Koherai Malakand lose a lot of economy due to the attack of civet on fruits and domestic poultry. The three-years data show that *Vitis vinifera* had the highest economic loss which is $ 12,897.63 followed by domestic poultry $ 9,232.15, *Diospyros kaki* $ 7,846.21, and *Diospyros lotus* $ 3,168.66 (Table II). The rest of fruits have no such value but the civet have also killed by the local community because they consider civet is their enemy. Due to the economic loss the local community kill the civet to save their fruit and domestic poultry.

During the field observation, questionnaire and interview taken from the local community, the main root causes of the civet and local community conflict in the study area were the feeding habits of the civet. According to respondents fruits attack (40%) and domestic poultry attack (32%), are the major root of conflict followed by agriculture damage (12%), livestock attack (10%) and human settlement (6%) (Fig. 4).

Civet and local community conflict

Figure 5 shows the conflict (number of kills) in three years (2018-20). The most number of civet were killed in 2018 followed by 2019 and 2020. In 2018, 27 civets were killed in village Takoro and 14 in Koherai Malakand. In 2019, 20 civets were killed in Takoro and 9 in Koherai Malakand. In the year 2020 the number of civet killed was 13 at Takoro and 7 in Koherai Malakand (Fig. 5). The number of kills decreased due to decline in the population of the civet.

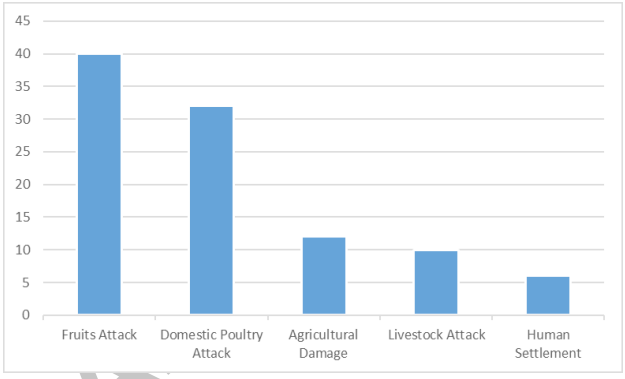

Fig. 4. Damage caused by civet attack in different areas.

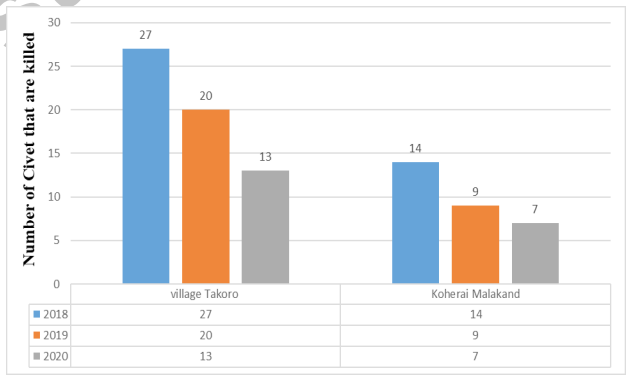

Fig. 5. Comparison of civet and local community conflict in three years (2018, 2019 and 2020).

Table II. Total loss due to civet attack and the importance of fruits and poultry for local community.

Food of civet	Total loss in three years		Total loss three years	
	Takoro	Koherai Malakand	PKR	US $
Diospyros lotus	PKR 322,000	PKR 245,000	567,000	3,168.66
Diospyros kaki	PKR 954,000	PKR 450,000	1,404,000	7,846.21
Vitis vinifera	PKR 1,507,000	PKR 800,900	2,307,900	12,897.63
Ziziphus mauritiana	No value	No value	No value	No value
Morus nigra + *alba*	No value	No value	No value	No value
Ficus carica	No value	No value	No value	No value
Melia azedarach	No value	No value	No value	No value
Triticum aestivum	No value	No value	No value	No value
Domestic poultry	PKR 1,007,000	6,450,000	1,652,000	9,232.15

The record of the District Lower Dir Wildlife Department shows that 8 persons from Takoro and five from Koherai Malaking who were involved in the illegal killing of the civet, during 2018-2020 and were fined PKR 5,000-45,000 along with 10 days of imprisonment sentences. The villagers often kill civets to use tails forwarding off evil eyes, and avoid mishaps and accidents.

DISCUSSION

The civet, a mostly nocturnal mammal, is the only fairly common mammal predator remaining. The civet is among the more omnivores viverrids (Torii, 2009). No systematic studies have been carried out in Pakistan, on their conflict with anthropogenic disturbance and on the civet diet, as fruits have traditionally been regarded the civet primary food (Wang, 1987; Grassman, 1998; Nowak, 1999; Jiang *et al*., 2003; Lundrigan and Baker, 2003). In preliminary research several complaints, anecdotes and description of civet behavior, impact on local community and the conflict between villagers and civets were reported. Human-wildlife conflict has a long history, it has become a major concern for wildlife management due to its expanding magnitude and nature complexity as previously, conflict over human wildlife was thought to be rural or agricultural problem (Messmer, 2000), affecting largely local communities nearer to forests. During current study it was found that the problem was mainly caused due to civet foraging habits, who damages and feeds on human cultivated fruits, stored wheat grains and attacks on their domestic poultry. The predation on domestic animals is also reported to be a cause of retaliated killing.

The current findings corroborate the earlier studies. Balaramapuram being a rural area, every home yard has one or more fruit plants. Excepting fig *Ficus* and mango *Mangifera indica*, which have no specific time of fruiting, thus fruits were available all year. As in the current study, majority of the data collected in the month of July and August comprised a single fruit species/food item grapes (*Vitis vinifera*), indicating that the civets ate a single source in bulk at most of its ripening stage, resulting in lack of grapes in the local population. It is determined that civets have sharp digestive system since they forage in large quantity at a time and defecate after a short period of time. Krishnakumar and Balakrishnan (2003) reported only 10 fruit species from common palm civet faeces in two semi urban habitats in Trivandrum, however Grassman (1998) found 13 fruit species in faeces pooled from common and masked palm civet (*Paguma larvata)* in Kaeng Krachan National Park (Thailand), according the current study civet ate at least 8 fruit species in the two villages of District Dir Lower of Northern areas of Pakistan.

Fruits were one of the most important food items consumed by civets in our study. As Shizuoka Prefecture (1996), identified that civets favoured sweet fruits such as *Rosaceae* spp. (e.g., cherry, strawberry) and *Diospyros kaki* (persimmon), we found in the current study that civet favored sour fruits such as *Vitaceae* spp. (e.g. grapes), Chinaberry (*Melia azedarach)* and persimmon (*Diospyros kaki*), showed significant monthly changes. The intensive consumption of *Vitaceae* spp. in July appeared to be associated with the peak availability of these fruits as they ripened in summer (Oda, 1991; Mogi *et al*., 2000). Similarly, that *D. kaki* was only eaten in late-summer (September-October) coincides with the beginning of its ripening season, into autumn (November; Yamada *et al*., 1994). As a result, civets in our research area appeared to be feeding opportunistically, and we speculate that they were modifying the composition of the predominant fruit species they devoured in response to variations in the availability of these fruits in the environment.

In their native range (subtropical central China; Zhou *et al*., 2008), the civet diet consists primarily of wild/cultivated fruits and small mammals/birds with seasonal fluctuations in fruit availability causing dietary alterations. In Japan, civet feeding behaviors have been studied in Shizuoka Prefecture (Shizuoka Prefecture, 1996), Chiba Prefecture (Matsuo and Ochiai, 2009), Gunma Prefecture (Anezaki *et al*., 2010), and in Tokyo (Yoshino and Hagiwara, 2010). While these studies show that civets prefer fruits, they also highlight that they can eat a variety of other foods such as arthropods, molluscs, fish, reptiles, and scavenged items.

In Ethiopia, Bekele *et al*. (2008) discovered a high incidence of scavenging in human habitats by the African civet *Civettictis civetta*, and Balakrishnan and Sreedevi (2007) discovered cooked rice and fish bone in Small Indian Civet excrement collected near human habitats. As in the current study, it has been identified that civ*et al*so act as a scavenger when the villagers perform some functions and use chickens as a cooked meat, so remaining residues consumed as a scavenging. So where, civet has harmful effect for local community, it also beneficial for the local community. But when civets attacks the domestic poultry, as it also defecate in water courses, that is the source of drinking of the local community so due to immense behavior, villagers kills civets considering it the species as a menace.

Wang (1987) suggested that if a civet encounters a tree containing mature fruits, it will return to that foraging site on a regular basis.

Frugivorous may disperse seeds (Herrera, 1989; Nakashima *et al*., 2010). When an animal ingests fruits, the successful dispersal of the seeds depends on feeding

behaviour of the frugivores, the seed viability after consumption and gut passage and the movement of animals (Koike *et al*., 2008). The seeds collected from the faeces as sampling scats were identified as belonging to *P. larvata* based on the appearance (e.g., color, shape, and size), texture, and characteristic odor; other evidence of civets (e.g., tracks, feeding signs, active dens, or daybeds) associated with feces; the opinion of local trappers (Wang, 1999). Because of their smaller size (scat diameter for civets = 5–20 mm versus > 40 mm for bears) (Gatti *et al*., 2006; Juarez and Marinho, 2002; Manfredi *et al*., 2004), civet scats were easily differentiated from bear scats. The feces of masked palm civets were distinguished from those of leopard cats in the study area by their characteristic shape and odor, as determined by comparison with a scat reference collection made from zoo specimens (Ja´como *et al*., 2004). Daily movement patterns of civets in the present study area were not studied, but elsewhere (Rabinowitz, 1991; Joshi *et al*., 1995, Su-Su and Sale, 2007) civets move long distances so may transport seeds equivalently. Even though faeces collected in this study were from rocks, trails and water courses, the animals defecated may well have been more suitable for germination. It is plausible to assume that civets in the study area may be acting as a disperser of fruit plants in the locality. By defecating viable seeds, civet may help the effective dispersal of these economically important trees.

In 2020 the number of civet kill are minimum because the population of civet are decline and the number of attack on poultry and fruits are also decrease if their killing exist the civet will become endangered.

CONCLUSION

To conclude, masked palm civets are generalist and opportunistic feeders in our study, feeding on fruits and stored wheat grains, the conflict between local community and wildlife conservation are a major threat to biodiversity and human well-being globally. The civets consume a variety of fruits from cultivated trees and also attacked on domestic poultry when the fruits have become less availability. Our data also demonstrate that they defecate in water courses as the source of drinking of local community. The majority species associated with only one type of damage (i.e. either damage to crops or livestock loss). Our study illustrates civets presence in areas of human habitation contribute to fears and negative perceptions so the local community faces distinct livelihood challenges from civet specie at different times of the year, so the villagers kills them with shooting method.

Statement of conflicts of interest

The authors have declared no conflict of interest.

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