Diet of Fishing Cat (*Prionailurus viverrinus*) in Koshi Tappu Wildlife Reserve, Eastern Lowland Nepal

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In partial fulfillment of the requirements for the award of the degree of Master of Science in Zoology with special paper Ecology and Environment

Submitted to

Central Department of Zoology

Institute of Science and Technology

Tribhuvan University

Kirtipur, Kathmandu

Nepal

May 2023

DECLARATION

I hereby declare that the work presented in this thesis **"Diet of Fishing Cat (*Prionailurus viverrinus*) in Koshi Tappu Wildlife Reserve, Eastern Lowland Nepal"** has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by the reference to the author(s) or institution(s).

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RECOMMENDATION

This is to recommend that the thesis entitled thesis **"Diet of Fishing Cat (*Prionailurus viverrinus*) in Koshi Tappu Wildlife Reserve, Eastern Lowland Nepal"** has been carried out by Beenu Khadka for the partial fulfillment of Master's Degree of Science in Zoology with a special paper Ecology and Environment. This is her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institution.

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LETTER OF APPROVAL

On the recommendation of supervisor "Laxman Khanal, PhD" this thesis submitted by Beenu Khadka entitled thesis **"Diet of Fishing Cat (*Prionailurus viverrinus*) in Koshi Tappu Wildlife Reserve, Eastern Lowland Nepal"** is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for Master's Degree of Science in Zoology with special paper Ecology and Environment.

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CERTIFICATE OF ACCEPTANCE

This thesis work submitted by Beenu Khadka entitled **"Diet of Fishing Cat (*Prionailurus viverrinus*) in Koshi Tappu Wildlife Reserve, Eastern Lowland Nepal"** has been accepted as a partial fulfillment for the requirements of Master's Degree of Science in Zoology with special paper Ecology and Environment.

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LIST OF ABBREVIATIONS/ACRONYMS

Abbreviated forms	Details of abbreviation
IUCN	International Union for Conservation of Nature
PA	Protected Area
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNP	Chitwan National Park
BNP	Bardiya National Park
PNP	Parsa National Park
ShNP	Shuklaphanta National Park
LR/NT	Lower Risk/ Near Threatened
VU	Vulnerable
EN	Endangered
DNPWC	Department of National Parks and Wildlife Conservation
NPWC	National Parks and Wildlife Conservation
CDZ	Central Department of Zoology
ANOVA	Analysis of Variance
FO	Frequency of occurrence
PO	Percentage of occurrence
KTWR	Koshi Tappu Wildlife Reserve

ABSTRACT

Fishing cat (*Prionailurus viverrinus*) is an endangered felid that inhabits wetlands and marshy areas. Koshi Tappu Wildlife Reserve is one of the major habitats of fishing cats in Nepal and being partially dependent on fish there are conflicts with fish farmers. This study aimed to find the diet of fishing cats, including the contribution of commercially reared fishes in their diet, in the Koshi Tappu Wildlife Reserve in eastern lowland of Nepal. A total of 36 scats of fishing cats were collected by transect survey from human and livestock trails, roads, and pond edge for four weeks in the months of February, October and November in 2022. The scats were analyzed by scat analysis method in laboratory to determine the diet of fishing cats. The scats were washed in a sieve mesh and undigested prey remains were allowed to dry in sun. Then the dehydrated sample were separated into different taxonomic groups by the presence of hairs, feathers, fish scales, bones, and insect parts. Hair samples were then used to make medullar and cuticular slides which were compared with reference slides and images. Results of this study reveal that the accumulation and distribution of scats was found near water bodies, highlighting the significance of conserving the habitat of fishing cat. The main diet of fishing cat consists of mammals, fish, and plant matter, with insects, reptiles, and stones being less frequently consumed. Fish accounted for 52.7% of their diet by weight. The quantification of scat contents showed a higher contribution of mammals especially species of the order Rodentia, particularly those belonging to the *Bandicota*, *Mus*, and *Rattus* genera. Additionally, the presence of plastic in their diet emphasizes the importance of preserving their habitat and reducing the pollution by non-degradable items like plastic, which can have an adverse impact on their health. This study contributes to the understanding of the dietary habits of fishing cat and emphasizes the need for conservation efforts to protect their habitats.

1. INTRODUCTION

1.1 Background

There are 12 species of felids in Nepal making it the second richest country in the world for felid diversity (Aryal et al. 2018). Different big and small (wild and domestic) cats fall under the Felidae family. Population of small wild cats are more in comparison to the big cats in Nepal (Chaudhary 2020). Out of 12 wild cats found in Nepal, 4 are big cat species i.e. tiger (*Panthera tigris*), leopard (*Panthera pardus*), snow leopard (*Panthera uncia*), and clouded leopard *(Neofelis nebulosa*) and 8 are small cat species i.e. Eurassian lynx (*Lynx lynx*), leopard cat (*Prionailurus bengalensis*), Asiatic golden cat (*Catopuma temminckii*), pallas's cat (*Otocolobus manul*), jungle cat (*Felis chaus*), marbled cat (*Pardofelis marmorata*) , fishing cat (*Prionailurus viverrinus*) and rusty spotted cat (*Prionailurus rubiginosus*) (Aryal et al. 2018). There are huge information gaps on the distribution and status of smaller felids in Nepal (Poudel et al. 2019). The majority of information on small cat species comes from older references and physical evidence, as well as studies and surveys done in protected areas for larger cats (Poudel et al. 2019).

Fishing cat (*Prionailurus viverrinus*), is the second largest among the endangered wild cats (Thudugala & Ranawana 2015). Fishing cat is a threatened species which live in wetlands and marshy areas (Malla et al. 2018). They are found in swamps and marshy areas, oxbow lakes, reed beds, tidal creeks and mangrove areas (Aryal et al. 2018). Fishing cat was also found feeding on a dog-faced water snake (*Cerberus rynchops*) and pond heron (*Ardeola grayii*) in Mangroove of Godavari delta in India, small birds, rodents, insects, frogs, molluscs and crustaceans (Haque & Vijayan 1993; Sunquist & Sunquist 2002; Malla et al. 2018). Within Terai of southern Nepal, fishing cat is recorded from five protected areas- Koshi Tappu Wildlife Reserve (KTWR), Shuklaphanta National Park (ShNP), Chitwan National Park (CNP), Parsa National Park (PNP) and Bardia National Park (BNP) and three non-protected wetland areas- Bankalwa (Sunsari), Bodhban (Bara) and Jagdishpur Reservoir (a Ramsar site in Kapilvastu) (Timilsina et al. 2021; Mishra et al. 2021, 2022). Population of fishing cat is low in KTWR though it consists good habitat for fishing cat, the fish farming areas in eastern buffer zone and the core reserve areas are the places where fishing cat is evenly distributed (Mishra et al. 2021).

1.2 Species introduction

Fishing cat is a medium-sized cat that is categorized as “Vulnerable” in the IUCN Red List of Threatened Species (Mukherjee et al. 2016). Fishing cat is the only cat which has its common name derived from its feeding habit. The Latin name of this cat is *Prionailurus viverrinus* named by the English zoologist Edward B. Tennet because of its resemblance to the viverrid family, especially the large Indian civet (Sunquist & Sunquist 2002). It is endemic to South and Southeast Asia (Mishra et al. 2018).

1.2.1 Morphology

Fishing cat has deep chested body with comparatively shorter legs (Thudugala & Ranawana 2015) which is roughly twice the size of a large domestic cat with females weighing significantly lesser (6–7 kg) than males (Timilsina et al. 2021). Male fishing cat has a body length of 718 mm and female has a body length of 660 mm, with male weighing 15 kg (Thudugala & Ranawana 2015). It has distinct stripes and spot patterns on the head, face, and body (Thudugala & Ranawana 2015). There are six to eight black lines travelling from the brow to the neck, splitting into shorter lines and spots on the shoulders (Thudugala & Ranawana 2015). It has small rounded ears and an elongated face (Sunquist & Sunquist 2002). Fishing cat has partially webbed toes in the front feet with the tail which is about one-third the length of the cat's head and body, and is thick and muscular near the body (Sunquist & Sunquist 2002).

1.2.2 Habitat

Fishing cat is habitat specialist, preferring wetlands, rivers and marshes (Miththapala 2004). Only 4.4% of Nepal was discovered to have possible habitat for fishing cat, mainly in the Terai lowlands (Mishra et al. 2021). Outside of the PAs, the majority (65%) of potentially good habitat for fishing cat is located (Mishra et al. 2021). Fishing cat’s distribution is limited to the coastal zone, from mangroves to swamps flanked by rice fields, aquaculture farms, and human settlements up to roughly 50 meters above sea level (Shekhar Palei et al. 2018). Fishing cat also prefer tall grassland surrounding oxbow lakes and riverbanks (Mishra et al. 2018). Fishing cat has been recorded not only in their natural habitats, but also in agricultural areas and fish farms across all countries where they are found (Chowdhury et al. 2015; Mishra et al. 2021, 2022). This suggests that, fishing cat may exist in other regions of the Terai (Mishra et al. 2022).

1.3 Research objectives

General objective of the study was to understand the feeding ecology of fishing cat in Koshi Tappu Wildlife Reserve.

Specific objectives were:

i. To explore the distribution and abundance of fishing cat indirectly through scats in Koshi Tappu Wildlife Reserve.
ii. To find out the relative proportion of different prey species in the diet of fishing cat.

1.4 Significance of the study

As the diet of fishing cats is one of the least studied topics, this study intends to fill the gaps in the research field by studying the diet of fishing cat. This research intended to find the answer for two questions i.e., diet of fishing cats and contribution of commercially reared fishes in their diets. According to the farmers in the KTWR, commercially reared fishes are eaten by fishing cat in large amount. Fish farmers in the KTWR have claimed that many fishing cats are killed at retaliation due to the conflict between fish farmers and fishing cats as the later are partially dependent on fish (Mishra et al. 2021). As there are not many researches on the diet of fishing cats in KTWR, other prey species of fishing cats in KTWR needs to be identified.

This study provides the information on diet of fishing cats which will give the relative proportion of different prey species. This study may help to solve the existing conflict between the fish farmers and fishing cats by finding the contribution of commercially reared fish in their diet which will suggest measures to reduce the threats to fishing cats in near future.

1.5 Research limitations

The study of diet composition of fishing cat was confined only to the eastern part of the KTWR. Also, the seasonal analysis of diet was not done, so, the finding in this study is based on only one season. All the prey species were not identified to species level due to lack of necessary references for the identification.

2. LITERATURE REVIEW

2.1 Distribution of fishing cats

Fishing cat (*Prionailurus viverrinus*) is the medium sized cat endemic to South and Southeast Asia (Mishra et al. 2018). Fishing cat occurs in India, Pakistan (Sindh), Nepal, Bangladesh, Sri Lanka, Thailand, Cambodia and java (Janardhanan et al. 2014). It prefers wetland habitat and is widely distributed but unevenly across Asia (Mukherjee et al. 2012). The two main factors affecting the ecological niche of the fishing cat are wetlands (18.36%) and elevation (17.15%) as it was expected to be mostly restricted to river basins in South and South-east Asia that are (about 111 m) low-elevation wetlands but due to urbanization it was estimated that about 23.74% of its habitat has been lost. The majority of the world's fishing cat population is in South Asia, where the Ganges Brahmaputra Basin and the Indus Basin are two very significant locations that share transboundary territories with exceptionally suitable habitat and numerous high priority conservation units (Adhya et al. 2022).

Sri Lanka, Bangladesh, West Bengal in India, and the Terai-Duar zone in the Himalayan foothills in India and Nepal are known strongholds (Chutipong et al. 2019). Chutipong (2019) states that in Southeast Asia, records from 2000 to 2016 are sparse and the species' occurrence is extremely patchy in Vietnam, Cambodia, Thailand, Myanmar, and Indonesia. Thailand may be one of the major and important strongholds for the fishing cat and a country with a high priority for its conservation in because it has few habitats that are degraded and are potentially suitable for the fishing cat. Examples of such habitats include coastal mangroves, within large protected areas with strict law enforcement, and populations of species like otters that share similar ecological characteristics with fishing cat (Chutipong et al. 2019). Only a small number of inland and coastal wetlands in Thailand have been found to have fishing cat. An important national stronghold for this species in the nation is Khao Sam Roi Yot National Park and its surrounding habitats (Phosri et al. 2021). The actual distribution of fishing cat in Southeast Asia is still poorly known, so the actual distribution needs clarity with target studies being conducted only in Thailand and Cambodia (Thaung et al. 2018; Chutipong et al. 2019). The range or distribution of the fishing cat in Myanmar is unknown due to lack of credible field record so the data on (Lin & Platt 2019). There is a scarcity of information about the occurrence and distribution of the fishing cat in Myanmar (Lin & Platt 2019). Morris (1936) reported seeing two fishing cats and collecting one along the Chindwin River at Dalu (Taro) where is now Hukaung Valley Wildlife Sanctuary. The study done by Lin and Platt (2019), found two

recent photographic recordings of fishing cat from known origin that establish the presence of the Ayeyarwady Delta, which provides the proof of its presence in Myanmar which is the first verifiable record in Myanmar since the account of Morris (1936). Despite widespread camera-trapping in eastern and northern Cambodia including Kulen Promtep Wildlife Sanctuary in recent years, fishing cat was not recorded in Cambodia (Mukherjee et al. 2016). According to data of Mukherjee et al. (2016), in Vietnam fishing cat was last camera trapped in 2000 in the Mekong Delta and its occurrence in the Red River Delta has very less possibility.

In Sri Lanka, although the fishing cat has not been observed in north of the Central region, it is found throughout the island, even at high elevations and in both wet and dry zone woods (Miththapala 2004). Fishing cat has also been documented in Wasgomuwa National Park both in the buffer zone area and within the park (Seidensticker 2004 as cited in Miththapala 2004). In a study carried out in Sri Lanka five individuals of fishing cat used highly urbanized area in Colombo at night to avoid daytime human activity (Ratnayaka et al. 2022) which shows that as long as there is water, they can adapt to human presence and exist in and near human settlement (Miththapala 2004). In a study done by Thudugala & Ranawana (2015), fishing cat were recorded in eight photographs in Gnroruwa Forest Reserve after 1200 trapping hours using camera traps. Sundarbans mangrove forest and wetlands in northeast Bangladesh are important appropriate habitats for fishing cat (Rahman 2017). The most secure population of fishing cat may be in Sundarbans, as there have been no any reports of human-fishing cat conflicts from this protected area (Chowdhury et al. 2015). Only one fishing cat was reported between 2010 and 2013 from the dry area of Rangpur division in Bangladesh's far north (Chowdhury et al. 2015). The fishing cat is found primarily in eastern parts of India covering parts of Andhra Pradesh, Odisha, West Bengal and Bihar, in the Himalayan foothills (Uttarakhand, Uttar Pradesh), in the northeast (Arunachal Pradesh and Assam), and in Rajasthan (Janardhanan et al. 2014; Shekhar Palei et al. 2018). Also fishing cat has been recorded from Keoladeo Ghana National Park, Bharatpur (Sunquist & Sunquist 2002), from Ranthambhore Tiger Reserve and it is expected to occur in southern India as there is distribution of fishing cat in Sri Lanka (Janardhanan et al. 2014). In Odisha fishing cat occurs largely along the coastal zone and are widely distributed along the entire coastline (Shekhar Palei et al. 2018). Mishra et al. (2022) revealed that fishing cat can be found in the lowland Terai of Nepal at elevations below 310 meters, which is consistent with similar findings throughout their range. However, fishing cat has been observed at higher elevations in Sri Lanka, reaching up to 1800 meters as reported by Mukherjee et al. (2016).

Fishing cat have been recorded at eight different locations in Nepal's Terai, including three sites outside of protected areas (Sunsari, Bara, and Kapilvastu) and five protected areas (Koshi Tappu Wildlife Reserve, Parsa National Park, Chitwan National Park, Bardia National Park, and Sukhlaphanta National Park) (Dahal & Dahal 2011; Mishra et al. 2021). During a camera trap survey aimed at capturing tigers between 2014 and 2016, the fishing cat was first observed by Poudel et al. (2019) at Parsa National Park, located in the southern central region of Nepal. In Nepal, fishing cat have a discontinuous distribution with five separate clusters, including the KTWR region in the east, the CNP-PNP-Bara district complex in the center, the Jagdishpur region in the west, the BNP region in mid-western, and the ShNP region in the far west with the highest number of fishing cat recording from Sukhlaphanta National Park followed by Koshi Tappu Wildlife Reserve (Mishra et al. 2021). A review by Mishra et al. (2022), revealed that over the period of 2009 to 2020, a total of 312 fishing cat records were detected across 150 locations with the help of different types of evidences like camera trap, carcass record, roadkill and photographic record in different protected areas and not protected areas of Nepal.

2.2 Diet of fishing cat

Although major prey of fishing cat is fish, they also feed on frog, ducks, coots (Sunquist & Sunquist 2002). Fishing cat was also found taking poultries according to the locals in Thailand (Cutter & Cutter 2009). Haque & Vijayan (1993) studied food habitat of fishing cat in Keoladeo National Park, Rajastan and found that birds were the next preferred food of fishing cat after fishes and in small number of scats insects and rodents were also found. Fishing cat was also found feeding on carcass of a cow (Haque 1988). According to Seidensticker (2004), porcupine (*Hystrix indica*) remains was found in fishing cat scats, showing that they supplement their aquatic food with terrestrial species (Miththapala 2004). As the fish become less prevalent in stream systems at higher elevations, fishing cat may typically survive on alternate foods such as crustaceans, cockroaches, rats, and mice when it is difficult for them to get suitable food (Thudugala & Ranawana 2015). Fishing cat have been recorded to prey mostly on fish, followed by aquatic birds and small animals, though they have been known to devour dogs, calves and fawns, and even small children (Sunquist & Sunquist 2004 as cited in Miththapala 2004). The study of feeding ecology of fishing cat has not been carried out properly in Nepal.

2.3 Research on fishing cat in Nepal

Fishing cat was first recorded by Brian Houghton Hodgson in Nepal in 1836 (Chaudhary 2021). In a study carried out by Dahal and Dahal (2011), in Chitwan National Park, two different individuals of fishing cat were captured on the traps baited by the team and were released. The

traps where the fishing cat were captured were placed close to the wetlands created by the Rheu River's overflow in an area of grassland (Dahal & Dahal 2011). Mishra (2013) identified five individuals from three locations in six independent events in Chitwan National Park. Also, the sign surveys revealed a patchy distribution of signs across probable habitats ranging from the Narayani River in the west to Amrite in the northeast and Thori in the southeast (Mishra 2013). A survey done by Poudel et al. (2019) captured four images of fishing cat at three camera trap stations located at the southeastern edge of Parsa National Park. Pandey and Kaspal (2011) conducted a survey in KTWR and its buffer zone and discovered that the fishing cat visits the local fish ponds on a regular basis (Dahal et al. 2015). Taylor et al. (2016) carried out a study from 2011 to 2013, from their study fishing cat occured across most of KTWR and its Buffer Zones. They appeared to be more concentrated along the eastern edge and Buffer Zone than along the drier western side (Taylor et al. 2016). In a 2011 survey, nine distinct individuals of fishing cats were identified three from Prakashpur, three from Madhuwan, and one from Kusaha and in a survey of 2013 thorough intensive study, eleven different cats were discovered, but their real number of individuals was not related due to unclear photos. Mishra et al. (2021) conducted a camera trapping and questionnaire surveys in the winter of 2016 and 2017 in KTWR and its buffer zone. The camera traps used on fish farms in 2016 in the eastern buffer zone recorded at least nine fishing cat individuals going to the surveyed fish ponds, they were captured from 16 out of 20 fish farms of which 9 fish farms were the farms where the conflict between fishing cat and farmers were recorded and 6 were the ponds where no conflict between the fishing cat and farmers were recorded (Mishra et al. 2021). The study suggests that fishing cat visits the fish farms more frequently than the reserve's natural wetlands. Furthermore, it is unclear whether fishing cat visits ponds to prey on fish or other animals. Despite numerous visits by fishing cat to the fish farms, the study found no solid evidence of fishing cat eating fish. Though fishing cat may kill small fish and swallow the entire corpse without leaving a sign, remains of large fish should remain and be recognized (Mishra et al. 2021).

2.4 Major conservation threats to fishing cat

Fishing cat is extremely sensitive to wetlands degradation, which is one of their primary habitats (Thudugala & Ranawana 2015). One of the major threats for fishing cat in Sri Lanka is the snares and noose traps set for wild boar and deer, conflict with humans, road kills, (Miththapala 2018). Fishing cat is also killed for their flesh for medicinal value and are eaten in Hingurangoda/ Kaudulla (de Alwis 1973 as cited in Miththapala 2018). In a study carried out by Phosri et al. (2021) in Thailand reported that 25 out of 80 interviewees, experienced

conflict with fishing cat. The majority of these disputes (18 cases) were raids on poultry, while two cases involved fish depredation and five cases involved damage to fishing equipment (Phosri et al. 2021).

Local population of fishing cat is heavily threatened by a variety of challenges, the most serious of which include road kills, poisoning, hunting pressure, electric fencing and habitat degradation (Thudugala & Ranawana 2015). Road deaths are frequently the result of a significant degree of habitat fragmentation caused by the rapid expansion of the national road network (Thudugala & Ranawana 2015). Chowdhury et al. (2015) carried out a study where they gathered information on fishing cat and human conflict, where they found out that the reasons of death of fishing cat in almost all cases were direct killing, snaring, captures, and subsequent starvation of the cats by the local people. The main reason for direct killing of fishing cat may be because the locals believe Fishing cat prey on their cattle, fisheries, and poultry (Chowdhury et al. 2015). In a study carried out by Chowdhury (2015), fishing cats were killed in 55.82% of the 206 incidents recorded between 2010 and 2021 in the districts of southern West Bengal, where retaliatory killings and road kills were identified as the leading cause of death. The retaliatory killing by farmers may be because of the loss and fragmentation of large croplands by fishing cat as many cultivated lands with dense cover have been found to be used by fishing cat to take refuge (Chakraborty et al. 2022). Because of the competition between humans and other animals for resources like land, water, and fish, these ecosystems are in grave danger. To meet the demands of an increasing human population, several wetlands are being quickly destroyed, split into agricultural land, or both which is the another major threat for fishing cat (Mukherjee et al. 2012). If the aforementioned dangers continue, it has been estimated that the global fishing cat population has decreased by 30% over the past 15 years and would decrease by another 30% in the upcoming decade (Shekhar Palei et al. 2018). Due to a number of factors like poaching, human over-exploitation of local fish stocks, retaliatory killing, wetland shrinkage and conversion, pollution and other conflicts with humans, fishing cat have been facing extinction threats (Timilsina et al. 2021).

A minimum of six fishing cats were killed in retaliation or as roadkill throughout the survey's five-year period from 2012 to 2016 in Koshi Tappu area. Eight of the respondents claimed that cats were caught using traps, guard dogs, and electrocution (by surrounding their fish farm with live electric wire) with retaliation. When they were crossing the highway in Haripur (in the reserve's southeast), two of the respondents reported seeing a fishing cat killed on the road. Respondents recommended creating barriers at fish ponds to restrict fishing cats' movement,

increasing community knowledge, and offering compensation for the fish lost to fishing cat in order to lessen confrontation with communities and potential reprisal (Mishra et al. 2021).

3. MATERIALS AND METHODS

3.1 Study area

The study was carried out on the Koshi Tappu Wildlife Reserve (KTWR), which is located in the Saptari, Sunsari and Udaypur districts of Eastern Nepal extending between 86°55'–87°05'E and 26°34'–26°45'N on the stunning alluvial flood plains of the Saptakoshi river. After the NWPC Act 1973 was strengthened, KTWR was created and made public in July 1976 with the main goal of protecting the last remaining population of wild water buffalo (*Bubalus arnee*) and their habitat. KTWR was added to the Ramsar list on 17 December 1987, when the site's significance was recognized (IUCN 1990). It is now a wetland of worldwide significance.

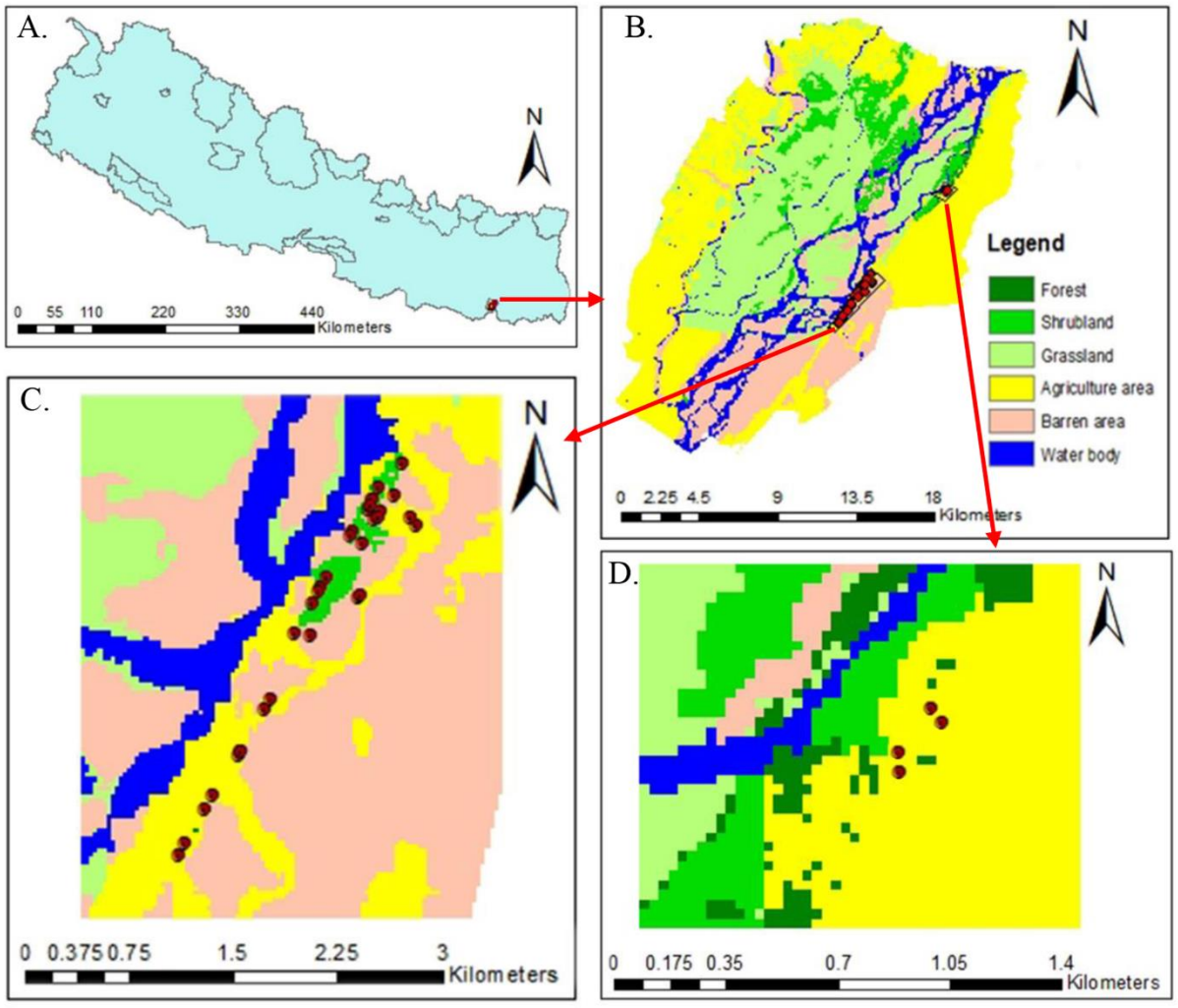


Figure 1. Map of the study area. A- Map of Nepal showing Koshi Tappu Wildlife Reserve (KTWR); B- Map of the KTWR shoing the land use pattern; C- Map of Paschim Kusaha showing sampling localities; and, D- Map of Madhuwan showing sampling localities.

3.1.1. Geology and soil

KTWR is geologically located in a low-lying terrain, and its alluvial deposits are primarily made up of thin fine sand, silt and clay that frequently alternate in varying amounts. Based on the timing of sedimentation and the emergence of plants throughout the following years, the soil's nutrient content varies substantially. The following five different types of soils, namely sandy, sandy loam, loam, sandy clay loam, and clay loam, were described in the village surrounding KTWR area during a reconnaissance soil survey (Pradhan et al. 1969).

3.1.2. Climate

The KTWR is sub-tropical climatic type and consists of three distinct seasons- summer, winter and monsoon. Summer is quite hot and has little precipitation (February through May). Temperatures under shade might get to 40°C. Beginning in late May or early June and lasting until September, the Monsoon brings with it strong, regular rains. Although July is when it rains the most, the entire season is characterized by high temperatures and relative humidity. Clear skies and a moderate temperature characterize Winter (October through January). However, it can still get extremely cold (KTWR 2018).

3.1.3. Topography

As it is nourished by seven major Rivers- Arun, Tamor, Likhu, Tamakoshi, Indrawati, Dudhkoshi and Sunkoshi Rivers. The KTWR is basically a flat, rectangular area that is spread out in the flood plain of the koshi River. To retain the river's water and control monsoon floods, affluent bunds 5–7 meters high were built on both its eastern and western sides. Crated stone spurs have been used to supplement afflux bunds. The eastern afflux bund stretches 35 kilometers from the barrage to Chakarghatti. The western afflux bund is shorter, only spanning 8.5 kilometers upto Pathari. Both bunds on either side of the river effectively limit the river's spread to a maximum width of 10 km (DNPWC 2009).

3.1.4. Flora

The vegetation of the reserve is primarily made up of mixed deciduous riverine forest, mixed *Dalbergia sissoo*/*Acacia catechu* woodland, meadows, and marshy vegetation. According to Dahlal et al. (2009), the vegetation in the eastern side of the Koshi was divided into four main types: Woody vegetation, tall grassland, dry grassland, and woody mixed. *Acacia catechu, Bombax ceiba,* and *Dablergia sissoo* are three species that predominate in the relatively open, degraded forests that make up the KTWR (Dahal et al. 2009).

3.1.5. Fauna

The last remaining population of wild water buffalo (*Bubalus arnee)* and their environment were the main reasons the reserve was created. Wild boars (*Sus scrofa*) are widespread. Nilgai (*Boselaphus tragocamelus*) and spotted dear (*Axis axis)* are still found in KTWR. Small carnivores like fishing cat (*Prionailurus viverrinus),* jungle cat (*Felis chaus),* Indian fox (*Vulpus vulpes)* and jackal (*Canis aureus*) also found in Koshi Tappu Wildlife Reserve (Sah 1997). And in river small population of *Platanista gangetica* is found.There have been reports of the critically endangered gharial crocodile (*Gavialis gangeticus*) in the Sapta-Koshi River. The Koshi River has also been linked to sightings of the endangered freshwater marsh crocodile (*Crocodylis palustris*) (Shrestha 1994). There are also the garden lizard (*Calotes versicolor*), roofed turtle (*Kachuga kachuga*), and monitor lizard (*Varanus bengalensis)* to be found (Shakya 1994). Also, the world's 63 bird families are represented by a total of 526 bird species, including both migratory and resident species in KTWR. Out of 39 species of globally threatened species in Nepal, 26 species have been recorded at KTWR (KTWR 2018).

3.2 Materials used

Ziploc bag
Aluminum foil
Blotting paper
Weighing machine
Stationaries
GPS
Gloves
Spatula
Microscope
Ethanol
Nailpolish
Diethyl ether
Distilled water
Acetone

3.3 Field and laboratory methods

3.3.1 Survey method

A preliminary survey was conducted to identify various pathways and trails in which signs of the presence of fishing cats, such as footprints (pugmarks) and droppings (scats), were

observed. Based on these initial findings, line transects were established, and further surveys were carried out along these transects to collect samples of fishing cat scats within the buffer zone of KTWR. The survey focused on areas along roads and pond edges, where the movement of fishing cats was particularly active. Scat samples were collected from a range of locations, including paths used by both humans and livestock, roads, and agricultural lands.

3.3.2 Scat collection and preservation

Scat collection of fishing cat was done for 4 weeks in 2022 in the months of February, October and November in the eastern side of KTWR. Total 16 transects of each 500m were made along the roads and pond edge (8 along the edge of ponds of buffer zone and 8 along the road of core forest) and surveyed on 10m distance on either side of the transect. The number of scats that were located in each transect were noted and the distance to forest and water source from the midpoint of transect was measured to find the relation between the response variable i.e., number of scat and the predictor variable i.e., distance to forest and water source. During the collection of scats, the following things were recorded: date and time of collection, location of scats. Scats were identified on the basis of its shape, size, odour, color, contents and presence of pugmark within the periphery. Collected scats were picked with hand using gloves and kept inside the Ziploc bags. Labelling was done in the bags containing samples. The collected scats were sundried to avoid the fungal growth then sealed into different Ziploc bags again.

3.3.3 Laboratory analysis

Separation of different content in scats

The scats were washed and quantified following the procedure given by Reynold and Aebischer (1991). Dried scats were soaked in hot water until they get wet and washed through a tap water in two layered sieve of mesh size 0.5 mm and 0.1 mm. After that the undigested prey remains present in the scats were transferred into a Petri dish with the label of different sample numbers. Once the washing of scat in sieve was complete, the contents of the scats were allowed to dry naturally at room temperature using blotting paper, before being sun dried in the direct sunlight until they were completely dry. Finally, the dried scats were carefully sealed into individual Ziplock bags to ensure their preservation for the future identification purposes.

Sampling contents from scat samples

Scat samples were analyzed using hand picking method and microscope. The dehydrated contents that were carefully stored in Ziploc bags were used for further analysis. These contents included various remnants of prey, such as the hair and bones of mammals, the scales and bones

of fish, the feathers, nails and bones of birds, as well as the remains of reptiles, amphibians, insects, plastic, stones and vegetable matter. To identify the types of prey consumed by the fishing cat, contents from each sample were carefully separated and the constituent parts were weighted for quantitative analysis.

Preparation of cuticular slides

For the preparation of cuticular slides, 5 hair samples from each sample were used and carefully dipped in solution consisting of 1:1 ratio of ethyl alcohol and diethyl ether for 30 minutes. After this the hair samples were allowed to dry using blotting paper. Then a thin layer of transparent nail polish was painted on a glass slide and a tuft of hair was placed the polished surface. It was then allowed to dry. After the slides were totally dried the hairs were removed from the slide. The imprints of hair on the slides were observed under the microscope and the photographs were taken.

Medullar slides

For the preparation of medullar slide, the hair samples plucked from the cuticle slides were used. To prepare the slide for medullar analysis the hairs were carefully dipped in the acetone solution for 20 minutes. Then the hairs were dried and placed on the slide having paraffin oil as mounting medium. The medullary structure of the hairs was observed under microscope and photographs were taken.

Reference samples

To create the reference hair slides of various prey species, hair sample of known species were collected from the surrounding area and from the Museum of the Central Department of Zoology. During the preparation of reference sample, guard hairs of species were uses for preparation of slide as there are largest, straight and most robust of all hair types. A typical guard hair comprises a narrow proximal shaft with no constrictions, followed by a large flattened shield region that narrows into a fine tip (Day 1966). The cuticular and medullary slide preparation of the reference hair sample were analyzed using the same procedure mentioned above.

The cuticular and medullar patterns of the prey hairs present on the scat were then compared with the reference samples prepared in the lab of Central Department of Zoology, Tribhuvan University. Various reference samples were also searched and were compared with the hairs of prey. The reference hair sample were used to identify the prey item in the diet of fishing cat by

comparing with the hair samples found in the scat. The cuticular and medullar sides of prey hair samples were compared to reference hair samples prepared at the CDZ lab and reference samples obtained from secondary sources (Blew 1988; Cornally et al. 2016; Day 1966; De et al. 1998; Kamalakannan 2017; Lee et al. 2014; Menike et al. 2012; Niroshini & Meegaskumbura 2015).

To identify the fish present in the wetlands, I consulted with the pond owner and compiled a list of the fish species found in the area. After obtaining the fish scales in the scat, I identified the scale type present on the scat sample where the presence of two types of scales - Cycloid scales and Ctenoid scales were found. The identification of fish was based on the type of scales. To confirm the scat samples of fishing cat the scat samples were analyzed in the lab. To support the identification of the hairs of fishing cat, reference literature from Singh et al. (2020) and Cutter (2015) was consulted, external hair morphology was compared with the literature of Cutter (2015), while the cuticular and medullar slides of hair pattern were analyzed in reference to Singh et al. (2020). Also, the hair samples were compared with the reference literature on hair sample of golden jackal given by Arpacık (2021) and Srinivas & Jhala (2021). This comparative analysis aimed to ascertain whether the scat samples belonged solely to the fishing cat or golden jackal too. It confirmed that none of the collected scats contained the hairs from golden jackal, another carnivore distributed in the same area.

3.4 Data analysis

3.4.1 Scat analysis

The prey remains in the scat were expressed in terms of frequency of occurrence and percentage of occurrence for diet study of fishing cat. The frequency of occurrence was calculated as;

$$\text{Frequency of occurrence} = n/N \times 100 \quad \ldots\ldots\ldots \text{(i)}$$

Where n is the number of samples that contain an item and N is the total number of scat sample.

The percentage of occurrence was calculated as;

$$\text{Percentage of occurrence} = n/N \times 100 \ldots\ldots\ldots \text{(ii)}$$

Where n is the total frequency of a particular item and N is the sum of frequency of all items.

3.4.2 Niche breadth

Niche breadth was calculated using Levins' index:

$B = 1 / (\Sigma p_i^2)$

where, p_i is the percentage of occurrence of a prey type.

This index was standardized to a scale ranging from 0 (generalist, when prey items are consumed in equal proportions) to 1 (specialized, when few prey categories are eaten in greater frequency, while most are eaten in lower frequency) by using the formula:

$B_{sta} = (B-1) / (n-1)$

where, B is Levins' index and n is the total number of prey types consumed.

3.5 Statistical analysis

Pirates' plot was made to find the abundance of scat accumulation in various places i.e., the distance from water bodies, distance from road and distance from core forest which is helpful in determining the abundance of scat in those places.

The data obtained from transect survey was used to perform Simple linear regression which can be useful to understand the relation between scat samples and environmental variables i.e distance to water and forest from the transect.

One-way ANOVA was performed in excel to test the significant difference between all the prey items in the scat preferred by the fishing cat i.e., mammal, fish, herpetofauna, birds and vegetable matter by fishing cat. Also, the prey composition of fishing cat was plotted in pie chart.

4. RESULTS

Total 36 scats of fishing cat were collected in the KTWR. The majority of fishing cat scats (69.4%) were found on bare sandy land that was higher than the surrounding region, such as the pond edge or river bank with the highest height. Scats were found less in core forest road compared to that of buffer zone. Pugmarks of fishing cat were also frequently (n =5) observed near scats in Paschim Kusaha. Five scats were found around the ponds of Koshi camp in Madhuwan and 31 were found in Paschim Kusaha. Most of the scats were collected from the pond edge (69.4%), from the river bank, wetland area and few (30.6%) from the Chatara Road.

4.1 Distribution of scats in the study area

The abundance of scat within each distance range for each variable (road, water, and forest) is shown in Figure 1. It shows that the scats tend to be more concentrated in area closer to the water bodies with less distance from water sources which suggests that this variable is important predictor of scat location. Similarly, distance from forest shows a wider distribution which shows that this variable has less impact on the scat location.

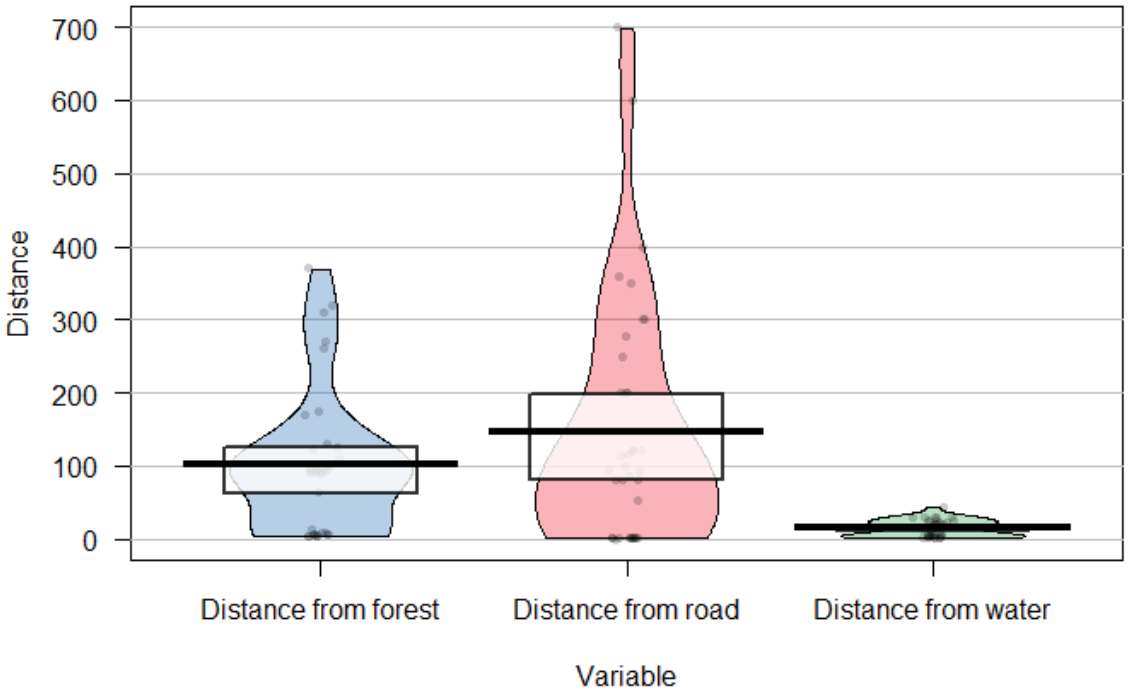


Figure 2. Pirates plot showing scat abundance in different habitats in terms of distance from nearest road, forest and water bodies.

The result of simple linear regression shows that the predictor variable i.e., distance to water has significant effect on the response variable i.e., the number of scat samples of fishing cat whereas another predictor variable i.e., distance to forest doesn't have significant effect on response variable.

Table 1. Table showing results of simple linear regression

Variables	**Estimate**	**Std error**	**t value**	**p**
intercept	4.27	0.92	4.619	0.0005***
DTW	-0.059	0.02	-2.485	0.02*
DTF	-0.002	0.004	-0.587	0.56

Residual standard error: 1.392 on 12 degrees of freedom; Multiple R-squared: 0.3419, Adjusted R-squared: 0.2322; F-statistic: 3.117 on 2 and 12 DF, p = 0.08124

4.2 Diet composition of fishing cat

4.2.1 Frequency and percentage of occurrence of prey items

Frequency of occurrence and Percentage of occurrence were calculated on class level of prey species. The prey items were categorized into different groups such as mammals, fish, birds, reptiles, insects, plastic, vegetable matter, amphibians, and stone.

Vegetable matter and mammals were the most common prey types ingested by fishing cats. This demonstrates that fishing cat's main source of food is mammalian prey (Table 2). The prey items that are less frequently consumed are insects, reptiles, and amphibians. This indicates that these prey items are not an important part of fishing cat's diet.

Table 2. Diet composition of fishing cat showing Frequency of Occurrence (F.O) and Percentage of Occurrence (P.O)

S. No.	Prey items	F. O	P. O
1	Mammal	94.4	26.3
2	Fish	52.8	14.7
3	Birds	44.4	12.4
4	Reptiles	16.7	4.6
5	Insects	27.8	7.7
6	Plastic	8.3	2.3
7	Grass	97.2	27.1
8	Amphibian	5.5	1.5
9	Stone	11.1	3.1

Based on the analysis of 36 scat samples, it was observed that 10 samples had cycloid scales while 5 samples had ctenoid scales. Here is the list of fishes found in the ponds of KTWR according to the pond owner (Table 3).

Table 3. Fishes found in ponds of KTWR.

S. No.	Name of fish species
1	*Hypophthalmichthys molitrix*
2	*Labeo calbasu*
3	*Ctenopharyngodon idella*
4	*Cyprinus carpio*
5	*Catla catla*
6	*Hypophthalmichthys nobilis*
7	*Oreochromis niloticus*
8	*Channa striata*
9	*Gudusia variegate*
10	*Colisa fasciata*
11	*Puntius sophore*
12	*Channa punctata*
13	*Cirrhinus mirgala*
14	*Puntius conconius*

4.2.2 Niche breadth

The niche breadth based on prey identified to class level showed fishing cat as the generalist (B_{sta} = 0.53) (Table 4).

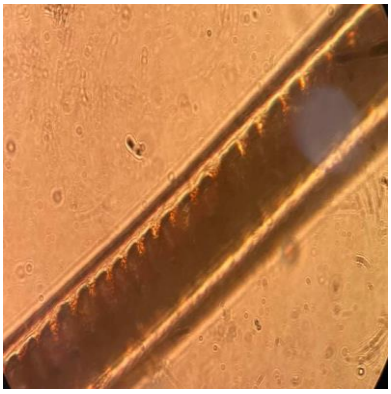
Table 4. Table showing niche breadth

Prey	Frequency	p	p^2
Mammal	34	0.2635	0.0694
Fish	19	0.1472	0.0216
Birds	16	0.1240	0.0153
Reptiles	6	0.0465	0.0021
Insects	10	0.0775	0.0060
Plastic	3	0.0232	0.0005
Grass	35	0.2713	0.0736

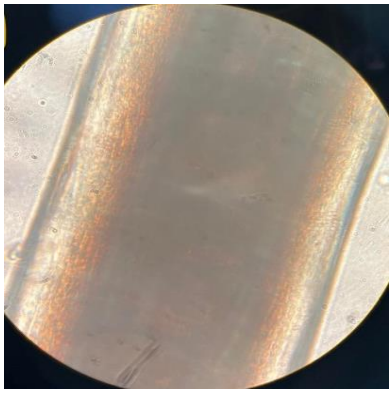
Amphibian	2	0.0155	0.0002
Stone	4	0.0310	0.0009
Total	129		0.1900
Levins niche breadth(B)			5.2611
B-1			4.2611
N-1			8
Standard Niche Breadth			0.5326

4.2.3 Prey composition in fishing cat scats

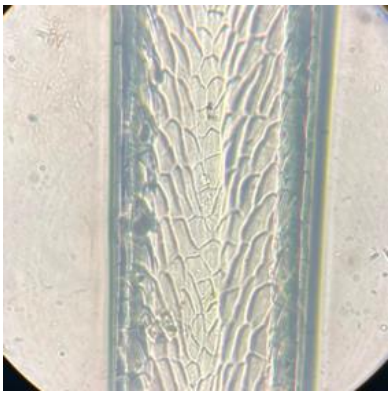
It was found that the fishing cat exhibits a clear preference for species of the order Rodentia over all other small mammals. Although the order Lagomorpha and Soricomorpha were also identified in their diet, the genus was not determined. The fishing cat showed a clear preference among the Muridae species, followed by Sciuridae. When considering the Muridae family, the fishing cat exhibits a particular affinity for species within the *Bandicota*, *Mus*, and *Rattus* genera. Furthermore, the examination of prey hair samples revealed similarities to members of the Sciuridae family i.e., Five-striped palm squirrel. Also, some of the hair slide matched with the hair reference of mongoose.



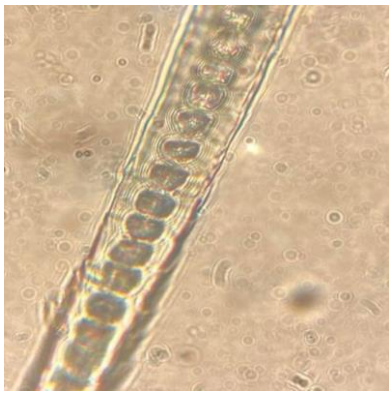
Hair of sciuridae family



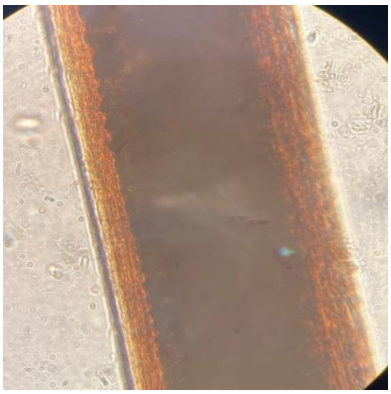
Hair of *Rattus* spp.



Hair of *Rattus* spp.



Hair of lagomorph



Hair of mongoose

Figure 3. Some representative slides of hairs of prey species of fishing cat

The analysis of the weight of different contents found in the scat of the fishing cat reveals some interesting findings about its diet. The data shows that mammals contribute significantly to the scat of the fishing cat, with the weight of mammal bones being the highest, followed by fish bones. This indicates that these prey items make up a significant part of the fishing cat's diet. Also, the vegetable matter was present in almost all of the scats.

In contrast, the contribution of insects and herpetofauna to the fishing cat's diet was found to be relatively low. The presence of stones in its diet was quite unusual, as it is unlikely that stones could be eaten by mistake.

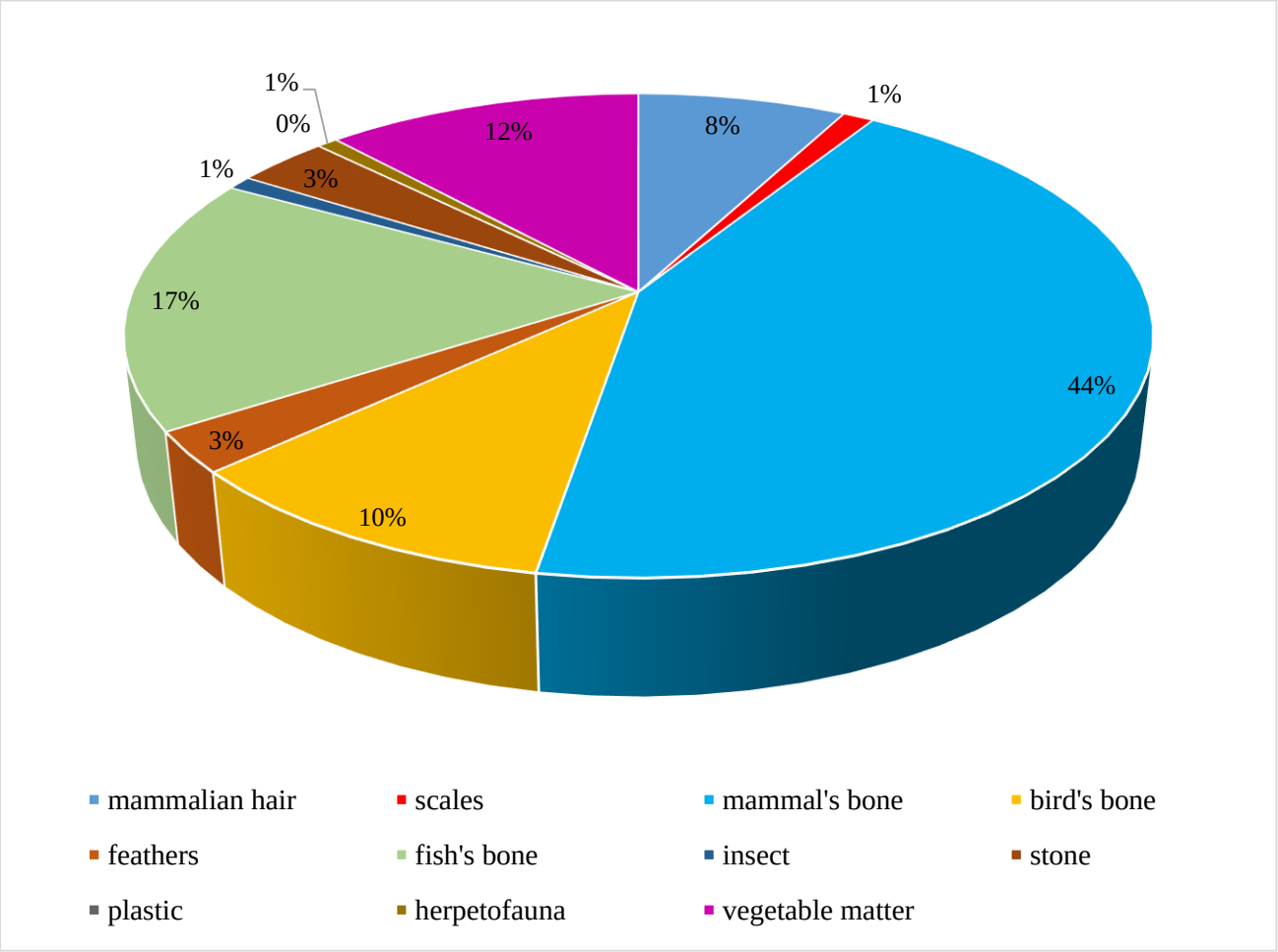


Figure 4. Pie chart showing different composition of prey items in the scat.

The proportion of plastic found in the scat was very low, indicating that it may have been ingested by mistake or that the prey consumed by the fishing cat may have ingested it, leading to it being present in the cat's diet. The quantification of scat contents provides important insights into the dietary habits of the fishing cat and offers valuable insights on the different prey items consumed by the fishing cat.

Result of ANOVA indicated for a significant difference between the prey species ($F = 21.7$; $df = 4,175$; $p<0.05$).

Table 5. Table showing prey composition and their weight in scat.

Prey	Composition	Weight in scat (gm)
Fish	Scales	6.7
	Bone	
Bird	Feathers	4.8
	Claws	
	Bones	
Small mammals	Hair	18.9
	Bone	
	Teeth	
	Nails	
Insects	Different body parts	0.33
Vegetable matter	Leaves	4.3
	Paddy	
	Potato peel	
	Typha elephantina	
	Thorny spikes	
Herpetofauna	Scales	0.28
	Bones	

5. DISCUSSION

5.1 Distribution of scats of fishing cat

The abundance of scat was found near the water bodies than the road or in core forest. The abundance of scats detected along the pond edge or near the water bodies suggests that fishing cat regularly hunt in close proximity to water bodies. Additionally, the eastern area of the reserve (Sunsari district) was noted to be less impacted by overgrazing when compared to the western area (Saptari district). Around 1-2 km towards the west of main river channel of a cluster of islands are located, characterized by natural vegetation, such as long grassland, swampland, and forest, provides an ideal habitat for fishing cats. These findings are consistent with previous study, which concluded that the eastern section of the reserve was the preferred location for fishing cats (Taylor et al. 2016). Also, the results of simple linear regression showed that as the distance to water increases, the number of scats of cat tends to decrease.

5.2 Diet composition of fishing cat

In order to accurately predict the effects of predators on the dynamics of prey populations, it is crucial to have a comprehensive understanding of their dietary habits. As such, the study of species' diet and feeding behaviors is widely explored. However, the investigation of the diet of smaller feline species can be particularly challenging due to their smaller home ranges compared to larger felines. This study aimed to address this issue by investigating the dietary preferences of the fishing cat, a small carnivorous species found in South and Southeast Asia. The findings revealed that fishing cats are opportunistic predators, a characteristic which was also previously noted by Cutter (2015) in his study.

To investigate the dietary habits of the fishing cat, direct observation in the field was not feasible, and therefore this study was conducted through scat analysis. The hand separation method was utilized to differentiate and identify various prey items from the scat, and their composition was analyzed through micro histological analysis of prey hair cuticular and medullar slides. In line with previous research, the results of this study demonstrated that the primary sources of prey in the fishing cat's diet include rodents, fish, birds, insects, and reptiles (Haque & Vijayan 1993; Harika et al. 2023). In this study, rodents were found to be the major diet of fishing cat which don’t align with previous studies which stated fish to be the main prey and have major contribution (Cutter 2015; Haque & Vijayan 1993). This may be due to the fact that fishing cat showed a high temporal overlap with rodents that means the rodents and the fishing cat were active at the same time (Shankar et al. 2020).

The value of niche breadth determines either the species is specific or generalist i.e., if the value of niche breadth is near 0, the species is specific and if the value of niche breadth is near 1 then the species is generalist. In my study, the niche breadth value for the fishing cat was found to be 0.53, which suggests that the species is a moderate generalist in its dietary habits. With a niche breadth of 0.53, the species has some dietary specialization but is also able to consume a moderate range of prey items. Also, in previous studies fishing cat was identified as the obligate generalist which eat live or dead prey (Cutter 2015; Ratnayaka et al. 2023). It should be noted that the niche breadth value is based on the identified prey to class level, and a detailed analysis of the prey to species level could result in a different niche breadth value.

Some of the hair matches to that of mongoose through which we can conclude that mongoose is also eaten by fishing cat. Recent study of Harika et al. (2023) also showed the similar result.

This study found that plastic was also present in the feces of fishing cat. This aligns with a previous study conducted by Ratnayaka et al. (2023) where they unexpectedly found macroscopic plastic debris in some of the samples while separating the remains of prey from individual fecal samples. This may suggest that the transfer of plastics through the food chain occurred, with fishing cat consuming prey that had been contaminated with plastic. It is worth noting that felids, including fishing cat, are obligate generalist carnivores and consume only live or recently deceased prey and do not ingest waste (Ratnayaka et al. 2023).

The major composition of prey items in the diet of fishing cat discovered during my research were fishbones, rodent hair, bird nails, mongoose hair, bird feathers, fish ctenoid scales, plants, plastics, and unidentifiable prey items. This lines up with the previous study that have suggested the same prey items to be present in the scat of fishing cat (Harika et al. 2023). Fishing cat has been known to prey on small mammals such as rodents, birds, and fish (Sunquist & Sunquist 2002) and the presence of mammalian hairs and bones, fish's scales and bones and bird's feathers and bones in the scat supports this. The presence of amphibian in the scat in relatively low proportion lines up with (Sunquist & Sunquist 2002) where one student saw the cat catching a frog and consuming it while waiting for an opportunity to hunt for fish along the edge of a small canal. This observation provides further evidence that the fishing cat is an opportunistic predator. Our study found that the contribution of insects and reptiles to the cat's diet was relatively low. This finding is consistent with a previous study conducted by (Haque & Vijayan 1993; Cutter 2015), which also reported a relatively small number of insects and reptiles in the diet of the fishing cat. Vegetable matter was also found in high amounts,

suggesting that the fishing cat may eat plants in addition to catching fish. Paddy was also present, which may have been ingested while the cat was in the paddy field to catch rodents. Also, the findings of our study regarding the presence of grass in large amount in the diet of the fishing cat are consistent with the results of a previous study conducted by Haque and Vijayan in 1993. Their study also revealed that the fishing cat feeds on grasses, which are commonly found in aquatic areas, and that they have a preference for certain types of grasses.

The quantification of scat contents provides valuable insights on the different prey items consumed by the fishing cat, which can be useful in developing conservation strategies to protect the species and their habitats.

The findings of my study have revealed that fishing cat primarily rely on mammals rather than fish. This knowledge could be useful in resolving the ongoing conflicts between fish farmers and fishing cat. Additionally, it is worth noting that birds constitute a relatively small portion of the fishing cat's diet, which is important information for farmers in KTWR who have reported incidents of fishing cat stealing their poultry. As a result, the findings of this study may be useful in developing effective methods to reduce disputes and enhance coexistence between fishing cat and local communities.

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The collection of 36 scats and observation of pugmarks helped to determine the abundance and distribution of the fishing cats in the Koshi Tappu Wildlife Reserve. The scats were mainly found on bare sandy areas, such as the pond edge or river bank with the highest height. It provides important details on the diet such as fish not being the major preferred prey of fishing cat, presence of plastic in their diet and mammal as the preferred prey of fishing cat. Using hair analysis technique on the scat samples it was found that that the fishing cat clearly shows preference for species of the order Rodentia over all other small mammals, with particular preference for species within the *Bandicota*, *Mus*, and *Rattus* genera. The presence of plastic in their diet highlights the importance of conservation efforts to protect the habitats of fishing cat. Overall, the findings of this study can contribute to the development of effective conservation strategies for the protection of this threatened species and its ecosystem.

6.2 Recommendations

To ensure the long-term survival of fishing cat, several actions need to be taken. The following key points highlight the necessary steps that can be taken for the conservation of fishing cats:

i. Further research on the diet of fishing cat is crucial to understand the prey species to the species level.
ii. Non-degradable items such as plastic should not be allowed to pollute the habitat of fishing cat, as this can adversely affect their diet.
iii. A strong conservation strategy is essential to conserve and protect fishing cat and their co-existing species.

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APPENDICES

Appendix 1: Data sheet used for scat collection

Name of data collector:

Study area:

Date:

Transect no:

Weather:

Sample No.	Gps		Time	Distance from water	Distance from road	Distance from forest
	Latitude	Longitude				

Appendix 2: Research permission letter from the Department of National Parks and Wildlife Conservation, Nepal

नेपाल सरकार
वन तथा वातावरण मन्त्रालय
राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
(................................ शाखा)

फोन नं. : ४२२०८५० ४२२०९१२ ४२२७९२६
फ्याक्स नं. ४२२७६७५

पो. ब. नं.:- ८६०
बबरमहल, काठमाडौं
Email: info@dnpwc.gov.np
http://www.dnpwc.gov.np

पत्र संख्या :- ०७८/७९
चलानी नं :- ०७८/७९ इको १८२ १०८६

मिति: २०७८/१०/१०

विषय: अध्ययन अनुमति सम्बन्धमा ।

श्री कोशी टप्पु वन्यजन्तु आरक्ष, पश्चिम कुशाह, सुनसरी ।

प्रस्तुत विषयमा तहाँ संरक्षित क्षेत्रमा निम्नानुसारको अध्ययन अनुसन्धानको अनुमति प्रदान गरिएको व्यहोरा आदेशानुसार अनुरोध छ ।

अनुसन्धानकर्ताको नाम	Beenu Khadka		फोन नं. ९८६१०३१८८५
ठेगाना	Kalika 7, Chitwan	इमेल bnu.khadka4141@gmail.com	
सम्बद्ध संस्था	Central Department of Zoology, Kirtipur, Kathmandu		
अनुसन्धानको प्रकृती	व्यक्तिगत		
पद	विद्यार्थी		
अनुसन्धानको तह	स्नातकोत्तर		
अनुसन्धानको शिर्षक	Trophic Niche Overlap between Fishing Cats and Jungle Cats in Koshi Tappu Wildlife Reserve, Nepal		
अनुसन्धान विधि	Scat collection and Diet analysis	नमुना संकलन गर्ने	नमुना परिक्षण कहाँ गर्ने त्रि.वि को प्राणी शास्त्र केन्द्रीय विभागको प्रयोगशालामा
अनुसन्धानको अवधि	२५ जनवरी २०२२ देखि ३० अप्रील २०२२ सम्म		

शर्तः

१.अनुसन्धानकर्ताले राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण ऐन २०२९ र नियमावली २०३० तथा मातहतका सबै नियमावलीहरुको पूर्ण पालना गर्नु पर्नेछ ।

२.अध्ययन गर्दा सम्बन्धित संरक्षण क्षेत्र कार्यालयसंग समन्वय गरी गर्नु पर्नेछ ।

३.अनुसन्धानकर्ताले आफ्नो अनुसन्धानको प्रस्ताव सम्बन्धित संरक्षित क्षेत्र कार्यालयमा समेत पेश गर्नु पर्नेछ ।

४.अनुसन्धानकर्ताले अनुसन्धान समाप्त भएपछि प्राप्त तथ्यांक, एक प्रति कागजी प्रतिवेदन र एक प्रति इलेक्ट्रोनिक प्रतिवेदन यस विभाग र सम्बन्धित संरक्षित क्षेत्र कार्यालयमा बुझाउनु पर्नेछ ।

५.अनुसन्धानकर्ताले नतिजाहरु प्रकाशित गर्दा अनुसन्धानमा संलग्न यस विभाग र अन्तरगतका कर्मचारीको योगदानको आधारमा सहलेखकको रुपमा समावेश गराउनु पर्नेछ ।

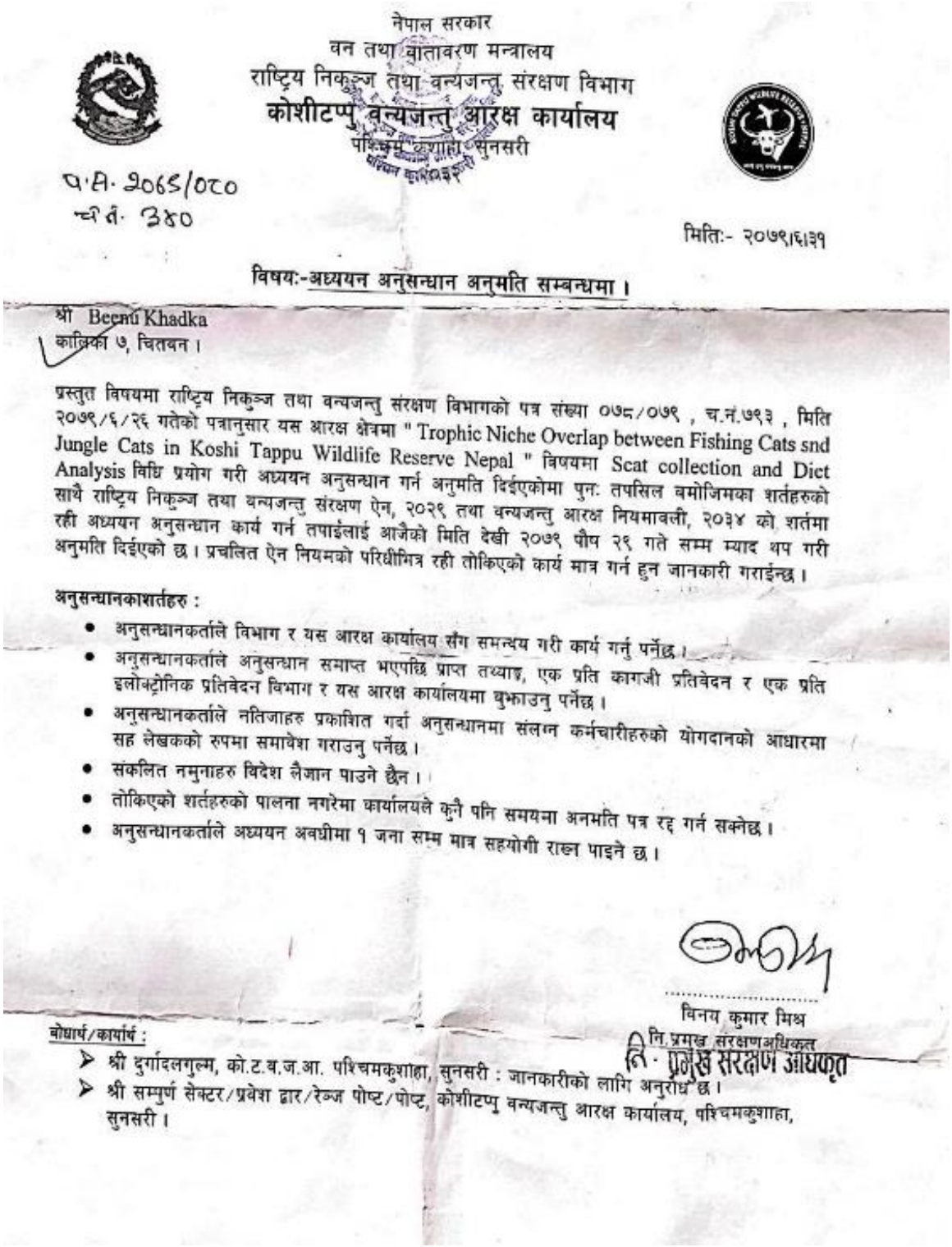
६.संकलित नमुना विदेश लैजान पाईने छैन ।

७.तोकिएका शर्तहरुको पालना नगरेमा विभागले कुनै पनि समयमा अनुमति पत्र रद्द गर्न सक्नेछ ।

अशिम थापा
(सहायक इकोलोजिष्ट)

बोधार्थः
श्री Beenu Khadka: सम्बन्धित संरक्षित क्षेत्र कार्यालयसंग समन्वय गरी अध्ययन अनुसन्धान गर्नु भई अध्ययन समाप्त भएपछि प्राप्त तथ्यांक र एक प्रति प्रतिवेदन यस विभाग र सम्बन्धित संरक्षित क्षेत्र कार्यालमा बुझाउनु हुन अनुरोध छ ।

Appendix 3: Research permission letter from the Koshi Tappu Wildlife Reserve, Nepal



नेपाल सरकार
वन तथा वातावरण मन्त्रालय
राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
कोशीटप्पु वन्यजन्तु आरक्ष कार्यालय
पश्चिम कुशाहा, सुनसरी

प.आ. २०६९/०८०
च.नं. ३४०

मितिः- २०७९।६।३१

विषयः-अध्ययन अनुसन्धान अनुमति सम्बन्धमा ।

श्री Beenu Khadka
काठमाडौं ७, चितवन ।

प्रस्तुत विषयमा राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभागको पत्र संख्या ०७८/०७९ , च.नं.७९३ , मिति २०७९/६/२६ गतेको पत्रानुसार यस आरक्ष क्षेत्रमा " Trophic Niche Overlap between Fishing Cats snd Jungle Cats in Koshi Tappu Wildlife Reserve Nepal " विषयमा Scat collection and Diet Analysis विधि प्रयोग गरी अध्ययन अनुसन्धान गर्न अनुमति दिईएकोमा पुनः तपसिल बमोजिमका शर्तहरुको साथै राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण ऐन, २०२९ तथा वन्यजन्तु आरक्ष नियमावली, २०३४ को शर्तमा रही अध्ययन अनुसन्धान कार्य गर्न तपाईलाई आजैको मिति देखी २०७९ पौष २९ गते सम्म म्याद थप गरी अनुमति दिईएको छ । प्रचलित ऐन नियमको परिधीभित्र रही तोकिएको कार्य मात्र गर्न हुन जानकारी गराईन्छ ।

अनुसन्धानकाशर्तहरु :

- अनुसन्धानकर्ताले विभाग र यस आरक्ष कार्यालय सँग समन्वय गरी कार्य गर्नु पर्नेछ ।
- अनुसन्धानकर्ताले अनुसन्धान समाप्त भएपछि प्राप्त तथ्याङ्क, एक प्रति कागजी प्रतिवेदन र एक प्रति इलोक्ट्रोनिक प्रतिवेदन विभाग र यस आरक्ष कार्यालयमा बुझाउनु पर्नेछ ।
- अनुसन्धानकर्ताले नतिजाहरु प्रकाशित गर्दा अनुसन्धानमा संलग्न कर्मचारीहरुको योगदानको आधारमा सह लेखकको रुपमा समावेश गराउनु पर्नेछ ।
- संकलित नमुनाहरु विदेश लैजान पाउने छैन ।
- तोकिएको शर्तहरुको पालना नगरेमा कार्यालयले कुनै पनि समयमा अनमति पत्र रद्द गर्न सक्नेछ ।
- अनुसन्धानकर्ताले अध्ययन अवधीमा १ जना सम्म मात्र सहयोगी राख्न पाइने छ ।

विनय कुमार मिश्र
नि. प्रमुख संरक्षण अधिकृत

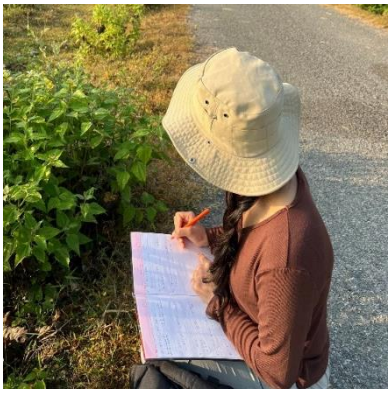
बोधार्थ/कार्यार्थ :

- श्री दुर्गादलगुल्म, को.ट.व.ज.आ. पश्चिमकुशाहा, सुनसरी : जानकारीको लागि अनुरोध छ ।
- श्री सम्पुर्ण सेक्टर/प्रवेश द्वार/रेञ्ज पोष्ट/पोष्ट, कोशीटप्पु वन्यजन्तु आरक्ष कार्यालय, पश्चिमकुशाहा, सुनसरी ।

Appendix 4: Photographs from the field work and laboratory analysis

Photograph 1. Pugmarks of fishing cat

Photograph 2. Scat of fishing cat



Photograph 3. Researcher in the field

Photograph 4. Fishing cat in museum of KTWR

Photograph 5. Left out fish by some predator

Photograph 6. Suspected kitten of fishing cat rescued by KTWR team

Photograph 7. Researcher collecting scat in Ziplock bag

Photograph 8. Fisherman fishing in wetland

Photograph 9. Researcher checking the scat contents

Photograph 10. Soaking scat sample in lab

Photograph 11. Researcher washing scat

Photograph 12. Weighing prey items in scat

Photograph 13. Mammal's hair and bones on scat

Photograph 14. Insect's remain in the scat

Photograph 14. Contents of scat sample

Photograph 16. Plastic retrieved from the scat sample