Final Evaluation Report

Your Details	
Full Name	Varsha Rai
Project Title	Conservation campaign and bat survey along the Tamakoshi River Corridor, Nepal with special focus on Hodgson's Bat *Myotis formosus*
Application ID	34930-1
Date of this Report	August 2023

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Document bat species diversity along Tamakoshi River Corridor				During this project, we could conduct four season survey and record 14 species. However, we could not record our focus species Hodgson's Bat *Myotis formosus*. There are only few accessible caves in the Tamakoshi River corridor. On top of that unfavourable weather affected our field work due to which several potential bat roost and mist-netting sites could not be surveyed. Our focus species *M. formosus* is a foliage and cave roosting species, and not much is known about its ecology. This suggests that the next study should extend the search area looking for potential cave roosts for *M. formosus* and other bat species higher uphill above 2000 m asl. During this survey, a new bat species to Nepal, *Vespertilio* sp. has been recorded and also new locality records for several bat species has been documented.
Record bat echolocation calls to contribute to bat call libraries				We recorded echolocation calls of all 12 captured bat species in handheld, hand release or inside roost conditions and in flight also for some of these species. These records will be contributed to the Nepal Bat Call Library and a Global Bat Call Library, the ChiroVox.
Engagement of locals in bat conservation				A significant positive change was seen in the level of knowledge and perception of locals through pre- and post-project scheduled surveys. Nine out of ten school bat clubs were formed that conducted at least one awareness activity such as essay, poem, speech competition and poster information sharing program in their respective schools. The club members shared about the importance of bats with friends and family. Similarly, four of five youth bat clubs were also formed. But members of only one youth club could be

				engaged in evening bat surveys due to their time unavailability and unfavourable weather. Also, the number of members in a bat club also varied as per the interest of students and youths, and most of the youths have been migrating from villages.

2. Describe the three most important outcomes of your project.

Outcome 1) Altogether 14 species of bats documented through four seasons field survey

Bats were surveyed in 35 different sampling sites along the Tamakoshi river corridor in Dolakha and Ramechhap districts. Different types of habitats/roosts included caves, trees, manmade structures and water sources (Figures 2, 3 & 4). However, bats were captured from 15 of those sites, while low to moderate bat activity was observed from the remaining sites. Mist netting was done in most of the sites, and we located five bat roosts (Table 1). Survey was highly affected by unfavourable weather, remoteness and lack of transportation throughout the project period.

Figure 1: A blur photograph taken of a Vesper bat roosting in a banana plant in a homestead garden in Jagat, Dolakha district (Note: Red circles indicate the leaves where the bat was photographed (left) and the bat zoomed in (right). 2 to 3 bats were roosting inside young, curled leaves but one flew and settled on the leaf shown, while others flew away.)

Table 1: Bat roosts searched in June, July and December 2022 and April 2023 (Note: Hip. arm.: Hipposideros armiger, Hip. gen.: Hipposideros gentillis, Rh. fer.: Rhinolophus ferrumequinum, Rh. sin: Rhinolophus sinicus, Rh. pe.: Rhinolophus pearsonii, Cy. sp.: Cynopterus sphinx, Ly. Ly: Lyroderma lyra, NA: Not surveyed)

Location name	Roost type	Elev. (masl)	Sp.	No. of inds.				Remarks
				Jun	Sept	Dec	Apr	
Suri Dobhan	Hydropower testing tunnel	1009	Hip. arm., Hip. gen.	20 to 25	20 to 25	7 to 8	NA	500 m deep tunnel as per the locals, however, could access only 50 m as water inside got deeper and deeper ahead. So, more bats could be potentially roosting in the deeper parts. Water also seeped through its walls and ceiling. It was on the bank of Tamakoshi River, below the vehicle road. A dead juvenile *H. gentilis* was found on the floor in June 2022. A Songmeter Mini bat also recorded a *Rhinolophus* species inside the tunnel with peak frequency (Fppeak or FME) at 99.58 kHz on 7th December 2022.
Hariyo daha cave	Cave	2352	Rh. fer.	NA	40 to 50	Nil	20 to 25	A small cave system on the rocky side of a hill with two different sections - one of which is just 6m deep and 3m high, while the other one is huge with a very narrow entrance (need to crawl) and a bigger interior and few stalagmite features – had 3 to 4 big and small compartments. The cave system was wet in September and dry in December and April. Our acoustic detector also recorded few calls of other *Rhinolophus* species with FME at

								84.45 kHz during cave search on 21st September 2022.
Rupthang cave	Cave	2241	Rh. sin, Rh. pe.	NA	NA	Nil	20 to 25	An underground cave with a steep and slippery vertical entrance inside forest. There were no bats in December, but guano pile was present on the floor.
Jagat banana plants	Tree/plant	1150	Cy. sp.	NA	1 to 7	Nil	Nil	Evidence of bats roosting on banana leaves was found in the area. Three banana plants had bats roosting on them during the day – two had one and seven individuals of *C. sphinx* each under the midrib of the leaves. The other one had 2 to 3 individuals of a vespertilionid bat roosting inside its young, curled leaves. However, it could not be captured (Figure 1).
Charnawati temple	Manmade structure	871	Ly. ly	NA	3 to 4	3 to 4	Nil	A Shiva temple in a small human settlement at the confluence of Tamakoshi river and Charange river (or Charnwati river). Bats were using it as night roost. The call of *H. armiger* was also recorded from 23:49-23:52 hrs inside the temple, on the same night as *L. lyra*.

Figure 2: Habitat types surveyed I (Left: A small artificial pond in a private agricultural land; Right: A small garden having banana, guava, coffee plants; on the bottom right corner – Unripe coffee fruits on the plant).

Figure 3: Habitat types surveyed II (A; Hariyo daha cave, B: Singati river; C: Hydropower testing tunnel, D: Siprin river meeting Tamakoshi River, E: A pool made by Khani khola stream, F: A small stream flowing through an open grazing area into the Tamakoshi River).

Figure 4: Habitat types surveyed III (A: Khahare stream, B: Buffalo shed, C: Shiva temple, D: Banana plant - Red circle shows chewed midrib of banana leaves as evidence of bats using it as a roost, E: R. luctus observed roosting on a Ficus bengalensis tree for some time, F: Bridge over Bhattauli river on the side of agricultural fields and haypiles).

Altogether, 14 species of bats were recorded during this study (Figures 5 & 6; Table 2). However, we were unable to locate our focus species Myotis formosus during the whole study period.

Table 2: Bats recorded throughout the study period (Note: '( )' indicate the number of individuals measured; N = Number of individuals captured/observed)

SN	Species name	Family	N	Method used	Habitat type	Forearm (FA in mm)
1	*Cynopterus sphinx*	Pteropodidae	15	Direct observation, Mist net	Banana leaves, fruit garden	63.80±3.32 (8)
2	*Lyroderma lyra*	Megadermatidae	3	Mist net	Temple in the forest edge in a small human settlement besides a river	67.29±1.46 (3)
3	*Rhinolophus ferrumequinum*	Rhinolophidae	5	Roost search, direct capture	Cave inside forest	60.87±1.92 (5)
4	*Rhinolophus lepidus*	Rhinolophidae	4	Mist net	River with huge rocky cliffs nearby human inhabited area	38.22 ± 1.18 (4)
5	*Rhinolophus luctus*	Rhinolophidae	1	Direct observation	Small human settlement with huge fig trees and old abandoned thatched houses	NA
6	*Rhinolophus pearsonii*	Rhinolophidae	1	Roost search, direct capture	Cave inside forest	55.05 (1)
7	*Rhinolophus sinicus*	Rhinolophidae	2	Roost search, direct capture	Cave inside forest	48.49±0.29 (2)
8	*Hipposideros armiger*	Hipposideridae	5	Roost search, scoop net, harp trap	Hydropower testing tunnel	91.9±2.35 (5)
9	*Hipposideros gentilis*	Hipposideridae	2	Roost search, scoop net	Hydropower testing tunnel	41.04±0.91 (2)
10	*Barbastella darjeelingensis*	Vespertilionidae	1	Mist net	Open grassland with small stream on the bank of Tamakoshi River nearby human settlement	40.33 (1)
11	*Eptesicus serotinus*	Vespertilionidae	1	Mist net	A smaller river with huge rocky cliffs flowing into Tamakoshi River	51.28 (1)
12	*Pipistrellus*	Vespertilionidae	2	Mist net	A smaller river with huge rocky cliffs	31.05±2.19 (2)

	javanicus				flowing into Tamakoshi River; a small artificial pond in an agricultural land	
13	*Pipistrellus coromandra*	Vespertilionidae	1	Mist net	Small pool of water formed by a flowing stream near roadside	31.03 (1)
14	*Vespertilio* sp.	Vespertilionidae	1	Mist net	A smaller river with huge rocky cliffs flowing into Tamakoshi River	47.84 (1)

Figure 5: Bat photo plates 1 (A: Cynopterus sphinx; B: Lyroderma lyra; C: Rhinolophus ferrumequinum; D: Rhinolophus lepidus; E: Rhinolophus luctus; F: Rhinolophus pearsonii; G: Rhinolophus sinicus; H:Hipposideros armiger; H:Hipposideros gentilis).

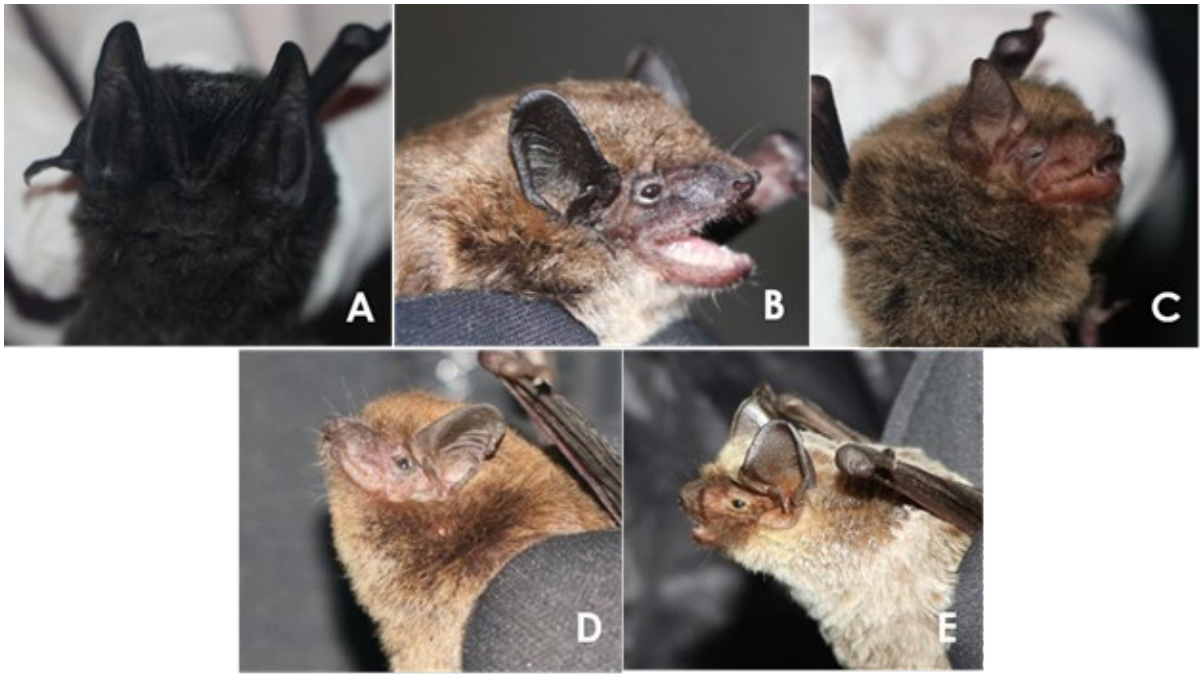

Figure 6: Bat photo plates 2 (A: Barbastella darjeelingensis; B: Eptesicus serotinus; C: Pipistrellus javanicus; D: Pipistrellus coromandra; E: Vespertilio sp.).

Among 14 bat species identified, Vespertilio sp. is a species new to Nepal (Figure 6). However, the species is yet to be confirmed through genetic analysis as it appears similar to both V. sinensis and V. murinus morphologically. This is the first ever record of Vespertilio sp. (or Parti-Coloured Bat) in Nepal. One female individual was caught via mist net over Siprin river. It had whitish grey or silver dorsal pelage.

There are two known species of Parti-coloured Bats in the world – Vespertilio sinensis and Vespertilio murinus. The former species has a widespread distribution in East Asia that includes China, Mongolia, Japan, Taiwan and some parts of southeast Russia, in forests, wetlands, rocky cliffs and mountain area, caves and subterranean habitats (Fukui et al., 2019). The latter, on the other hand, has been recorded from the northern Palaearctic region, extending from France, Britain and the Netherlands through central, northern and eastern Europe and Siberia to the Pacific coast (Coroiu, 2016). This species also tends to use similar habitats to that of V. sinensis. Both the species have been listed as Least Concern in the IUCN Red List of Threatened Species (Coroiu, 2016; Fukui et al., 2019).

In addition, we had also captured seven individuals of Pipistrelle bats that could not be identified morphologically. So, genetic confirmations of these are also needed.

Outcome 2) Bat calls for 12 species recorded through acoustic survey
Echolocation calls of captured bat species were recorded (Figure 7, 8, 9 & 10; Table 3). However, C. sphinx is a fruit bat, so does not echolocate. Unfortunately, we lost all the call recordings of R. luctus.

Table 3: Echolocation call parameters of identified bat species along the Tamakoshi River Corridor (Note: Fstart = start frequency; Fend = end frequency; FME = frequency with maximum energy; FM = frequency modulation; QCF = quasi-constant frequency; CF = constant frequency; iFM = initial frequency modulation; tFM = terminal frequency modulation; '( )' indicates the number of pulses analysed)

Species	Recording condition	Call structure	FME (kHz)	Fmax (kHz)	Fmin (kHz)	Bandwidth (kHz)	Fstart (kHz)	Fend (kHz)	Duration (ms)
Cynopterus sphinx	-	-	-	-	-	-	-	-	-
Lyroderma lyra	Handheld (3)	Multi-harmonic FM	42.27 ± 3.04	110.14 ± 2.01	15.76 ± 0.64	94.38 ± 2.5	106.24 ± 1.47	20.4 ± 0.32	1.17 ± 0.14
	Inside roost (3)		58.76 ± 0.11	106.76 ± 0.83	15.04 ± 0.31	91.71 ± 1.13	102.23 ± 2.37	19.21 ± 0.83	2.82 ± 0.25
Rhinolophus ferrumequinum	Hand release (3)	iFM-CF-tFM	72.16 ± 0.03	75.5 ± 0.11	58.19 ± 1.03	17.31 ± 1.03	69.06 ± 1.36	62 ± 3.19	55.92 ± 1.91
	Inside roost (5)		71.73 ± 0.01	74.57 ± 0.07	58.87 ± 1.15	15.69 ± 1.2	67.08 ± 1.5	63.09 ± 0.82	53.05 ± 10.78
Rhinolophus lepidus	Hand release (4)	iFM-CF-tFM	102.21 ± 0.11	106.34 ± 0.36	77.73 ± 1.01	28.62 ± 1.12	93.66 ± 4.26	80.33 ± 1.35	31.66 ± 3.51
	Handheld (4)		99.87 ± 0.06	103.73 ± 0.23	74.04 ± 3.01	29.69 ± 3.08	91.68 ± 6.96	76.24 ± 2.84	24.63 ± 3.12
Rhinolophus luctus	-	iFM-CF-tFM	-	-	-	-	-	-	-
Rhinolophus pearsonii	Handheld (4)	iFM-CF-tFM	59.48 ± 0.01	63.7 ± 0.46	42.22 ± 1.12	21.48 ± 0.66	50.92 ± 1.58	45.85 ± 1.68	38.33 ± 1.38
Rhinolophus sinicus	Handheld (3)	iFM-CF-tFM	83.24 ± 0.02	87.33 ± 0.17	61.54 ± 0.36	25.78 ± 0.27	75.89 ± 6.72	66.09 ± 1	41.83 ± 13.95
Hipposideros armiger	Inside tunnel (3)	CF-tFM	68.88 ± 0.02	68.88 ± 0.02	68.88 ± 0.02	68.88 ± 0.02	68.88 ± 0.02	68.88 ± 0.02	68.88 ± 0.02
	Handheld (3)		67.89 ± 0.03	71.85 ± 0.13	55.73 ± 0.91	16.13 ± 1.01	68.33 ± 0.52	59.25 ± 0.91	11.53 ± 1
Hipposideros gentilis	Inside roost (3)	CF-tFM	118.08 ± 0.05	120.45 ± 0.28	99.83 ± 0.21	20.61 ± 0.32	118.32 ± 0.28	101.78 ± 0.66	7.61 ± 0.11

Barbastella darjeelingensis	Hand release (4)	Alternating FM	23.02 ± 0.52	84.39 ± 4.62	18.62 ± 0.38	65.77 ± 4.9	44.23 ± 0.93	23.05 ± 0.27	3.66 ± 0.21
Eptesicus serotinus	Handheld (4)	FM	32.74 ± 1.39	117.94 ± 1.41	19.63 ± 0.85	98.3 ± 1.9	54.38 ± 2.62	25 ± 2.46	2.62 ± 0.08
Pipistrellus javanicus	Hand release (3)	FM	56.64 ± 0.38	112.52 ± 1.12	34.94 ± 0.93	77.58 ± 1.24	79.01 ± 2.69	41.57 ± 4.03	2.07 ± 0.11
Pipistrellus coromandra	Hand release (3)	FM	47.88 ± 1.06	109.85 ± 1.57	37.21 ± 0.28	72.64 ± 1.29	72.96 ± 1.49	43.55 ± 0.28	2.24 ± 0.37
Vespertilio sp.	Handheld (2)	Multi-harmonic FM	49.53 ± 3.3	71.3 ± 3.73	9.55 ± 0.86	61.75 ± 4.6	68.25 ± 0.57	12.59 ± 0.57	11.19 ± 0.27

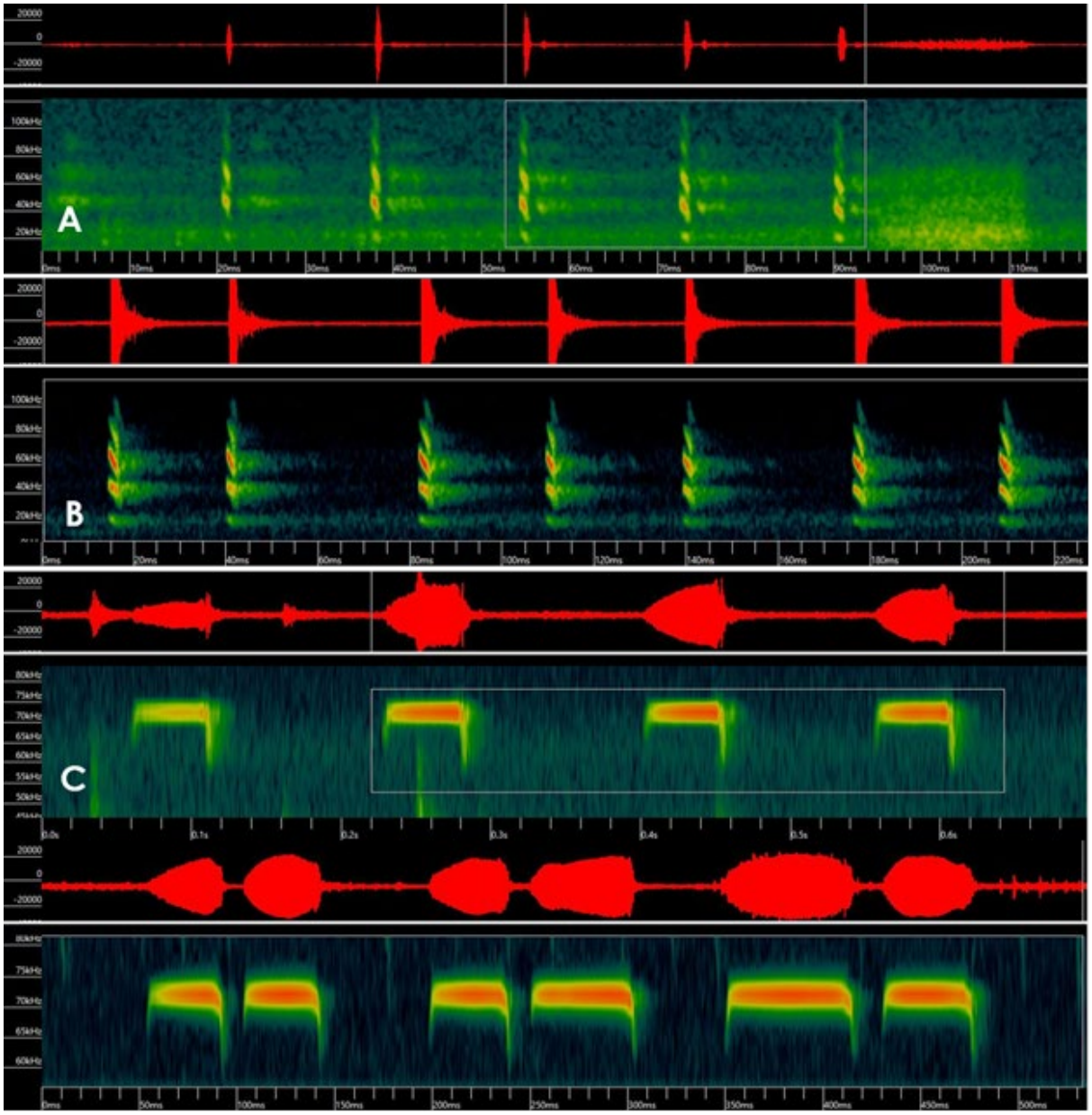

Figure 7: Echolocations calls recorded I (A – L. lyra while handheld; B – L. lyra inside roost; C – R. ferrumequinum during hand release; D – R. ferrumequinum inside roost).

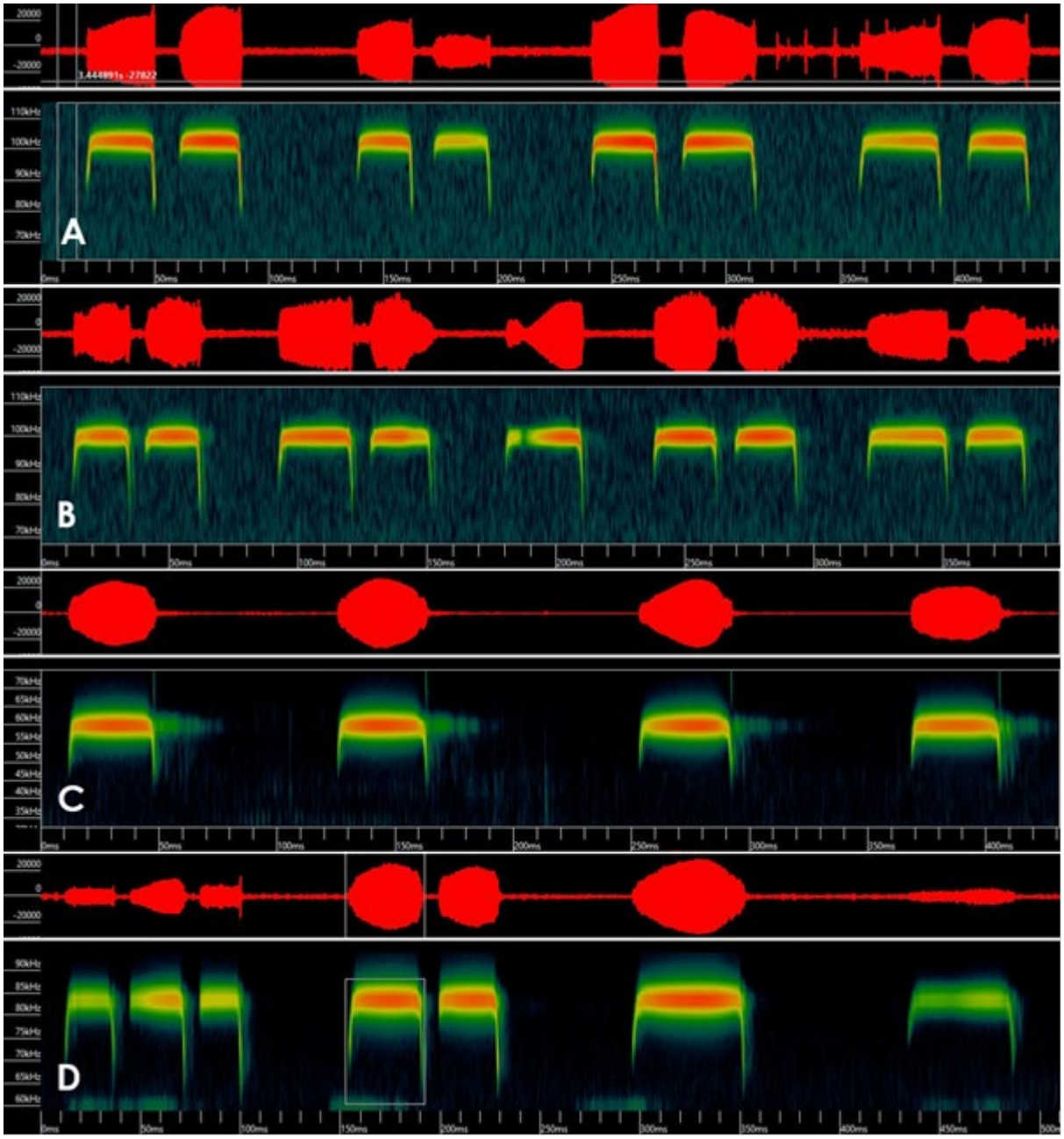

Figure 8: Echolocations calls recorded II (A – R. lepidus during hand release; B – R. lepidus while handheld; C – R. pearsonii while handheld; D – R. sinicus while handheld).

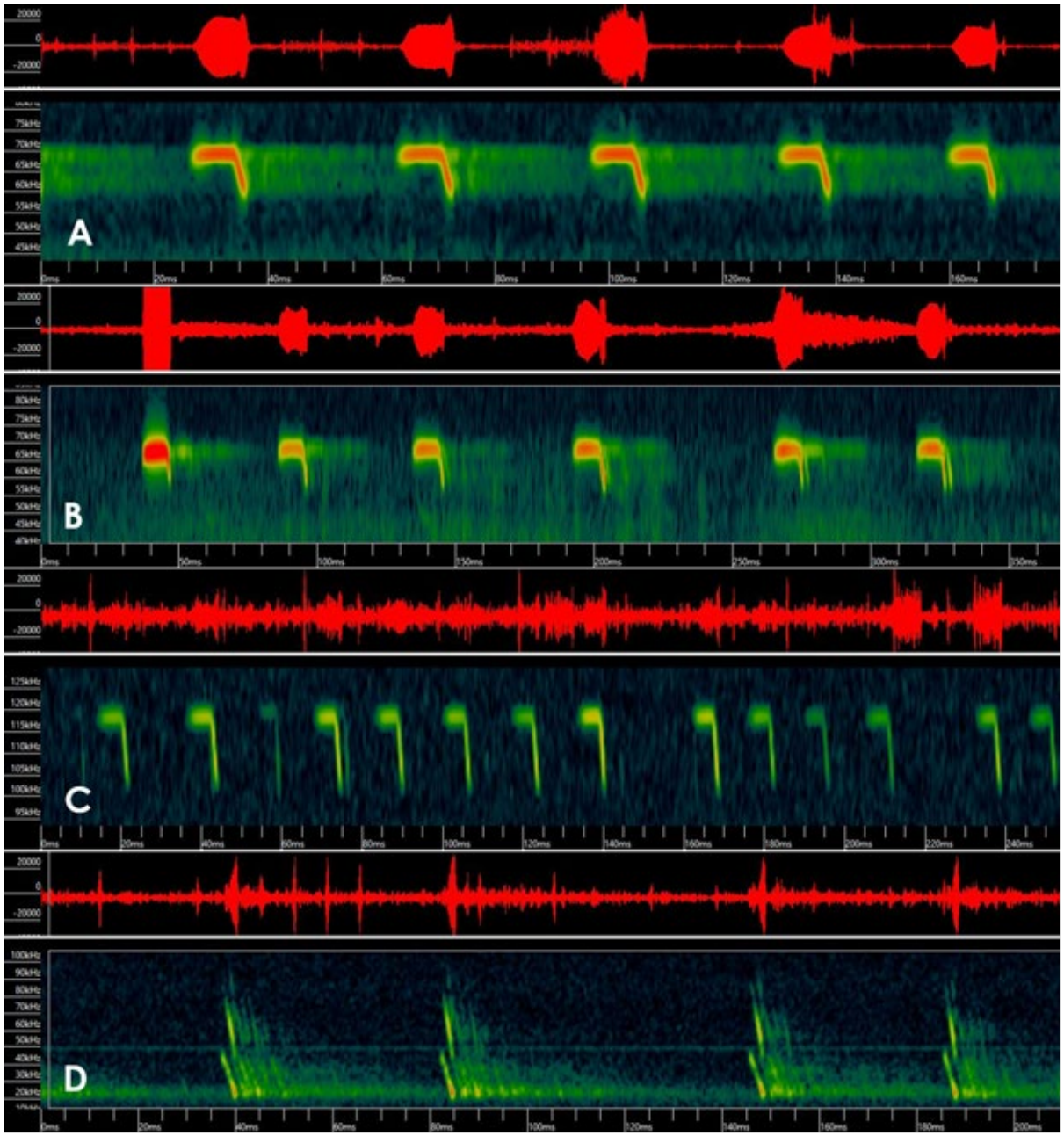

Figure 9: Echolocations calls recorded III (A – H. armiger inside roost; B – H. armiger while handheld; C – H. gentilis inside roost; D – B. darjeelingensis during hand release).

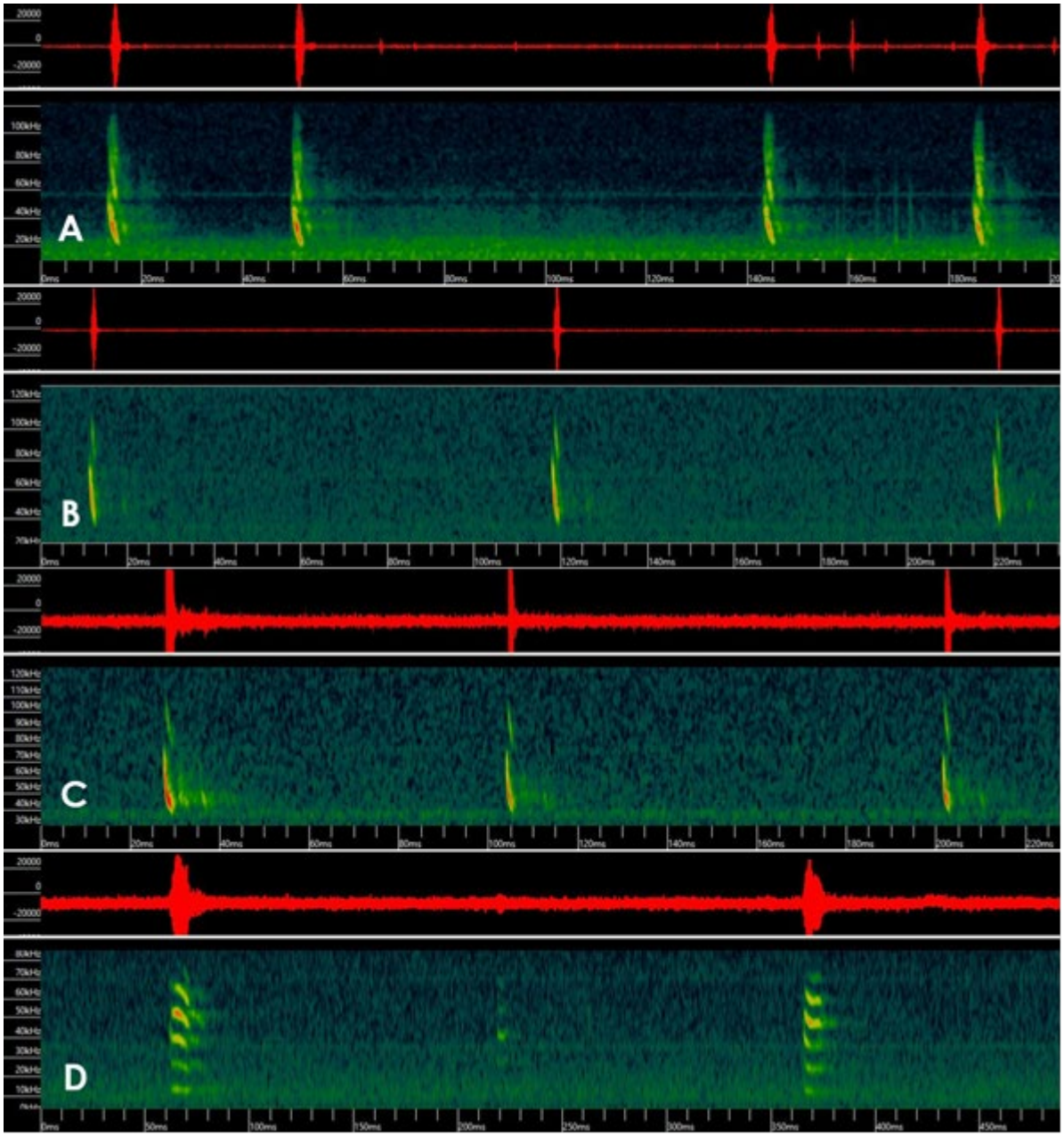

Figure 10: Echolocations calls recorded IV (A – E. serotinus while handheld; B – P. javanicus during hand release; C – P. coromandra during hand release; D – Vespertilio sp. while handheld).

In addition, other bat species have also been recorded using the ultrasonic recorders at mist netting sites during free flying condition, potentially Tadarida sp., Myotis sp., Submyotodon sp., Pipistrellus sp., Nyctalus sp., etc, however, these species could not be captured.

Outcome 3) Significant positive change in perception and awareness level of local people raised to more than 50 % through awareness campaign

Pre-project

A semi-structured questionnaire survey was carried out during the first phase of the project to assess the perception of local towards bats in their area and the level of

basic knowledge and importance of bats. Total of 50 people were interviewed nearby sampling sites (Figure 11), belonging to different ethnicities such as Tamang, Sherpa, Newar, Brahmin and Chhetri.

Majority of the respondents were male. More than 30% had at least primary level education, while 36% of them were literate. More than 50% of the respondents were farmers. More than 90% of them had seen bats in the area. However, most of them knew nothing about bats and their importance. Some people even mentioned that bat sightings have become rare in the recent times due to unknown reasons and agreed that bat population has been decreasing.

Figure 11: Scheduled survey being carried out by Ms. Sabina Koirala.

Post-project

Based on this information, awareness programs were conducted during the next phases. We also carried out post-project scheduled survey towards the end using the same semi-structured questionnaire used at the beginning of the project with 59 people. This was done to know if there was any change in the knowledge and perception of the locals about bats at the end of this project.

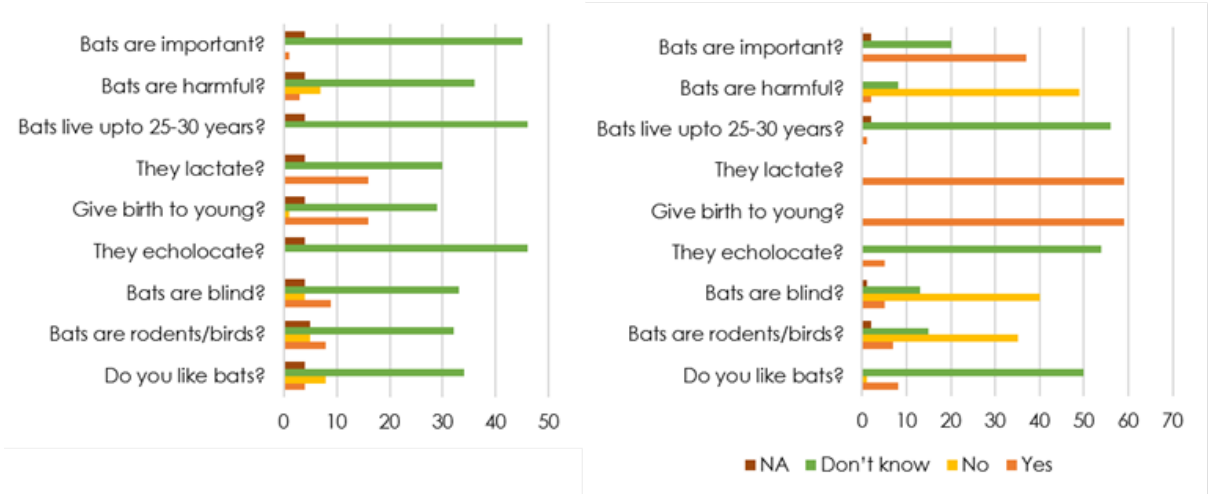

Figure 12: Knowledge and perception of respondents at the beginning (left) and end (right) of the project.

The results showed that there was a significant positive change in the knowledge and perception of the locals due to the project (Figure12).

Outcome 4) More than 1000 local people including 975 school children and 150 youths engaged in the bat conservation awareness

Outreach programs

Through the pre-project scheduled survey, we had found that even though majority people had seen bats but knew nothing about them and their importance. People also pointed out the fact that bat sightings have become rare, and perhaps the bat population has decreased. Based on these findings, we conducted various outreach activities in schools (Table 4) and communities to increase the level of awareness about the role of bats in maintaining the ecosystems, benefit to humans while trying to mitigate the negative attitude towards bats among youth and school children.

Awareness and outreach activities in schools

Table 4: List of schools where outreach program was conducted.

SN	Name of the School	Type	Number of classes run by the school
1	Kalinag Higher Secondary School, Singati	Govt.	Up to grade 12
2	Shree Gaurishankar Secondary School, Jagat	Govt.	Up to grade 10
3	Gaurishankar International Academy, Singati	Private	Up to grade 7
4	Basnet Academy English Boarding School, Singati	Private	Up to grade 8
5	Shree Tashi Chhime Gastal Basic School, Bigu	Run by monastery	Up to grade 7
6	Shree Gaurishankar Secondary School, Bigu	Govt.	Up to grade 10
7	Shree Himalayan Region Welfare English School, Bigu	Private	Up to grade 5
8	Vidyashram Basic School, Manthali	Govt.	Up to grade 8
9	Shree Bhimeshwor Rudra Secondary School, Manthali	Govt.	Up to grade 12
10	Karkaladevi English Boarding Secondary School, Manthali	Private	Up to grade 10
11	Shree Tamakoshi Janajagriti Secondary School, Khimti	Govt.	Up to grade 12

School children of grade six to eight were targeted for outreach activities, however, only grades six and seven were included for the lower-secondary schools that taught till grade seven. The program included an interactive 30-minutes lecture followed by a 30-minutes documentary "Secret world of Bats" about bats, their importance, threats and ways to protect them (Figure 13). We shortly verbally

disseminated the message from the documentary in Nepali language as the documentary was in English. A short discussion session and fun bat quiz was conducted at the end. One student from Basnet Academy English Boarding School asked "How can we convince our parents, elders and others to not harm bats when they see bats feeding on their banana and other fruits?" It was indeed wonderful to see young children be fascinated by bats and be willing to protect them.

Figure 13: Lecture and documentary session in Kalinag Higher Secondary School, Singati.

Awareness and outreach activities in communities

Figure 14: Talking with a local about bats and their roosts.

We distributed posters and interacted with the locals about anything they knew about bats (Figure 14). We were able to conduct four community outreach sessions

in Jagat, Bhorle, Bigu villages and Khimti (Figure 15). It involved a short lecture, open group discussion, documentary show and distribution of bat conservation materials such as posters and stickers. The people who gathered, enthusiastically took part in the program and interacted about bats and their importance. The participants expressed their happiness about getting to learn so much about bats and were so amazed by the fact that these small species played a huge role in nature.

The most important question in most of these sessions was about the relationship between bats and COVID-19. The participants were curious that if bats were actually responsible for the spread of this disease. Our team tried its best to tackle the questions/misconceptions/misinformation of the participants. Through the discussion, we found that some people still believed that bat meat could be used to cure Babesiosis "Laumutta" in cattle. Also, participants mentioned that some had seen bats living in bamboo of the bamboo thatched houses and one had seen a couple of bats roosting inside old shoes hung on the entrance of houses (to ward off the evil eye) a very long time ago.

Figure 15: Community outreach in Khimti, Ramechhap district.

Bat club formation

School bat clubs

In coordination with the school management, we formed altogether nine school bat clubs each including school children from grade six to eight/seven as per their interest in nine schools (Table 5).

Table 5: School Bat Clubs formed.

SN	Name of the School	School children of grade involved	Number of members
1	Kalinag Higher Secondary School Bat Club, Singati	6-8	13
2	Shree Gaurishankar Secondary School Bat Club, Jagat	6-8	10
3	Gaurishankar International Academy Bat Club, Singati	6-7	9
4	Basnet Academy English Boarding School Bat Club, Singati	6-8	10
5	Shree Gaurishankar Secondary School Bat Club, Bigu	6-7	10
6	Vidyashram Basic School Bat Club, Manthali	6-8	10
7	Shree Bhimeshwor Rudra Secondary School Bat Club, Manthali	6-8	10
8	Karkaladevi English Boarding Secondary School Bat Club, Manthali	6-7	10
9	Shree Tamakoshi Janajagriti Secondary School Bat Club, Khimti	6-8	10

Soon after bat clubs were formed, the members were delivered information on bat club management and activities the club needed to do. Open art competition was conducted within the members of each bat club where they drew bats or anything relating to them. Necessary materials such as art paper, pencil, crayon colours, etc. was provided to them. The session was followed by bat origami making where Varsha Rai and Prahesh Chalise demonstrated, and the club members followed. Towards the end, a winner was announced for the Open Art Competition who was awarded with a gift hamper that included educational materials such as a notebook, pen, pencil, posters, stickers, etc. At the end of the two-hours program, we conducted a fun quiz about bats. A teacher from respective school was assigned to each school bat club to mentor the bat club members to conduct club activities. The bat clubs were presented with some stationery and booklets on conservation of different animals by Small Mammals Conservation and Research Foundation (SMCRF) along with 20bat conservation posters and 20 stickers each.

Quarterly bat club meetings were also conducted in their respective schools. Stationeries such as an attendance register, diaries, pen, pencil, etc. and conservation materials that included several conservation posters and booklets were also distributed to the clubs. Almost all the school bat club members were present in the meeting. Everyone was given an opportunity to speak of themselves. The members shared that they were no more afraid of bats and realized the importance of bats in nature and that bats should be protected. We were glad that they remembered that bats help in pollination, seed dispersal and controlling harmful insects and agricultural pests. We reminded them that bats, if sick or found lying on

the ground, should not be touched with bare hands, and should be picked up with gloved hands and left on a tree higher from the ground. In case of dead bats, they should be buried immediately as there is always a high risk of spread of zoonotic diseases if eaten by pet or feral animals. They informed us that they shared about the importance of bats with their parents, grandparents, visiting relatives, friends and even in their neighbourhood. During the session, we also asked each member if they had seen bats or any roosts recently. Many had seen them in their homes flying in the evening, roosting under banana leaves while some had seen a bat hanging on a branch of a walnut tree in the evening, two bats hanging on a wire in front of the house, in caves and flying around school premises in the evening. The school club members suggested that they can help to conserve bats by conducting small outreach programmes and sharing what they knew personally with others. During the meeting, one of the members from the Basnet English Academy School Bat Club asked, "Are bats really the culprit for the spread of the coronavirus as people say?" We replied, "It is not yet proved that bats were responsible for the coronavirus outbreak. However, there is always a high risk of spread of zoonotic diseases from wildlife to humans and vice-versa, in case of unnecessary contact or mishandling. Same is true with our pet and domestic animals, too. We still do not know how exactly COVID-19 happened, but we can definitely say that such outbreak of diseases will lessen if humans learn to live in harmony with nature and be appreciative of what it has to offer. We, as researchers, have been working with bats for many years following strict protocols such that no animal is harmed and have not contracted any such disease till now. Thus, we should not fear bats, but learn and teach others to appreciate what bats do for us and let them be.".

The school bat clubs also carried out at least one bat awareness activity such as essay competition, poem competition, speech competition and poster information sharing in their respective schools. Certificates were provided to the club members for their active participation in bat club activities. The winners of essay, poem and speech competitions were also provided with a porcelain mug that had a bat photo and the motto of bat conservation printed on it, as a token of appreciation.

Youth bat clubs

Four youth clubs were formed during the project as per the interest of the locals (Table 6). We briefed the club members on their roles and activities need to be done. The youth club members were mostly farmers by profession in Dolakha district while Manthali Youth Bat Club consists of enthusiastic youths who have been involved in environmental and social causes from time to time engaged in professions like teaching, business, civil service, etc. However, it was difficult for us to engage the members in bat walks in the evening to demonstrate bat survey in the field environment due to their other work commitments or rain.

Table 6: Youth Bat Clubs formed.

SN	Youth Bat Club	Number of members
1	Jagat Youth Bat Club	4
2	Bhorle Youth Bat Club	10
3	Bigu Youth Bat Club	9
4	Manthali Youth Bat Club	6

We conducted meetings with our youth bat clubs, too. In Youth Bat Club meetings, the President and few of the members were present. Through the similar discussion with the Youth clubs, it was clear that our outreach sessions had a positive impact on the perception of the people towards bat conservation. The club members were happy and eager to help raise awareness in the smallest possible ways. The club members are responsible to locate bat roosts in the area and also report us along with any bat related incidences during the project and afterwards. Sajana Thami from Bhorle Youth Bat Club mentioned that she had seen 5-6 bats emerge and fly from the young, curled leaves of banana, while cutting the sick banana plant recently. The club members said that in the past they did not care if bats flew around or where they roosted, however, now they have started noticing bats.

Installation of information board

An information board standing 10 ft. tall with a UV print flex (7×4.5 sq. ft.; Figure 24) was installed at Jagat along the Tamakoshi River on the roadside in GCA, Dolakha district on 30th May 2023 in the presence of Mr. Pramod Raj Regmi, the Natural Resource Conservation Assistant of GCA. The information board contains the list and photos of bat species recorded during this project along with the information on their importance and ways to protect them.

Figure 16: Pasting UV print flex on the metal board frame before installation with the help of locals.

Sharing workshop

During the final phase of the project, a sharing workshop was conducted for two-hours. This programme was organized at the premises of Shree Gaurishankar Secondary School in Jagat, Dolakha district in GCA on 31st May 2023. Altogether, 23 local people participated in the workshop (Table 8) including officials from GCA, local government bodies, members of Community Forest User Groups (CFUGs), Conservation Area Management Committee (CAMC), teachers and members from the school bat clubs, youth bat club members and other local stakeholders. The primary objective of this workshop was to disseminate the findings of the project till date and interact with the participants for their comments and feedback.

Figure 17: Ms. Varsha Rai during the sharing workshop.

The workshop was moderated by Mr. Prahesh Chalise and was formally started by welcoming the Chair, Chief guest and other participants. Following that, Ms. Varsha Rai gave a power point presentation about the project, its challenges and results (Figure 19), followed by a discussion session (Table 7). The programme was chaired by Mr. Mem Bahadur Tamang, Chair of Ward-01, Bigu Rural Municipality.

Table 7: Questions asked, or comments/suggestions made by the participants.

SN	Participant's name and affiliation	Questions/comments/suggestions
1	Mem Bahadur Tamang, Bigu-1, Ward Chair	• We are appreciative of this very important work. And we are hopeful and ready to directly collaborate in such studies from now on.
2	Nimgyel Sherpa,	• We would like to thank you for this initiation. Prior to

	Gaurishankar-9, Ward Chair	this, we did not know the importance of bats and how they looked from up closely. But now we know that bats have their own significance in nature and they directly or indirectly help humans. We will now definitely convey this message to conserve bats in our area. • We would like also to like to request you to involve us in the project so that we can provide you with the help you need for its effective implementation at local level.
3	Hiramani Gautam, Principal, Shree Gaurishankar School Jagat	• Thank you so much for all the effort to document such neglected species in our area along with creating awareness about bat conservation. We are confident that our students have learnt a lot from you and our bat club members will continue to work for this cause. • There are so many hydropower stations being operated or under construction in the area along the Tamakoshi River. So, in addition to documenting biodiversity, I would like to suggest you to also look into the impacts such developmental projects are having on the environment and wildlife.
4	Pahalman Tamang, President, Conservation Area Management Committee (CAMC)	• We would like to thank you for letting us know about bats. They seem to be amazing, providing important services in nature helping humans. I have seen bats coming into our homes and in caves for as long as I can remember, however, their appearance has become rare these days. And now we know why. • There are a few potential bat caves that I have heard of, a little away from your current study area. These sites can be certainly explored in the future. • We would like to suggest you involve us in project fieldwork and mobilize our team, too, in the coming days.
5	Basanta Basnet, Principal, Basnet English Academy School Singati	• Thank you so much for this commendable work. We are always ready to encourage and support researchers/students to carry out such work. The bat club that you have started at our school will keep working to spread this message of conservation in any small way possible.

The programme formally ended with the closing remarks of our Programme Chair. The participants expressed their appreciation towards our initiative to carry out such work in the area. For them, this study was novel, and they were amazed to learn about bats. They were surprised that bats were that important. They said that they will definitely share the learnings from this workshop and persuade others to protect bats. They suggested that we need to extend our study area as the caves that harbour bats are present in higher hills and slopes from the Tamakoshi River. They were excited to know that a bat species new to Nepal has been recorded in their

area though this study. The participants expressed that they were motivated and were too ready to collaborate in such projects in the future.

3. Explain any unforeseen difficulties that arose during the project and how these were tackled.

One of the major unforeseen difficulties that arose during the project was the delay in permit. It took additional two months than normal to get permit from the Social Welfare Council (SWC) which was issued only during the first week of June 2022. This was due to the 2022 Nepalese local elections being held at that time. This delayed the start of our project and the monsoon had already started. So, we extended our field period till May 2023. The other unforeseen difficulty that we experienced was due to the noticeable increase in the level of water in Tamakoshi River during the evening every day. As per the locals and Gaurishankar Conservation Area (GCA) officials, the UTKHEP released water in the river during the evening. Due to this, we were not able to conduct mist-netting along the Tamakoshi river even during the winter month when the water level in the rivers is used to be low five years ago. Thus, we searched for other sample sites such as nearby streams, ponds, forest edges, etc. and did not only concentrate on the Tamakoshi River for mist-netting. In addition to that, other limitations that we faced were unfavourable weather and holiday season.

Due to late permits, monsoon highly affected our first field period in June 2022 and was cut short. Frequent rainfall also affected other phases and once it rained continuously for four days. Due to continuous rainfall, the roads reaching several remote sites were wrecked, landslide-prone and water level in river and streams was unsafe for deploying mist nets. Caves or crevices are mostly situated at high cliffs and hilly slopes, mostly unreachable due to the treacherous terrain or unfavourable weather. There was nothing much we could do about the weather, but we continued with our roost search wherever possible, and deployed mist nets whenever the weather was favourable. By the time we reached the southern part of our study area, schools were closed due to Dashain and Tihar, the biggest festivals of Hindus, as per the Nepalese Lunar Calendar observed generally around the month of September. Thus, we talked with the school officials and postponed our awareness and outreach activities in some schools and communities through the next phase in December 2022. And in the higher elevation and northern sites, winter vacations during December and January hampered our plan for school awareness in those sites.

4. Describe the involvement of local communities and how they have benefitted from the project.

Through scheduled survey, we found that most of locals did not know about bats and were unaware of their importance. Based on that information, we conducted outreach programmes in school and communities and saw a significant positive change in the level of knowledge and perception about bats in local people after that. We have formed school bat clubs and youth bat clubs that are responsible for spreading conservation message in smallest ways possible. School Bat Club members carried out at least one bat conservation awareness activity in their

respective schools and even shared their learnings with their friends and family. If not all, but members of one youth bat club, i.e., Jagat Youth Bat Club, were actively involved in couple of bat surveys in Jagat. We demonstrated how bat surveys were done and they were quite happy to see bats from so close as they had only seen it flying from afar. We were able to conduct a one or two club meetings with each bat club during the project period and it was clear that our outreach sessions had a positive impact on the perception of the people towards bat conservation. The club members were happy and eager to help raise awareness in the smallest possible ways. The club members are responsible to locate bat roosts in the area and also report us along with any bat related incidences during the project and afterwards.

Through the sharing workshop, it was evident that local stakeholders such as Conservation Area Management Committee (CAMC) and Community Forest User Groups (CFUGs) were ready to support and collaborate with us in such future studies. Thus, we can say that locals in the study area benefitted from this work by gaining knowledge and having a better understanding about the importance of bats. Also, the news of the record of a new bat species for Nepal from this region has increased their enthusiasm and encouraged them even more to protect biodiversity in their area.

5. Are there any plans to continue this work?

After this project, I am planning to work closely with the Gaurishankar Conservation Area (GCA) officials, rural municipalities and the bat clubs, and conduct our search for more bats in a wider area, record their calls and engage communities while doing so. Identifying bats based solely on their morphology and morphometric measurements is almost impossible in many cases due to the presence of many cryptic species in unexplored regions such as the Himalayas. Thus, I am planning to learn more on bat taxonomy and enhance my skills and knowledge on using genetic tools to study bats and their ecology in the coming years. With that, I will continue looking for M. formosus at higher elevations (2000 m asl) in the Tamakoshi River Corridor and also in other non-surveyed parts of GCA.

6. How do you plan to share the results of your work with others?

The major findings from this project were shared with the local government authorities, schools and communities through the reports, discussions and sharing workshop. We are looking forward to publishing the results from the project in at least one peer-reviewed journal and also as local newspaper column article. The data will also be added to the Global Biodiversity Information Facility (GBIF). The echolocation calls that we have recorded will be published in the Nepal Bat Call Library and ChiroVox: a public library for bat calls. We are planning to have these publications out within a couple of years.

7. Looking ahead, what do you feel are the important next steps?

The next important steps would be:

a) Continue to monitor the sites that were surveyed in this project.

b) Continue with bat conservation awareness activities in collaboration with the local stakeholders for research and conservation.
c) Efficiently train the bat clubs and youth clubs members to monitor bat roosts.
d) Extend the survey for potential cave roosts for M. formosus and other bat species higher uphill above 2000 m asl in the Tamakoshi River Corridor and other parts of the Gaurishankar Conservation Area.

8. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes, the Rufford Foundation logo was used in the posters (Figure 21), stickers (Figure 22), banners and porcelain mugs (Figure 23) produced for this project. An information board (Figure 24) has been installed in Jagat, Dolakha with the logo that includes the information of the bat species recorded during this project and the importance of bat conservation. The logo was also used in the PowerPoint presentation during a sharing workshop held in Gaurishankar Conservation Area, Dolakha.

9. Provide a full list of all the members of your team and their role in the project.

Varsha Rai: Team leader – was involved in developing and implementing the project, bat survey, conservation awareness activities, workshop management, data entry and analysis, report writing.

Prahesh Chalise: Field Assistant – was involved in field work, conservation awareness activities, social surveys, workshop management.

Sanjan Thapa: Supervisor – guided with the development and implementation of the project.

Sabina Koirala: Field Assistant – was involved in social surveys and bat surveys during the first phase of the project.

Prakriti Pant: Field Assistant – was involved in bat survey and conservation awareness activities during the second phase of the project.

Santosh Rai: Field Assistant – was involved in bat survey and conservation awareness activities during the third phase of the project.

Bidhan Rai and Kshitiz Rai: Field Assistants – was involved in bat survey during the fourth phase of the project.

Jit Bahadur Tamang: Local Field Assistant – helped us with locating bat roosts.

Pasang Sherpa: Local Field Assistant – helped us with locating bat roosts and bats.

Bishnu Achhami: helped in designing and preparing bat conservation awareness materials such as posters, stickers, porcelain mugs and information board.

10. Any other comments?

Other than hydropower project construction, other two major human activities impacting the ecosystem of Tamakoshi River were also observed such as sand and gravel extraction, and bridge construction (Figure 19 & 20).

Figure 19: Sand and gravel extraction being done in Tamakoshi River near Tamakoshi Bajar, Dolakha district.

Figure 20: Bridge construction on the Tamakoshi River in Manthali, Ramechhap district.

Figure 21: Bat awareness poster prepared for the project in Nepali (left) and English language (right).

Figure 22: Bat conservation sticker prepared for the project.

Figure 23: Porcelain mug prepared for the project with a photo of a bat (Myotis formosus) and conservation motto.

Figure 24: Information board content in Nepali (top) and English (bottom).

Table 8: List of participants of the sharing workshop.

SN	Name of the participant	Affiliation	Contact
1	Mem Bahadur Tamang	Bigu-01, Ward Chair	
2	Pahalman Tamang	Bigu-01, CAMC	9846003190
3	Netra Tamang	Bigu-01	9860494407
4	Pahalman Tamang	Bigu-01	9843658012
5	Krishna Prasad Bhattarai	Shree Gaurishankar Secondary School, Jagat, Conservation Education Teacher	9849374733
6	Basanta Basnet	Basnet English Academy, Singati	9844322743
7	Pramod Raj Regmi	NTNC-GCAP	9846113398
8	Aayush Thapaliya	Shree Gaurishankar Secondary School Jagat Bat Club	
9	Devlal Tamang	Shree Gaurishankar Secondary School Jagat Bat Club	
10	Netra Kumar Shrestha	Shree Gaurishankar Secondary School Jagat Bat Club	
11	Sabita Tamang	Shree Gaurishankar Secondary School Jagat Bat Club	
12	Dilli Bahadur Magar	Bigu-01, Lamabagar, CFUG	
13	Santa Tamang	Bigu-01, Lamabagar, CFUG	9860533849
14	Lopsang Tamang	Bigu-01, Lamabagar, CFUG	9851249420
15	Puskar Tamang	Bigu-01, Lamabagar, CFUG	
16	Ashim Shrestha	Bigu-01, Lamabagar, CFUG	

17	Shree Krishna Thakuri	Bigu-01, Lamabagar, CFUG	
18	Dil Kumar Tamang	Bigu-01, Lamabagar, CFUG	
19	Nir Bahadur Tamang	Shree Gaurishankar Secondary School, Jagat	
20	Dipika Thakuri	Shree Gaurishankar Secondary School Jagat Bat Club	
21	Lakpa Lamu Sherpa	Shree Gaurishankar Secondary School Jagat Bat Club	
22	Nimgyel Sherpa	Gaurishankar-01, Ward Chair	
23	Hiramani Gautam	Shree Gaurishankar Secondary School, Jagat, Principal	