#### STATUS SURVEY AND CONSERVATION EDUCATION CAMPAIGN: A COMMUNITY PARTICIPATION APPROACH TO PROTECT BATS IN THE THAR DESERT, INDIA

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#### ACKNOWLEDGEMENT

On behalf of the project team first and foremost I express our sincere gratitude to The Rufford Small Grant Foundation, UK for providing full financial support to undertake this project work. I extend my especial thanks to Ms. Jane Raymond (Director, Rufford Small Grant) for her cooperation throughout the project implementation period.

I personally extend my word of gratitude to Prof. G. Marimuthu (Head, Department of Animal Behaviour and Physiology, Madurai Kamraj University, Madurai, India), Dr. Paul Bates (Director, Harrison Zoological Museum, Kent, England) and Dr. Shahroukh Mistry (Associate Professor, Biology Department, Westminster College, New Wilmington, PA, USA) for their letter of recommendation and valuable guidance to execute this project.

I also extend my especial thanks to Dr. Ashok Purohit (Associate Professor, Department of Zoology, J. N. V. University, Jodhpur, India), Dr. Asad Rahmani (Director, Bombay Natural History Society), Dr. Sumit Dookia (Coordinator of this project and Secretary, Ecology and Rural Development Society, Jodhpur, India), Dr. Amit Sharma (Lecturer, Department of Zoology, Adarsh Mahavidhyalaya, Jodhpur) for their valuable support I received while execution of this project.

I duly appreciate the passionate attitude and hard work of our Project teammates; Area Research Coordinators Dr. Amit Kotia and Mr. Jeeva Ram Tank, Volunteer In-Charges Mr. Gajendra Singh, Mr. Narayan Ram Anjana, Mr. Chandan Singh, Mr. Tejkaran, Dr. Om Dookia, Mr. Girdhari Singh Kadwasara and Mr. Jitendra Seervi. I duly recognize the kind of support received from Ms. Suman (Dietitian and Social Worker, Jodhpur), Mr. Devendra Shrimali (Teacher, Medata Road) and Mr. Kamlesh Seervi (Tax Assistant, Income Tax Department, Jodhpur) to execute this project work. I would also like to thank officials of Forest Department, Jodhpur for their cooperation during the implementation of this project.

Successful execution of this project would not have been possible without the caring support I received from my wife Mrs. Suman Senacha and friend Chartered Accountant Mr. Ashok Choudhary. Last but not least, I would like to thank all the participants and person who directly or indirectly extended their help to execute this project. I wish them best of luck for all future endeavours to conserve bats in this area.

#### SUMMARY

Bats as pollinators, seed dispersers and preying insects are keystone species in ecosystems. Potential habitat and roosting sites of bats in Jodhpur region, a chiropteran diversity hotspot in Thar desert of India, facing serious threat of destruction with increasing anthropological pressures. Recent study shows four species of bats and various roosts reported here earlier have vanished over the period of last two decades and many more are facing serious threat. People are unaware of ecological role of bats and consider them as bad omen. Conservation of bat diversity in this area is one of the core ecological priorities. There is an urgent need to raise bat conservation awareness among local communities, through sensitizing them about their ecological significance.

For the first time ever, in December 2007, United Kingdom based organisation The Rufford Small Grant Foundation provided financial support to undertake here a project entitled "Status survey and conservation education campaign: a community participation approach to protect bats in the Thar Desert, India. The objectives of this project were, to undertake intensive survey of exploring the bat roosts in the limits of Jodhpur district of the Thar Desert and to identify the species of bats inhabited therein; to undertake a bat conservation education campaign - to teach ecological significance of bats and to uproot existing myths about bats among local people and to educate policy makers about ecological significance of bats.

The project was executed in period from January 2008 to September 2009. A total of 96 bat roosts belonging to 9 species, 2 mega chiropteran and 7 micro chiropteran, (Table 2 & 3, Photo gallery II) were explored in the limits of Jodhpur district (Fig.1). Beside Jodhpur city total of 87 settlements (town/villages/*dhanis*) were visited for bat conservation education campaign. Lectures themed of ecological significance, nature and diversity of bats in the Thar Desert were delivered in 5 colleges, 55 schools (53 co-ed. and 2 girl's school), 15 village *Panchayat Bhavans* and 45 small gathering at different destinations (Table 4). 15 schools were short listed near prominent bat roosts in the study area and motivated to formulate a bat club (Table 5). To create conservation awareness and to educate locals about ecological significance of bats total of 6500 pieces of informative educational material on scientific facts about bats of this region (500 big size, 500 medium size posters/ 4000 postcards/ 1500 pamphlets) were distributed among target groups during this campaign (Photo gallery I, III).

The response of campaign participants and audiences were overwhelming. Of the targeted spectators more than 98% were unaware of ecological significance of bats whereas 70-80 % were strongly believed in prominent myths like bats attack furiously on human nose and consider them as sign of sin. They admitted the fact that because of poor knowledge about its ecological significance presence of bats near human settlements has never been appreciated; rather they have always been misunderstood by the locals in this region. Therefore at many instances bats become victims and their roosts are debilitated by ignorant people.

Through personal conversation, group discussion and attending lectures participants of this campaign have updated their knowledge about bats. Upon learning about the ecological significance and natural facts they realized that bats are quite useful creatures and play important role to insure good health of an ecosystem. They seemed quite excited upon discarding their fear of bats attacking human nose and its image as sign of sin and get convinced that because of their ecological role bats should be considered as friends. They appreciated deeply the objective of bat conservation awareness campaign in this project. They were also quite impressed to learn that such short of bat conservation awareness program have initiated by the foreign organization and admired the novel effort of the Rufford Small Grant Foundation to fund this project.

#### INTRODUCTION

Bats, playing vital as pollinator, seed dispersers and insect consumer, contribute remarkably to the ecosystems and environment. An insectivorous bat may consume hundreds of insects per hour, while large colonies claim tonnes of insects each night, including beetle and moth species that otherwise cost

farmers and foresters billions of rupees annually (Mickleburgh *et al.*, 2002). Fruigvours bats pollinate at least 500 neotropical plant species of 96 genera, disperse seeds for many and play vital in global ecosystems (Humphrey and Bonaccorso, 1979). Jodhpur district (22,850 km2) remained hotspot for chiropteran diversity in the Thar, hot desert ecosystem of India (Fig.1). It had 12 species of bats out of 15 reported entirely across the Rajasthan part in Thar till early 1980s (Prakash, 1963; Sinha, 1979 and Gaur, 1981).



Bats ever misunderstood and ignored by people in this area as they neither aware of ecological significance nor know about their nature. Area is flooded with two strong myths, some believe bats attack on nose and suck our blood and others consider them a sign of sin, destruction and poverty. Four species of bats (*Megaderma lyra, Pipistrellus dormeri, Hipposideros fulvus* and *Tadarida aegyptiaca*) and various roosts reported earlier have vanished over two decades. Habitat destruction by anthropological factors is the foremost reason for this depletion and there is a need to start bat conservation awareness programs to protect diversity of bats in this study area (Senacha, 2003). However, in 2006 Senacha *et al.* reported presence of Short-nosed fruit bat for the first time from this area. Based on these studies and recommendations I formulated this project and was financially supported by the Rufford Small Grant Foundation, UK.

#### **PROJECT OBJECTIVES**

The objectives of this project were as under:

- 1. To explore the bat roosts in Jodhpur district of the Thar Desert by undertaking an intensive systematic survey.
- 2. To find out the species composition of bats at surveyed roosting sites.
- 3. Assessment of threats to bat roosts in the study area.
- 4. To eliminate existing myths about bats among locals in the study area through undertaking a bat conservation awareness campaign.
- 5. To provide a detailed report on status of bats in Jodhpur to state forest department such that bats get reasonable attention in upcoming wildlife management plan of government in this region.

#### MATERIALS AND METHODS

To accomplish the objectives of this project following material and methods were used:

#### 1. Survey of bat roosts:

Study area was travelled intensively and surveyed to locate bat roosts. Primary approach of survey was to interact with locals and inquire about the presence of bat roosts in their area. Upon getting information, those locations were approached, explored and assessed for the presence of bat species.

2. Identification of bat species: Project Investigator has eight years experience of working on bats of the Thar Desert and attained proficiency in identifying species bats of this region based on their morphological features and appearance. Doubtful individuals were caught in hoop net from roosts and identified based on morphological measurements.

#### 3. Bat conservation awareness campaign:

Majority of bat in the study area roosts either in historical monuments (forts and *havalies*) or dilapidated buildings and unused wells that are in direct approach of people. They therefore are prone to face anthropological disturbances incurred by the virtue of existing bat myths and consequences of renovation activities. People in the study area do hate bats and do not want to see them in their surroundings. This leads intentional damage to bats on their roosting sites. To overcome with this problem, as a part of this project, we have launched bat conservation awareness campaign in this region. The prime objective of this conservation campaign was to change negative attitude and to inculcate the sense of appreciation about bats among locals.

To achieve this, we approached children and youths, at schools and colleges, and elders, at their settlements, that live in vicinity of existing roosts and imparted education, through lectures and personal demonstration and communications, about significance and nature of bats.

The project has been executed in following three phases:

#### (i) Preparatory phase (January to March 2008):

(a) Assessment of threat to bat roosts: All existing bat roosts were surveyed for assessment of current population status and their potential threats.

- (b) Volunteer training: People in vicinity of bat roosts have been interacted and area wise potential candidate were chosen to work as volunteers in this programme. They were provided direct exposure to bat roosts and trained to assist and strengthening the bat conservation campaign.
- (c) Production of publicity material: Posters and leaflets, illustrating the local bat species and their significance were developed for distribution during the implementation phase of campaign.

#### (ii) Implementation phase (April 2008 – August 2009):

- (a) Bat roost monitoring: Selected bat roosts were monitored during this phase for studying the population fluctuation and reproductive behaviour of the species of bats inhabited therein.
- (b) Education Campaign: Series of lectures and workshops were organized at schools, colleges and in local communities, on bats and their role in betterment of environment, to create awareness.
- (c) Field trips: were organised for onsite exposure of bats for bat enthusiastic people at nearby roosts.
- (d) Bat clubs: were formed at selected educational institutes with representation from local people for effective and constant monitoring, and to ensure safety of bat roosts in their area. Volunteers were encouraged to act as bat club coordinator and for disseminating valuable information on bats to all class of people and future generations there, such that to they protect their roosts forever.
- (e) Local media: were approached to obtain publicity support to this campaign through newspapers and local TV channels.

#### (iii)Report writing and follow up phase (September – December 2009):

Final report has been prepared and activities of bat clubs were followed up during this phase.

#### **OBSERVATIONS AND RESULTS**

#### (A)Survey and assessment of bat roosts:

A sum of nine species of bats, 7 micro chiropterans and 2 mega chiropterans (Table 1, Photo gallery II) were reported from Jodhpur district of the Thar Desert during this investigation from their 89 active roosts. Of the 19 bat roosts reported earlier from this area, from 1960 to 2007, seven were found deserted completely while other five have seen depletion in number of species inhabited there (Table 1 & 2, Fig. 11 & 12). Beside this we explored 77 new bat roosts (3 mega chiropterans and 74 micro chiropterans) from this study area (Table 3, Fig. 2 to 10).

Species composition at micro chiropteran roosts varied significantly from prevailing congregation of Greater Mouse-tailed bat, *Rhinopoma microphyllum kinneari* and Lesser Mouse-tailed bat, *Rhinopoma hardwickii* to solitary roosts of each species. We have observed the co-existence of *Rhinopoma microphyllum kinneari*, *Rhinopoma hardwickii*, *Taphozous perforators* and *Rhinolophus lepidus* at some of the roosts. However, at one roost in Tinwari four micro chiropteran species, *Rhinopoma microphyllum kinneari*, *Rhinopoma hardwickii*, *Taphozous perforatus*, *Taphozous nudiventris* and a mega chiropteran species, *Cynopterus sphinx* were found to roost together (Table 2 & 3).

Occupancy estimates revealed that *Rhinopoma microphyllum kinneari* is the most common among micro chiropterans followed by *Rhinopoma hardwickii*, *Taphozous nudiventris*, *Taphozous perforatus*, *Rhinolophus lepidus*, *Pipistrellus tenuis* and *Scotophilus heathii* prevailing respectively; but, *Pteropus giganteus* found abundant than *Cynopterus sphinx* among mega chiropterans.

Based on regular monitoring of some selected sites, temporal fluctuations in population size were observed in six of the seven micro chiropterans. Population of *Rhinopoma microphyllum kinneari* declined significantly in late summer whereas *Rhinopom.a hardwickii* population showed a spike during the same time. *Rhinolophus lepidus* and *Taphozous perforatus* populations declined gradually from winter to summer and remaining stable thereafter, but no significant fluctuations were observed in *Taphozous nudiventris* and *Scotophilus heathii* populations. It shows that some of the micro chiropteran species performs local migration to either overcome the effect of seasonal changes in microclimatic parameters of their roosts or to accommodate with food abundance, while others do not. Due to difficult roost access we could not study trend on population fluctuation in *Pipistrellus tenuis*.

As far as breeding of bats in the study area is concern, mating in *Pteropus giganteus* was observed in months of October and November, whereas parturition was observed in March and April. They found to deliver one pup and just after parturition the newborn hold position in mother's ventral body part by gripping her in head to head direction. Mating in Rhinopoma microphyllum kinneari and Rhinopoma hardwickii occurs in March and April, whereas parturition takes place in July and August. These too deliver single pup and remain attached to the ventral body parts of mother in head to tail direction. Parturition in *Taphozous perforatus* was observed in May and June, but we could not conclude their mating time. Most delivered females of this species were seen with single pups but few others were sighted to carry two pups, possibly the twins. The direction of attachment of pups to their mother was head to head. Mating in *Taphozous nudiventris* was usually observed in March and April, but some pairs seen to be mounting in July and August. Parturition in this species was observed in July and August and pups found attached to mother in head to head direction. Parturition in Scotophilus heathii was observed in June and July, but their mating time could not be studied. Most delivered females seen with single pups, but remaining carried twins attached to mother's ventral body parts in head to head direction. However, parturition in Rhinolophus lepidus was observed in May and June, period of mating could not be defined. Delivered females were found to carry single pup attached to their ventral body part in head to tail direction. We could not observe breeding activities in species of *Cynopterus sphinx* and *Pipistrellus tenuis*.

Mega chiropteran species, *Pteropus giganteus* found roosted on the seven species of trees *viz., Ficus bengalensis* (Banyan), *Ficus religiosa* (Peepal), *Azadirachta indica* (Neem), *Syzygium cumini* (Jamun), *Albizia lebeck* (Sares), *Saraca asoca* (Ashoka) and *Pithecellobium dulce* (Vilaiti Imaly), but *Cynopterus sphinx* were found roosted in deserted historical buildings like Havelies. The micro chiropteran species *viz, Rhinopoma microphyllum kinneari, Rhinopoma hardwickii, Taphozous perforatus, Taphozous nudiventris* and *Rhinolophus lepidus* are found roosted in the segregated locations of deserted public wells (Pisaca's), stepwells (Bhavadi's) unattended ruined building structures, under roofs of mud houses, manmade tunnels, temples and natural caves, whereas *Pipistrellus tenuis* was found roosted in deep dark crevices in concrete and mud walls of building's or rocks. In contrast to all these, the *Scotophilus heathii* found to roosts in the hollow spaces under dry foliage of palm trees.

Comparative analysis of data from current investigation to that with data from studies conducted in past from 1960 to 2007 revealed that seven bat roosts reported earlier have been deserted or destroyed completely in due course of time (Fig. 12). Of the nine prominent micro chiropteran roosts reported in recent past (Senacha, 2003) two, Shrinathji kee Haveli at Mahamandir and Krishna Nagar at New Pali Road in Jodhpur have became abandoned following the renovation activities and public intervention in due course of time(Table 2 and Fig. 12). While significant depletion is observed in species composition and populations at other seven micro chiropteran roosts. (Table 2 and Fig. 11). Two roosts of mega chiropteran species, Pteropus giganteus, the Rail Sadan and the Balsamand Garden reported earlier by Senacha (2003) have also seen remarkable depletion in their populations. Micro chiropteran species, Rhinolophus lepidus reported earlier co-existing with other three of the micro chiropterans at Mandore tunnel roost in Jodhpur by Senacha (2003) found missing in this investigation (Table 2 and Fig. 11). The species is comparatively timid to anthropological disturbances and might have moved out following generation of frequent vibrations through regular dynamite earth blasts in nearby stone mines. Earlier, this roost was comparatively far from the stone mining sites but now this distance has reduced with expansion in mining area.

Wild growth of the tree of *Prosopis juliflora* at openings of micro chiropteran roosts is unique but severe threat at least to species of *Rhinopoma microphyllum kinneari*, if not to others. Purohit *et al.* (2002) were first to report the death of individuals of *Rhinopoma microphyllum kinneari* by entangling in thorns of *Prosopis juliflora*, grown in close proximity of their roost openings. The findings are further supported by observations of Senacha (2003). We have also come across similar observation of death of *Rhinopoma microphyllum kinneari* individuals, by entangling in thorns of *Prosopis juliflora*, at some sites explored during this study. However, considering the fact that *Rhinopoma microphyllum kinneari* possess power of echolocation, it must not fail to detect presence of *Prosopis* twigs and thorns. Interestingly though other micro chiropteran species coexists in same roosts none of their individuals were found trapped in *Prosopis* thorns. These observations have raised a questions mark on potential of echolocation ability of *Rhinopoma microphyllum kinneari*. It seems either echolocation power become weak in some unhealthy or old individuals or be start malfunctioning temporarily in certain physiological or atmospheric conditions, leading this short of unique causalities. To unearth the exact fact behind this phenomenon detailed investigation is required on echolocation capabilities of individuals of this species.

Electrocution reported earlier in *Pteropus giganteus* by Purohit and Senacha (2003) and Senacha (2003) is quite common in this area and similar incidents were reported during this study (Fig.43). Total 28 individuals of this species were found dead due to electrocution at various feeding locations in this study area. Analysis of data revealed that most of these incidents took place, near the trees of *Ficus religiosa* (Peepal tree) planted road sides, on the open electricity wires installed for road lights or electricity supply to the houses. Individuals of *Pteropus giganteus* use eye vision and sense of smell to find their way while foraging as they lacks power of echolocation. While

approaching to feed on *Ficus religiosa* fruits and foliage individuals of this species sometime fails to detect electricity wires located in proximity of feeding trees and hit them incidentally falling prey of electrocution. Though it is quite expensive and difficult task to either replace open electricity wires to coated cables or displace electricity line from proximity of their feeding trees or switch on to underground electricity system, these are the only possible options to overcome with this short of problem.

Micro chiropteran roosts located in premise of ancient Forts and Havelies are prone to face threat of renovation. As these buildings are quite old their authorities are in process of renovation at most of the sites. We therefore approached the concern authorities and tried to convince them to not to disturb roosts of bats. However some were quite positive other seemed bit reluctant in lieu of the other benefits out of renovations. Majority of micro chiropteran populations in rural areas roosts in unattended public or personal wells used traditionally to source ground water for drinking, irrigation and household purpose. Ground water level receded drastically over the time in this area and most of the wells become dry and useless, but, they serve as preferred and safe roosts for micro chiropterans. Drinking water is supplied now by municipality pipelines in most of the villages while others opted to source ground water by tube wells or hand pumps. Therefore, dried wells, serving as roosts for micro chiropterans, are no longer appreciated by villagers in many places. To avoid any possibilities causality of animals and children falling in these deserted wells people have sealed them completely in some places and others have intension to do or fill them completely with debris and soil.

An emerging threat for chiropterans in this study area is establishment of wind energy farms at various locations that comprises of installation of large number of wind mills. Around 250 wind mills have already been installed in different locations and many more are underway of installation. Wind mills have proven dangerous claiming life of bats in many other parts worldwide. The reason behind short of incidents is that running wind mills located in series create dangerous zones of low atmospheric pressure. When bats enter this zone while performing foraging activities their blood pressure began falling rapidly and leads to failure of blood circulatory system, resulting into their death (Arnett, 2005). To minimize the short of expected incidents one has to initiate proper investigation on this issue and suggest proper damage control measures to the concern authorities.



Fig. 2. Distribution map of Pteropus giganteus roosts in Jodhpur district of the Thar Desert.



Fig. 3. Distribution map of Cynopterus sphinx roosts in Jodhpur district of the Thar Desert.



Fig. 4. Distribution map of Rhinopoma microphyllum kinneari roosts in Jodhpur district of the Thar Desert.



Fig.5. Distribution map of Rhinopoma hardwickii roosts in Jodhpur district of the Thar Desert.



Fig.6. Distribution map of Taphozous perforatus roosts in Jodhpur district of the Thar Desert.



Fig.7. Distribution map of Taphozous nudiventris roosts in Jodhpur district of the Thar Desert.



Fig.8. Distribution map of Rhinolophus lepidus roosts in Jodhpur district of the Thar Desert.



Fig.9. Distribution map of Scotophilus heathii roosts in Jodhpur district of the Thar Desert.



Fig.10. Distribution map of Pipistrellus tenuis roosts in Jodhpur district of the Thar Desert.



Fig.11. Distribution map of bat roosts that have seen depletion in number of species reported earlier in Jodhpur district of the Thar Desert.



Fig.12. Distribution map of completely deserted bat roosts in Jodhpur district of the Thar Desert.

#### (B) Bat conservation education campaign:

As mentioned earlier people in this area have been misunderstanding bats over last many generations and consider them as evil and sign of sin. They also believe in myth of bat attacking human nose. While campaigning we have delivered lectures and demonstrations about nature and significance of bats to children, students, youths and elders living in many of the urban and rural settlements of the study area (Figs. in Photo Gallery III) This exercise of bat campaign has helped many locals to sweep out existing myths on bats from their minds and turned them a lifelong admirer of bats. It is thus believed that these people will play key role in imparting right message to remaining public about nature and prevailing benefits of species of bats thriving in this area. Initiated bat clubs will be the source to teach the future generations about bats. By this way existing myths about bats from public mind would sweep out completely over the period of time and with their changed attitude people will start appreciating existence of bats in this area. Thus initiative of bat conservation through this project will flourish well and would be considered ahead a milestone achievement in field of wildlife conservation in this area.

#### RECOMMENDATIONS

Based upon the observations of this study following are the recommendations to conserve the roosts and species diversity of bats in Jodhpur of the Thar Desert.

- Myths about nature of bats are deep rooted among locals. However, bat conservation campaign played significant role to uproot bat myths and update knowledge about significance of bats among locals, efforts are further required to ensure that this message persuade thoroughly to maximum number of people and their future generations. To ensure this, constant efforts are required to educate people through means of articles in local newspapers, repeating series of lectures in schools, colleges and gatherings at settlements (towns/villages/dhanies) in due course of time.
- 2. Majority of bats in Jodhpur rural roosts in traditional public wells (Pisaca) used to source ground water. Most of these wells are running out of drinkable water and are not in use now. These, therefore, face a threat of either seals them completely or levels them with soil to avoid possibilities of animals and children falling in accidentally. It is therefore of vital importance that concern authorities of these wells be approached and convinced to not to level them, but be allowed to seal partially in such a way that a comfortable opening be left for bats to make in and out moment while foraging.
- 3. Chiropteran roosts located in ancient monuments like Forts and Havelies are prone to face threat of renovation. Therefore, constant efforts are required to convince the concern authorities to avoid probable damage to these bat roosts. If comfortable, they can be further better educated about importance and diversity of species of bats inhabited in roosts, located in their premise, and be encouraged to make it a wildlife spot to show to visitors. But, they should only be permitted if they follow the wildlife regulatory norms.
- **4.** Local wildlife department must be chased to rationalize their efforts to include bats in their conservation priorities. Currently bats are low profile and not in their conservation priority list.
- **5.** Study area should regularly be reinvestigated in due course of time to assess status of diversity of bats and to evaluate the impact of conservation measures initiated in this study.
- **6.** Similar approach of studying bats and efforts to create bat conservation awareness is well required in other parts of the Thar Desert, such that a wider objective of conservation of bats in this unique ecosystem be achieved.

#### FUTURE PLAN

Following is my future plan to conserve diversity of bat in the Thar Desert.

- 1. I would try to promote and ensure fruitful functioning of the bat clubs instituted in the study area, such that they achieve their objectives of imparting bat conservation awareness education and to inculcate sense of appreciation about bats among younger and future generations.
- 2. To achieve wider objectives of conservation of bats in the Thar Desert I would write some more project proposals and try that similar types of studies are undertaken and bat conservation awareness programme be launched in remaining parts of the Thar Desert.
- 3. I would also try to produce a documentary film on bats of the Thar Desert, which would be instrumental in imparting bat conservation education and strengthen the future initiatives of bat conservation awareness programme in this region.
- 4. Initiatives of community conservation have been quite successful and a proven tool to protect various wildlife species in this region. I therefore would target prominent community leaders to educate them about significance and facts on bats, and would try to convince them that bats are the symbol of prosper and healthy ecosystem. Then would request them to advertise and impart this message among their community followers such that they start protecting bats.
- 5. I would write popular articles and try to ensure that information on bats be frequently published in local newspapers, such that readers be updated about status of bats in their region.
- 6. I would appreciate to assist local forest department in providing scientific information on bats and in future bat conservation initiatives taken on their behalf, if required.

However, a lot many people and volunteers have contributed for the successful accomplishment of this project following are the key person who acted as project team. <b>Designation</b>	Name of the person
Principal Investigator	Dr. K. R. Senacha
Coordinator	Dr. Sumit Dookia
Area Coordinator	Dr. Amit Kotia
Area Coordinator	Mr. Jeeva Ram Tank
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Volunteer In-Charge, Shergarh Tahseel	Mr. Chandan Singh
Volunteer In-Charge, Phalodi Tahseel	Mr. Tejkaran
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#### **PROJECT TEAM**

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#### PHOTO GALLERY - I

Design and format of the posters developed for the purpose of bat conservation campaign.



Fig.13: Format of postcard size posters of Indian Flying Fox, *Pteropus giganteus*, and Greater Mousetailed bat, *Rhinopoma microphyllum kinneari* developed and distributed among target groups for publicity.



Fig.14: Postcard size poster of Indian Flying Fox, *Pteropus giganteus*, developed and distributed among target groups for publicity.



Fig.15: Format of bat informative poster developed in A4 and A3 sizes and distributed among target groups during the bat conservation education campaign in Jodhpur. It was also developed in size of 4 x 6 ft to use as a visual aid in lectures delivered during this campaign.

#### PHOTO GALLERY - II

Photographic documentation of species and roosting sites of bats reported during this investigation from Jodhpur district of the Thar Desert.



Photo by: Dr. K. R. Senacha

Fig. 16: Indian Flying Fox, *Pteropus giganteus* roosted at Rail Sadan roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 17: Short-nosed Fruit bat, Cynopterus sphinx reported from Badi Haveli roost, Tinwari.



Photo by: Dr. K. R. Senacha

Fig. 18: Greater Mouse-tailed bat, *Rhinopoma microphyllum kinneari* reported from Mandore Tunnel roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig 19: Lesser Mouse-tailed bat, Rhinopoma hardwickii reported from Mandore Tunnel roost, Jodhpur



Photo by: Dr. K. R. Senacha

Fig. 20: Egyptian Tomb bat, Taphozous perforatus reported from Mandore Tunnel roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 21: Naked-rumped Tomb bat, *Taphozous nudiventris* reported from Deval of Maharaja Shri Gaj Singh roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 22: Indian Pigmy bat, *Pipistrellus tenuis* reported from house wall crevices in Doli village, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 23: Asiatic Greater Yellow House bat, *Scotophilus heathii* reported from foliage of palm tree plantation roost, Mandore Garden, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 24: Blyth's Horse-shoe bat, *Rhinolophus lepidus* reported from Daijar Mata Mandir cave roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 25: A colony of Indian flying fox, *Pteropus giganteus* roosting on the tree of *Pithecellobium dulce* (Vilaiti Imaly) at Rail Sadan, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 26: A mix colony of *Rhinopoma microphyllum kinneari* and *Rhinopoma hardwickii* roosting on the fore walls of Chakelav well at Mehrangarh fort premise, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 27: A mix colony of *Rhinopoma microphyllum kinneari* and *Rhinopoma hardwickii* roosting inside Mandore Tunnel roost located at Mandore garden, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 28: A colony of Asiatic Greater Yellow House bat, *Scotophilus heathii* roosting inside the dry foliage of Palm trees in Mandore garden, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 29: A colony of Blyth's Horseshoe bat, *Rhinolophus lepidus* roosting inside a Daijar Mata Mandir cave, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 30: A day old pup (with the umbilical cord) of *Rhinopoma microphyllum kinneari* attached to ventral body parts of their mother at Mandore tunnel roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 31: An infant of *Rhinopoma hardwickii* attached with the ventral body part of their mother roosting at Bheem Bhadak roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 32: A maternity colony of Egyptian Tomb bat, *Taphozous perforatus* at Mandore tunnel roost located at Mandore garden, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 33: An infant of Naked-rumped Tomb bat, *Taphozous nudiventris* attached with the abdomen of their mother, at a historic monument called Deval of Maharaja Shri Gaj Singh in Mandore garden, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 34: A *Rhinolophus lepidus* mother along with her pup attached to ventral body parts in head to tail direction while roosting at Jain Bhavan roost, Dhava village, Luni Tahseel.



Photo by: Dr. K. R. Senacha

Fig. 35: Infants of *Taphozous perforatus* roosted alone at Mandore tunnel roost while their mothers were out for foraging in night.



Photo by: Dr. K. R. Senacha

Fig. 36: Individuals of *Rhinopoma microphyllum kinneari* (first two from the right) and *Taphozous perforatus* (all four others) roosted in close proximity at Mandore tunnel roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 37: Mix colony of *Cynopterus sphinx* (biggest individual in the center of the middle row); *Taphozous perforatus* (second from the left in the lower row) and *Rhinopoma microphyllum kinneari* (all others) roosting at Badi Haveli roost in Tinwari village, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 38: Roosting association of three micro chiropteran species, *Rhinopoma hardwickii*, *Taphozous nudiventris* and *Rhinolophus lepidus* at a cave in the premise of Ban Mata temple near Bhavad village in Osia, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 39: Hibernating colony of *Rhinopoma microphyllum kinneari* roosting at Mandore tunnel roost, Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 40: Individuals of *Pteropus giganteus* congregated over the trunk of tree of *Pithecellobium dulce* (Vilaiti Imaly) to overcome the effect of heat waves during hot afternoon of a summer day.



Photo by: Dr. K. R. Senacha

Fig. 41: Wild grown *Prosopis juliflora* at entrance of a micro chiropteran roost in Jodhpur evidencing death of individuals of *Rhinopoma microphyllum kinneari* trapped in its thorns.



Photo by: Dr. K. R. Senacha

Fig. 42: An individual of *Rhinopoma microphyllum kinneari* trapped freshly in thorns of *Prosopis juliflora,* while emergence at one of the micro chiropteran roosts in Jodhpur. We had have helped it to get out of pierced thorn and saved its life.



Photo by: Dr. K. R. Senacha

Fig. 43: Electrocuted dead individual of Pteropus giganteus near feeding tree Ficus religiosa in Jodhpur.



Photo by: Dr. K. R. Senacha

Fig. 44: Ruminants of bats sighted at evacuated roost of *Rhinopoma microphyllum kinneari* and *Rhinopoma hardwickii*, in Jodhpur, is probably a case of roost setting ablaze by miscreants to get rid of inhabiting bat in their locality.



Photo by: Dr. K. R. Senacha

Fig. 45: Farmers collecting guano of micro chiropteran bats to use in to use in crop field as a biofertilizer.

#### PHOTO GALLERY - III Photographic documentation of bat campaign conducted in Jodhpur district of the Thar Desert during the period of this project.



Fig.46: Principal Investigator of the project Dr. K. R. Senacha (left) presenting informative poster on bats to Principal of Senior Higher Secondary School of village Guda Bishnoiyaan in Jodhpur Tahseel for display in his school.



Fig.47: Principal Investigator of the project presenting lecture on bats to school children and teachers of Government Upper Primary Girls School of village Guda Bishnoiyaan in Jodhpur Tahseel.



Fig.48: School children of Senior Higher Secondary School, Mathania in Osia Tahseel while interacting with Principal Investigator of the project, after hearing his lecture on bats of the Thar Desert.



Fig.49: Principal Investigator of the project while interacting with villagers about bats, in Panchayat Bhavan of village Solankia Tala in Shergarh Tahseel of Jodhpur district, and acquiring information about bat roosts in their area.



Fig.50: Teachers of the Gehlot Upper Primary Girls School, Badali, while going through the content of informative poster on bats of Jodhpur.



Fig.51: Students of Government Primary School, village Sirda in Falodi Tahseel while posing with posters of bats after hearing informative lecture on bats by Principal Investigator of the project.



Fig.52: Principal Investigator of the project while delivering a lecture on bats in Jalandhar Nath Adarsh Upper Primary School, Bhungara in Shergarh Tahseel.



Fig.53: Volunteer In-Charge of Luni Mr. Narayan Ram Anjana and Volunteer In-Charge of Jodhpur Mr. Gajendra Singh along with Principal Investigator of the project while posing in front of a micro chiropteran roost, Well at Kago ki Dhani farm in village Doli, Tahseel Jodhpur.



Fig.54: Students of Jalandhar Nath Adarsh Upper Primary School, Bhungara in Shergarh Tahseel posing with bat posters.



Fig.55: Student attending lecture on bats by Principal Investigator of the project in Government Upper Primary School, Village Gelawas in Jodhpur Tahseel.



Fig.56: Children posing with bat campaign banner at village Tepu in Tahseel Falodi.



Fig.57: Principal Investigator of the project while enquiring, through elder villagers sitting on tea stall, about the possible bat roosts in their area.



Fig.58: Project team while investigating colony of bats roosted in an abandoned public well of village Alidas Nagar located near Shetarava in Shergarh Tahseel.



Fig.59: Bat informative poster pasted in a medical shop for public awareness in village Lohawat, Tahseel Shergarh.



Fig.60: People of village Kanasar in Tahseel Falodi while learning about species and ecological importance of bats found in Jodhpur of the Thar Desert.



Fig.61: Principal Investigator (left) and Volunteer In-Charge of Jodhpur, Mr. Gajendra Singh while posing with bat poster at milestone showing distance of Pokharan, world famous site for first atomic bomb testing in India .



Fig.62: Villager along with area coordinator of the project posing with banner of bat conservation education campaign in remote traditional settlement Buddi Ri Dhani in Falodi Tahseel. .



Fig.63: Salt pan laborer in bap village area of Tahseel Falodi while giving information of bat roosted in existing wells of this area.



Fig.64: Policeman posing with bat informative poster at Police Station in Bhojasar of Falodi Tahseel. The couple of posters were provided them to display at public places in their area.



Fig.65: A group of bat enthusiast taken for onsite exposure of bats in Fort roost in the village Danwara of Tahseel Osian.



Fig.66: A Poojari of temple while being taught about the ecological role and types of species of bats inhabited in Jodhpur district of the Thar Desert. Temple Poojari in this part are quite influential among locals and they follow their standing instructions.



Fig.67: Project Coordinator Dr. Sumit Dookia along with Mr. Girdhari Lal Kadwasara, Volunteer In-Charge of Bhopalgarh, at traditional step well (Bavadi) roost of micro chiropterans located in premise of Jogmaya Temple, Bagoria village, Tahseel Bhopalgarh.



Fig.68: Dr. Senacha while teaching young students about bats at Sagi ki Bhakari micro chiropteran roost near Jhalamand village in Jodhpur Tahseel.



Fig.69: Dr. Senacha while interacting with youngsters at Sagi ki Bhakari micro chiropteran roost near Jhalamand village in Jodhpur Tahseel.



Fig.70: Upcoming wind farms in Shergarh Tahseel, Jodhpur.



Fig.71: A view of under construction wind farms in Osia Tahseel, Jodhpur.



Fig. 72: Principal Investigator Dr. K. R. Senacha while observing bats at different roosts in the study area.



Fig. 73: Volunteers at the bat roosts while onsite exposure and demonstration about identifying the species of bats.

### Table 1 Taxonomic status of the chiropteran species reported at Jodhpur Thar Desert during this study

Name of the species	Common name	Family	Superfamily
Sub-order: Megachiroptera			
Pteropus giganteus giganteus (Brunnich, 1782)	Indian Flying Fox	Pteropodidae	-
Cynopterus sphinx (Vahl, 1797)	Shot-nosed fruit bat	Pteropodidae	-
Sub-order: Microchiroptera			
Rhinopoma microphyllum kinneari (Brunnich, 1782)	Greater Mouse-tailed bat	Rhinopomatidae	Emballonuriodea
Rhinopoma hardwickii (Gray, 1831)	Lesser Mouse-tailed bat	Rhinopomatidae	Emballonuriodea
Taphozous perforatus (E. Geoffroy, 1818)	Egyptian Tomb bat	Emballonuridae	Emballonuriodea
Taphozous (Liponycteris) nudiventris (Cretzschmar, 1830-31)	Naked-rumped Tomb bat	Emballonuridae	Emballonuriodea
Scotophilus heathii (Horsfield, 1831)	Asiatic Greater Yellow House	Vespertilionidae	Vespertilionoidea
	bat		
Pipistrellus tenuis (Temminck, 1840)	Indian Pygmy bat	Vespertilionidae	Vespertilionoidea
Rhinolophus lepidus (Blyth, 1844)	Blyth's Horseshoe bat	Rhinolophidae	Rhinolophoidea

### Table 2 Distribution of chiropterans reported earlier in and around Jodhpur and their current status

Roosting sites	Profile of bat species				
	Reported earlier (1961 to 2007)	Reported during this study (2008-2009)	Missing		
			IVIISSII Ig		
(I) Mega chiropteran					
roosts					
Balsamaand Garden,	Pteropus giganteus	Pteropus giganteus			
Jodhpur			Nil		
(26.33361° N, 73.02361° E)					
Rail Sadan, Jodhpur	Pteropus giganteus	Pteropus giganteus			
(26.27111° N, 73.01611° E)			Nil		
(II) Micro chiropteran		· ·			
roosts					
Meharangarh fort, Jodhpur	(i) Rhinopoma microphyllum kinneari	(i) Rhinopoma microphyllum kinneari			
(26.29333° N, 73.02028° E)	(ii) Rhinopoma hardwickii	(ii) Rhinopoma hardwickii	(i) Megaderma lyra lyra		
	(iii) Megaderma lyra lyra				

Mandore tunnel, Jodhpur	(i) Rhinopoma microphyllum kinneari,	(i) Rhinopoma microphyllum kinneari	(i) Hipposideros fulvus
	(iii) Hipposideros fulvus	(ii) Rhinopoma hardwickii	(ii) Megaderma lyra lyra
	(iv) Megaderma lyra lyra	(iii) Taphozous perforatus	(iii) Rhinolophus lepidus
	(v) Rhinopoma hardwickii	(,	(,
	vi) Rhinolophus lepidus		
Bheembhadak, Jodhpur	(i) Rhinopoma microphyllum kinneari	(i) Rhinopoma microphyllum kinneari	(i) Taphozous kachhensis
(26.29611° N, 72.95750° E)	(ii) Rhinopoma hardwickii	(II) Rhinopoma hardwickii	(1. nudiventris)
	(III) Tapnozous kachnensis (T. hudiventris)		
(26 32120° N 73 05534° E)	(i) Rhinopoma microphylium kinnean (ii) Tanbazous porforatus	INII	A//
(20:32129 N, 73:03334 E)	(i) Rhinonoma microphyllum kinneari	Nii	ΔΙΙ
(26.29531° N. 73.05713° F)	(ii) Rhinopoma hardwickii	1411	$\cap$ "
(,,,,,	(iii) Taphozous perforatus		
Balsamand garden, Jodhpur	(i) Rhinopoma hardwickii	Nil	(i) Rhinopoma hardwickii
(26.333946° N, 73.024156°			
E)			
Udai Mandir, Jodhpur	(i) Rhinopoma microphyllum kinneari	Nil	All
(26.29462° N, 73.03655° E)	(ii) Rhinopoma hardwickii		
Shripathii kaa hayali	(III) Tapnozous perforatus	NU	
Mahamandir Jodhnur	(i) Rhinopoma microphylium kinnean (ii) Phinopoma hardwickii	1111	A//
(26.30667° N 73.04361° F)	(iii) Taphozous perforatus		
Open Convocation Center.	(i) Rhinopoma microphyllum kinneari	(i) Rhinopoma microphyllum kinneari	Nil
JNV University New	(ii) Rhinopoma hardwickii	(ii) Rhinopoma hardwickii	
Campus, Jodhpur			
(26.24639° N, 73.02417° E)			
Mehalado, Soor Sagar,	(i) Rhinopoma microphyllum kinneari	Nil	(i) Rhinopoma
			microphyllum kinneari
(26.32972° N, 72.98806° E)			(i) Dhinanana
Krisnna Nagar, Joonpur	(I) Rhinopoma microphyllum kinneari	INII	(I) Kninopoma microphyllum kinnopri
(20.22001 N, 73.02000 E) Sagee kee Bhakari	(i) Rhinonoma microphyllum kinneari	(i) Rhinonoma microphyllum kinneari	(i) Taphozous pudiventris
Jhalamand	(ii) Rhinopoma hardwickii	(ii) Rhinopoma hardwickii	
(26.21361° N, 73.11972° E)	(iii) Taphozous nudiventris		
Daijar Mata Mandir, Jodhpur	(i) Rhinopoma hardwickii	(i) Rhinolophus lepidus	Nil
(26.39694° N, 73.05278° E)	(ii) Rhinolophus lepidus	(ii) Rhinopoma hardwickii	

Palm tree plantation of	(i) Scotophilus heathii	(i) Scotophilus heathii	Nil
Mandore garden, Jodhpur			
(26.35222° N, 73.02806° E)			
Deval of Maharaja Shri Ajit	(i) Taphozous nudiventris	(i) Taphozous perforatus	(i) Taphozous nudiventris
Singh, Mandore Garden,	(ii) Taphozous perforatus		
Jodhpur			
(26.35222° N, 73.03583° E)			
Deval of Maharaja Shri Gaj	(i) Taphozous nudiventris	(i) Taphozous nudiventris	Nil
Singh, Mandore Garden			
Jodhpur			
(26.35250° N, 73.03583° E)			
Mix roost of Mega chiropter	ans		
Badi Haveli, Tinwari, Osia	(i) Rhinopoma microphyllum kinneari	(i) Rhinopoma microphyllum kinneari	Nil
(27.03661° N, 71.51699°)	(ii) Rhinopoma hardwickii	(ii) Rhinopoma hardwickii	
	(iii) Taphozous nudiventris	(iii) Taphozous nudiventris	
	(iv) Taphozous perforatus	(iv) Taphozous perforatus	
	(v) Cynopterus sphinx	(v) Cynopterus sphinx	

Table 3

Species profile of the newly reported chiropteran roosts from Jodhpur district of the Thar Desert during this study through the years 2008 – 2009

Name of the roost site	Type of Roost	Geographical Position	Name of the city/village/settlem ent	Tehsil	Species Composition
Mega chiropteran roosts					
Jeevati Samadhi	Banyan tree	26.33960° N, 72.87443° E	Keru	Jodhpur	Pteropus giganteus
Khinyaniya well, Ramdwara	Neem tree	26.34848° N, 72.82760° E	Balesar Satta	Shergarh	Pteropus giganteus
Chowk in Meghwal colony	Neem tree	26.35302° N, 72.83818° E	Balesar Durgawata	Shergarh	Pteropus giganteus
Micro chiropteran roosts					
Ram Ka Kua	Well sidewalls	26.17812° N, 72.88430° E	Doli	Luni	Rhinopoma microphyllum kinneari

House of Mr. Jagmal Ram	Wall Crevices	26.17375° N,	Doli	Luni	Rhinopoma microphyllum
Anjana Farra Mall Kara ki Dhani		72.88617° E	Dell	L	Kinneari Disistra Ilus, tanusia
Farm Well Kago Ki Dhahi	well sidewalls	26.20189° N,	Doll	Luni	Pipistrelius tenuis
	Dilamidatad	72.90572° E	Dhave	L	Dhina la nhua da nisha
Jain Bhavan (Gram	Dilapidated	26.05989° N,	Dhava	Luni	Rhinolophus lepidus
Panchayat Bhavan)	building	72.74289° E			
House of Sh. Ganga Singh Ji	Semi-constructed	26.53922°N, 72.38058°	Aagolai	Shergarh	Rhinopoma microphyllum
	building	E			kinneari
					Rhinopoma hardwickii
Public Well (Deserted)	Well sidewalls	26.59675° N,	Alidas Nagar, near	Shergarh	Rhinopoma microphyllum
		72.34292° E	Shetarana		kinneari
Farm Well at Saro ki Dhani	Well sidewalls	26.59589° N,	Madasar - Deda	Shergarh	Rhinopoma microphyllum
		72.34473° E			kinneari
Fort premise	Ruined rooms	26.59594° N,	Setarawa	Shergarh	Rhinopoma hardwickii
		72.34469° E			
Public Well (Pisaca)	Well sidewalls	26.53650° N,	Solankia Tala	Shergarh	Rhinopoma microphyllum
		72.26992° E			kinneari
Public Well (Pisaca)	Well sidewalls	26.43903° N,	Bhungra	Shergarh	Rhinopoma microphyllum
		72.28225° E		Ŭ	kinneari
Goga Dev Temple	Temple ceiling	26.43597° N.	Bhungra	Shergarh	Rhinopoma hardwickii
	and walls	72.28350° E	- <b>J</b> -	5	
Door Singh ka Kua	Well sidewalls	26.49128° N.	Gada	Shergarh	Rhinopoma hardwickii
		72 36672° F		e	Rhinopoma microphyllum
		12:000:2 2			kinneari
Public well (Pisaca)	Well sidewalls	26 52461° N	Ketu	Shergarh	Rhinopoma hardwickii
		72 45486° F		onorgani	
Public Well (Pisaca) – Kharia	Well sidewalls	26 55569° N	Bhalu Kalla	Sheragarh	Rhinonoma hardwickii
Rera		72 50319° F	Dhala Kalla	oneragam	
Rhinonoma micronhyllum kinne	l ari	72.00010 E			
Public Woll (Pisaca) – Nava		26 55621° N	Bhalu Kalla	Shoragarh	Phinonoma hardwickii
Public Well (Fisaca) – Naya		72 50211° E		Sherayan	Phinopoma microphyllum
Dera		72.50311 E			kinnoori
Bublic Wall (Discos) Kharia	Wall aidewalls	26 58026° N	Pholy Potongorh	Shargarh	NIIIIIdall Dhinonomo hardwiakii
Public Well (FISaca) – Khafia		20.30030 IN,	Dhalu Kalangam	Shergan	Rilliopoma narowickii
Dera		12.31/01 E			Kninopoma micropnylium
		00 500 45° N	Dhalu Datau waiti	Oh a na a nh	
Public VVell (Pisaca) _ Naya	vveli sidewalis	20.58345° N,	Bhalu Ratangarh	Snergarn	Rninopoma nardwickii
Bera		/2.51/21° E			Kninopoma microphyllum

					kinneari
Public Well (Pisaca)	Well sidewalls	26.65550° N, 72.57789° E	Chamu	Shergarh	Rhinopoma hardwickii
House of Mr. Dhana Ram Paliwal	Dilapidated mud house	26.73476° N, 72.47704° E	Barnau	Shergarh	Rhinopoma hardwickii Rhinopoma microphyllum kinneari Taphozous nudiventris
Public Well (Pisaca)	Well sidewalls	26.77328° N, 72.32633° E	Dechu	Shergarh	Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	26.92078° N, 72.13650° E	Dhadhu	Phalodi	Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	27.02286° N, 72.12550° E	Khara	Phalodi	Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	27.19047° N, 72.05647° E	Sihara	Phalodi	Rhinopoma hardwickii Rhinopoma microphyllum kinenari
Ground Water Tank	Tank ceilings	27.19050° N, 72.05650° E	Sihara	Phalodi	Taphozous nudiventris
Public Well (Pisaca)	Well sidewalls	27.27392° N, 72.02082° E	Tepu	Phalodi	Rhinopoma hardwickii Taphozous nudiventris
Public Well (Pisaca)	Well sidewalls	27.44772° N, 72.11086° E	Kanasar	Phalodi	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Public well (Pisaca)	Well sidewalls	27.48548° N, 72.11346° E	Nava	Phalodi	Rhinopoma microphyllum kinneari
Public Well (Pisaca)	Well sidewalls	27.48114° N, 72.13132° E	Bhadala	Phalodi	Rhinopoma microphyllum kinneari
Dilapidated mud building, near Main Market	Ceiling sidewalls	27.37350° N, 72.35517° E	Вар	Phalodi	Rhinopoma hardwickii
Dilapidated building (deserted) near	Well sidewalls	27.37339° N, 72.35508° E	Вар	Phalodi	Rhinopoma hardwickii
Salt Pan well of Mr. Pachu Lal Sanda	Well sidewalls	27.33796° N, 72.38717° E	Вар	Phalodi	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Dilapidated Mud House (Deserted)	Dilapidated mud house	27.31083° N, 72.51636° E	Jambu	Phalodi	Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	27.22983° N,	Bhinyasar	Phalodi	Rhinopoma hardwickii

		72.77325° E			
Public Well (Pisaca)	Well sidewalls	27.22983° N, 72.80217° E	Bhojasar	Phalodi	Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	27.20075° N, 72.26564° E	Aau	Phalodi	Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	27.09203° N, 72.88236° E	Sewap	Phalodi	Rhinopoma hardwickii Rhinopoma microphyllum kinneari
Thakurji Temple	Temple ceiling / walls	27.08361° N, 72.95292° E	Esharu	Phalodi	Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	26.96231° N, 72.87756° E	Matoda	Osia	Rhinopoma hardwickii Rhinopoma microphyllum kinneari
Public Well (Pisaca)	Well sidewalls	26.88436° N, 72.88939° E	Padsala	Osia	Rhinopoma hardwickii Rhinopoma microphyllum kinneari
Village Fort	Fort	26.71269° N, 73.09492° E	Danwara	Osia	Rhinopoma hardwickii Rhinopoma microphyllum kinneari
Public Well (Pisaca)	Well sidewalls	26.80350° N, 73.13497° E	Chandrak	Osia	Rhinopoma microphyllum kinneari
New Public Well (Pisaca)	Well sidewalls	26.82680° N, 73.17284° E	Hania	Osia	Rhinopoma microphyllum kinneari
Jagdamba Temple	Temple ceiling / walls	26.80600° N, 73.27694° E	Bhari Nagar	Osia	Rhinopoma hardwickii
Thakurji Temple	Temple ceiling / walls	26.76478° N, 73.42125° E	Paladi	Bhopalgarh	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Baba Raghuram Temple	Temple Tomb Crevices	26.70839° N, 73.47614° E	Surpura Khurd	Bhopalgarh	Scotophilus heathii Pipistrellus tenuis
Fort	Fort ceiling / walls	26.70132° N, 73.47112° E	Surpura Khurd	Bhopalgarh	Rhinopoma microphyllum kinneari
Fort	Fort ceiling / walls	26.65489° N, 73.49178° E	Bhopalgarh	Bhopalgarh	Rhinopoma hardwickii Rhinopoma microphyllum kinneari
Shimbhasheva Ashram	Ashram ceiling / walls	26.65423° N, 73.49214° E	Bhopalgarh	Bhopalgarh	Rhinopoma hardwickii Rhinopoma microphyllum

					kinneari
Temple Bavadi (Step Well)	Step Well	26.59822° N, 73.49769° E	Bagoria	Bhopalgarh	Rhinopoma microphyllum kinneari
Tukon ka Bhakar (Near Sujannath Temple)	Rock crevices	26.60531° N, 73.44600° E	Sopado	Bhopalgarh	Rhinopoma microphyllum kinneari
Shyam Manohar Prabhu Temple	Store room	26.26962° N, 72.94765° E	Choupasani	Jodhpur	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Old building near Arana Jharna Bath Kund	Unattended rooms	26.30156° N, 72.93604° E	Arana Jharna	Jodhpur	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Dilapidated building in Maheshawari Mohalla	Unattended ruined rooms	26.34497° N, 72.87322° E	Keru	Jodhpur	Rhinopoma microphyllum kinneari Rhinopoma hardwickii Rhinolophus lepidus
A building of Mr. Meethalal Jain	Unattended ruined building	26.53910° N, 72.38154° E	Aagolai	Shergarh	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
A building Ramdwara	Unattended rooms	26.34845° N, 72.82785° E	Balesar Satta	Shergarh	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
House of Mr. Nema Ram in Meghwal colony	Roof of room of this house	26.35383° N, 72.83785° E	Balesar Durgawata	Shergarh	Rhinolophus lepidus
Ban Mata temple	Cave roof and sidewalls	26.46174° N, 73.10627° E	Bhavad	Osia	Rhinopoma microphyllum kinneari Rhinopoma hardwickii Rhinolophus lepidus Taphozous nudiventris
An unattended house in Brahmapuri Mohalla	Roof and walls of a room of this house	26.61976° N, 73.17754° E	Bavadi	Osia	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Meethia Bera public well (Pisaca)	Well sidewalls	26.62954° N, 73.13572° E	Bada Kelava	Osia	Rhinopoma microphyllum kinneari
Jeevati Samadhi premise	Roof and walls of a room of a building	26.64421° N, 73.13695° E	Mevasa	Osia	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Public Well (Pisaca)	Well sidewalls	26.64705° N,	Santoda Khurd	Osia	Rhinopoma microphyllum

		73.15146° E			kinneari
Public Well (Pisaca)	Well sidewalls	26.65322° N, 73.17062° E	Basani Bhatian	Osia	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Kot of Maharaja Ummed Singh	Roof and walls of unattended rooms	26.66512° N, 73.19035° E	Ummed Nagar	Osia	Rhinopoma microphyllum kinneari
Unattended haveli of Kotecha Thakur	Roof and walls of	26.69202° N, 73.22457° E	Bada Kotecha	Osia	Rhinopoma microphyllum kinneari
nattended rooms					
Aasop Fort	Roof and walls of unattended rooms	26.79310° N, 73.58240° E	Aasop	Osia	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Haveli of Mr. Vijaya Raj Tailor	Roofs and walls of unattended rooms	26.79588° N, 73.58105° E	Aasop	Osia	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Gadi ka Bera Public Well (Pisaca)	Well sidewalls	26.79153° N, 73.58008° E	Aasop	Osia	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Unoccupied rooms in premise of Aai Mata Temple	Roofs and walls of rooms	26.18093° N, 73.70536° E	Bilara	Bilara	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Deserted mud house	Roofs and walls of rooms	26.21443° N, 73.61541° E	Bhavi	Bilara	Rhinopoma microphyllum kinneari
House of Shri Ratan Bishnoi	Wall crevices	26.33421° N, 73.14269° E	Banar	Jodhpur	Pipistrellus tenuis
Public Well	Well sidewalls	26.26252° N, 73.28660° E	Dangiyawas	Jodhpur	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Unoccupied house of Shri Khem Chand Jain	Roofs and walls of rooms	26.37850° N, 73.54428° E	Pipar	Bilara	Rhinopoma microphyllum kinneari
Public Well	Well sidewalls	26.06669° N, 73.07265° E	Kakani	Luni	Rhinopoma microphyllum kinneari Rhinopoma hardwickii
Unoccupied house of Shri Nena Ram Bishnoi	Roofs and walls of rooms	26.03350° N, 73.07770° E	Luni	Luni	Rhinopoma microphyllum kinneari

# Table 4List of institutes visited during the campaign

Name of the Institute	Name of the city/village/settlement	Tahseel
Schools		
Government Senior Secondary School, Guda	Guda Bishnoiyan	Jodhpur
Bishnoiyan		
Government Upper Primary Girls School, Guda	Guda Bishnoiyan	Jodhpur
Bishnoiyan		
Government Upper Primary School, Khejarali	Khejarali	Jodhpur
Government Upper Primary School, Jhalamand	Jhalamand	Jodhpur
Gehlot Upper Primary Girls School, Badali	Badali	Jodhpur
Government Senior Secondary School, Tilwasani	Tilwasani	Jodhpur
Government Upper Primary School, Dangiyawas	Dangiyawas	Jodhpur
Government Higher Secondary School, Bilara	Bilara	Bilara
Shri Aaiji Vidhaya Mandir Senior Secondary	Bilara	Bilara
School, Bilara		
Government Secondary School, Bhavi	Bhavi	Bilara
Government Senior Secondary School, Luni	Luni	Luni
Government Senior Secondary School, Doli	Doli	Luni
Government Upper Primary School, Nar Nadi	Nar Nadi	Luni
Government Upper Primary School, Gelawas	Gelawas	Luni
Government Senior Secondary School, Dhava	Dhava	Luni
Government Upper Primary School, Chichoraly	Chichoraly	Luni
Government Higher Secondary School, Agolai	Agolai	Shergarh
Government Senior Secondary School, Shergarh	Shergarh	Shergarh
Government Secondary School, Dhadhania	Dhadhania	Shergarh
Government Senior Secondary School, Balesar	Balesar	Shergarh
Government Secondary School, Kili	Kili	Shergarh
Government Higher Secondary School, Setarawa,	Setarawa	Shergarh
Government Primary School, Alidas Nagar	Alidas Nagar	Shergarh
Government Secondary School, Solankia Tala	Solankia Tala	Shergarh
Government Secondary School, Bhungara	Bhungara	Shergarh
Jalandhar Nath Adarsh Upper Primary School,	Bhungara	Shergarh
Bhungara		
Government Upper Primary School, Rai Singh	Rai Singh	Shergarh

Government Upper Primary School, Door Singh Ka Kua, Gada	Gada	Shergarh		
Government Upper Primary School, Ratan Singh Ki Dhani, Choppan Mill	Chopan Mill	Shergarh		
Government Primary School, Ketu	Ketu	Shergarh		
Government Secondary School, Bhalu Kala	Bhalu Kala	Shergarh		
Government Upper Primary School, Bhalu Ratangarh	Bhalu Ratangarh	Shergarh		
Government Higher Secondary School, Chamu	Chamu	Shergarh		
Government Upper Primary School, Kalania Ki Dhani	Kalania Ki Dhani	Shergarh		
Government Upper Primary School, Thodia	Thodia	Shergarh		
Government Upper Primary School, Jagaria	Jagaria	Phalodi		
Government Secondary School, Bavadi Kalla	Bavadi Kalla	Phalodi		
Government Senior Secondary School, Shekhasar	Shekhasar	Phalodi		
Government Upper Primary School, Sirdha	Sirdha	Phalodi		
Government Senior Secondary School, Tepu	Тери	Phalodi		
Government Senior Secondary School, Kanasar	Kanasar	Phalodi		
Government Senior Secondary School, Bap	Вар	Phalodi		
Government Primary School, Jambha	Jambha	Phalodi		
Government Primary School, Padiyal	Padiyal	Phalodi		
Government Secondary School, Bhinyasar	Bhinyasar	Phalodi		
Government Upper Primary School, Isaru	Isaru	Phalodi		
Government Upper Primary Sanskrit Vidhyalaya,	Danwara	Osia		
Danwara				
Government Secondary School,	Dhanavi Kalla	Osia		
Government Senior Secondary School, Osia	Osia	Osia		
Government Secondary School, Tinwari	Tinwari	Osia		
Government Upper Primary School, Mathania	Mathania	Osia		
Government Primary School, Sargaya Molaya	SargayaMolaya	Bhopalgarh		
Government Secondary School, Artiya Kalla	Artiya Kalla	Bhopalgarh		
Government Upper Primary School, Godawas	Godawas	Bhopalgarh		
University / Colleges				
Department of Zoology, J N V University, Jodhpur	Jodhpur	Jodhpur		
Dr. Radhakrishnan Women's College of Teacher's	Jodhpur	Jodhpur		
Education, Subhash Nagar, Jodhpur				
Jai Narain Vyas Mahila Mahavidhyalaya, Pratap	Jodhpur	Jodhpur		

Nagar, Jodhpur		
Adarsh Mahavidhyalaya, Pratap Nagar, Jodhpur	Jodhpur	Jodhpur
Department of Zoology, Government College, Phalodi	Phalodi	Phalodi
Smt. Sitadam Chunnilal Bardia Government Girls College, Pipar City	Pipar City	Bilara

# Table 5 List of institutes selected and promoted to form bat clubs in the study area

Name of the Institute	Name of the city/village/settlement	Tahseel
Government Senior Secondary School, Guda	Guda Bishnoiyan	Jodhpur
Bishnoiyan		
Government Upper Primary Girls School, Guda	Guda Bishnoiyan	Jodhpur
Bishnoiyan		
Gehlot Upper Primary Girls School, Badali	Badali	Jodhpur
Shri Aaiji Vidhaya Mandir Senior Secondary	Bilara	Bilara
School, Bilara		
Jalandhar Nath Adarsh Upper Primary School,	Bhungara	Shergarh
Bhungara		
Government Secondary School, Solankia Tala	Solankia Tala	Shergarh
Government Senior Secondary School, Bap	Вар	Phalodi
Government Upper Primary School, Isaru	Isaru	Phalodi
Government Upper Primary Sanskrit Vidhyalaya,	Danwara	Osia
Danwara		
Government Secondary School, Dhanavi Kalla	Dhanavi Kalla	Osia
Government Senior Secondary School, Osia	Osia	Osia
Government Secondary School, Tinwari	Tinwari	Osia
Government Upper Primary School, Mathania	Mathania	Osia
Government Primary School, Sargaya Molaya	SargayaMolaya	Bhopalgarh
Government Secondary School, Artiya Kalla	Artiya Kalla	Bhopalgarh

### दैनिक भारकर चार प्रजातियों के चमगादड़ जोधपुर से लुप्त

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नार विस्तीय से बी पहा जला

Plate 3: An article on project activities published in leading national newspaper (Dainik Blaskar, www.bhaskar.com, on April 8th 2008).

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Dr. K. R. Senacha, Principal Investigator of this project is one of the renowned bat biologists from India. He completed his degrees of M.Sc. (Zoology) and Ph.D. from J. N. V. University, Jodhpur, India. During his doctoral research from 2001 to 2003 he worked on eco-status and demographic changes among bats of the Thar Desert with special reference to Jodhpur, Jaisalmer and Bikaner. Thereafter in 2004 he joined Bombay Natural History Society (BNHS), a premier wildlife research organization in India, as a Scientist and worked there till December 2008. During this period he primarily worked on conservation of vultures but also focused himself to study bats of Northern India. During 2009 he devotedly worked to conserve bats in the Thar Desert. His research efforts are recognized by the publication of around 40 research papers and articles in reputed national and international scientific journals and magazines. He further intends to work on bats of Northern and Central India.



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