Template/Pro forma for Submission

NMHS-FINAL TECHNICAL REPORT (FTR)

Demand-Driven Action Research Project Grant

NMHS Reference No.:	NMHS/SG-2016/017	Date of Submis	3 d	1 D	0 m	9 m	2 y	0 Y	1 y	9 y

PROJECT TITLE (IN CAPITAL)

"POPULATION DYNAMICS AND BIOGEOGRAPHY OF HIMALAYAN MOUSE-HARE *OCHOTONA ROYLEI* IN RELATION TO THEIR IMPACT ON THE MEDICINAL FLORA OF WESTERN HIMALAYA" (NMHS/SG-2016/017)

Project Duration: *from* (**01.04.2016**) *to* (**31.09.2019**).

***Submitted to*:**
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NMHS-Final Technical Report (FTR) *template*

Demand-Driven Action Research Project

DSL: Date of Sanction Letter

3	1	0	3	**2**	**0**	**1**	**6**
d	d	m	m	y	y	y	y

Completion

DPC: Date of Project

3	0	0	9	**2**	**0**	**1**	**9**
d	d	m	m	y	y	y	y

Part A: Project Summary Report

1. Project Description

i.	Project Reference No.	NMHS/SG-2016/017							
ii.	Type of Project	Small Grant		✓	Medium Grant		Large Grant		
iii.	Project Title	"Population Dynamics and Biogeography of Himalayan Mouse-Hare *Ochotona roylei* in Relation to their Impact on the Medicinal Flora of Western Himalaya"							
iv.	State under which Project is Sanctioned	Uttarakhand							
v.	Project Sites (IHR States covered) (Maps to be attached)	• Tungnath • Madhyamaheswar • Badrinath • Rudranath (Maps attached)							
vi.	Scale of Project Operation	Local		Regional		Pan-Himalayan	✓		
vii.	Total Budget/ Outlay of the Project	26,54,200.00 (in Cr)							
viii.	Lead Agency	Department of Zoology & Biotechnology H.N.B. Garhwal University, Srinagar Garhwal Pin: 246174							
	Principal Investigator (PI)	Prof. S.N. Bahuguna							

	Co-Principal Investigator (Co-PI)	Nil
ix.	Project Implementing Partners	Prof. M.C. Nautiyal
	Key Persons / Point of Contacts with Contact Details, Ph. No, E-mail	

2. Project Outcome

2.1. Abstract

Background of Study: The Himalaya is distinguished as a rich biodiversity centre due to its different climatic conditions and supplies a variety of ecosystems with floral as well as faunal diversity. Garhwal Himalaya situated (30°01'N to 30°58' N latitude and 78°27' E to 78°32'E longitude) in Uttarakhand, India is the present study area. The study area is enriched with myriad types of floral as well as faunal diversity. *Ochotona roylei* is a primarily crepuscular (Smith et al., 1990). They are restricted to high elevational regions of the Himalayas, the mountains and steppes of central Asia and the mountains of western and North America (Khanal, 2007; Yang, et. al*.,* 2008; Bahuguna and Upadhyay, 2008). They live in groups composed of parents and their offspring, with low densities of 12.5 per ha (Smith et al., 1990) to 14 individuals per hectare (Koju et.al, 2012 b). Their distribution depends directly on the availability of the forage plant species. Haleem et al (2012) observed that highest distribution of *Ochotona* in Kedarnath wildlife sanctuary, India at mixed habitat, high rock cover and north east aspect whereas lowest distribution was found at low rock cover, east facing slope and open habitat. According to best fit models, rate of predation risk influences the amount of forage consumed and forage left (Bhattacharyya et al., 2013). Deo et al., (2008) observed that Native Himalayan *Ochotona* species are sensitive to slight climatic characteristics, mainly rise in temperature and is considered as primary indicator of climate change.

Objective/Aim: The project was Sanctioned to achieve the following goals; (a) To identify habitat at different altitude rich in Himalayan Mouse-hare populations,(b) Quantitative and Qualitative study of the selective medicinal plants feeding by the Himalayan Mouse-hare, (c) Population dynamics and carrying capacity of Himalayan

Mouse-hare, versus medicinal plant damage, (d) To characterize the Biogeographical structure of Himalayan Mouse-hare and (e) Conservation strategies to conserve the Himalayan Mouse-hare and its impact on medicinal and aromatic flora of Western Himalaya.

Methodologies; Extensive survey was carried out at high elevational ranges study areas to identify the area occupied by Himalayan Mouse-Hare. For first objective Transect trial and GRID sampling (Martin and Batson, 1993., Nemitz and Huetmann, 2015) method was applied to identify the inhabited areas by Himalayan Mouse-Hare. For second objective behavioural study was done by Focal sampling (Altmann, 1973). Standard Quadrat method was used for plant quantification (Misra, 1968) and focal sampling was done for identification of plants (Gaur,1999). Density, abundance and species diversity were calculated as following Misra (1989), Shannon & Weaver (1949);Odum (1971) respectively. Cafeteria method was implemented for the observation of food preference. Selection index of foraged plant spp. was calculated using Rodgers index (Krebs, 1999). Population abundance, population density and behaviour of Pikas 100m×100m quadrats were plotted in trail transect of 500×500m. Den density, active, abandoned and inactive den count was done by using plugging tunnel method (Sun et al., 2008). Valid count method also used to estimate population density (Koju et.al, 2012 b). For fourth objective morphometric study at species level of Himalayan Mouse-hare was done at different area with altitude differentiation in Garhwal Himalaya. For fifth objective Scat collection and analyses was done under Olympus Stereomicroscope (trinocular zoom microscope model SZX 7) to observe the impact of anthropogenic pressure on Himalayan Mouse-Hare.

Approach: For general behaviour, both direct and indirect evidences of mammals are sampled to know about the Himalayan Mouse-hare during different seasons of the year (Bahuguna and Upadhyay, 2008; Bhattacharyya et al. 2014.Some valuable supports as well as helpful information about mouse hare is collected usually by spending considerable time with the villagers. Local old age people also gave much valuable information about Pika.

Results: In present study, 6 different habitats were identified at different study area which was inhabited by Himalayan Mouse-Hare viz. Man-Made walls, broken Slopes, Forest gaps, *Danthonia* Grassland, Rocky Alpine Meadow and Alpine Meadow. In which the altitudinal range of distribution is 2450masl to 5000masl and above. During the present study, average population density at Tungnath area was observed to range between 6±0.40 (Spring) and 22.5±2.10 (autumn), Badrinath area

was observed to range between 19.25±2.98 (Autumn) and 32.5±0.95 (Monsoon), Madhyamaheswar area was observed to range between 17±1.73 (Spring) and 29±1.29 (Monsoon) and Rudranath Area was observed to range between 22.5±0.65 (Autumn) and 31.75±2.46 (Monsoon). Biogeographical distribution of Himalayan Mouse-hare in different areas of Garhwal Himalaya (30°01'N to 30°58'N **latitude** and 78°27'E to 78°32'E **longitude**) viz. **Tungnath, Hemkund Shahib & Valley of Flower, Madmaheswar, Rudranath, Badrinath, Yamnotri, Gangotri, Dayara bugyal,** and **Roopkund** area.

Conclusion: In present study, observations are made from the Western Himalaya, Uttarakhand, the Himalayan Mouse-hare collects and hoards different foraged plants viz. grasses, stems, roots, bulbs, fruits, flowers before winter along with some of the herbs during the onset of winter mainly on some medicinal plants like *Dactylorhiza hatagira, Frageria nubicola, Danthonia cachemyriana, Artemisia spp.,Thymus linearis, Iris kumaonensis, Rubus nepaliensis, Potentilla lineate, Bistorta affinis, Rumex nepalensis, Cirsium verutum, Allium humile, Primula denticulate, Fragaria vesca, Polygonatum verticillatum, Aconitum balfourii, Gaultheria nummularioide, Primula denticulate, and Arnebia.*Mean population density of Himalayan Mouse-Hare was recorded as 15.3 individuals/ha (Bhatacharya et al., 2009) at Tungnath region of Uttarakhand (India), Western Himalaya. Whereas Bhardwaj et al (2019) observed the mean population density of 17.43 Himalayan Mouse-Hare/ha at an altitudinal range of 3200m asl – 3500 m asl at Madhyamaheswar region of Uttarakhand, India. Similarly, Smith et al (2012) observed the population density of *Ochotona roylei* 12.5 individuals/ha in Nepal. During present study, Mean observed density at Badrinath area was 27.8 Ind/ha. which was almost double to population density observed 12.5 Ind/hac. at Nepal Himalaya by Smith et al., (2012).

Recommendations: Ochotona preferably consume aromatic and medicinal flora of high altitudinal zones of Himalayan region. By consumption and cycling of these minerals or nutrient rich medicinal & aromatic flora it increases soil fertility of inhabited area. The present study should be replicated at differential altitudinal ranges of Uttarakhand, Himachal Pradesh, Jammu & Kashmir and Ladakh. Habitat identification, Floral and Faunal distribution, inter-specific relationship and anthropogenic pressure will also be studied at different areas with respect to *Ochotona roylei.*

2.2. Objective-wise Major Achievements

S. No.	Objectives	Major achievements (in bullets points)
1	To identify habitat at different altitude rich in Himalayan Mouse-hare populations;	➢ The area rich in Himalayan Mouse-hare population was identified. ➢ Different sites were marked by GPS for study of Population dynamics, Foraging behaviour, Biogeography and Impact of Anthropogenic pressure on Population of Himalayan Mouse-hare.
2	Quantitative and Qualitative study of the selective medicinal plants feeding by the Himalayan Mouse-hare;	➢ The study of Foraging behaviour was done in Tungnath, Badrinath, Madhyamaheswar and Rudranath areas of Garhwal Himalaya region. ➢ The Qualitative Study was done according to focal sampling (Altmann, 1973), foraged plants were identified by study of faecal material under Olympus Stereomicroscope (trinocular zoom microscope model SZX 7) in laboratory. ➢ Quantitative study of Foraging behaviour was done by Standard Quadrate method, used for plant quantification (Misra, 1968) and focal sampling was done for identification of plants (Gaur,1999). Density, abundance and species diversity were calculated as following Misra (1989), Shannon and Weaver (1949);Odum (1971) respectively. Cafeteria method was implemented for the observation of food preference.
3	Population dynamics and carrying capacity of Himalayan Mouse-hare versus medicinal plant damage;	➢ Population density of Himalayan Mouse-hare was estimated; according to baseline data, the dynamicity of population of Himalayan Mouse hare was studied. ➢ The co-relation between medicinal plants density and population density of Himalayan Mouse-hare was studied.
4	To characterize the Biogeographical structure of Himalayan Mouse-hare;	➢ The Biogeographical study of Himalayan Mouse-hare was done in different area of Garhwal Himalayan region. ➢ Morphometry at species level was done according altitudinal gradient for characterization of Biogeographical distribution of this species in study area.

5	Conservation strategies to conserve the Himalayan Mouse-hare and its impact on medicinal and aromatic flora of Western Himalaya	➢ The impact of anthropogenic pressure was studied in these four sites of study area. ➢ Microscopy of faecal material reveals the interference of human activity in food chain of Himalayan Mouse-hare. ➢ Awareness programme was done in sensitive study areas affected by human interference.

2.3. Outputs in terms of Quantifiable Deliverables*

S. No.	Quantifiable Deliverables*	Monitoring Indicators*	Quantified Output/ Outcome achieved	Deviations made, if any, and Reason thereof:
1	New knowledge in the form of quantitative and qualitative database on feeding behaviour by the Himalayan Mouse-hare	Quantitative and Qualitative Assessment Reports on the selective medicinal plants fed by the Himalayan Mouse-hare **(Nos/ species)**	In case of sampling site Rudranath 32 plant species were observed as food preference of *Ochotona roylei* out of which 25 plant species were majorly given to feed the *Ochotona roylei* during experiment, according to their preference and when cafeteria experiment were applied it gave the result of plant species *Potentilla lineate* in first year and *Dactylorhiza hatagira* in second year to be majorly fed by *Ochotona roylei*. Like-wise in case of Madhyamaheswar area 18 plant species were observed as food preference and out of which 15 plant species were given to feed during experiment, according to their observed feeding preference. Out of which *Rumex nepalensis* was	

			majorly fed by *Ochotona roylei* during both year. In case of Tungnath 30 plant species were observed to be food preference of *Ochotona roylei* and out of which 25 plant species were major food preferences and during experiment *Fragaria nubicola* in first year and *Ranunculus shirtellus* in second year was majorly fed by *Ochotona roylei.* Now in case of Badrinath 20 plants species were observed as food preference of *Ochotona roylei* and out of which 15 plant species were given during experiment and out of these 15 plants, *Artemisia spp.* in first year and *Danthonia cachemyriana* was majorly fed by *Ochotona roylei.*	
2	Database on population dynamics and biogeography of the species	Knowledge products on variation analysis of population dynamics and biogeography of the species **(Nos).**	During the present study, average population density at Tungnath area was observed to range between 6±0.40(Spring) and 22.5±2.10 (autumn), Badrinath area was observed to range between 19.25±2.98 (Autumn) and 32.5±0.95 (Monsoon), Madhyamaheswar area was observed to range between 17±1.73 (Spring) and 29±1.29 (Monsoon)	

			and Rudranath Area was observed to range between 22.5±0.65 (Autumn) and 31.75±2.46 (Monsoon).	
		Compilation of standard conservation practices to conserve the Himalayan Mouse-hare **(Nos).**	For conserving *Ochotona roylei* the first and foremost step should be its Habitat identification this milestone has been achieved with this project in Garhwal region of Uttarakhand and for making the conservation program more impactful the habitat identification should be done in Kumaun region of Uttarakhand, Himachal Pradesh, Jammu Kashmir and Ladakh. Habitat identification helps in making policies for conservation according to need of area. As in Garhwal region of Uttarakhand only Mana was the place where anthropogenic activities could be observed so only there awareness program can be organized and this has been done under this project while all other sites were only pilgrimage sites so least anthropogenic activities were there but tourists were present very frequent throughout the year and for that awareness program and policies should be formed so that tourist could be taught to not harm the habitat of *Ochotona roylei*. Sites where *Ochotona roylei* are present, generally are scenic beauty places and thus attracts many tourists and many of these places are being worked upon for	

			turning into skiing and other fun activity spots by government (as in Dayara Bugyal) so policies for these places should be made while keeping *Ochotona roylei* and its habitat conservation in mind.	
		Standard Protection Practices for MAPs of Western Himalaya **(Nos).**	For Medicinal and Aromatic plant protection of Western Himalayan region their habitat identification must be done in order to protect them. Habitat identification is important step for making conservation policies. Awareness program about their benefits should be organized in local region to protect them. Initiative from government side should be taken for harvesting such plants in their habitat region. Their illegal smuggling should be prevented by taking required measures.	

(*)As stated in the Sanction Letter issued by the NMHS-PMU.

2.4. Strategic Steps with respect to Outcomes (in bullets)

S.No.	Particulars	Number/Brief Details	Remarks/ Enclosures
1.	New Methodology developed	No	
2.	New Models/ Process/ Strategy developed	No	
3.	New Species identified	No	
4.	New Database established	Yes	
5.	New Patent, if any		
	I. Filed (Indian/ International)		

S.No.	Particulars	Number/Brief Details	Remarks/ Enclosures
	II. Granted (Indian/ International)		
	III. Technology Transfer (if any)		
6.	Others (if any)		

3. Technological Intervention

S. No.	Type of Intervention	Brief Narration on the interventions	Unit Details (No. of villagers benefited / Area Developed)
1.	Development and deployment of indigenous technology	**Not applicable**	
2.	Diffusion of High-end Technology in the region	**Not applicable**	
3.	Induction of New Technology in the region	**Not applicable**	
4.	Publication of Technological / Process Manuals	**Not applicable**	
	Others (if any)		

4. New Data Generatedover the Baseline Data

S. No.	New Data Details	Status of Existing Baseline	Additionality and Utilisation New data
1	**Permanent GPS marking of Sites of *Ochotona roylei s'* Habitat**	**Pre-existing knowledge of Only Distributional region in Uttarakhand**	
2	**Medicinal & Aromatic flora database with respect to Foraging behaviour of *Ochotona roylei***	**Knowledge about use of medicinal and aromatic plants**	
3	**Population Status of *Ochotona roylei***		
4	**Biogeography of *Ochotona roylei* with reference to altitudinal gradient**		

5. Demonstrative Skill Development and Capacity Building/ Manpower Trained

S. No.	Type of Activities	Details with number	Activity Intended for	Participants/Trained			
				SC	**ST**	**Woman**	**Total**
1.	Workshops	**Not applicable**					
2.	On Field Trainings	**Not applicable**					
3.	Skill Development	**Not applicable**					
4.	Academic Supports	**Not applicable**					
	Others (if any)	**Awareness Programme**			**45**	**45**	**45**

6. Linkages with Regional & National Priorities (SDGs, INDC, etc)/ Collaborations

S. No.	Linkages /collaborations	Details	No. of Publications/Events Held	Beneficiaries
1.	Sustainable Development Goal (SDG)	**Not applicable**		
2.	Climate Change/INDC targets	**Not applicable**		
3.	International Commitments	**Not applicable**		
4.	Bilateral engagements	**Not applicable**		
5.	National Policies	**Not applicable**		
6.	Others collaborations	**Not applicable**		

7. Project Stakeholders/ Beneficiaries and Impacts

S. No.	Stakeholders	Support Activities	Impacts
1.	Gram Panchayats	**Not applicable**	
2.	Govt Departments (Agriculture/ Forest)	**Not applicable**	
3.	Villagers	**Not applicable**	
4.	SC Community	**Not applicable**	
5.	ST Community	**Not applicable**	
6.	Women Group	**Not applicable**	
	Others (if any)	**Not applicable**	

8. Financial Summary (Cumulative)

S. No.	Financial Position/Budget Head	Funds Received	Expenditure/ Utilized	% of Total cost
I.	Salaries/Manpower cost	9,45,147.00	7,59,093.00	
II.	Travel	1,01,199.00	71,481.00	
III.	Expendables &Consumables	4,72,614.00	4,95,563.00	
IV.	Contingencies	1,05,021.00	81,392.00	
V.	Activities & Other Project cost			
VI.	Institutional Charges	1,34,140.00	1,34,140.00	
VII.	Equipment	6,40,000.00	6,30,025.00	
	Total	23,98,121.00	21,71,694.00	
	Interest earned	***61,759.00**		
	Grand Total	24,59,880.00		

A sum total of 46,796.00 from earned interest of 61,759.00 was adjusted in consumable and contingency.

* Please attach the consolidated and audited Utilization Certificate (UC) and Year wise Statement of Expenditure (SE) separately, *ref.* **Annexure I.**

9. Major Equipment/ Peripherals Procured under the Project** (if any)

S. No.	Name of Equipment	Cost (INR)	Utilisation of the Equipment after project
1.	Nikon DSLR Camera with additional lens.	97,150.00	Will be submitted to the department
2.	Bacteriological Incubator 125ltr MAC Microprocessor based temp. indicator controller	73,500.00	Will be submitted to the department
3.	Research Olympus trinocular stereo zoom microscope model SZX 7 with camera attachment and accessories	4,24,725.00	Will be submitted to the department
4.	Water Bath (MAC) 6 holes 75mm, 8ltr	34,650.00	Will be submitted to the department
5.			

Details should be provided in details **(*ref* Annexure III &IV).

10. Quantification of Overall Project Progress

S. No.	Parameters	Total (Numeric)	Remarks/ Attachments/ Soft copies of documents
1.	IHR States Covered	*1*	
2.	Project Site/ Field Stations Developed	*4*	*Map Attached In appendix* (Fig. 29)
3.	New Methods/ Modelling Developed	*No*	
4.	No. of Trainings arranged	*No*	
5.	No of beneficiaries attended trainings	*No*	
6.	Scientific Manpower Developed (PhD/M.Sc./JRF/SRF/ RA):	*JRF*	
7.	SC stakeholders benefited	*No*	
8.	ST stakeholders benefited	*No*	
9.	Women Empowered	*No*	
10.	No of Workshops Arranged along with level of participation	*1*	
11.	On field Demonstration Models initiated	*No* (attached map about location & photos)	
12.	Livelihood Options promoted	*No*	
13.	Technical/ Training Manuals prepared	*No*	
14.	Processing Units established	*No*	
15.	No of Species Collected	*30....* (attach photos)	
16.	New Species identified	*No*	
17.	New Database generated (Types):	*Yes*	
	Others (if any)		

11. Knowledge Products and Publications:

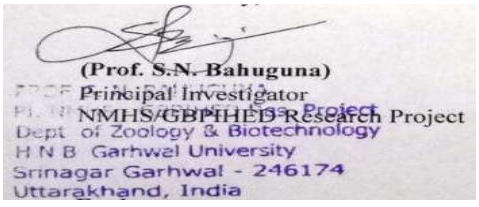
S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
1.	Journal Research Articles/ Special Issue:	2		0	Paper attached
2.	Book Chapter(s)/ Books:	-			
3.	Technical Reports	-			
4.	Training Manual (Skill Development/ Capacity Building)	-			

S. No.	Publication/ Knowledge Products	*Number*		*Total Impact Factor*	*Remarks/* Enclosures
		National	International		
5.	Papers presented in Conferences/Seminars	5			
6.	Policy Drafts/Papers	-			
7.	Others:	-			

* Please append the list of KPs/ publications (with impact factor and further details) with due Acknowledgement to NMHS.

12. Recommendation on Utility of Project Findings, Replicability and Exit Strategy

Particulars	Recommendations
Utility of the Project Findings	*Ochotona roylei* spread seeds of medicinal & aromatic plants of inhabited area by hoarding in den which germinates according to their germination period lead diversification of faunal community. People of this region collect these faunal species and use as traditional medicine. The utilization of medicinal & aromatic plants of this area can lead to economic benefit of local people. The ecological and economic considerations are there-fore to be combined to attain ecologically sustainable development.
Replicability of Project	The present study should be replicated at differential altitudinal ranges of kumaun region of Uttarakhand, Himachal Pradesh, Jammu & Kashmir and Ladakh.
Exit Strategy	Please describe the Exit Strategy of the project, self-sustaining and benefitting the stakeholders and local community: Not applicable



(**PROJECT PROPONENT/ COORDINATOR**)

(Signed and Stamped)

(**HEAD OF THE INSTITUTION**)

(Signed and Stamped)

Place: ……..

Date: …../……/……