

**Zoological Survey of India, Kolkata-700053**  
**National Mission on Himalayan Studies (NMHS)**

**HIMALAYAN RESEARCH FELLOWSHIP**

“LEPIDOPTERA (INSECTA) AS POTENTIAL INDICATOR-TAXA FOR  
TRACKING CLIMATE CHANGE IN THE INDIAN HIMALAYAN LANDSCAPE”

(HSF 2015-16 003)

**[Reporting Period: from 1.6.2016 to 31.12.2016]**

Name of the Institution/ University:	Zoological Survey of India, M Block, New Alipore, Kolkata 700053
No. of Himalayan Research/Project Associate:	03
No. of Himalayan Junior Research/Project Fellows:	10

**Himalayan Research Associate (HRA)**

**H-RAs Profile Description:**

S. No.	Name of RA	Date of Joining	Name of the PI	Qualification
1.	Dr. Abesh Kumar Sanyal	03.06.2016	Dr. Kailash Chandra	Ph.D.
2.	Dr. Arockia Lenin	13.10.2016	Dr. Kailash Chandra	Ph.D.
3.	Dr. Boni Amin Laskar	01.07.2016	Dr. Kailash Chandra	Ph.D.

**Progress Report: To be filled for each HRA in separate row.**

RA No.	Research Objectives	Achievements	Addressed Deliverables	Location of Field Site with Details, if any
1.	Number of Long-Term Ecological/ Environmental Monitoring (LTEM) sites establishment  Status & distribution of threatened Apollo and other Parnassini butterflies	Initial gradsects (Permanent Monitoring plots along altitudinal gradient) established across Indian Himalayan Region: In Hemis NP, Jammu & Kashmir, Trans Himalaya, one gradient was explored starting from 3600m to 5200m. Along this gradient, 6 light trap stations were established.  In Great Himalayan NP, Himachal Pradesh, North-Western Himalaya, three gradsects were established	Secondary data compilation and analysis for Himalayan Lepidoptera: Total 7853 entries of moths were encountered in different Himalayan sites. Among them 5751 entries with valid GPS coordinates were used for spatial representation in GIS domain.	Hemis NP, Jammu & Kashmir  GHNP, Himachal Pradesh  Askot WLS, Uttarakhand  DDBR, Arunachal Pradesh  (Details of every sites are provided in attached report)

		<p>from 1500m to 3200m and 9 light trap stations were established.</p> <p>In Askot Wildlife Sanctuary, Uttarakhand, Western Himalaya, one gradsect was established from 600m to 3400m and 6 light trap stations were explored.</p> <p>In Dihang-Dibang Biosphere Reserve, Arunachal Pradesh, Eastern Himalaya, two gradsects were explored covering 400m to 2400m and 16 light trap stations were established.</p> <p>Along these gradsects, Nested Quadrates were established (three NQs per light trap station) which will be sampled in next field session for vegetation, disturbance and other significant habitat variables. These altitudinal sites along with NQs will be our permanent/long-term monitoring sites to explore relationship between Lepidopteran diversity and climatic variables.</p> <p>Two species of threatened Parnassini, Apollo butterflies were recorded from three Protected Areas: Hemis, GHNP and Askot.</p>		
2	<p>Monitoring surveys in historical collection localities</p> <p>Climate-Envelope modeling &amp; Distribution mapping for responses to changing climate</p>	<p>Historical Collection Localities have been identified from secondary literature survey. Survey will be conducted next year.</p> <p>Survey conducted in Singalila NP, West Bengal</p>	<p>Species list compilation and Validation from Historical Localities are in progress.</p> <p>Reconnaissance surveys conducted in Central Himalaya during November-December, 2016. Light Trap stations established in different gradients and preliminary collections made.</p> <p>Species list compilation and Validation from Historical Localities are in progress. So far 200 noctuidae species have been</p>	<p>Singalila NP, West Bengal</p> <p>(Details of every sites are provided in attached report)</p>

			<p>validated with Lepindex and Funet.</p> <p>Initial habitat variables for Climate Envelop Modelling collected</p>	
3.	<p>Molecular Phylogenetic Work through DNA Barcoding to resolve species complexes</p>	<p>Leg samples of Lepidoptera specimens have been targeted for DNA sources. Achieved success of DNA isolation from the subsamples.</p> <p>Amplification of the target gene segment was achieved through LCO-HCO primer pair. The PCR profile has been standardized and practiced.</p> <p>DNA sequencing of the target segment through Sanger sequencing protocol. Already standardized protocols have been used.</p> <p>DNA sequences were annotated in Sequence scanner and MEGA softwares.</p>	<p>Sequences were individually BLUST with NCBI database and correct ORF was made.</p> <p>Around 200 samples have been processed for DNA isolation.</p> <p>All the DNA samples have been amplified for the target gene segment.</p> <p>Around 100 gene sequences have been generated.</p> <p>All the generated gene sequences have corrected and prepared for final submission to the BOLD.</p>	<p>DDBR, Arunachal Pradesh survey conducted.</p> <p>DNA samples were collected from all the study sites.</p>

Note: Data, table and figures may be attached as separate source file (.docx, .xls, .jpg, .jpeg, .png, .shp, etc. ): Detailed Tour Report has been attached with this mail.

## Himalayan Junior Research/Project Fellows

### H-JRFs Profile Description:

S. No.	Name of JPF	Date of Joining	Name of the PI	Qualification
1.	Mohd. Ali	29.09.2016	Dr. Kailash Chandra	M.Sc.
2.	Kaushik Mallick	06.05.2016	Dr. Kailash Chandra	M.Sc.
3.	Uttaran Bandyopadhyay	14.05.2016	Dr. Kailash Chandra	M.Sc.
4.	Monsoon Jyoti Gogoi**	14.05.2016	Dr. Kailash Chandra	M.Sc.
5.	Kamalika Bhattacharyya	14.05.2016	Dr. Kailash Chandra	M.Sc.
6.	Subrata Gayen	14.05.2016	Dr. Kailash Chandra	M.Sc.
7.	Gaurab Nandi Das	14.05.2016	Dr. Kailash Chandra	M.Sc.
8.	Sumantika Chatterjee	03.05.2016	Dr. Kailash Chandra	M.Sc.
9.	Angshuman Raha	03.05.2016	Dr. Kailash Chandra	M.Sc.
10.	Rohit Kumar Jaiswal	15.05.2016	Dr. Kailash Chandra	M.Sc.

\*\* Resigned in September, 2016.

**Progress Report: To be filled for each JRF in separate row.**

JRF No.	Research Objectives	Achievements	Addressed Deliverable	Location of Demonstration/ Study Site with Details
1. Mohd. Ali	<p>To investigate the differential processes influencing the distribution pattern of Lepidoptera assemblages (moths and butterflies) of HNP</p> <p>Generation of robust datasets generated through ecological monitoring at habitat level</p>	<p>Preliminary survey for selecting sampling sites undertaken during September 2016.</p> <p>(Specimen collection details provided in the attached report)</p> <p>Around 60 literatures on butterflies of Ladakh have been collected.</p> <p>Compilation of specie distribution data is under process. Specimens were sorted according to families and stretching was done.</p> <p>Seven sampling sites have been chosen as permanent monitoring sites - Sumdo, Nemaling, Nagdang village, Nagdang Pho-I-II-III and Markha, from National Park. At every sampling site, at least 2-3 sampling points have been chosen for repetitive sampling based on habitat type, elevation, and habitat quality.</p> <p>Species abundance data were also</p>	<p>Specimens sorted, stretched and tagged for further taxonomic study</p> <p>Literature review for Trans Himalayan Lepidoptera</p> <p>Selected for pursuing Ph.D. from Saurashtra University, Gujarat.</p>	<p>Hemis National Park, Jammu &amp; Kashmir</p> <p>(details provided in the attached report)</p>

		<p>collected.</p> <p>The research team also approached local villagers for questionnaire about different issues pertaining to Lepidoptera diversity and agriculture practice to make an affective conservation plan.</p>		
2. Kaushik Mallick	<p>To investigate the differential processes influencing the Lepidoptera diversity of GHNP</p> <p>Generation of robust datasets generated through ecological monitoring at habitat level</p>	<p>Preliminary surveys for selecting sampling sites undertaken during August-September in Great Himalaya National Park and November-December, 2016 in Askot Wildlife Sanctuary and Great Himalaya National Park. (Specimen collection details provided in the attached report)</p> <p>Reference collection of Lepidoptera from Zoological Records from the year of 2008, 2011, 2014 and compilation of total reference from 2008-2014.</p> <p>Butterfly data entry in BOLD (Barcoding Life Data System) format (Uttarakhand-250 specimens) from secondary literature.</p> <p>Genitalia dissection and identification of Moths (26 individual samples of family Noctuidae and 3 individual samples of family Arctiidae, 5 individual samples of Lymantriidae and 9 individual samples of family Crambidae).</p> <p>Validation of 200 Species of moths done, which recorded from Indian Himalayan Region.</p> <p>Validation of 180 Notodontidae species found in India from literature for checklist preparation.</p> <p>Collection data entry in BOLD format, Stretching and tagging of 600 Lepidoptera specimens done which were collected from Great Himalaya National Park.</p> <p>Literature Collection of Great Himalaya National Park.</p> <p>300 Lepidoptera specimens of Valley of Flower National park has been</p>	<p>Specimens sorted, stretched and tagged for further taxonomic study</p> <p>Literature review for North-Western Himalaya Lepidoptera</p> <p>Selected for pursuing Ph.D. from Saurashtra University, Gujarat.</p>	<p>Great Himalayan National Park, Askot Wildlife Sanctuary</p> <p>(details provided in the attached report)</p>

		<p>stretched.</p> <p>Great Himalaya National Park: Two reconnaissance surveys were done in August and December in which a total of four trek routes (sampling gradients) have been selected. About 650 specimens of Moth have been collected from GHNP and the adjacent areas. Live photograph of all moth specimen was taken in the field. All specimen were sorted and stretched. From the August tour, 11 species of butterflies have been recorded with photographic evidence. Among them, two very rare species of Subfamily Parnassinae (<i>Parnassius hardwickii</i> &amp; <i>Papilio machaon</i>) have been found.</p>		
3. Uttaran Bandyopadhyay	To investigate how diverse are the Lepidopteran assemblages in AWLS Generation of robust datasets generated through ecological monitoring at habitat level	<p>Two reconnaissance surveys were done in Great Himalayan National Park and Askot Wildlife Sanctuary in the months of August-September and November-December to select sampling sites (Specimen collection details provided in the attached report).</p> <p>Reference collection of Lepidoptera from Zoological Records from the year of 2008, 2011, 2014 and compilation of total reference from 2008-2014.</p> <p>Butterfly data entry in BOLD (Barcoding Life Data System) format (Sikkim- 256 species) from secondary literature.</p> <p>Genitalia dissection and identification of Moths.</p> <p>Validation of 250 Species of moths done, which recorded from Indian Himalayan Region.</p> <p>180 Species detail from literature entered for preparing Notodontidae checklist.</p> <p>Collection data entry in BOLD format, Stretching and tagging of 570 Lepidoptera specimens done which were collected from Great Himalaya National Park and Askot Wildlife Sanctuary.</p>	<p>Specimens sorted, stretched and tagged for further taxonomic study</p> <p>Literature review for Western Himalaya Lepidoptera</p> <p>Selected for pursuing Ph.D. from Saurashtra University, Gujarat</p>	<p>Great Himalayan National Park, Askot Wildlife Sanctuary</p> <p>(details provided in the attached report)</p>

		<p>Stretching of 200 Lepidoptera specimen collected from Singalila National Park and Neora Valley National Park.</p> <p>Literature Collection of Askot Wildlife Sanctuary.</p> <p>Askot Wildlife Sanctuary: Two reconnaissance surveys were done in September and November in which two trek routes (sampling gradients) have been selected. About 570 specimens of Moth have been collected from AWLS and the adjacent areas. Live photograph of all moth specimen was taken in the field. All specimens were sorted and stretched. From the August-September tour, 12 species of butterflies have been recorded with photographic evidence. One rare and important species of Subfamily Parnassinae (<i>Parnassius epaphus</i>) was also recorded from the region.</p>		
4. Monsoon Jyoti Gogoi**	<p>To investigate the differential processes influencing the Lepidoptera diversity of KBR</p> <p>Generation of robust datasets generated through ecological monitoring at habitat level</p>	<p>H-JPF resigned and surveys will be conducted after the permission from forest department</p>	<p>Surveys will be conducted after the permission from the forest department of Sikkim</p>	
5. Kamalika Bhattacharyya	<p>To investigate the differential processes influencing the Lepidoptera diversity of SNP</p> <p>Generation of robust datasets generated through ecological monitoring at habitat level</p>	<p>Preliminary surveys for selecting sampling sites undertaken during August-September and November-December, 2016 (Specimen collection details provided in the attached report)</p> <p>Compilation of species data for butterflies of central Himalaya was made for 669 species from Darjeeling district, WB and 319 species from Sikkim based on literature from State Fauna Series, ZSI. Literature on moths of central</p>	<p>Specimens sorted, stretched and tagged for further taxonomic study</p> <p>Literature review for Central Himalaya Lepidoptera</p> <p>Selected for pursuing Ph.D. from Saurashtra University, Gujarat</p>	<p>Singalila National Park, Neora Valley National Park, West Bengal  (details provided in the attached report)</p>

		<p>Himalayan region has been compiled for present status of work on moths in the region. 912 species of moth has been validated for species name using FUNET and LEPINDEX and the work is under progress.</p> <p>SNP: Reconnaissance survey conducted in August-September 2016 for selecting sampling sites and collection of ecological parameter at habitat level. 137 samples were collected, as a team effort, in the first survey from outside the boundary of the National Park. Photographic sampling for 500 moths were done for the core and buffer zone. Repeat sampling conducted in in November- December 2016. 121 moths and 6 butterflies collected, as a team effort, in the repeat survey from outside the boundary of the National Park. Samples were sorted, stretched and stored in insect boxes for further taxonomic studies.</p> <p>NVP: Reconnaissance survey conducted in upper and lower NVP respectively in August-September and November-December, 2016 for selecting sampling sites and collection of ecological parameter at habitat level. 4197 samples of lepidopterans were collected, as a team effort, from the survey. 1197 samples has been sorted, stretched and stored in insect boxes for further taxonomic studies. Of these 121 samples have been processed for DNA analysis. 3000 samples have been sorted and is under processing for stretching and preservation.</p>		
6. Subrata Gayen	To investigate the differential processes influencing the distribution pattern of Lepidoptera assemblages (moths and butterflies) of DDBR	<p>Preliminary surveys for selecting sampling sites undertaken during August-September and November-December, 2016 (Specimen collection details provided in the attached report)</p> <p>We obtained 485 Lepidoptera specimens, over the two field (August-September 2016 and November to December 2016) to assess the species and taxonomic diversity of Dihang Dibang Biosphere reserve and targeted</p>	<p>Specimens sorted, stretched and tagged for further taxonomic study</p> <p>Literature review for Eastern Himalaya Lepidoptera</p>	<p>Dihang Dibang Biosphere Reserve, Arunachal Pradesh</p> <p>(details provided in the attached report)</p>



	Generation of robust datasets generated through ecological monitoring at habitat level	four different route to assess environmental factors and species diversity. Those routes are having the highest altitudinal gradients up to 4000 m in Eastern Himalaya. All collected specimens have been stretched and documented. Photographic documentation is in process. The processed data has been gathered in Excel Workbook (BOLD format) and genitalia base identification is in process.		
7. Gaurab Nandi Das	To investigate the differential processes influencing the distribution pattern of Lepidoptera assemblages (moths and butterflies) of DDBR  Generation of robust datasets generated through ecological monitoring at habitat level	Preliminary surveys for selecting sampling sites undertaken during August-September in SNP and November-December, 2016 in DDBR (Specimen collection details provided in the attached report)  About 175 Literature of butterflies of Himalayan region were collected, including 21 records of ZSI. Compilation of specie data is now going on (about 41 papers data has complied). Compilation of state fauna series, ZSI is in progress.  SNP: A total about 450 specimen of moths have been collected from SNP and their adjacent areas. Live photographs of moths were taken in field. All specimens were sorted and stretched. From this tour, we have recorded 18 species of butterflies with photographic evidence. Among them, mostly dominated genera <i>Lethe</i> with 6 species, of which <i>Lethe atkinsonia</i> , <i>Lethe maitrya</i> and <i>Lethe goalpara</i> were recorded. These species are rare and restricted to elevation above 1800m, as per Evans, 1932.  DDBR- From this tour about 200 specimens of moths were collected and all were sorted and stretched. About 139 species of butterflies were recorded in 17 transects from various sites. Among these butterflies most interesting finding is <i>Drupadia scaevacyara</i> . The species is first time record from Arunachal Pradesh, eastern Himalaya, and recorded after 83 years from India (last recorded by Eliot, 1934 from Gangtok). This is also first photographic evidence from mainland	Specimens sorted, stretched and tagged for further taxonomic study  Literature Review for Himalayan Butterfly  Field work for butterfly monitoring in Central & Eastern Himalaya	Singalila National Park, Neora Valley National Park, West Bengal  Dihang Dibang Biosphere Reserve, Arunachal Pradesh  (details provided in the attached report)

		India. Other interesting findings include <i>Elymnias patna</i> , <i>Hypolimnas misippus</i> , <i>Tajuria</i> sp etc.		
8. Sumantika Chatterjee	Study of Molecular Taxonomy	<p>Sub-samples of legs from the Lepidoptera specimens from all the five study sites were collected with proper labeling for downstream work with DNA.</p> <p>DNA isolation protocol was standardized using phenol-choloform method.</p> <p>PCR protocol was standardized using LCO-HCO primer pair for amplification of the target gene segment.</p> <p>DNA sequencing of the target gene segment was accomplished.</p>	<p>All the DNA source materials have been stored at -80°C.</p> <p>DNA isolation is in progress for more than 500 specimens so far collected from all the five study sites.</p> <p>Followed by DNA isolation, PCR of the target gene segment for the samples have been continuing in large scale.</p> <p>DNA sequencing has been done in first phase for 100 samples.</p> <p>Second phase DNA isolation, PCR and sequencing is in progress.</p>	Sub-sampling of leg from Lepidoptera samples from all the five study sites for DNA work
9. Angshuman Raha	Morphology- based Taxonomy	<p>Field work conducted in GHNP, Western Himalaya during August-September, 2016. In this field survey, a total of 403 lepidopteran and 73 other insect specimens were collected from a single elevational gradient ranging from 1500 m to 3600 m. Details of collections were provided in the attached document.</p> <p>For identification, stretched lepidopteran specimens from five biogeographic provinces viz. Trans, North West, West, Central and Eastern Himalayas were sorted according to families. From preliminary observation, specimens belonging to 25 lepidopteran families were found. These are Papillionidae, Nymphalidae, Lycaenidae, Pieridae, Hesperidae, Totricidae, Pterophoridae, Cossidae, Zygaenidae, Callidulidae, Limacodidae, Pyralidae, Crambidae, Lasiocampidae, Saturniidae, Sphingidae, Eupterotidae, Drepanidae, Uraniidae, Geometridae, Notodontidae, Erebidae, Euteliidae, Nolidae, Noctuidae. Among these, Geometridae comprises</p>	Genitalia dissection and morphology based identification is in progress	GHNP, Himachal Pradesh  (details provided in the attached report)

		<p>major portion of the collection. Other notable families include Erebidae, Noctuidae, Crambidae and Sphingidae. Morpho species wise specimens of each family have been sorted.</p> <p>Genitalia dissection of specimens belonging to Geometridae, Eupterotidae, Sphingidae and Noctuidae are in progress.</p>		
10. Rohit Kumar Jaiswal	<p>Modelling on GIS-framework and Data Compilation</p> <p>Comparison of robust datasets generated through ecological monitoring</p>	<p>Toposheets for study sites acquired from Survey of India.</p> <p>Initial boundary was demarcated for all PAs along with initial sampling routes and sampling points were marked at every 200 m vertical distance &amp; vegetation type.</p> <p>Satellite data for DEM (ASTER G- DEM data) &amp; NDVI (MODIS) data downloaded from United States Geological Survey (USGS), climatic variable data downloading are in progress from WorldClim for different temporal scale.</p>	<p>Digitization of toposheets and boundary demarcation of all PAs.</p> <p>Workshop on MAXENT (Species Distribution Modelling) attended at Indian Statistical Institute, Kolkata</p> <p>Literature review &amp; Practice on distribution modelling at Arc GIS &amp; "R" Software platform</p>	<p>SNP &amp; Neora Valley NP, West Bengal</p> <p>Askot WLS, Uttarakhand</p> <p>GHNP, Himachal Pradesh</p> <p>(details provided in the attached report)</p>

Note: Data, table and figures may be attached as separate source file(.docx, .xls, .jpg, .jpeg, .png, .shp, etc.): **Details attached as separate .docx file**

(Signature of Registrar/ Head of Department)

**Report (hard copy) should be submitted to:**

The Nodal Officer, NMHS-PMU  
G.B. Pant National Institute of Himalayan Environment and Sustainable Development (GBPNIHESD)  
Kosi-Katarmal 263 643, Almora, Uttarakhand

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