

Digitization of Mushrooms and Lichens collections from Nepal: Bringing Underrepresented Taxonomic Groups into the Global Biodiversity Database

Programme:BIFA

Project ID: BIFA5_023

Project lead organization:Global Institute for Interdisciplinary Studies

Project implementation period:1/7/2020 - 31/7/2021

Report approved: 11/11/2021

Narrative Final report

Executive Summary

Fungi are complex biotic resources and constitute the most diverse group of eukaryotic organisms on earth. Despite their myriad roles within the world's ecosystems and also being an integral part of human well-being, they have received limited attention in biodiversity studies. This project aims to transfer digitalized data of lichens and mushrooms specimens in two herbarium centres (National Herbarium and Plant Laboratories - KATH and Tribhuvan University Central Herbarium- TUCH) and a museum (Natural History Museum - NHM) of Nepal, with proper management (sorting, curating, labelling) into the GBIF platform and provide an immense opportunity to maximise their visibility fulfilling taxonomic and geographical gaps in the global database.

We digitized 2462 specimens of lichens (TUCH:1123; KATH: 1207; NHM: 132) and 3971 specimens of mushrooms (TUCH:707; KATH: 1620; NHM: 1644) The occurrence data (totalling 6433) obtained from this digitization have been managed in six datasets (two lichens and mushrooms) for each of TUCH, KATH and NHM) and published on the GBIF Portal. Before the project started, it was difficult to quantify the number of fungal specimens at working institutions because most of them did not have the registered individual catalogue number. Here, we explored barcode applications as unique identifiers to complement specimen digitization.

During the project implementation, we realized/learned, how important is to bring proper field-level data, preserve specimens and the importance of digitization for the global audiences. Despite the Covid-19 pandemic and its consequences on the implementation of targeted activities, we have brought most of our major deliverables within the designed time frame with slight adjustments on the working modalities.

Progress against milestones

Has your project completed all planned activities?: Yes

Has your project produced all deliverables?: No

Rationale: We are not able to publish checklists of lichens and mushrooms as we decided to incorporate a comprehensive list of the collections with their taxonomic details from recent collections and revisions. It is worthwhile to mention that we decided to submit checklists for quality journals with considerably good impact factors.

Report on Activities

Activity implementation summary

Despite the ongoing COVID-19 pandemic, we implemented most of the planned activities and succeeded to meet targets/deliverables. Training young minds (Research Asistantants and

Volunteers) and inception of digitization programme on the understudied mycological group are of great achievement. Securing co-funding from the ForestAction Nepal and, Himalayan Climate and Science Institute, USA (HCSI) to bring additional datasets and for other complimentary supports was also a remarkable success. Nevertheless, the remaining parts of the project (though not the major ones) like checklists and technical data papers are in progress and will be published within the next couple of months (tentatively within the next six months). We have also realized that we made excessive ambition of the proposal to bring so many deliverables within this short time frame.

Completed activities

Activity name: Literature Review

Description: - During this period, an intensive review on available literature based on lichens and mushrooms collections from Nepal were made. Team members were asked to share the bibliographic databases that they have found useful in working with Nepalese lichens and mushrooms. Some of the noteworthy databases found include Web of Science, Scopus, GoogleScholar, Digital Library of Commons(<https://dlc.dlib.indiana.edu/dlc/>); Regional database for Hindu Kush Himalayan region(<http://rds.icimod.org/Home/Data?group=17>), National Herbarium and Plant Laboratories(KATH) website etc. To access grey literature, publications on Nepalese language, local bulletins, proceedings, books and similar grey literature were compiled. For a moment and also for a long run this compilation is helpful to bring mycological knowledge from Nepal in different local, regional and global assessment processes. Dr. Devkota (main applicant of this project) is also contributing as a research fellow, for the IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) /Sustainable use of wild species assessment (2018 - 2022). IPBES is an independent intergovernmental body, having 133 member countries, provides policymakers with objective scientific assessments about the state of knowledge regarding planet's biodiversity, ecosystems and the contribution they make to the people. Research process and progress on this planned project on mushrooms and lichens are already helpful to share and discussed the primary findings among the participants of the assessment during Chapters meetings and workshops. This kind of sharing and learning will definitely help to deliver the project's aims to the wider audiences in such a global forum. Simultaneously, having strong knowledge of such underrepresented taxa, it will be really good to bring noble information and knowledge on IPBES assessment process itself.

- Though major portion of this activity was carried between aforementioned period, still this is an ongoing process until we bring out checklists of lichens and mushrooms. So far, collected information is used to bring a scientific publication - which is published in a journal " Diversity".

Start Date - End Date: 1/7/2020 - 31/7/2020

Verification Sources: <https://ipbes.net/sustainable-use-wild-species>
assessment <https://ipbes.net/users/shiva-devkota>

<https://www.mdpi.com/1424-2818/13/7/330>

<https://www.mdpi.com/1424-2818/13/7/330>

Activity name: Attendance of BIFA Capacity Enhancement Workshop followed by Inception workshop

Description: Shiva Devkota, PI of BIFA5_023 has participated on the 2020 virtual Data Mobilization Workshop for Asia (21-24 July) and completed a course successfully. It was an instrumental training to learn about project planning, data capture, data management and data publishing tools.
<https://www.gbif.org/event/BoAe3g7KjGeJUzC3oxs9v/data-mobilization-workshop-for-asia-2020>

- Inception workshop was cancelled because of the COVID-19 situation, but in-person meetings in small clusters were carried out at each institutions.

Start Date - End Date: 21/7/2020 - 24/7/2020

Verification Sources: The basic badge obtained by Shiva Devkota
<https://openbadgepassport.com/app/badge/info/307289>

Activity name: Data Additions/ Fieldwork (Co-funding)

Description: A week long field trip was conducted in Jalthal area, Jhapa to collect post-monsoon mushroom species and to document local ethnomycological knowledge. It was kindly supported by the ForestAction (Forest Resources Studies and Action Team) Nepal under the ongoing project framework "Uprating Community Forest management in Nepal: enhancing biodiversity and livelihoods" supported by Darwin Initiative, UK. Jalthal forest is a biodiversity rich fragmented remnant forest in the densely populated region of eastern lowland of Nepal. The forest is used by around 100,000 people living around it. The surrounding forest is inhabited by ethnic minority Meche people. Meche people have their own language and culture are found only in Jhapa district of Nepal especially around the Jalthal forest. There are several other groups of indigenous people Santhal, Rajbanshi, Rai, Limbu, Tamang

and other ethnic groups like Bahun and Kshetri. The forest is an important resource for many people living around the forest and there has not been a proper documentation of natural history and traditional knowledge of the area.

Start Date - End Date: 12/12/2020 - 18/12/2020

Verification Sources: <https://www.darwininitiative.org.uk/project/DAR26022/>

<https://www.forestation.org/programs/index/14>

[https://www.facebook.com/photo?](https://www.facebook.com/photo?fbid=10158986703142154&set=pcb.10158986715882154)

[fbid=10158986703142154&set=pcb.10158986715882154](https://www.facebook.com/photo?fbid=10158986703142154&set=pcb.10158986715882154)

Activity name: Digitization of herbarium at KATH, TUCH and NHM

Description: We digitized 2462 specimens of lichens (TUCH:1123; KATH: 1207; NHM: 132) and 3971 specimens of mushrooms (TUCH:707; KATH: 1620; NHM: 1644)

Start Date - End Date: 1/9/2020 - 31/7/2021

Verification Sources: [https://www.gbif.org/project/1oof3btlISyNanpvIWQYwz/digitization-of-mycological-collections-in-nepal#Appendix1-\"Some glimpse of project activities - BIFA5_023-Updated Version"](https://www.gbif.org/project/1oof3btlISyNanpvIWQYwz/digitization-of-mycological-collections-in-nepal#Appendix1-\)

Activity name: Database management and submission to GBIF

Description: The occurrence data obtained from this digitization have been managed in six datasets. All data have been cleaned and formatted following DwC, checked by experts for the taxonomy and georeferenced, and then published to GBIF. All datasets have been published using Integrated Publishing Toolkit (IPT) of the hosted by International Center for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.

Start Date - End Date: 1/9/2020 - 31/7/2021

Verification Sources:

Mushrooms Flora of Nepal at National Herbarium and Plant Laboratories (KATH)

<https://www.gbif.org/dataset/c92e9439-601d-47d4-8727-ff16ef69952f>

Lichens Flora of Nepal at National Herbarium and Plant Laboratories (KATH)

<https://www.gbif.org/dataset/37742167-d38a-4a4e-8b7d-76f75c2baed8>

Mushrooms Flora of Nepal at Natural History Museum

<https://www.gbif.org/dataset/bbd4effa-9796-4e0c-8c1a-0b92f6a95907>

Lichens Flora of Nepal at Natural History Museum, Tribhuvan University, Nepal

<https://www.gbif.org/dataset/841c97b3-a5e1-428f-aa78-5953bdf01328>

Mushrooms Flora of Nepal at Central Department of Botany, Tribhuvan University, Nepal

<https://www.gbif.org/dataset/3968921a-e2e4-4d2c-a190-ef6655b8c0a5>

Lichens Flora of Nepal at Central Department of Botany, Tribhuvan University, Nepal

<https://www.gbif.org/dataset/cb28169b-df56-44d5-994a-b35cdaa81fa6>

Activity name: Submission of data papers

Description: A part of information from this project is used to review useful lichens from the Nepal Himalayas - which in turn helps to collaborate with lichenologists from China and Switzerland to bring a collective review paper entitled "Ethnolichenology—The Use of Lichens in the Himalayas and Southwestern Parts of China" - published in a well circulated scientific journal "Diversity"

Other data-papers on lichens and mushrooms are being prepared and will be submitted after bringing few more missing information.

Start Date - End Date: 1/1/2021 - 31/7/2021

Verification Sources: <https://www.mdpi.com/1424-2818/13/7/330>

<https://doi.org/10.3390/d13070330>

Activity name: Result sharing workshop and final report submission

Description: Due ongoing pandemic we've only made in-persons meetings in small clusters. A

Webinar will be concluded with all the partner organizations and stakeholders once we are ready with our data papers and, checklists of lichens and mushrooms. Discussion has been already established with Dr. Bandana Shakya, Node Manager HKH-BF at ICIMOD Kathmandu and she is also supportive with this plan. It is likely that ICIMOD could facilitate this webinar bringing other stakeholders from working countries in the Hindu Kush Himalayan region.

Start Date - End Date: 15/7/2021 - 31/7/2021

Verification Sources: -Final Report

- Dr. Bandana Shakya, Node Manager HKH-BIF (Email: bandana.shakya@icimod.org)

<https://www.icimod.org/ecosystem-services/hkh-bif/>

Report on Deliverables

Production of Deliverables - Summary

The main long term objective of this project is to contribute to bringing recent information on much-underestimated taxa like lichens and wild mushrooms in Nepal and to mobilize/deliver the species occurrence data based on information of the collection at the museum and major herbariums centres of Nepal onto GBIF for the wider scientific community. Having a set target of publishing at least six datasets, we have published all datasets as planned. In spite of having these unprecedented times,

We managed to bring additional occurrences records/data paper on fungi from a very new collection site Jalthal, Jhapa (before our study, not a single fungal species were collected from there).

Additionally, we've also brought a data paper and published in a scientific journal and almost 75% done with checklists of lichens and mushrooms.

Furthermore, we are also planning to bring (within the next 4 months) two technical papers (each on lichens and mushrooms) mainly describing methodology and lessons learned on digitization and publication procedures.

Production of deliverables

Title: Mushrooms Flora of Nepal at National Herbarium and Plant Laboratories (KATH)

Type: Dataset

Status update: PUBLISHED

Dataset scope: For the wider audiences.}

Expected number of records: 1620

Data holder: National Herbarium and Plant Laboratories (KATH) / Department of Plant Resources (DPR)

Data host institution: International Centre for Integrated Mountain Development (ICIMOD)

Sampling method: Based on the herbariums deposited at KATH

% complete: 100

DOI: <https://doi.org/10.15468/485yak>

Expected date of publication:

Title: Lichens Flora of Nepal at National Herbarium and Plant Laboratories (KATH)

Type: Dataset

Status update: PUBLISHED

Dataset scope: For the wider audiences.}

Expected number of records: 1207

Data holder: National Herbarium and Plant Laboratories (KATH) / Department of Plant Resources (DPR)

Data host institution: International Centre for Integrated Mountain Development

Sampling method: Based on the herbariums deposited at KATH

% complete: 100

DOI: <https://doi.org/10.15468/v4bntu>

Expected date of publication:

Title: Mushrooms Flora of Nepal at Central Department of Botany, Tribhuvan University, Nepal

Type: Dataset

Status update: PUBLISHED
Dataset scope: For the wider audiences.}
Expected number of records: 707
Data holder: Tribhuvan University Central Herbarium (TUCH) / Central Department of Botany, Tribhuvan University
Data host institution: International Centre for Integrated Mountain Development (ICIMOD)
Sampling method: Based on the herbariums deposited at TUCH
% complete: 100
DOI: <https://doi.org/10.15468/9dyswy>
Expected date of publication:

Title: Lichens Flora of Nepal at Central Department of Botany, Tribhuvan University, Nepal

Type: Dataset

Status update: PUBLISHED
Dataset scope: For the wider audiences}
Expected number of records: 1123
Data holder: Tribhuvan University Central Herbarium (TUCH) / Central Department of Botany, Tribhuvan University
Data host institution: International Centre for Integrated Mountain Development (ICIMOD)
Sampling method: Based on the herbariums deposited at TUCH
% complete: 100
DOI: <https://doi.org/10.15468/zewugc>
Expected date of publication:

Title: Mushrooms Flora of Nepal at Natural History Museum

Type: Dataset

Status update: PUBLISHED
Dataset scope: For the wider audiences.}
Expected number of records: 1644
Data holder: Natural History Museum, Tribhuvan University (NHM/TU)
Data host institution: International Centre for Integrated Mountain Development (ICIMOD)
Sampling method: Based on the herbariums deposited at NHM
% complete: 100
DOI: <https://doi.org/10.15468/c2sus4>
Expected date of publication:

Title: Lichens Flora of Nepal at Natural History Museum, Tribhuvan University, Nepal

Type: Dataset

Status update: PUBLISHED
Dataset scope: For the wider audiences.}
Expected number of records: 132
Data holder: Natural History Museum, Tribhuvan University (NHM/TU)
Data host institution: International Centre for Integrated Mountain Development (ICIMOD)
Sampling method: Based on the herbariums deposited at NHM
% complete: 100
DOI: <https://doi.org/10.15468/mw4ksm>
Expected date of publication:

Title: Ethnolichenology—The Use of Lichens in the Himalayas and Southwestern Parts of China

Type: Data Papers

Description: Chinese samples are available in the Lichen Herbarium of the Kunming Institute of Botany (KUN-L) and we reviewed useful lichen collections housed at different herbaria (KATH, TUCH) and at the Natural History Museum, Tribhuvan University, Nepal, for their additional notes.
Sources of verification: <https://www.mdpi.com/1424-2818/13/7/330/htm>

Title: Mushroom flora of Jalthal forest, Jhapa, Eastern Nepal

Type: Data Papers

Description: A comprehensive list of wild mushrooms recorded from Jalthal, Jhapa. Previously, we had prepared a list only with post monsoon species but later on decided to include pre-monsoon and monsoon species. Amidst this pandemic, it is hard to make trips to collect such field level data.

Sources of verification: For the further information: Dr. Lila Nath Sharma, lila@forestaction.org <https://www.forestaction.org/publications/jfl/151>

Title: Mass Digitization of Lichens Herbariums in Nepal : Lessons Learned and Future Prospects

Type: Data Papers

Description: Based on the BIFA5_023 Project, we are drafting a manuscript to submit in a peer reviewed journal.

Sources of verification: Further information can be obtained from a co-author, Ms. Til Kumari Thapa, Research Officer, National Herbarium and Plant Laboratories (KATH), Department of Plant Resources, Gov. of Nepal. Email: tilkumarithapa75@gmail.com

Title: Mass Digitization of Mushrooms Herbariums in Nepal : Lessons Learned and Future Prospects

Type: Data Papers

Description: Based on the BIFA5_023 Project, we are drafting a manuscript to submit in a peer reviewed journal.

Sources of verification: Further information can be obtained from a co-author, Ms. Til Kumari Thapa, Research Officer, National Herbarium and Plant Laboratories (KATH), Department of Plant Resources, Gov. of Nepal. Email: tilkumarithapa75@gmail.com

Impact of COVID-19 pandemic on project implementation

Amidst this pandemic, we had tried our best to implement BIFA5_023 activities taking every care and precaution. Having this stringently hard time, some of the plans have been changed and the following working strategies were adapted to bring the best.

As the mass gathering was strictly prohibited, we simply organized informal meetings (avoiding mass gatherings for inception and closing workshops) in small clusters each with a single collaborating institution. The remaining meetings cost and surplus money from internet service are used to purchase covid preventive health items and pre-cautions.

To maximise our output and to undertake desktop work. we had rented a room for six months period in Kupandole, height Lalitpur utilizing the pending travel budget (travel restrictions in the public vehicle).

Additional occurrence records of mushrooms (co-funding) for these pre and monsoon periods have been postponed due to the ongoing pandemics. This has hindered the publication of a scientific paper on their taxonomy and ecology. We are planning to bring complete checklists after bringing additional species details.

Events

GIIS Monday #webinar series-13. "Wild Mushrooms in Nepal: Plate to Poison"

Dates: 2020-08-04 - 2020-08-24

Organizing institution: Global Institute for Interdisciplinary Studies (GIIS)

Country: Nepal

Number of participants: 100

Comments: This webinar series was mainly focused on wild mushrooms of Nepal, its present status and future prospects. Here, Shiva Devkota also highlighted about ongoing digitization project under GBIF/BIFA framework and also highlighted the importance for the data documentation and visualization.

Website or sources of verification: <https://www.youtube.com/watch?v=1INGi6LBA3s&t=1544s>

Events

A talk programme by Mycological Association of Washington DC, USA

Dates: 2020-11-10 - 2020-11-10

Organizing institution: Mycological Association of Washington DC

Country: USA

Number of participants: 80

Comments: Shiva Devkota presented a live talk from Nepal, sharing his expertise on Nepalese fungi and also describing his recent mycological work with GBIF/BIFA and further plans including Ethnomycological Expedition in Nepal.

Website or sources of verification: <http://mawdc.org/event-3907320> / <https://www.youtube.com/watch?v=BtU-sf3QPU>

Events

A talk programme: 23rd Annual San Diego Fungus Fair of the San Diego Mycological Society

Dates: 2021-02-21 - 2021-08-21

Organizing institution: San Diego Mycological Society

Country: USA

Number of participants: 300

Comments: Shiva Devkota has also presented the research of the digitization project and the designed mycological expedition in Nepal in another live talk, this time during the 23rd Annual San Diego Fungus Fair of the San Diego Mycological Society, held in February 2021. <https://www.youtube.com/watch?v=UtnWkeddvBg>

Website or sources of verification: <http://sdmyco.org/fungus-fair/>

Communications and visibility

The Global Institute for Interdisciplinary Studies (GIIS) has provided BIFA5_023 details on its website: <https://www.thegiis.org/project-details/digitization-of-mushrooms-and-lichens-collections-from-nepal:-bringing-underrepresented-taxonomic-groups-into-the-global-biodiversity-database.html>

Shiva Devkota has discussed and presented (n = 5: in five provincial states in Nepal) about ongoing digitization project while serving as a resource person for a project "Strengthening capacities for implementation of the Nagoya Protocol in Nepal" by IUCN Nepal in close collaboration with the Ministry of Forest and Environment, Nepal Government. # Pictures attached. Presentations were made for the provincial government officials mainly from the forestry, agrobiodiversity, plant resources, veterinary offices, universities and related stakeholders. # Appendix 1

BIFA5_023 updates are also regularly being provided and available on the page: <https://www.gbif.org/project/1oof3bltISyNanpviWQYwz/digitization-of-mycological-collections-in-nepal>

ICIMOD/HKH-BIF (Hindu Kush Himalayan Biodiversity Information Facility) has just uploaded two of Shiva Devkota's mushrooms pictures into its newly designed webpage. ICIMOD is an associate member of the Global Biodiversity Information Facility (GBIF), and HKHBIF is the GBIF-mediated publishing platform that is hosted by ICIMOD. It is a regional node of GBIF. <https://www.icimod.org/ecosystem-services/hkh-bif/>

Monitoring and evaluation

Final Evaluation

From the inception of the project, we were committed to the accountability, learning and dissemination through which our mutual work with GBIF/BIFA "translated" into more effective, efficient and sustainable programme interventions.

Earlier a mid-term evaluation and thereafter close observation help to bind the experience made so far. It was found that the collaborating government and academic institutions (GIIS, KATH, TUCH and NHM) are in a single framework (though there are several limitations with this COVID) to implement this project and are delivering their activities effectively amidst this pandemic time.

Some of the changes which we introduced than mentioned in a proposal are as below and such

changes turned out to be important decisions.

- working from a rented room to overcome the COVID fear;
- the focused work on digitization bringing contributions of five research assistants (Mycologist, Lichenologists, and Digitization Expert)
- Bring additional scientific publications for peer-reviewed journals (data papers) on digitization techniques and lessons learned.

Furthermore, all partner organizations are agreed to work further on the citizen science approach to bring occurrence records of lichens and mushrooms.

The GBIF logo was used in PowerPoint slides and GBIF/BIFA and Ministry of the Environment, Government of Japan were greatly highlighted and acknowledged in scientific publications. As this digitization project is focused on the less-studied group of biodiversity, the GBIF could use this work and publications (datasets and data papers) for the further reinforcement of similar works in other countries. # Appendix 1- "Some glimpse of project activities - BIFA5_023-Updated Version"

Best Practices and Lessons Learned

We realized that there were some areas, which could be addressed to make this kind of digitization programme more friendly (in terms of capital and physical assets). Proper curation and labelling of the herbarium are necessary not only for future uses but equally essential to gear up the digitization process.

Post Project Activity(ies)

As stated earlier, we'll finalize checklists of lichens and mushrooms and manuscripts will be submitted to ISI journals. Simultaneously, will be working to prepare data papers on digitization technology and lesson learning. We'll be happy to share our publications with the GBIF/BIFA coordination team, once papers are published.

Nepal which is located in the Central Himalayan region is the centre of origin, adaptation, growth and dominance of different biotypes. Many interesting species are present within narrow elevational gradients starting from the lower belt to the higher landscapes. Among the studied species, wild mushrooms and lichens are very poorly explored and described irrespective of the higher plants and flagship animals. So, the next priority should be to foresee mycological surveys in many virgin lands, seeking their diversity, genetic variation and ecology and bring such information to the widely shared/available GBIF Portal.

Sustainability plans

This initiation should not be stopped and it is of utmost necessity that we must continue working on lichens and wild mushrooms in the next season too. Our team is the first to start digitization of these understudied taxa in Nepal and we are committed to bringing/add more occurrences data in the days to come.

Having these sorts of evidence-based datasets, help to understand the existing fungal scenario/gap analyses in Nepal and will play an instrumental role to design further explorations/collections trips finding much underexplored areas/taxonomic groups. Involved institutions are fully convinced with these data and planning to arrange further field trips accordingly.

The effectiveness of the further explorations will be measured based on finding understudied taxonomic groups from less explored areas of Nepal.

With this project, all the partner institutions will continue to promote open science to benefit the development of biodiversity data mobilization.

GBIF leads the Biodiversity Information Fund for Asia (BIFA), a programme funded by the Ministry of the Environment, Government of Japan. The programme provides supplementary support for activities addressing the needs of regional researchers and policymakers through mobilization and use of biodiversity data.

