# Open Access to, and publication of, Mountain Biodiversity Data of the Hindu Kush-Himalayan region

14-18 June 2010, ICIMOD, Kathmandu, Nepal

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A regional workshop/training by ICIMOD, Global Biodiversity Information Facility and Global Mountain Biodiversity Assessment

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Compiled by Sunita Chuadhary, Bandana Shakya and Nakul Chettri

**Summary**

The Hindu-Kush Himalayan region is significantly rich in terms of biodiversity resources but it presents us with one of the least studied in the globe. The available data in the region are sporadic, inaccessible and not well managed and formatted. The inventory, assessment and sharing well-documented biodiversity information of the region have become essential to improve understanding, efficient conservation and management of these resources. There is an urgent need to fill the geographical and taxonomic data gaps. Based on previous efforts, the International Centre for Integrated Mountain Development (ICIMOD) in cooperation with the Global Biodiversity Information Facility (GBIF) and the Global Mountain Biodiversity Assessment (GMBA) took an initiative and organised a regional workshop and hands on training. The aim of the workshop was to provide a global platform to publish, harvest and use biodiversity data from the HKH region by using international data, metadata standards and geo-referencing biodiversity data. The workshop brought together 25 representatives from ICIMOD's eight regional member countries of the Hindu Kush-Himalayan region: Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan as well as two invited guest representatives from Georgia. Discussion on GBIF infrastructure and framework for primary biodiversity data, discovery, publishing and its use in the region were discussed. Activating ICIMOD as a regional node of GBIF and initiating a regional collaboration to develop and share biodiversity information in the region were sought as a way forward.

**Introduction**

The Hindu-Kush Himalayan region (HKH) is endowed with a rich variety of species and ecosystems of global importance; is on the priority list for many global conservation agendas. This region provides numerous vital ecosystem services including fresh water that serves more than 200 million people in the immediate vicinity and 1.3 billion people living in the downstream river basins. The eight HKH regional member countries Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan are signatories to the Convention on Biological Diversity (CBD) and are committed to conservation. As a measure towards the immediate protection of globally significant landscapes, these countries have set aside more than 39 percent of their most biologically rich land terrain; the region now has a total of 488 protected areas, 29 Ramsar sites, 13 UNESCO Heritage sites and 330 Important Bird Areas (IBAs).

Despite its importance, this region is one of the least studied in the globe. The available data on the HKH are sporadic, inaccessible and in different formats and standards. Inventorying, assessing, documenting and sharing HKH biodiversity information is essential to improve the understanding, conservation and effective management of this biodiversity. Therefore, there

is an urgent need of filling the existing taxonomic and geographical data gaps for a better decision-making.

The International Centre for Integrated Mountain Development (ICIMOD) in cooperation with the Global Biodiversity Information Facility (GBIF) and the Global Mountain Biodiversity Assessment (GMBA) encourages a global effort to make biodiversity data accessible and mobilise biodiversity databases on mountain organisms, to achieve a better understanding of mountain biodiversity and predicting its changes.

Therefore, ICIMOD, GBIF and GMBA jointly organised a regional workshop and hands on training on "**Open Access to, and publishing of, Mountain Biodiversity Data of the Hindu Kush Himalayan region**" at ICIMOD's headquarter in Kathmandu from the 14th to 18th of June 2010. The overall goal of the workshop was to provide a global (online) platform to publish, harvest and use biodiversity data from the HKH region by using internationally certified data, metadata standards and geo-referencing biodiversity data.

### Objectives of the workshop

The objectives of the workshop were to bring the eight Regional Member Countries (RMCs) to discuss on the opportunity that GBIF infrastructure and framework represents for primary biodiversity data discovery, publishing and use for the HKH countries and the region; and to strengthen the capacity of biodiversity researchers and data publishers from the HKH region to discover, digitise and publish biodiversity data by adopting GBIF promoted tools, standards and processes. The workshop discussed critical issue of developing a framework and partnership needed for continuous promotion of easy and open access to standardized and harmonised biodiversity information in the HKH region.

### Opening Session

Mr. Berend de Groot, Director of Programme Operations of ICIMOD, welcomed the participants and emphasized the importance of long-term partnerships among ICIMOD's member countries and global partners to promote standardized and harmonized biodiversity data and information. He highlighted an urgent need to fill the gaps in data in HKH region revealed by the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). He further accentuated that 'Transect Approach' is promoted by ICIMOD for biodiversity assessment and long-term monitoring in the region to link to biodiversity data and information sharing activities.

In delivering the Key Note during the opening session, Dr. Vishwas Chavan from GBIF stressed the importance of information management as an integral part of the research agenda. He urged the regional member countries and the thematic global partners to use the opportunity to mainstream biodiversity informatics. Furthermore, Dr. Eva Spehn from GMBA stressed how global biodiversity datasets can be used to address questions related to mountain biodiversity and climate change data and an urgent need to broaden the data types to supplement biodiversity data.

In his subsequent remarks at the opening session, Dr. Eklabya Sharma, Programme Manager of Environmental Change and Ecosystem Services Programme (ECES) at ICIMOD put emphasis on regional collaboration between countries for sharing of biodiversity data. In this regard, he also added an important role that ICIMOD is playing to provide a platform for sharing of biodiversity information in the HKH region.

Speaking on the occasion, Mr. Krishna Prasad Acharya, Joint Secretary of the Ministry of Forest and Soil Conservation, Government of Nepal welcomed the approaches and emphasized the importance of free access data for effective conservation and importance to support such initiatives.

**GBIF Presentations**

**Introduction to GBIF and its potential relevance to the HKH region**

<u>Dr. Vishwas Chavan</u>, Senior Programme Officer for DIGIT introduced GBIF as an intergovernmental initiative to share biodiversity information across borders. The institution currently has 54 countries and 44 intergovernmental organizations as members globally. The establishment of GBIF was endorsed by the Science Ministers to the Organization for Economic-Cooperation and Development (OECD) in 2000. It is government initiated and funded in response to the needs of government agency for biodiversity information access and management. It is in service to science as a global public good to facilitate free and open access to biodiversity data worldwide via internet, to underpin scientific research, conservation and sustainable development. GBIF has an international mandate to work towards the establishment of efficient open access regimes for digital research data from public funding in accordance with the following objectives and principles:

- Openness: balancing interests of open access to data to increase the quality and efficiency of research and innovation with the need for restriction of access in some instances to protect social, scientific and economic interests.
- Online data sharing: more than 200 million biodiversity data records mapped to 1*1 degree grid
- Facilitating access/exchange of high quality data.

Dr. Chavan talked about data portal, data access, data sharing, data repatriation and explained about the query capabilities for mountain biodiversity data. He explained how to build a comprehensive architecture to resolve taxonomic names (GNA) and Global Information Infrastructure for biodiversity focusing on improved access to names, metadata and primary biodiversity data. The Global Biodiversity Resources Discovery System (GBRDS), the GBIF Integrated Publishing Toolkit and the Data Hosting Centre were explained in detail. The best practice guidelines for sharing biodiversity data and few successful examples were shared among the participants.

In his presentation, Vishwas he focused on the relevance of GBIF to HKH region. GBIF offered to use its Global Information Infrastructure; Biodiversity data discovery and publishing framework; Cross-domain, their expertise and experience; and community agreed standards, tools, protocols and processes as well as their international recognition. He encouraged the RMCs participants to collaborate on innovative data sharing projects and help in determining success. The GBIF Data Portal and query capabilities for mountain biodiversity data were further explained.

**GBIF informatics infrastructure: present and future**

Dr. Chavan was also the speaker on the Informatics Suite of GBIF. He spoke about improved discovery, faster indexing, richer user interfaces, more data types and richer content as main challenges of biodiversity information management today. He covered the details of key processes required for data publishing on GBIF platform and discussed the key components of GBIF Informatics:

- <u>Publishing component:</u> The Integrated Publishing Toolkit (IPT) provides a robust and user-friendly publishing tool like TAPIR compliant, WFS-WMS, and EML etc. It improves the existing standards like Darwin Core and enables the provision of richer content through extensions for specialized communities; and supports the publishing of more data types such as Metadata.
- <u>Harvesting/indexing component:</u> Harvesting and Indexing Toolkit (HIT) harvests distributed data publishers using multiple protocols and schemas; and multiple data

types (primary biodiversity data, metadata). It synchronizes with GBIF registry and indexes into a central database.

- Registry component: The Global Biodiversity Resources Discovery System (GBRDS) which is at a testing phase provides registry of organization and resources; schema and extensions; services and tools; and a compass for all information networks.
- Portal component: The Nodes Portal Toolkit is at the planning phase and it provides a platform that publishes primary biodiversity data, Names, Metadata. It further designs it as a flexible and customisable platform to meet the needs of a variety of community and their requests.
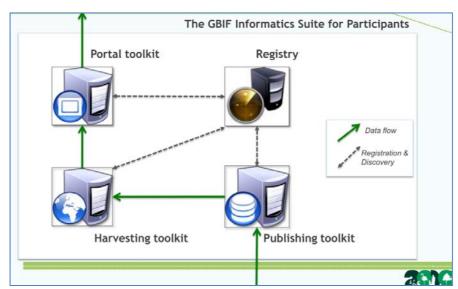


Figure 1: Key components of GBIF Informatics Suite

He further discussed the data discovery of species and informatics strategy of GBIF. He reported that GBIF is a preferred source mechanism for biodiversity data and provides a platform for publishing, integration, access, and use of biodiversity data. He gave a successful example of the Nordic Genetic Resources Centre (NordGen) and ended his presentation by making a call to participate in GBIF data publishing community. He then asked the participants to actively engage in the decentralisation of GBIF architecture to meet their needs, use/test/contribute to GBIF Informatics Suite, address challenges in data quality and thus constantly monitor data usage and review the informatics developments.

**Biodiversity data discovery and publishing strategy**

Next, Dr. Chavan presented about the biodiversity data discovery and publishing strategy of GBIF. He started his presentation by explaining how GBIF enabled data is useful in addressing the science-policy interface. He said GBIF collected and published biodiversity data is helpful in policy development and decision making at local, national, regional and global level contributing to management, conservation and sustainable use of biodiversity.

GBIF has 9,900 data resources with 316 data publishers. More than 201 million biodiversity records mapped to (1*1) degree grid are available online. Biodiversity data are categorised by major taxonomic group with more coverage on animals especially birds, mammals and fishes (i.e. Animalia; 72%, Protozoa: 1%, Plantae: 26% and Fungi: 1%). It has 44, 706.505 plants records available online for terrestrial and marine data for North America, Europe/North Asia and the Atlantic.

Along with the components of the data discovery and publishing strategy, Dr. Chavan explained activities of Content Needs Assessment (CNA) and Model CNA exercise. He discussed why CNA is necessary and how CNA is done step by step. He then focused on characteristics of GBIF Contents Needs Assessment and highlighted CNA assessment done all over the globe. GBIF got 750 responses from 77 countries with two-third responses only from the developed countries. The primary biodiversity data (PBD) of CNA is useful for applied issues (endangered species, migration, invasion, conservation planning, genetics etc), societal issues (ecotourism, recreation, public health) and basic issues (taxonomy, diversity, population dynamics, biogeography, ecology and evolution). He said the PBD of CNA is best used when integrated with other types of data. As far as possible, CAN should be kept simple with less number of questions and it should be well practiced in advance. He also talked about activities of Content Gap Analysis and data resources discovery system. Some of the activities are:

- Identify key activities and projects
- Identify the resultant data resources (past, present and future)
- Document/register a resource through metadata catalogue
- Publish catalogue
- Enlist existing and potential data producers, custodians, publishers and aggregators.

He further talked about mobilization and publishing strategy and action plan focusing on the following components:

- Propose mobilization and publishing
- Develop demand-driven and deterministic action plans
- Develop business proposal
- Mobilize resources and
- Implementation and evaluation

**Data digitisation**

The planning for digitisation is essential for demand-driven strategisation, business case, implementation and risk analysis. Before digitisation, one should identify its goals and try to answer certain questions like who are the major users, how much data one needs, what sort of data, data capture/interpretation needed and about the future requirements.  He also pointed out that digitisation can't create new information and has certain limitations and resources such as.

- Staffing, digitisers, data experts and owners
- Data entry procedures and restriction on access to data
- Legacy data and funding

He presented good database solutions and illustrated his presentation with tools and best practices. For example:  Biota (Biodiversity Database Management), BioLink etc.

Figure 2: Tools and best practices

He urged to initiate a digitisation project and develop an action plan before running any digitisation projects. Assessing and enhancing fitness-for-use data is critical for scientific and social relevance of biodiversity science. The data quality assessment and quality control are two important components of fitness-for-use regime. It is significantly important for an organization to have a vision with respect to having good quality data, policy to implement that vision and a strategy for its implementation. He further discussed issues influencing and responsible players for data quality; and a framework for data cleaning. He ended his presentation by talking about the principles of best practices like accuracy, effectiveness, efficiency, reliability, accessibility, transparency, timeliness and relevance. The GBIF Training Manual 1: 'Digitisation of natural history collections data' is available at http://www2.gbif.org/TM1.pdf

**GMBA Presentation**

**Introduction to GMBA and its Mountain biodiversity portal**

Dr. Eva Spehn, GMBA Executive Director, University of Basel, Switzerland introduced GMBA as a cross-cutting network of DIVERSITAS embracing issues of their four core projects bioGENESIS, bioDISCOVERY, ecoSERVICES, and bioSUSTAINABILITY. It primarily aims to provide a scientific basis for the conservation and sustainable use of mountain diversity by encouraging and synthesising hidden and fragmented results of research on high elevation organismic diversity, it's regional and global patterns, its cross- and intercontinental comparisons, and its causes and functions. In other words, it aims to document and synthesise knowledge on the biological richness of the mountains of the world and the changes undergoing as a result of direct and indirect human influences.

She explained three GMBA Synthesis Volumes on Mountain Biodiversity published in 2002, 2006 and 2009. Two workshops were organised on Geo-referenced biological databases in 2006, Kazbegi where a Geo-referenced biological databases Research Agenda was developed. The second workshop was held 2007 in Copenhagen.

A Mountain Biodiversity Portal developed in collaboration with GBIF was explained. It allows to explore biodiversity archive data for mountain regions. How to search data from region to globe, or mountain life zones by range of elevation or thermal belts were presented online. Recommendations made during the Convention on Biological Diversity (CBD)'s Fourteenth

Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-14) for GMBA on their continuous work on mountain biodiversity were briefed. The presentation ended with sharing of experiences on workshops on Linking Geodata with Biodiversity Information in the Himalayas held during 16-18 November, 2008 and Open Access to, and documentation of Mountain Biodiversity data held during 29-930 July 2009 in China.

**Extensive Markup Language (XML)**

Dr. Falk Huettmann, University of Alaska, United States introduced and defined XML conceptually and technically. XML forms the basis for the applications presented here, and for the workshop to come. It is a freeform text document with content which is an ideal format for online information and data transfer. It is a semi-structured database which can be used for books, documents, worksheets or databases. Information in Darwin Core and in FGDC NBII is structured in XML format. The pros and cons of XML, its security as well as its complexity were discussed. Hypertext Markup Language (HTML) was explained as an applied example of XML in a web browser. Keyhole Markup Language (KML), Geography Markup Language (GML) designed for maps and spatial information and Ecologically Markup Language (EML) for ecological data were presented.

**Metadata theory, philosophy, tools, data fields and purpose**

Next, Dr. Huettmann gave a detailed presentation on metadata theory, tools and purposes with some examples. He defined metadata as data about data and talked about the global relevance of metadata. i.e. providing online information for science-based sustainable management of world's natural resources. Metadata helps to find, assess, understand and use data correctly. It is essential for the global users and scientists. Different types of metadata and formats exist:

- Discovery metadata: Telephone Entry style, e.g. DIF, ABCD
- Content Metadata: Description of Data, e.g. FGDC
- Combined: Discovery + Content + Technical Formats, e.g. ISO, EML

The speaker explained the underlying philosophy of metadata. Metadata is a government service and ISO compliant. It promotes data, it use and updates as needed. He thoroughly discussed the steps in writing a good metadata. i.e. Title, abstract, keywords, methods, authorship and vocabularies.

**Specific GIS data and applications**

With the growing application of GIS in biodiversity conservation and management, Dr. Huettmann presented next about specific GIS data and their use. By using Digital Elevation Mode (DEM), he showed how to prepare climate layers for precipitation and temperature, land cover layers, forestry layers, hydrology layers, road layers, proximity layer, human footprint layers and protected areas maps. He further explained how to detect changes in land use, cover, climate etc by using GIS data. The GIS data can be applied in predicting status for the future, impacts as well as the current status.

Dr. Huettmann also talked about modeling the potential impacts of climate change and use of biodiversity data for policy making. While explaining the use of GIS tools for conservation planning, he introduced Marxan for strategic conservation planning. It is a freely available conservation planning software which provides decision support to a range of conservation planning problems including the design of new reserve systems, reporting on the

performance of existing reserve systems and developing multiple use zoning plans for natural resource management.

**Digital Taxonomies: What, Why, Applications, and Formats**

Next, Dr. Huettmann defined taxonomy as the practice of science of (species) classification. He explained the vocabularies of taxonomy in words, taxonomic string and the taxonomic database for major biological groups like mammals, birds and plants. The Taxonomic Serial Number (TSN), a globally unique number for each species of the world is stable and searchable online. He then explained the importance of ITIS and its applications with few examples. ITIS is helpful for species classification and listing; and human inquiry. It is useful for biodiversity inventory, monitoring and other conservations measures; and can also be applied in the field of genetics and evolution. Conservation organisations like GBIF, Ocean Biogeographic Information System (OBIS), GENEBANK, and National Biological Information Infrastructure (NBII) have been using digital taxonomy for their conservation projects. A digital taxonomy is applied for interactive web, hierarchical search, change detection and geophylobuilder. The formats required for a digital taxonomy are *.doc, ASCII, *.txt, SGML, XML and *.nwk.

**Data mining, predictive modeling and adaptive management**

In the next presentation, Dr. Falk Huettmann presented about data and web mining, predictive modeling by using online data and for an adaptive management. Based on online data, how predictions can be made was explained by the speaker. He said predictions are necessary as it fills data gaps and can provide reliable and transparent scenarios of the future. Today, predictions are done by developing a model from many studied locations, building robust non-linear models, applying models to location for an internal accuracy assessment and thus applying those models out of study area and for performance assessment. He explained how predictions can be made by using spatial modeling with the use of GIS and illustrated with an example of GBIF data on open modeler (http://openmodeller.sourceforge.net/ ).
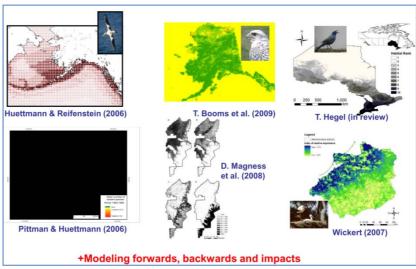


Figure 3: Prediction examples

**ICIMOD Presentations**

**Biodiversity Initiatives at ICIMOD**

Dr. Eklabya Sharma, Environmental Change and Ecosystem Services Programme Manager of ICIMOD talked about biodiversity initiatives taken by ICIMOD in the HKH region. He first thoroughly explained about the significant rich biodiversity status in the region. Then, approaches adopted by ICIMOD for conserving and managing biodiversity in different landscape in the region were explained in detail: Landscape approach; Regional Cooperation Framework (RCF); Transboundary approach; and Access and Benefit Sharing (ABS) framework. The actions implemented like feasibility assessment, understanding socio-economic dimensions and climate change vulnerability assessment in the region were also presented.

ICIMOD has always given importance to regional information sharing mechanisms. HKH Conservation Portal is one of initiatives taken by the centre to enable free and universal access to data and information on landscape level conservation initiatives in the region. Similarly, the conservation portal to share information on biodiversity of Nepal has been promoted by ICIMOD. Wetland Information System and Himalayan Conservation Approaches and Technologies (HIMCAT) were some of the information sharing mechanisms explained during his presentation.

The presentation ended with sharing of future plans of ICIMOD for biodiversity management in the HKH region. In particular, the Trans-Himalayan Approach to fill data gaps in HKH region, Payments for Environmental Services (PES) and Mountain Biodiversity Information Network were shared.

**Geo-data sharing and applications in the HKH**

Mr. Basant Shrestha, Program Manager of Mountain Environment and Natural Resources Information System (MENRIS) at ICIMOD introduced the centre as regional mountain knowledge and learning centre and importance of biodiversity in the region. MENRIS was briefly introduced with its goals and objectives of information sharing. Thematic portals have been developed by the program for easy access and sharing of information at regional level. The Cryosphere/Water, Disaster/Natural Hazards, Land cover/use, REDD, Air/Atmosphere and Biodiversity/Ecosystem portals developed by the centre were briefly explained. ICIMOD's role as a facilitator for international standardization, capacity building of the regional member countries and regional networking were shared. MENRIS focuses on a common approach for development of regional databases and promotes open access to data and information for informed decision making.

**Mountain Geo-portal and Conservation Portal**

Mr. Birendra Bajracharya, GIS Officer at MENRIS of ICIMOD explained about portals developed by the centre for information sharing in the HKH region. Along with in-depth explanation on portals, how to use the portals were also demonstrated online.

- The Mountain Geo-Portal is a web-based platform to build, share and disseminate geo-information and knowledge resources in the HKH region. It is a regional gateway and clearinghouse for earth observation derived products and geo-information services. http://geoportal.icimod.org

- The HKH Conservation Portal is a thematic portal to promote sharing conservation information in the HKH. It aims to provide free and open access to primary data and information related to landscape-level conservation initiatives in the HKH region including PA, corridors and biodiversity resources.

**Database concepts**

Mr. Kiran Shakya, Internet GIS Programmer at ICIMOD started the second day with introduction on standards and different tools for publishing biodiversity data. The session was mainly focused on different protocols/standards to make biodiversity data interoperable. The GBIF's Data portal was presented step by step strategically. Then, the presentation was preceded with explanation on Wrapper tools for data publishing.

- Distributed Generic Information Retrieval (DiGIR) Wrapper Tool (2002) uses HTTP as a transport mechanism and XML for encoding message sent between the client and institution, allowing data in an online database to be exchanged in a standard format
- Biological Collection Access Services (BioCASE) Wrapper Tool (2003) builds on work started by DiGIR which also uses HTTP as a transport mechanism and XML for encoding messages sent between client and the institution.
- Taxonomic Database Working Group (TDWG) Access Protocol for Information Retrieval (TAPIR) Wrapping Tool (2007) is designed as a generic tool to apply in domains other than biodiversity and natural science collections data. It combines and extends features of DiGIR and BioCASE protocols which are flexible to use the data exchange standards.

Then, the standards and the need of standards to exchange data between the institutions were presented with a particular focus on the following standards:

- Darwin Core (DwC) is a database template and facilitates the sharing of information about the biological diversity and its extensions provide a mechanism to share additional discipline specific information.
- Access to Biological Collections Data (ABCD) supports the exchange and integration of living and preserved specimens along with the observation data in one single database. It is not ISO compliant and not so widely used yet, though.
- Metadata Standards (see mentioned on section above).
- OGC Web services Standards are OpenGIS Web Map Services (WMS) whose implementation specification provides three operations (GetCapabilities, GetMap, and GetFeature Info) in support of the creation and display of registered and superimposed map like views of information that come simultaneously from multiple remote and heterogeneous sources. The protocols like Web Map Service (WMP), Web Feature Service (WFS) and Web Coverage Service (WCS) were also explained.

Due to its importance, a special session on Darwin Core and its standards was held. The general concepts on ABCD (primary occurrence record), Taxon Concept Schema (taxon level information), Metadata web services, Open Geospatial Consortium (OGC) services and Generic Wrapper Protocols (DiGIR, Biobase protocols) were explained. The Taxonomic Database Working Group (TDWG), an international collaboration for development of standards for exchange of biological diversity data was briefly explained among the participants. The standards, terms and versions of Darwin Core with a sample were thoroughly explained during his presentation. The GBIF's IPT based on Darwin Core terms for core biodiversity data types built in and different dataset types such as Occurrence, Checklist, and Metadata records used to describe it were explained.

**Integrated Publishing Toolkit (IPT)**

As IPT is an essential part of new GBIF set of tools, Mr. Shakya thoroughly explained IPT as an open source java web application tool used especially for small data publishers or those with limited internet access. The tool has a richer environment than other wrapper tools providing visualization capabilities and the ability to publish dataset metadata. It publishes through Biodiversity Information Standards like TAPIR, Darwin Core; and Open Geospatial Consortium (OGC) like Web Map Services and Web Feature Services. He explained the

general features, base of publication, types of data required for IPT, key components of GBIF informatics and one-step entry point to data discovery on IPT. He further explained how to register organization at GBIF, upload data on it and access information online. After explanation on the theory of IPT, he demonstrated how to install and use GBIF IPT.

**Case Studies**

Different case studies were presented to the participants during the training to give participants an overview of systems tools and experience working at different organisations.

India GBIF Node experience: Dr. Gautam Talukdar from the Wildlife Institute of India (WII) shared how India GBIF node was established. He said WII has been designated as the country node and the Botanical Survey, Zoological Survey, National Biodiversity Authority and Foundation of Revitalisation of Local Health Traditions as four thematic nodes. As WII has been selected as National Biodiversity Information Facility (NBIF), its link and coordination with GBIF would help the institute to develop information products and services; promote online publication of scientific data, implement information infrastructure and analyze data to help address scientific questions and decision making needs. An action plan for Biodiversity Informatics to meet user's needs has been developed in cooperation with the GBIF Secretariat and Indian nodes. He further pointed out that biodiversity informatics capacity building and outreach activities are some of the major objectives of the national node. Dr. Talukdar said that the Indian Biodiversity Information Facility (IBIF) Data Portal shares primary data on internet for the public use, integrate their GIS data with other scientific data and thus build a web portal for others to view and share data. Difficulty in finding staff to handle authenticity, database manegemnt and application programming; and varying levels of data availability, formats and web based database are some of the difficulties faced by IBIF.

Knowledge Management: Mr. Daan Boom, Integrated Knowledge Management (IKM) Coordinator of ICIMOD briefly talked about the Integrated Knowledge Management System of ICIMOD. Being a regional knowledge development and learning centre, ICIMOD always put a premium on developing, capturing, sharing and disseminating knowledge and information for the benefit of its partners of RMCs and its mountain people and communities. In his presentation, Mr. Boom focused on two major initiatives recently taken by ICIMOD: Regional Statistical Database and Regional Digital Repository. The main goal of the Regional Statistical Database is to build a database/information management platform comprising or linking to relevant statistical data in the HKH region. The database is focused on information on socio-economic, environmental and hydro data. During the regional workshop held on February 2010, the RMCs agreed on minimal datasets they can provide to ICIMOD. National workshops and discussion are planned to foster the initiative. The Ministry of Understanding (MoU) between the RMCs and ICIMOD for data exchange will be made; and protocols will be finalized.

The HKH Digital Library Project is funded by the Elsevier Foundation to transform ICIMOD's traditional library into a Mountain Learning and Information Centre. The project will connect all the libraries of the universities involved in the Himalayan University Consortium (HUC). It will focus on grey literatures and thesis with open source applications. A workshop will be held on August 2010 with the HUC librarians and ICIMOD platform will be ready by October 2010.

<u>GEOSS and Online Modeller</u>: Dr. Huettmann presented about online opportunities available on the internet for free. He briefly introduced the Global Earth Observations System of Systems (GEOSS), Ocean Biogeography Information System (OBIS) and Polar Web Portal. He also gave an example of the GMBA's Himalayas Uplands Plant Database from B. Dickore et al. and showed to participants how the database works and what it entails.

**Hands on exercises**

The mentioned Experts of ICIMOD and GMBA gave live demonstration of some portals and helped the training participants in conducting hands on exercise on the following:

- Metavist, NP metadata editor, TKME, EML and ArcCatalogue
- Preparation of data using GBIF templates and publishing using GBIF IPT
- Publishing data online on GBIF platform

**Group work**

A group work was held on the final day of 5-days training to formulate a way forward for regional strategies, priorities to foster biodiversity informatics and biodiversity data mobilisation in the HKH as well as setting up a regional helpdesk. Participants and resources person were divided into Policy Group and Technical Group and each group was given three questions.

- Develop an action plan for new few years and beyond yourself, your institution and country
- What is needed to implement an action plan?
- What are constraints and challenges?

The result of the group work is briefed below:

For the Policy Group, their action plan in 5 years is to *transfer knowledge with different audiences in their institute and take actions based on feedback mechanism.* For implementation of that action plan, their need was basically human resources, financial resources and institutional support. Software updates, internet hardware, metadats and database expertise are some of their challenges and constraints. As they are not much familiar with GIS software, they need more practice to implement the action plan and need multi-media support.

The action plan for the Technical Group in coming years is *to disseminate GBIF Darwin Core standards in the Regional Member Countries in GBIF-Darwin Core template by addressing d*ecision makers and professionals. Writing funding proposals for training and digitization projects would be their priority. They committed to provide two datasets to ICIMOD and GBIF. For implementation of their action plan, they need strong political and institutional support and therefore requested ICIMOD and GBIF to support the regional member counties at different levels. A national and regional network for data sharing would be an asset for their action plan. Lack of resources and restriction on data dissemination from the government end are main constraints for implementation of their action plan.

The group work was presented by the groups and the session was kindly concluded by Dr. Eva Spenh. The participants argued that there should be political and institution commitment for developing a regional strategy on data sharing and access. The participants suggested ICIMOD and GBIF to support regional member countries in overcoming political and

technical obstacles and move ahead to foster biodiversity informatics and data mobilisation in the HKH region.


**Evaluation**

The regional training was evaluated to judge the quality of the training. The content, resources and usefulness of the training were focused during the evaluation. On the content side, the relevance of the topics included, materials distributed, systems and tools introduced, applications of those tools and standards were focused. The participants were very much satisfied with the content of the training as most of the participants voted for highest rating 4-5 (i.e. 65% voted for 4-5). Similarly, quality of instruction, clarity of presentation, use of audio-video aids and adequacy of IT infrastructure were evaluated and most of them rated 4 (i.e. 50% voted for 4). Overall, the participants found the training very useful and built their capacity to use different standards and data mining tools (Annex II: Evaluation sheet).

**Participant's additional comments and feedback**

Comments and feedback from the participants were received and summarized below:

Most useful: The participants found GBIF and GMBA biodiversity data resources, tools for data sharing and internet address, data standardization, Darwin Core, GBIF-IPT and biogeomancer most useful during the training. They thanked ICIMOD for organizing this training and for updating data through various ICIMOD presentations.

Least useful: During the training, the participants found data mining, the predictive modeling, metadata templates, the installation techniques and use of different software for same standards least useful. Data mobilization and linking multiple databases systems were very confusing to some of the participants. And one of the participants was scared of putting the gained knowledge into practice.

Proposed modifications: The participants proposed to increase time for hands-on training exercises. They asked to devote one full day for Darwin Core and focus more on technical session like metadata building work, use of data tool search and software. They proposed to share the database with the large audience and expand the horizon for other fields.


**Way Forward**

To develop a regional framework and partnership needed for promoting easy and open access to standardized and harmonized biodiversity information in the HKH region, a way forward has been sought by ICIMOD and GBIF during the workshop. The way forward is to:

1. Activate ICIMOD as a regional node of GBIF: As a regional node, ICIMOD will provide technical support to the regional member countries as per required. The centre will also conduct national level trainings to the government officials, biodiversity researchers and managers by developing training materials and guidelines. A call for mini grants, proposals and awards as bridging fund will be made in order to help the national and regional partners to initiate or collaborate in biodiversity informatics project. Participation of national partners, scientists and researchers will be encouraged to support ICIMOD as a regional node of GBIF.

2. Initiate a regional collaboration to develop and share biodiversity information in the HKH region by developing a concept proposal through regional consensus,

developing collaborative proposal for funding with national partners and GMBA and implementing pilot and complementary projects.

ICIMOD has already started to act on its immediate complimentary plan. Some of the actions of the immediate plan are as follows:
- Developing database of Brahmaputra-Salween Landscape by the end of 2010
- Mainstreaming in the ongoing and future projects/programmes
- Conducting national level trainings in India, China and Nepal for the Kailash Sacred Landscape
- Running pilot projects in the Kailash and Brahmaputra landscapes
- Following Darwin core format and making it mandatory for all primary researches
- Three interns from the region have already been trained.


## Concluding Session

The five day long training concluded with brief remarks from the participant representatives who strongly expressed their motivation towards biodiversity data publishing and thought the training was very  useful in terms of exposure to understanding various tools for biodiversity data standarisation, database management and data publishing. Participants also gave their commitment in submitting a dataset within two months of time to ICIMOD or to the national node to get it published via GBIF. As a token of appreciation and on behalf of organisers, Mr. Berend de Groot, Director of Programme Operations, ICIMOD presented the participants with the "Certificate of Achievement". Dr. Eklabya Sharma ICIMOD and Dr. Eva Sphen (GMBA) made final remarks on behalf of the organisers. Dr. Eva expressed her satisfaction over the successful completion of the training and appreciated the participants for their enthusiasm. Dr. Eva also presented a book, **Data Mining for Global Trends in Mountain Biodiversity edited by Eva M. Spehn and Christian Korner** to the ICIMOD Library. Highlighting the significance of harmonization of biodiversity data for the Hindu Kush Himalayan region, Dr. Sharma expressed his happiness that all regional member countries of the HKH could be part of this important training. He stated that ICIMOD as a regional node for GBIF, will be fully supportive of RMC's action towards developing a partnership for promoting open access to harmonized biodiversity data from the region. During the closing remark, Mr. Berend urged the representative participants from all the eight nations to take advantage of the global platform and work together to publish as many biodiversity data as possible. He indicated towards the commitment by each nation in adopting the global standards for publishing the biodiversity data and metadata towards its use for meaningful outcome for the entire region. He also expressed his hope that the participants will be able to share the learning from the workshop and replicate the efforts to strengthen the regional biodiversity database. At the end, Mr. Birendra Bajracharya gave vote of thanks to all those who were involved in the regional workshop/ training on "Open Access to, and publication of, Mountain Biodiversity Data of the Hindu Kush Himalayan Region".

**Appendix I: Program**

| Day 1, 14 June 2010 | | |
|---|---|---|
| **Inaugural Session (9:30- 11:00)** | | |
| 9:00-9:30 | Registration | Jennysa Chettri/Neetu Ghale |
| | | Berend de Groot, ICIMOD |
| 9:30-9:45 | Welcome address | Vishwas Chavan, GBIF |
| 9:45-10:00 | Keynote: *Global Information Infrastructure for Conservation and Resources Management in HKH Regions* | |
| 10:00-10:10 | Remarks | Eva Spehn, GMBA |
| 10:10-10:20 | Remarks | Eklabya Sharma, ICIMOD |
| 10:20- 10:30 | Remarks | Yuba Raj Bhusal, Secretary, MoFSC |
| **10:30- 11:00    Group photo and tea** | | |
| **Introductory Session** | | |
| 11:00- 11:20 | Introduction by participants/resource persons | All Participants and Resource person |
| 11:20- 11:40 | Introduction to workshop objectives | Nakul Chettri, ICIMOD |
| 11:40- 12:30 | Introduction to GBIF and its potential relevance for the HKH region | Vishwas Chavan, GBIF |
| 12:30- 13:00 | Introduction to the GBIF Data portal (data.gbif.org) including its mountain biodiversity data query capabilities | Vishwas Chavan, GBIF |
| **13:00- 14:00** | **Lunch** | |
| 14:00- 14:45 | Introduction to GMBA and its Mountain Biodiversity Portal (www.mountainbiodiversity.org) to GBIF data | Eva Spehn, GMBA |
| 14:45- 15:15 | Practical exercise: data portals | Eva Spehn, GMBA |
| 15:15- 15:45 | Biodiversity initiatives at ICIMOD | Eklabya Sharma, ICIMOD |
| **15:45- 16:00** | **Tea break** | |
| 16: 00- 16:30 | Geo-data sharing and applications in the HKH | Basanta Shrestha, ICIMOD |
| 16:30- 17:00 | Mountain Geoportal & Conservation portal | Birendra Bajracharya, ICIMOD |

**Reception Dinner at Bhojan Griha (18:30-20:30)**

| Day 2, 15 June 2010 | | |
|---|---|---|
| **Database concepts** | | |
| 9:30- 9:50 | Introduction to data standards: | Kiran Shakya, ICIMOD |
| 9:50 – 10:10 | − General concepts | Kiran Shakya, ICIMOD |
| 10:10- 10:30 | − Darwin Core | Falk Huettmann, GMBA |
| | − XML | |
| **10:30- 10:45** | **Tea break** | |

| | | |
|---|---|---|
| 10:45- 11:15 | Taxonomy ITIS and other standards | Falk Huettmann, GMBA |
| 11:15- 11:45 | Large Databases: concepts, formats and justifications | Falk Huettmann. GMBA |
| 11: 45:12:15 | Geo-referencing: GPS, GIS, Biogeomancer, quality of geo-referencing needed and obtained for mountain research | Falk Huettmann, GMBA |
| 12:15-13:00 | The GBIF informatics infrastructure: present and Future | Vishwas Chavan, GBIF |
| **13:00- 14:00** | **Lunch** | |
| **Data discovery, mobilisation, and publishing** | | |
| 14:00- 15:15 | Data mobilisation strategies | Vishwas Chavan, GBIF |
| 15:15- 15:45 | Data publishing framework | Vishwas Chavan, GBIF |
| **15:45- 16:00** | **Tea break** | |
| 16:00- 17:00 | How to initiate a digitisation project? | Vishwas Chavan, GBIF |
| **Day 3 – 16 June 2010** | | |
| **Data discovery, mobilisation, and publishing (cont.)** | | |
| 9:00- 9:30 | Applications: Data Mining, Predictive Modelling, Adaptive Management | Falk Huettmann, GMBA |
| 9:30- 10:00 | Metadata theory, philosophy, tools, data fields & purpose | Falk Huettmann, GMBA |
| 10:00- 10:30 | Specific data and GIS applications | Falk Huettmann, GMBA |
| **10:30- 10:45** | **Tea Break** | |
| 10:45- 13:00 | Hands on exercises (Metavist, NP metadata editor, TKME, EML, ArcCatalogue) | Falk Huettmann, GMBA |
| **13:00- 14:00** | **Lunch** | |
| 14: 00- 14:30 | The GBIF Integrated Publishing Toolkit | Kiran Shakya, ICIMOD |
| 14:30- 15:15 | Demonstration on how to install the GBIF IPT | Kiran Shakya, ICIMOD |
| **15:15 -15:30** | **Tea break** | |
| 15:30- 17:00 | Hands on exercises on the preparation of data using GBIF Templates and publishing using the GBIF IPT | Kiran Shakya, Bandana Shakya, ICIMOD. |
| **Day 4 – 17 June 2010** | | |
| **Data use** | | |
| 9:30- 10:00 | Using biodiversity data for policy making: an introduction including modeling potential impacts of climate change | Falk Huettmann, GMBA |
| 10:00- 10:30 | Strategic Conservation Planning (Marxan) | Falk Huettmann, GMBA |
| **10:30- 10:45** | **Tea Break** | |
| 10:45- 12:15 (30 minutes each) | Case studies<br>  – India GBIF node experience<br>  – Knowledge Management<br>  – GMBA (Case) | Gautam Talukdar, WII<br>Daan Boom, ICIMOD<br>Falk Huettmann, GMBA |
| 12:15 -13:00 | Global Online Opportunities: GEOSS, Online Modeller & beyond | Falk Huettmann, GMBA |

| | | |
|---|---|---|
| **13:00- 14:00** | **Lunch** | |
| **Hands on Exercise** | | |
| 14:00- 15:30 | Publishing data online and follow up on questions | Falk Huettmann, GMBA |
| **15:30- 15:45** | **Tea break** | |
| 15:45- 17:00 | Presentations by participants on future plans for digitisation back in their countries | Participants |
| **Day 5 – 18 June 2010** | | |
| **Group work and way forward** | | |
| 9:30 - 11:00 | Regional strategy, plans and priorities to foster biodiversity informatics and biodiversity data mobilisation in the HKH, including the set up of a regional helpdesk | Chaired by Eva Spehn, GMBA |
| **11:00 - 11:15** | **Tea break** | |
| 11:15 - 11: 45<br><br>11: 45 - 12:00<br>12: 00 - 12:40<br>(20 minutes each)<br>12:40 - 13:00 | Plenary: Group presentation/discussion on participating in GBIF<br>Conclusion of the session by the Chair<br>Way forward (GMBA and ICIMOD)<br><br><br>Course evaluation | Group representatives<br><br>Eva Spehn, GMBA<br>Falk Huettmann, GMBA<br>Basanta Shrestha, ICIMOD<br><br>Participants all |
| **13:00- 14:00** | **Lunch** | |
| **Closing session** | | |
| 14:00 -14:10<br><br>14:10 - 14:20<br><br>14:20 - 14:30<br><br>14:30 – 14:40<br><br>14:40 - 14: 50 | Concluding remarks<br><br>Participant remarks<br><br>Certificate distribution<br><br>Closing remarks<br><br>Vote of thanks | Eklabya Sharma, ICIMOD and Eva Spehn, GMBA<br><br>Two representative participants<br>Berend de Groot, ICIMOD<br><br>Berend de Groot, ICIMOD<br><br>Birendra Bajracharya, ICIMOD |
| **14:50 - 15:15    Tea Break and the end of programme**<br>**City Tour for Interested participants** | | |

**Appendix II: Evaluation of the Course**

| Content | Ratings | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| Topics included in the training were relevant and well suited | | | 2 | 6 | 14 |
| The material distributed were adequate and useful | | | 7 | 9 | 6 |
| GBIF-IPT system is useful for wider publishing of biodiversity data | | | 1 | 11 | 10 |
| I have understood GBIF tools, standards and processes on publishing biodiversity data | | 3 | 9 | 5 | 5 |
| I have understood GMBA tools, standards and processes for publishing mountain related biodiversity data | | 5 | 8 | 5 | 4 |
| I am aware of usage application of GBIF based data and metadata | | 1 | 7 | 6 | 8 |
| I am able to install IPT system for my organization (if required)and am familiar with the software required for its installation | 3 | 1 | 8 | 7 | 3 |
| I am able to put my own data in the GBIF-IPT templates | | 3 | 9 | 5 | 5 |
| I am aware of applications related to data mining, predictive modeling, geo-referencing and taxonomy | 1 | 1 | 7 | 9 | 4 |
| **Resources/Presentation/ Hands-on** | | | | | |
| The quality of instruction was good | | 1 | 1 | 10 | 10 |
| The presentation were clear and practical | | 1 | 2 | 10 | 9 |
| Proper training/workshops aids and audio-visual aids were used | | | 5 | 10 | 7 |
| Participation, questions and interaction were encouraged | | 2 | 5 | 8 | 8 |
| Adequate time was provided for the group work | 1 | 2 | 5 | 9 | 5 |
| The IT infrastructure was adequate for such training | | 2 | 8 | 8 | 4 |
| **Training/Workshop specific questions** | | | | | |
| How do you rate the usefulness of overall training/workshop | | | 2 | 11 | 9 |
| The workshop provided opportunity to discuss issues in the HKH region regarding the publishing of primary biodiversity data | | | 4 | 8 | 10 |
| It built my capacity on use of various standards and data mining tools. | | 1 | 5 | 11 | 5 |

## Appendix III: List of Participants

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| Mr. Sayed Humayoon Jalal<br>Wildlife Survey Manager<br>Protected Area Department<br>Ministry Of Agriculture, Irrigation and livestock<br>Kabul, Afghanistan<br>Email: humayoon_jalal@yahoo.com | Mr. Ahmad Shah Amarkhil<br>Forest Nursery Manager<br>Forest Department, NRM<br>Ministry Of Agriculture, Irrigation and Livestock<br>Kabul, Afghanistan<br>Email: ah.amarkhil@gmail.com |
| Md. Zaheer Iqbal,<br>Deputy Conservator of Forest<br>Department of Forest<br>Ministry of Environment and Forestry<br>Dhaka, Bangladesh<br>E-mail: z.iqbal67@yahoo.com | Ms. Momtaz Mahal Mirza<br>Senior Scientific Officer, Bangladesh National Herbarium, Ministry of Environment & Forests, Government of the People's Republic of Bangladesh<br>Dhaka, Bangladesh<br>Email: momtazmahalmirza@yahoo.com |
| Mr. Ngawang Gyeltshen<br>Assistant  Biodiversity Officer<br>National Biodiversity Centre<br>Thimphu, Bhutan<br>Email: yangzome3@gmail.com | Ms Singye Wangmo<br>Nature Conservation Division<br>Ministry of Agriculture and Forests<br>Royal Government of Bhutan<br>Thimpu, Bhutan<br>Email: siiwangmo@gmail.com |
| Ms. Wang Yun<br>Kunming Institute of Botany<br>Chinese Academy of Sciences (CAS)<br>Heilongtan, Kunming, Yunnan<br>P.R. China<br>Email: wangyun@mail.kib.ac.cn | Dr. He Yongtao<br>Incharge, Environmental Monitoring<br>Lhasa Ecological Research Station<br>Chinese Academy of Sciences<br>Dagze County, Lhasa<br>Tibet Autonomous Region 850100, China<br>Fax: +86 891 6142216<br>Email: Heyt@igsnrr.ac.cn |
| Ms Han Xi<br>Kunming Institute of Botany<br>Chinese Academy of Sciences (CAS)<br>Heilongtan, Kunming, Yunnan<br>P.R. China<br>Email: hanxi@mail.kib.ac.cn | Dr. K Chandra Sekar<br>G B Pant Institute of Himalayan Environment and Development (GBPIHED)<br>Kosi Katarmal, Almora, 263643<br>Uttarakhand, India<br>Tel: 91-5962-241041; +91-5962-241038;<br>Fax: 91 5962 241150<br>kcsekar1312@rediffmail.com |
| Dr. Gautam Talukdar<br>Scientist- C,<br>Wildlife Institute of India,<br>Chandrabani, Dehradun, Uttarakhand,<br>India 248001<br>Tel: + 91-9456178697<br>Email: gautam@wii.gov.in  ;<br>gautamtalukdar@gmail.com | Dr. Uma Shankar<br>Professor of Botany,<br>North-Eastern Hill University<br>Shillong 793022, India<br>Email: arshuma@yahoo.com |
| Mr. Anand Gazmer<br>Research associate<br>Ashoka Trust for Research in Ecology and the Environment ATREE<br>Eastern Himalayan Programme<br>E2, Floor Second, Golden Heights, Gandhi Road Darjeeling 734101 West Bengal | Mr. Zaw Min Htun<br>Ranger<br>Forest Department<br>Ministry of forest<br>Myanmar<br>Email: kyawhtun.mof@gmail.com |

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|---|---|
| Email: anand.wasandy@gmail.com | |
| Mrs. Hla Hla Yi<br>Staff officer<br>Forest Department<br>Ministry of Forest<br>Myanmar<br>Email: kyawhtun.mof@gmail.com | Mr. Chitra Bahadur Baniya, PhD<br>Central Department of Botany (CDB)<br>Tribhuvan University (TU), kiritipur,<br>Kathmandu,Nepal |
| Mr. Ukesh Raj Bhuju<br>Chairman<br>Nepal National Committee of IUCN Members<br>Wise Use House, Jwagal, Lalitpur<br>Naxal, Kathamndu, Nepal<br>Tel: 5550452, Cell: 9841 292829<br>Fax: 4011006<br>E-mail: ukeshbhuju@hotmail.com | Mr. Gopal Prakash Bhattarai<br>Chief Conservation Officer<br>Shivapuri Nagarjun National Park<br>Department of National Parks and Wildlife<br>Conservation (DNPWC)<br>Babar Mahal<br>Nepal<br>Email: cbbaniya_@yahoo.com |
| Mr. Gauri Shankar Timala<br>District Forest Officer<br>District Forest Officer Lalitpur<br>Hattiban, Lalitpur<br>Nepal | Giorgi Mikeladze<br>GIS specialist<br>Tbilisi Botanical Garden & Institute of<br>Botany<br>Botanical Str., 1<br>0105 Tbilisi. Georgia |
| Mr. Faiz Ali Khan<br>National Director<br>Program For Mountain Area Conservation<br>Ministry of Environment<br>Islamabad<br>Tel : 92-52-2251627<br>Fax: 92-51-2251628<br>Cell: 13225001230<br>Email: faizalik@gmail.com | Ketevan Batsatsashvili (self funded)<br>Ilia State University,<br>Tbilisi Botanical Garden & Institute of<br>Botany<br>Botanical Str., 1<br>0105 Tbilisi. Georgia<br>Fax: +995 32 723409 |
| ICIMOD<br><br>Ms. Sunita Chaudhary: schaudhary@icimod.org<br>Mr. Suman Jaiswal: sjaiswal@icimod.org<br>Mr. Bikash Dangol: bdangol@icimod.org<br>Mr. Sudip Pradhan: spradhan@icimod.org<br>Ms. Jennysa Chhetri: jchetti@icimod.org | |
| Resource persons (ICIMOD)<br>Eklabya Sharma: esharma@icimod.org<br>Basanta Shrestha: bshrestha@icimod.org<br>Nakul Chettri: nchettri@icimod.org<br>Birendra Bajracharya: bbajracharya@icimod.org<br>Kiran Shakya: kshakya@icimod.org<br>Bandana Shakya: bshakya@icimod.org<br>GBIF<br>Vishwas Chavan: vchavan@gbif.org<br>GMBA<br>Falk Huettmann: fhuettmann@alaska.edu<br>Eva Spehn: gmba@unibas.ch | |