FINAL ACTIVITY REPORT

DEVELOPMENT OF THE BIODIVERSITY DATABASE SYSTEM IN VIET NAM

Prepared by **Biodiversity Conservation Agency (BCA)**

Viet Nam Environment Administration (VEA)

Ministry of Natural Resources and Environment (MoNRE), Viet Nam

Ha Noi, January 2017

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ACRONYMS AND ABBREVIATIONS

BCA	Biodiversity Conservation Agency
BIFA	Biodiversity Information Fund for Asia
COB	Center of Biodiversity
NBDS	National Biodiversity Database System
GBIF	Global Biodiversity Information Facility
IEBR	Institute of Ecology and Biological Resources
MARD	Ministry of Agriculture and Rural Development
MoNRE	Ministry of Natural Resources and Environment
NMNS	National Museum of Natural Science
JBIF	Japan Biodiversity Information Facility
ToT	Training for Trainers
VAST	Vietnam Academy of Science and Technology
VEA	Viet Nam Environment Administration
VNU	Vietnam National University, Hanoi
VNUF	Viet Nam National University of Forestry

1. Executive summary

This report is to generalize the outcomes and achievements in implementing the project relevant to three major project activities, namely: training and raising awareness on the Global Biodiversity Information Facility (GBIF), the Viet Nam National Biodiversity Database System (NBDS) and biodiversity information; development of a roadmap on participation of Viet Nam in GBIF including recommendations about infrastructure, human resources and mechanisms; and assessment of the compatibility and to recommend mechanisms to share information on biodiversity of Vietnam for GBIF.

During project deployment, the Biodiversity Conservation Agency (BCA), Viet Nam Environment Administration (VEA), Ministry of Natural Resources and Environment (MoNRE)- the national implementer has involved a wide range of stakeholders, including independent local experts, institutes, universities and academies and government agencies to address key questions: 1) The necessity in participation in GBIF, 2) Identify the key stakeholders will be involved in mobilizing and sharing information should being anode of GBIF; 3) Mechanism for data accumulation, sharing, benefits and responsibilities.

After a several training sessions on NBDS, GBIF has contributed to enhance the understanding and awareness not only about NBDS and GBIF, but also the importance of development of a national databases system on biodiversity as well as sharing of biodiversity data in the region and over the world.

The consultation meetings with the participation of several local experts for 2 main outcomes of the project namely, Road map on participation in GBIF and coordination mechanism for sharing information to GBIF, and identify compatibility and to recommend mechanisms to share information on biodiversity of Vietnam for GBIF respectively have recorded a number of opinions and comments from specialists and managers on the necessary steps taken to Viet Nam to joined GBIF with in-depth evaluation of SWOT analysis and cost benefit.

Besides the evaluation of the results achieved in the project implementation, this report also indicates the advantages and challenges encountered during project implementation and proposing next steps after an explicit roadmap for the participation is elaborately developed.

2. Contact information

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3. Project Summary

The BIFA Project entitled “Development of The Biodiversity Database System In Viet Nam” (Viet Nam BIFA Project) is funded by the the Biodiversity Information Fund for Asia (BIFA), implementing in a period of March 2016 to January 2017. The Project

aims to build capacity of Vietnam in biodiversity information and database management and preparation to actively take part in GBIF as well as building on existing collaboration between the partner countries to further develop a national biodiversity database system.

The Biodiversity Conservation Agency (BCA), an arm of Vietnam's Ministry of National Resources and Environment (MoNRE) charged with the management of the country's biodiversity database is the project national implementer. BCA has actively cooperated with a variety of stakeholders with the focus on proposing a roadmap to participating GBIF of Viet Nam which is the science based study for the Government's decision. The key different national partners such as Viet Nam Academy of Science and Technology (VAST), Ministry of Agriculture and Rural Development (MARD), Institute of Ecology and Biological Resources (IEBR) are usually informed and consulted by BCA about

The achievements of project's outputs are highly facilitated by the financial and technical support from JICA Viet Nam and Biodiversity Information Facility (JBIF), Japan.

The Key achievements of Project are as follows:

- Awareness raising on the significance of biodiversity data accumulation and sharing; Generating understanding on GBIF to the key stakeholders in Viet Nam through a number of trainings for trainers conducted by BCA
- Consulting the key stakeholders about the participation of such a global biodiversity data network as GBIF; Evaluating the willingness and consensus of them in involving in a node in the future.
- Proposing a road map on participation of Viet Nam in GBIF which plans the route for Viet Nam to become a member of GBIF, magnifying the opportunities and challenges in being a GBIF node for the national competent agency.
- Identifying compatibility and recommending mechanisms to share information on biodiversity from the National Biodiversity Database System (NBDS)

managed by MoNRE and other existing database systems to the GBIF, with the view to strengthening the network to support the long-term mobilization, management and use of biodiversity information across the world.

3.1. Activities completed

To the end of December 2016, BCA finished all kinds of scheduled project activities including trainings, consultation meetings and other supporting activities relating to finance of the project. The Roadmap and report about the compatibility of the system come to completed the final ones after the independent reviews of some leading experts.

The major accomplishments of the project include

i) Identification of potential biodiversity data holders for Viet Nam Biodiversity Information Facility (VBIF) in the future and engage them in VBIF;

ii) The capacity building in biodiversity data accumulation, digitization and sharing in a GBIF node from experience of Japan node for key trainers;

iii) A training workshop for trainers who are potential information holders and relevant stakeholders on GBIF is held

iv) A promotion workshop on Biodiversity Information in Viet Nam for relevant stakeholders is organized.

v) Development of roadmap on participation in GBIF and coordination mechanism for sharing information to GBIF after several consultation meetings with key stakeholders and independent review.

vi) A thematic report on identifying the compatibility and to recommend mechanisms to share information on biodiversity of Vietnam for GBIF is developed after mainstreaming the comments from relevant stakeholders for completion.

vii) A brochure to provide the fundamental understandings about GBIF, specifically the vision, objectives, organization and access of GBIF to

the target audiences.

viii) A midterm report completed in August, 2016 and approved by GBIF

3.2. Ongoing and post-project activities

By beginning of January 2017, all of the approved project activities have been completed and the outcomes of the project are finalized.

The post-project activities have been outlined to maintain the sustainability of the project.

First of all, BCA schedules to develop the dossier for approval of Viet Nam's participation in GBIF of the Government. The roadmap will serve as crucial inputs for the dossier in combination with consulting all the line ministries and governmental agencies involved because the process for ratification of GBIF's participation not only focuses on the development of the dossier but also requires the consensus of relevant ministries.

In addition, the supplementary financial and technical support from GBIF, BIFA and other nodes are needed to establish effectively a node in Viet Nam.

4. Project objectives

The project on Development of the Biodiversity Database System in Viet Nam aims to build capacity of Vietnam in biodiversity information and database management and preparation to actively take part in GBIF. It actually enables BCA to have a better understanding on biodiversity management in the world as well as to confirm the approach to become a member of GBIF in future.

Specifically, the project aims to:

- To identify the compatibility of the current National Biodiversity Database System with the Global Biodiversity Information Database and then, to recommend mechanisms to share information on biodiversity of Vietnam for open, free and broader access via GBIF

- To convince and increase the willingness to share biodiversity information of all biodiversity stakeholders and data managers in the country to further develop the national biodiversity database system (NBDS), contributing to inform decision makers in the policy development on biodiversity conservation and management.

- To prepare a rational proposal on road map on participation in GBIF and coordination mechanism for sharing information on biodiversity of Viet Nam to GBIF consistently and sustainably.

5. Project deliverables

In the approved BIFA project's proposal of Viet Nam, BCA planned to work to achieve 07 expected deliverables. The table below will give a comparison on the level of accomplishments of the major deliverables under the project period time.

Table 1: Comparison in the level of accomplishments of the major deliverables

No.	Expected deliverables	Project's accomplished deliverables
1.	2-3 persons visited JBIF and well understand the operation of Node (*Details in the Annex 1*)	From 13-17 June 2016, 04 resource trainers (3 qualified experts in biodiversity conservation, biodiversity information and informatics and 01 key official from BCA) who partially are funded by JICA Viet Nam participated in the 5 days training course at the National Museum of Nature and Science (NMNS), Japan. They later on became the trainers for *the training workshop for trainers on GBIF* (19th – 21st July 2016) and *the promotion workshop on Biodiversity Information in Viet Nam for relevant stakeholders* (03rd – 04th August 2016). Two (02) key resource trainers with their leading expertise and comprehension on GBIF also are consultants developing 2 main outputs of the project (the Roadmap and the compatibility)
2.	At least 5 core trainers will be comprehensively trained (*The details in the Annex 2*)	After the 3 day ToT workshop, there are 34 participants being get approached to GBIF, the applications and software of GBIF. They also practice to utilize NBDS

		and IPT. Some participants from IEBR, the Viet Nam National University of Forestry (VNUF), the Centre of Biodiversity, VNUF and the Forest Inventory and Planning Department, MARD who had some certain understanding about GBIF beforehand have got more comprehensive about the NBDS and operation of GBIF. Because their organization and work closely relating to biodiversity conservation, their interest and awareness will strengthen their cooperation in this issue.
3.	A number of stakeholders (expected 3-5 organizations) will be worked with BCA for providing information *(The details in the Annex 3)*	Actually, by the completion of project period, the potential information holders have been identified. BCA has worked with IEBR, VAST for times about providing information to the national node in the future. Two sides have basically agreed about the information sharing and cooperation. However, two sides should pay more effort into establishing a local network for data accumulation and sharing, get involvement of a variety of stakeholders into the network as well as building a mechanism for data provision, mobilization and sharing. The Director of IEBR and the leader of BCA agreed to

		keep on working forwarding to signing an MOU which detail the responsibilities and roles of each party in operating a node in Viet Nam upcoming time. BCA has discussed with the Centre of Biodiversity (CoB), Viet Nam National University of Forestry (VNUF), to evaluate the support of VNUF in participation of Viet Nam in GBIF as well as the willing to share the researches' results and data on biodiversity. In principle, the Director of CoB, Assoc. Prof Hoang Van Sam showed his strong support for the participation because of the opportunities and benefits being a member. He also affirmed the high demand for exploit the international data on biodiversity in order to referring for domestic researches. CoB also committed to engage more related scientists and experts of VNUF in the network of data provision for the future node of Viet Nam. Viet Nam National University (VNU) is also one of key partners who supports BCA in establish a network and information sharing mechanism for the future VBIF. Therefore, BCA proposed VNU to cooperate in networking scientists as well as providing technical

		support for the node in the future. The discussion between BCA and VNU achieved the positive results when VNU and the affiliated agencies will play role as advisor agency for MoNRE relating to integrate systems and System optimization. *The meeting minutes for discussion between BCA and key stakeholders are provided in the ANNEX 3 of this report.*
4.	Various stakeholders (expected 50 persons) understand GBIF and support Vietnam to be a member *(The details in the Annex 4)*	About 80 participants who attended the ToT workshop and the promotion workshop on Biodiversity Information in Viet Nam for relevant stakeholders were provided understanding about NBDS and GBIF. Based on the results of Workshop evaluation of the promotion workshop on Biodiversity Information in Viet Nam, nearly 40 out of 45 participants agree about the necessity of participation in GBIF and data sharing to the future node.
5.	A proposal on road map on participation in GBIF and coordination mechanism for sharing information to GBIF *(The details in the Annex 5)*	A proposal on road map on participation in GBIF and coordination mechanism for sharing information to GBIF were actively commented by BCA, consulted with a number of leading experts, the JBIF node manager, Dr. Tsuyoshi Hosoya, National Museum of Nature and Science for the roadmap. It is submitted to the GBIF Secretariat as attachment of

		this report. The participation of Viet Nam into GBIF should track the guidance of the guidance of GBIF Secretariat. On the other hand, Viet Nam also takes into consideration of typical context of the country. Therefore, a customized roadmap is proposed under 3 key phases, in detail: *Phase I: Discussion prior to participate in GBIF* - Step 1: Establish a core local team to facilitate the participation in GBIF - Step 2: Understand the motivation of Viet Nam for joining GBIF: - Step 3: Identify drivers (science: research infrastructure and environment (policy, decision making) and priorities (producing highly processed information, publishing primary data) at highest level for establishing a biodiversity information facility. - Step 4: Organize a meeting with key stakeholders to consult about the participation of Viet Nam, determine their willing as well as possible positions of key stakeholders - Step 5: Assign formal roles, including: Head of Delegation (potentially BCA/VEA/MoNRE) and temporary Node Manager (potentially Institute of Ecology and Biological Resources (IEBR)). *Phase II- Preparation for participatory process* - Agree roles in the process: BCA and Node will make final recommendation based on consulting with invested

		stakeholders. – Preparatory studies: content needs assessment, data holders inventory, stakeholder mapping etc. – Identify relevant examples from GBIF network such as Japan, Tanzania and some other countries. – Identify key stakeholders who will be invited to contribute. It is very important for the Head of Delegation to convene a group of representatives from the key biodiversity stakeholder institutions. This will be ensured their ownership of the process from the beginning. Key stakeholders will include BCA, IEBR and Center of Multidisciplinary Integrated Technologies for Field Monitoring (FIMO). *Phase III- Participatory process* – Scoping the biodiversity information facility and node – Defining implementation mechanism for the biodiversity information facility and node – Potential data holders and users in Vietnam – Proposal for organization and coordination mechanism of future VBIF A SWOT analysis for joining of Viet Nam to GBIF is included into the roadmap.
6.	A report on recommendation for develop a mechanisms to share information on biodiversity of Vietnam to GBIF (The detail in the Annex 6)	The understanding of the technology of GBIF from the training in Japan and discussion with the actual implementing staff of NMNS is the practical inputs for the report on recommendation for develop a mechanism to share

		information on biodiversity of Vietnam to GBIF. It also were developed in consultation with the NBDS chief advisor, Dr. Yoichi Kogure
7.	Brochure on NBDS, (potential) VBIF and GBIF will be introduced (The detail in the Annex 7)	The content with the focus on GBIF of GBIF is prepared by BCA. Then, they are published in order to build the understanding and awareness about GBIF in the country. They will be expected to be the leaflets for the

The deliverables of the Project can be found at the ANNEX of this report as attachments.

Project communications

The final report will be communicated and submitted to GBIF Secretariat and published at the website http://www.gbif.org/programme/bifa/2015/biodiversity-database-system-vietnam)

The communications contact persons for this undertaking are as follows:

- Main Contact: Dr. Hoang Thi Thanh Nhan, Deputy Director of BCA (email: hoangnhan.bca@gmail.com)
- Alternate Contact: Dr. Nguyen Xuan Dung, Chief of Administrative Office (email: xuandungbt@gmail.com)

BCA will release related news about the project and events taking place about the project from time to time at the website.

6. Evaluation: findings and conclusions

During the project period, BCA has made a lot of consultation with the universities, institutes and academies for completion of the roadmap and the compatibility report of the system. Most of the stakeholders agree with the necessity of participation of Viet Nam into GBIF. The key data holders express their positive support and willingness to involve in the training and consultation. Specific findings are as following:

1) Experiences of Japan node for capacity building in biodiversity data accumulation, digitization and sharing in a GBIF node;
2) List of potential biodiversity data holders for Viet Nam Biodiversity Information Facility (VBIF) in the future and engage them in VBIF;
3) Potential information holders and relevant stakeholders on GBIF is strengthen through training workshops.
4) A promotion workshop on Biodiversity Information in Viet Nam for relevant stakeholders is organized.

5) Roadmap on participation in GBIF and coordination mechanism for sharing information to GBIF is developed
6) A thematic report on identifying the compatibility and to recommend mechanisms to share information on biodiversity of Vietnam for GBIF is developed
7) A brochure to provide the fundamental understandings about GBIF, specifically the vision, objectives, organization and access of GBIF to the target audiences is designed and published.

7. Recommendations and lessons learned

Some of recommendations and lessons learned should be considered after project implementing as following:

1) Study tours, workshop and trainings should be supported and organized by GBIF in establishing a national node with a view to improving capacity for stakeholders in the future; The need for training the local staffs to operate node for VBIF in the future is also remarked.
2) National Biodiversity Database System in Viet Nam should be strengthened and supported by GBIF and other partners in term of technical, financial and management as well as data input for operation toward joining GBIF soon.
3) Establishment of mechanism for information sharing on biodiversity data in Vietnam

8. Future plans

In the future, priority activities should be actualized as following

1) Roadmap for participating in GBIF have to be approved by authority together with the action plan in detail;
2) Continuing preparation activities for Vietnam to become a member of GBIF;
3) Continuing mobilizing funds and grant for support Vietnam to become member of GBIF;
4) Continuing improving national biodiversity data system and its operation.

Signed on behalf of the project partners	Date

ANNEX 1: The Training Course Program on Building capacity for developing and maintaining the database system as well as for utilization of GBIF

Main Venue: National Museum of Nature and Science, Tsukuba, Ibaraki, Japan

14 June-17 June, 2016

Program:

Day1 (14 June, Tuesday): Getting started: sharing information

[Japan side]

1) **Welcome and self-introduction [All]**
   Self-introduction and brief introduction of the scientific background of the participants are presented.

2) **Review of the Proposal of the Mentoring Program (with JICA) [Hosoya]**
   By reviewing the Proposal, we clarify the goal of the whole project. Connection to JICA SNRM (Sustainable Natural Resource Management Project) will be discussed

3) **Clarifying the aim and goal of the visit [Hosoya]**
   The participants are expected to clarify the thematic aim and the final product of the visit.

4) **Relationship with JICA program [Kenmiya]**

- JICA program for biodiversity information is explained in relation to the present program.

5) **Introduction to GBIF [Hosoya]**
   Using slides, JBIF provides fundamental information (e.g. organization, strategy, background to the regionalization, activities, functions, benefit whenjoining GBIF) of GBIF to the participants. Quick overview of the website of GBIF with reference to the available resources will be presented.

   Experience in joing GBIF (data sharing mechanism to collect, analyze and share data and information?)

6) **Activities in Asia Region [Hosoya]**
   Using the slides, Asian representative provides the recent activities in Asia region (Regional strategy, scientific activities, etc.). Experiences in join in GBIF (advantages, disadvantages, responsibility of member);

(PM)

1) **Introduction to the status of Japanese Node (JBIF) [Hosoya]**

- - The Node manager provides the status report of JBIF including its organization (how many nodes, role of Ministry of Environment and other related organization).

- - Requirements of human and financial resources and technical standards, strategy, function, maintenance and operation of JBIF. One of the major topic the Science Museum Net will be discussed separately below.
- - The connection between GBIF and JBIF, national database system (any disadvantage, member responsibility).

2) How Science Museum Net works [Hosoya]

- Science Museum Net is a domestic network for data publication to GBIF and data sharing mechanism for domestic use. The presenter will provide its organization and function (Input, update, output, data standards…), structure based on the website and other resources (The typical or technical standards for input data? Any limits or disadvantage in connecting to other resources?)

3) Observation on specimen collection and data digitization from external view [Ebihara]

A researcher's view on current status on specimen collection and data digitization in Vietnamese institute will be presented.

4) Applying cumulated data to political decision making [Ebihara]

- An example is presented for providing a data based on the analysis of cumulated specimen data for potential conservative policy making in Japan is presented.

5) DarwinCore [Jinbo, Osawa]

- Overview of the fields of Darwin Core and Darwin Core Archives will be presented.

6) Other key words and concepts for understanding biodiversity informatics (data paper, open data, CC license, DOI, etc.) [Osawa, Jinbo]

- Some technical terms to understand biodiversity informatics will be presented and explained with their backgrounds.

[Vietnam side]

1) Status of biodiversity informatics in Vietnam [Vietnam Participants, TBD]

- Status report on digitization and data mobilization are expected to be presented from the Vietnamese participants.

2) NBDS: its function [Vietnam Participants, TBD]

Overview of NBDS (National Biodiversity Data System) is expected to be presented from the Vietnamese participants.

Day2 (15 June, Wednesday): Discussion regarding the possible organization and role of Vietnam Node

(AM)

1) Accelerating data mobilization from Natural Historical Collection [Nakae]

Questionnaire presented by the GBIF working group, process of response collection, and the results so far obtained will be presented.

(PM)

1) **Discussion regarding the possible organization of Vietnam Node [Vietnam Participants, TBD]**

A group discussion on possible organization of Vietnam Node, followed by a presentation from the Vietnamese participants.

2) **Discussion on the data mobilization [Vietnam Participants, TBD]**

- A group discussion on possible mechanism and incentives on data mobilization, followed by a presentation from the Vietnamese participants.

Day3 (16 June, Thursday): IPT function and data exploitation

1) **Examples of exploitation of the data in GBIF [Totsu]**

- Various interface and function to utilize data provided by GBIF will be presented based on JBIF's experience.

2) **IPT (Local use) [Osawa]**

IPT (Integrated Publication Toolkit) is a software required to send the biodiversity data to GBIF. One of the function of IPT is to publish a data paper compatible to Pensoft journal. The installation and data conversion will be demonstrated. The participants will learn the fundamental function of IPT through the process. The participants are recommended to bring their own PCs.

Day4 (17 June, Thursday): Visit to National Institute of Genetics

1) **Observation on IPT (connection to GBIF) [Yamazaki, Otsubo]**

IPT installed in server is to be used for data publication to GBIF. The function and user interface of IPT will be demonstrated by the specialist at NIG.

2) **Group discussion on data publication to GBIF**

The way forward to install IPT in the future is expected to be discussed by the Vietnamese participants.

ANNEX 2: Training workshop for trainers (TOT) on GBIF in Hanoi (19-21 July 2016)

ATTCHMENT 1: List participants for workshops for trainers in Hanoi

LIST OF ATTENDANTS
"Training course for trainers on GBIF"

No.	Name	Organization	Attendance allowance	Signature
1	Tran Manh Tien	Fimo - VNU	3 days x 20 EUR = 60 EUR	
2	Bui Quang Thi	VNU		
3	Lê Công Thắng	FIMO	3days x 20 EUR = 60 EUR	
4	Nguyễn Văn Dương	FIMO	3days x 20 EUR = 60 EUR	
5	Hoàng Xuân Phương	VNU	3days x 20 EUR = 60 EUR	
6	Nguyễn Văn Điệp	VNU	3days x 20 EUR = 60 EUR	
7	Lê Xuân Cảo	FIMO	3days x 20 EUR = 60 EUR	
8	Đỗ Thị Thu Thủy	JICA	3days x 20 EUR = 60 EUR	
9	KAMI SHINGO	JICA		
10	Tsuyoshi Hira	JICA		
11	Vũ Anh Tài	Institute of Geography	3days x 20 EUR = 60 EUR	
12	Nguyễn Thiên Tạo	VNMN	3days x 20 EUR = 60 EUR	
13	Hoàng Văn Chung	Fi Pi	3days x 20 EUR = 60 EUR	
14	Vũ Quang Nam	ĐH Lâm nghiệp	3days x 20 EUR = 60 EUR	
15	Nguyễn Văn Sinh	Viện Sinh thái và TNSV	3days x 20 EUR = 60 EUR	
16	Hoàng Văn Sâm	ĐH Lâm Nghiệp	3days x 20 EUR = 60 EUR	
17	Trịnh Văn Thành	ĐH Lâm Nghiệp	3days x 20 EUR = 60 EUR	
18	Đỗ Văn Tú	Viện Sinh thái		
19	Nguyễn Xuân Dy	BCA		
20	Lê Anh Dũng	Dân ABS	3days x 20 EUR = 60 EUR	

No.	Name	Organization	Attendance allowance	Signature
21	Đỗ Thị Kim Nhung	Viện NC Sinh thái và MTR	3 days × 20 EUR = 60 EUR	Nhung
22	Nguyễn Đình Duy	Viện sinh thái TNSV	3days × 20EUR = 60EUR	Duy
23	Phan Nguyễn Thị Sen	Cục TTKHCNQG	3days × 20EUR = 60 EUR	Sen
24	Chu Thị Hằng	Viện sinh thái & TNSV	3days × 20EUR = 60EUR	Hằng
25	Bùi Văn Thanh	Viện Sinh thái TNSV	3days × 20EUR = 60EUR	Thanh
26	Ngô Huy Hoàng	Trường ĐH KHTN HN	3days × 20 EUR = 60 EUR	Hoàng
27	Ngô Hoàng Hảo	FLPI	3days × 20EUR = 60 EUR	Hảo
28	Hoàng Việt Nguyên	Bộ [illegible]	3days × 20EUR = 60EUR	Nguyên
29	Phương Thảo	Bộ [illegible]	3days × 20EUR = 60 EUR	Thảo
30	Trương Q. Trang	Cục BTĐDSH	3days × 20EUR = 60 EUR	Trang
31	Phùng Thu Thủy	BCA	/	Thủy
32	Nguyễn Nhung	VEA	3days × 20 EUR = 60 EUR	Nhung
33	Phùng Văn Vui	MONRE	3days × 20 EUR = 60 EUR	Vui
34	Hà Tuấn Minh	Sở KHCN	3days × 20 EUR = 60 EUR	Minh

ATTACHMENT 2: The Agenda of Training workshop for trainers (TOT) on GBIF in Hanoi

Time: 19-21 July 2016

Venue: Meeting Hall of Ministry of Natural Resources and Environment

DAY 1: 19/7/2016

Time	Activities	Responsibility
Morning Session		
8:00 – 8:15	**Registration**	Biodiversity Conservation Agency
8:15-8:30	Opening Remark	Biodiversity Conservation Agency
8:30 – 9:00	- Introduction to NBDS - Overview of collaboration mechanism on data sharing for NBDS - How provinces and other organizations can collaborate in biodiversity data sharing for NBDS	Biodiversity Conservation Agency together with resource persons
9:00 – 9:40	Discussion Q & A	All Participants
09:40-10:10	**Break**	
10:10-10:35	Sharing the data input into NBDS and providing the guidance for data input into NBDS	Resources Person/ IT technician Centre for Environmental

Time	Activities	Responsibility
		Information and Data, Viet Nam Environment Administration
10:35 – 11:45	Discussion Q & A	
11:45	**Lunch**	
Afternoon session		
13:30 – 14:30	Demonstrating the functions and manipulation on NBDS interface The data input, export and data exploitation on NBDS	Dr. Nguyen Xuan Thuy Data Manager Centre for Environmental Information and Data, Viet Nam Environment Administration (Trainees from Japan training course)
14:30–15:00	Discussion Q&A	All Participants
15:00 -15:15	**Break**	
15:15- 16:15	Practice in using NBDS with the collected data from the trainees	Dr. Nguyen Xuan Thuy Data Manager Dr. Bui Quang Hung Vietnam Science and Technology University, VNU Resource persons Technical assistants Centre for

Time	Activities	Responsibility
		Environmental Information and Data, Viet Nam Environment Administration (Trainees from Japan training course)
16:15- 16:30	**Break**	
16:30-17:00	Discussion Q & A session	All participants
17:00	**Wrap- up and Closure for day 1**	Biodiversity Conservation Agency

DAY 2: <u>20/7/2016</u>

Time	Activities	Responsibility
Morning Session		
8:00 – 8:15	**Registration**	Biodiversity Conservation Agency
8:15-10:00	Continue to practice on data input/ data export from the system	Dr. Nguyen Xuan Thuy Data Manager

Time	Activities	Responsibility
	Data searching and utilization in the NBDS	Dr. Bui Quang Hung Vietnam Science and Technology University, VNU Resource persons Technical assistants Centre for Environmental Information and Data, Viet Nam Environment Administration (Trainees from Japan training course)
10:00- 10:30	**Break**	Biodiversity Conservation Agency together with resource persons
10:30- 11:10	- Overview and Introduction on GBIF - Sharing experiences in data mobilization, processing and sharing from Japan	Dr. Do Van Tu Institute of Ecology and Biological Resources-IEBR (Trainees from Japan training course)
11:10-11:45	Discussion Q & A	All Participants
11:45	**Lunch**	
Afternoon session		

Time	Activities	Responsibility
13:30 – 14:30	Introduction on DarwinCore and IPT software of GBIF	Dr. Bui Quang Hung Vietnam Science and Technology University, VNU Trainer from Japan training course
14:30–15:30	Discussion Q&A	All Participants
15:30-15:45	**Break**	
15:45- 16:40	Installation of IPT and DarwinCore files into the laptops	Dr. Bui Quang Hung Vietnam Science and Technology University, VNU Dr. Nguyen Xuan Thuy Data Manager Trainers from Japan training course
16:40-17:00	Discussion	All Participants
17:00	**Wrap- up and Closure for day 2**	Biodiversity Conservation Agency

DAY 3: <u>21/7/2016</u>

Time	Activities	Responsibility
Morning Session		

Time	Activities	Responsibility
8:00 – 8:15	**Registration**	Biodiversity Conservation Agency
8:15-10:00	Practice on using IPT software to publish data to GBIF	Dr. Nguyen Xuan Thuy Data Manager Dr. Bui Quang Hung Vietnam Science and Technology University, VNU Resource persons Technical assistants Centre for Environmental Information and Data, Viet Nam Environment Administration (Trainees from Japan training course)
10:00- 10:30	**Break**	Biodiversity Conservation Agency together with resource persons
10:30- 11:30	Discussion Q & A	All participants
11:30	**Lunch**	
13:30 – 15:30	Practice on using IPT software to publish data to GBIF (cont)	Dr. Bui Quang Hung Vietnam Science and Technology University, VNU Trainer from Japan training course
15:30-15:45	**Break**	
15:45-17:00	Discussion	All Participants
17:00	**Wrap- up and Closure**	Biodiversity Conservation Agency

ATTACHMENT 3: The Evaluation Questionnaire for trainees at Training workshop for trainers on GBIF in Hanoi

EVALUATION QUESTIONAIRE

TRAINING WORKSHOP FOR TRAINERS ON NBDS AND GBIF

Hanoi, 19- 21 July 2016

	Greatly Interesting	Interesting	Normal	Not interesting
1. The topics of the training workshop	☐	☐	☐	☐

Comment :

.....

	greatly useful	Useful	Normal	Limited
2. Contents of **Presentations**	□	□	□	□

Comment :

.....

3. Methods of trainers	Greatly exciting	Exciting	Normal	Boring
Presentation on NBDS overview				
Presentation on NBDS data input/ export /search/using				

3. Methods of trainers	Greatly exciting	Exciting	Normal	Boring
Presentation on functions and manipulation on NBDS interface				
Practice of NBDS				
Presentation on Overview and Introduction on GBIF				
Presentation on Introduction on DarwinCore and IPT software of GBIF				
IPT installation and practice				

Comment

.....

4. The explanation and interpreting of the trainers	Greatly exciting (1)	Exciting (2)	Normal (3)	Boring (4)	Not understanding (5)
Presentation on NBDS overview					
Presentation on NBDS data input/ export /search/using					
Presentation on functions and manipulation on NBDS interface					
Practice of NBDS					
Presentation on Overview					

and Introduction on GBIF					
Presentation on Introduction on DarwinCore and IPT software of GBIF					
IPT installation and practice					

Comment/ clarification of point (5)

.....

6. Difficulties faced in practicing NBDS. Specify :

.....

7. Difficulties faced in practicing IPT to publish data. Specify :

.....

8. Other comments for improving the system of NBDS or reccomend other fuctions

.....

9. Other topics and themes you would like to further discuss and know more about ?

.....

10. Other contents on GBIF you would like to know more ?

.....

Thank you for your evaluation.

ANNEX 3: MEETING MINUTES FOR DISCUSSION WITH KEY PARTNERS

ANNEX 3.1: Meeting Minutes for Discussion of the Biodiversity Conservation Agency (BCA) and Institute of Ecology and Biological Resources (IEBR), Viet Nam Academy of Science and Technology (VAST)

I. Time and Venue

- Time: 13:30 – 16:45, 04/8/2016

- Venue: The meeting hall of Ministry of Natural Resources and Environment

II. The Participants

1. Participants from BCA

- Dr. Hoang Thi Thanh Nhan, Deputy Director of BCA

- Dr. Nguyen Xuan Dung, Chief of Administrative Office, BCA

- MSc. Phung Thu Thuy, Official of BCA

- Ms. Truong Quynh Trang, Official of BCA

2. Participants from COB, VNUF

- Dr. Nguyen Van Sinh, Director of IEBR, VAST

- Dr. Do Van Tu, Biologist, Expert in Marine species, IEBR

3. Dr. Tsuyoshi Hosoya, JBIF Node Manager, National Museum of Nature and Science

4. Representatives of JICA Sustainable Natural Resources Management Project

II. The contents of the meeting

1. Mrs. Hoang Thi Thanh Nhan proposed some main issues, specifically:

- To engage the participation of IEBRR as one of the technical focal point, in another word the node manager of Viet Nam when Viet Nam being a member of GBIF.

- BCA recommends that at the time the Institute review its mandates and functions under VAST, IEBR will propose some types of budget lines allocating for environment and biodiversity data collection and development in the regular tasks of the Institute. Although Ministry of Natural Resources and Environment (MoNRE) will actively support IEBR, the stipulations in the official mandates and responsibility of IEBR will enable the Institute to actively carry out the information – related tasks.

- In the future, BCA recommend that 2 sides should work more for signing an MOU which outline the potentials for cooperation between 2 parties, not only in data accumulation and providing but also other technical duties and missions.

- BCA will promote an official exchange between the top leaders of the superior governing body (MoNRE and VAST). It will be large- scaled cooperation between 2 bodies with long term programs, projects and activities that have a larger scale. In order to achieve the expected outcome, BCA commits to promote internally in MoNRE and requesting IEBR will lead the moves with VAST.

2. Dr. Nguyen Van Sinh principally agrees with Ms. Nhan and expresses some views:

First of all, the participation in GBIF though being a small investment but having an impact on the image of Viet Nam as well as good effect in public awareness raising about the importance of biodiversity data in our country. I am highly supportive for the participation.

JBIF is a good example for Viet Nam to refer in terms of techniques and operating experience. However, due to the different context, Viet Nam need some certain incentives for the scientists and experts who involve in the GBIF's data provision and sharing because it hardly can be voluntary in practice.

Secondly, the published information/data is needed to be cautiously reviewed to avoid the negative impacts on the professional authors.

I believe that IEBR entirely are full possibility of being a national technical body for GBIF. However, I really concern about the coordination mechanisms between MONRE- as National delegation and Node manager, and with different nodes.

I totally agree with Ms. Nhan about a Joint MOU between MONRE and VAST for ensuring our large potential cooperation.

Finally, I would like to inform that our monitoring station at Me Linh, Vinh Phuc is responsible for a related research at present. In short time, IEBR will soon receive a number of data /information useful for our biodiversity conservation, hopefully being a abundant sources of data for our future node.

III. Conclusion

- After the meeting, BCA and IEBR agree that 2 sides will work much more to further outline an MOU for cooperation, emphasizing the role of IEBR as a technical advisor body for so- called VBIF in the future.

- 2 parties will continue cooperating together in order to carry out the proposed roadmap for participation of Viet Nam as a main outcome from the BIFA Viet Nam Project

- IEBR commits to strongly support BCA in engaging the national/local data holders for data sharing for the node in the country.

ANNEX 3.2: Meeting Minutes for Discussion of BCA and the Centre of Biodiversity (COB), Viet Nam National University of Forestry (VNUF)

I. Time and Venue

- Time: 14:00 – 17:00, 05/9/2016

- Venue: The meeting room of the Centre of Biodiversity (COB), Viet Nam National

II. The Participants

1. Participants from BCA

- Dr. Hoang Thi Thanh Nhan, Deputy Director of BCA

- Dr. Nguyen Xuan Dung, Chief of Administrative Office, BCA

- MSc. Phung Thu Thuy, Official of BCA

- Ms. Truong Quynh Trang, Official of BCA

2. Partipants from IEBR, VAST

- Assoc.Prof. Hoang Van Sam, Director of COB, VNUF

- Mr. Trinh Van Thanh, Officer of COB

- Mr. Vu Quang Nam, Lecturer of VNUF

II. The contents of the meeting

1. Mrs. Hoang Thi Thanh Nhan given some introduction, information on GBIF, the responsibility and benefits of member, the support from BIFA for Viet Nam in participate in GBIF as well as the progress of BCA in propose a roadmap for participation of Viet Nam into GBIF;

- Ms. Nhan stressed the importance of biodiversity information sharing for the national database systems (NBDS) and other global database systems such as GBIF…;

- BCA is studying and proposing a rational mechanism for data accumulation and sharing among relevant stakeholders and partners in Viet Nam;

- BCA encourages COB with the experience and expertise to have involvement with BCA in the procedure of roadmap design as well as the submission to higher level

- BCA hopes that COB will be one of the key stakeholders in data provision and sharing when Viet Nam becomes a member of GBIF as well as a chain in the network for data sharing.

- COB and BCA should strengthen the traditional cooperation in the past as well as enhance the cooperation in research for coming time.

2. Hoang Van Sam, Director of COB shares his points of view as following:

First of all, I totally support the participation in GBIF because even before the proposal of BCA, COB and our experts have used GBIF as one of the data sources for our researches.

Secondly, COB is willing to sharing our own believable existing data with the careful review. However, we note the need of data verifying and utilization's authorization when Viet Nam publish data to GBIF.

We also request BCA- as the future focal point of MONRE to work more to ensure the intellectual property right of the data and information because this issue will become more serious in the future at global scale.

In addition, we also need to be sure that our sharing are under a national legal framework.

3. Mr. Vu Quang Nam, Lecturer of VNUF confirms that as being a scientist, he recognizes the significance of biodiversity data sharing in the country. He also supports Viet Nam to join GBIF. Personally, he will encourage his college to utilize the Viet Nam's node as well as sharing data with a certain basement for data providing.

III. Conclusion

- After the meeting, BCA and COB agree that 2 sides will discuss more in detail about the data providing at the time Vietnam being the member of GBIF.

- COB is willing to work with BCA as well as consulted by BCA when BCA establishes the node in Viet Nam.

- COB shares the interest in collaboration with BCA in developing a legal frame for data providing in the country.

ANNEX 3.3: Meeting Minutes for Discussion of the Biodiversity Conservation Agency (BCA) and Viet Nam National University , Ha Noi (VNU) and the Center of Multidisciplinary Integrated Technologies for Field Monitoring (FIMO), VNU

I. Time and Venue

- Time: 09:00 – 11:00, 21/9/2016

- Venue: The meeting room of Ministry of Natural Resources and Environment

II. The Participants

1. Participants from BCA

- Dr. Nguyen Xuan Dung, Chief of Administrative Office, BCA

- MSc. Phung Thu Thuy, Official of BCA

- Ms. Truong Quynh Trang, Official of BCA

2. Partipants from VNU

- Dr. Le Xuan Tuan, Dean of Biology Department, VNU

- Dr. Bui Quang Hung, Information and Technology Department, VNU. Director of FIMO

- Dr. Nguyen Thi Nhat Thanh, the lecturer of Information and Technology Department, VNU, Officer of FIMO

- Mr. Hoang Xuan Phuong, Master fellow of FIMO, Officer of FIMO

II. The contents of the meeting

1. Dr. Nguyen Xuan Dung given some introduction, information on GBIF, the responsibility and benefits of member, the support from BIFA for Viet Nam in participate in GBIF as well as the progress of BCA in propose a roadmap for participation of Viet Nam into GBIF;

- Dr. Dung stressed the importance of biodiversity information sharing for the national database systems (NBDS) and other global database systems such as GBIF…;

- BCA is studying and proposing a rational mechanism for data accumulation and sharing among relevant stakeholders and partners in Viet Nam;

- BCA hopes that VNU will lead the roles in connecting the scientists and experts in data sharing, data verification and data publish

- The FIMO centre will work as an advisor agency to advise BCA in establishing the data sharing mechanism, connecting among NBDS and other existing Database systems together and to GBIF. FIMO can be a potential outsource for BCA in technical issues of the system

2. Dr. Le Xuan Tuan, the Dean of Biology Dept, VNU confirm his interest in GBIF and data development in Viet Nam

- I hope that joining GBIF will give the chance for the domestic scientists to assess to a reliable data resources as well as providing a gate to publish more research on biodiversity of Viet Nam to the world.

- However, I raise my concern on the legal issues associating with sharing data to the outside and stress the importance of censorship if needed.

In addition, I am willing to engage other scientist into our network

3. Dr. Bui Quang Hung, Lecturer of VNUF, Director of FIMO express his interest in cooperating with BCA in develop an more effective system for NBDS and the future node.

He believes that FIMO can be not only a contractor for IT for BCA but also a partner to develop the application tools for the system.

III. Conclusion

- After the meeting, BCA and representative of VNU agree that there is necessary 2 sides to promote in their agency to have stronger and deeper commitments.

- FIMO can propose some relevant options for enhancement of the current infrastructure of database systems in Viet Nam for BCA's review. Such proposal also can be the inputs for the roadmap of MONRE about the demands for national system to submit the Government for approv

ANNEX 4: The Promotion Workshop on Biodiversity Information in Viet Nam

ATTCHMENT 1: List of Participants of the Promotion Workshop on Biodiversity Information in Viet Nam for Relevant Stakeholders:

LIST OF ATTENDANTS
"Training course for trainers on GBIF"

No.	Name	Organization	Attendance allowance	Signature
1	Tran Manh Tien	Fimo - VNU	3 days x 20 EUR = 60 EUR	
2	Bui Quang Hiep	VNU		
3	Le Cong Thang	FIMO	3days x 20 EUR = 60 EUR	
4	Nguyễn Văn Dương	FIMO	3days x 20 EUR = 60 EUR	
5	Hoàng Xuân Phương	VNU	3days x 20 EUR = 60 EUR	
6	Nguyễn Văn Điệp	VNU	3days x 20 EUR = 60 EUR	
7	Lê Xuân Cảo	FIMO	3days x 20 EUR = 60 EUR	
8	Đỗ Thị Thu Thủy	JICA	3days x 20 EUR = 60 EUR	
9	[illegible]	JICA		
10	Tsuyoshi Hiro	JICA		
11	Vũ Anh Tài	Institute of Geography	3days x 20 EUR = 60 EUR	
12	Nguyễn Thiên Tạo	VNMN	3days x 20 EUR = 60 EUR	
13	Hoàng Văn Chung	Fi Pi	3days x 20 EUR = 60 EUR	
14	Vũ Quang Nam	ĐH Lâm nghiệp	3days x 20 EUR = 60 EUR	
15	Nguyễn Văn Sinh	Viện Sinh thái và TNSV	3days x 20 EUR = 60 EUR	
16	Hoàng Văn Sâm	ĐH Lâm Nghiệp	3days x 20 EUR = 60 EUR	
17	Trịnh Văn Thành	ĐH Lâm Nghiệp	3days x 20 EUR = 60 EUR	
18	Đỗ Văn Tú	Viện Sinh thái		
19	Nguyễn Xuân Dy	BCA		
20	Lê Anh Dũng	Dân ABS	3days x 20 EUR = 60 EUR	

LIST OF ATTENDANTS
"Workshop on Biodiversity Information in Vietnam"

No.	Name	Organization	Attendance allowance	Signature
1	Đào Thái Hâu	VEA	2days x 20 EUR = 40 EUR	
2	Lê Trung Dũng	ĐH Sư phạm HN	2days x 20 EUR = 40 EUR	
3	Bùi Văn Thanh	Viện STTNSV-VAST	2days x 20 EUR = 40 EUR	
4	Ng Đình Duy	VAST	2days x 20 EUR = 40 EUR	
5	Vũ Anh Tài	Viện địa lý	2days x 20 EUR = 40 EUR	
6	Đỗ T Thu Thuỷ	Jica	2days x 20 EUR = 40 EUR	
7	Phạm Hồng Thái	Bảo tàng TN VN	2days x 20 EUR = 40 EUR	
8	Ng Huy Vũ	Sở TNMT HN	2days x 20 EUR = 40 EUR	
9	Trần Thị Hồng	ĐH KHTN	2days x 20 EUR = 40 EUR	
10	Hoàng Thu Hiền	MOST	2days x 20 EUR = 40 EUR	
11	Đỗ Thị Kim My	Viện NC STX MT miền	2days x 20 EUR = 40 EUR	
12	Phan Ng T Sen	Cục TT CN Q Gia	2days x 20 EUR = 40 EUR	
13	Đỗ Văn Tứ	Viện STTNSV	2days x 20 EUR = 40 EUR	
14	Ng Thu Phương	IMHEN	2days x 20 EUR = 40 EUR	
15	Ng Hoàng Hảo	FIPI	2days x 20 EUR = 40 EUR	
16	Hoàng Minh Nguyệt	FIPI	2days x 20 EUR = 40 EUR	
17	Hoàng Văn Chung	WWF	2days x 20 EUR = 40 EUR	
18	Hoàng Ngọc Khắc	ĐHTN & MT Hà Nội	2days x 20 EUR = 40 EUR	
19	Lê Quang Tuấn	VAST	2days x 20 EUR = 40 EUR	
20	Ng Huy Hoàng	Trường ĐHKH HN	2days x 20 EUR = 40 EUR	

No.	Name	Organization	Attendance allowance	Signature
21	Ng Mai Hường	MONRE	2days x 20 EUR = 40EUR	
22	Mã Văn Linh	MARD	2days x 20EUR = 40UER	
23	Phạm Văn Mậu	Chi cục Kiểm HN	2days x 20EUR = 40UER	
24	Ng Thị Thu	TTAD SM, AN lương thực	2days x 20 EUR = 40UER	
25	Lê Thanh Huyền	ĐNTN&MT HN	2days x 20EUR = 40UER	
26	Trần Mạnh Tiến	ĐH Hà Nội	2days x 20 EUR = 40UER	
27	Bùi Quang Hưng	VNU	2days x 20EUR = 40UER	
28	Lê Công Thắng	ĐH Bách Khoa	2days x 20EUR = 40UER	
29	Ng Văn Dương	FIMO-VNU	2days x 20EUR = 40UER	
30	Hoàng Xuân Phương	FIMO- VNU	2days x 20 EUR = 40UER	
31	Ng Văn Điệp	ĐHCN	2days x 20 EUR = 40 UER	
32	Lê Xuân Cần	ĐHCN	2days x 20 EUR = 40 UER	
33	Ng Huyền Nhung	VFA	2days x 20 EUR = 40UER	
34	Nguyễn Xuân Dỹ	BCA	2days x 20 EUR = 40 UER	
35	Phùng Văn Vui	MONRE	2days x 20 EUR = 40 UER	
36	Lê Anh Dũng	Dán ABS	2days x 20 EUR = 40 UER	
37	Trương Q. Trang	Cục BTĐDSH	2days x 20 EUR = 40 UER	
38	Phan T. Quỳnh Yến	BCA	2days x 20 EUR = 40 UER	
39	Trần T Nguyệt	Cục BTĐDSH	2days x 20 EUR = 40 EUR	
40	Hà T. Minh Thảo	MARD	2days x 20 EUR = 40 EUR	
41	Đào Minh Oanh	Sở KHCN HN	2days x 20 EUR = 40 EUR	

No.	Name	Organization	Attendance allowance	Signature
42	Phùng Thu Thuỷ	B/A	2days x 20 EUR = 40 EUR	
43	Đào Thu Hường	Sở KH CN HN	2days x 20 EUR = 40 EUR	
44	Hà Lê Mai	VAST	2days x 20 EUR = 40 EUR	
45	Bùi Hoàng Linh	MONRE	2days x 20 EUR = 40 EUR	

ATTCHMENT 2: Agenda of The Promotion Workshop On Biodiversity Information In Viet Nam For Relevant Stakeholders

Time: 03- 04 August 2016

Venue: MONRE meeting Hall, 10 Ton That Thuyet Str., Hanoi

DAY 1: 03/08/2016

Time	Activities	Facilitors
8:00 – 8:15	**Registration**	Biodiversity Conservation Agency
8:15-8:30	Opening Remark	Biodiversity Conservation Agency
8:30 – 9:00	- Introduction to NBDS - Overview of collaboration mechanism on data sharing for NBDS - How provinces and other organizations can collaborate in biodiversity data sharing for NBDS	Biodiversity Conservation Agency together with resource persons
9:00 – 9:30	- Overview on GBIF - Node function exemplified by Japan (JBIF)	Tsuyoshi Hosoya PhD, National Museum of Nature and Science, Japan
9:30 – 10:00	Sharing experiences in data mobilization, processing and sharing from Japan	Resource persons (Trainees from Japan training course)
10:00 – 10:30	Discussion Q & A	All Participants
10:30 – 10:45	**Break**	
10:45-11:15	Introduction of the 1st draft road map for Vietnam to participate in GBIF	Biodiversity Conservation Agency Dr. Do Van Tu Expert tem IEBR
11:15–12:00	Discussion Q&A	All Participants

Time	Activities	Facilitors
12:00	**Lunch**	
13:30 – 15:00	Discussion with key potential data holders - Participation of Viet Nam in GBIF -The roadmap for Vietnam to become GBIF member -The possible data mobilization strategy/mechanism - The possible data sharing strategy/mechanism	- Biodiversity Conservation Agency - Tsuyoshi Hosoya PhD, National Museum of Nature and Science, Japan - All key data holders
15:00- 15:10	**Break**	
15:10-16:30	Discussion (continue)	
16:30	**Wrap- up and Closure**	Biodiversity Conservation Agency

DAY 2: 04/08/2016

Time	Activities	Facilitors
8:00 – 8:15	**Registration**	Biodiversity Conservation Agency
8:15-8:30	Introduction on FORMIS (Forestry Management Information System)	FORMIS project
8:30 – 9:00	Discussion Question and Answer (Q&A) Section	All Participants
9:00 – 9:30	Sharing experience from using NBDS for inputting data	Biodiversity Conservation Agency
9:30 – 10:00	**Break**	
10:00 – 10:30	Discussion	All Participants

Time	Activities	Facilitors
	Question and Answer (Q&A) Section	
10:30-11:15	Sharing experiences in data mobilization, processing and sharing from some major data holders	Institute of Geography Forestry Inventory and Planning Institute
11:15–12:00	Discussion	
12:00	**Closure** **Lunch**	
13:30 – 15:00	Discussion (continue)	
15:00- 15:10	**Break**	
15:10-16:30	Discussion (continue)	
16:30	**Wrap- up and Closure**	Biodiversity Conservation Agency

ATTACHMENT 3: The Evaluation Questionnaire for the Promotion Workshop

EVALUATION QUESTIONAIRE

PROMOTION WORKSHOP ON BIODIVERSITY INFORMATION IN VIET NAM

Hanoi, 03- 04 August 2016

	Greatly Interesting	Interesting	Normal	Not interesting
1. The topics of the training workshop	☐	☐	☐	☐

Comment :

.....

.....

.....

	greatly useful	Useful	Normal	Limited
2. Contents of **Presentations**	☐	☐	☐	☐

Comment :

.....

.....

.....

3. Methods of trainers	**Greatly exciting**	**Exciting**	**Normal**	**Boring**
Presentation on NBDS overview and introduction				
Presentation on GBIF and JBIF introduction				
Presentation on Sharing experiences in data mobilization, processing and sharing from Japan				
Presentation on Introduction of the 1st draft road map for				

3. Methods of trainers	Greatly exciting	Exciting	Normal	Boring
Vietnam to participate in GBIF				
Presentation on Introduction on FORMIS (Forestry Management Information System)				
Presentation on Sharing experience from using NBDS for inputting data				
Presentation on Sharing experiences in data mobilization, processing and sharing from some major data holders				

Comment

.....

.....

The explanation and interpreting of the trainers	Greatly exciting	Exciting	Normal	Boring	Not understanding
Presentation on NBDS overview and introduction					
Presentation on GBIF and JBIF introduction					
Presentation on Sharing experiences in data mobilization, processing and sharing from Japan					
Presentation on Introduction of the 1st					

The explanation and interpreting of the trainers	Greatly exciting	Exciting	Normal	Boring	Not understanding
draft road map for Vietnam to participate in GBIF					
Presentation on Introduction on FORMIS (Forestry Management Information System)					
Presentation on Sharing experience from using NBDS for inputting data					
Presentation on Sharing experiences in data mobilization, processing and sharing from some major data holders					

Comment/ clarification of point (5)

.....

.....

.....

6. Assess the necessity of Viet Nam's participation in GBIF

Truely necessary ☐ Necessary but more consideration ☐ Not truely Necessary ☐

Specify :

.....

.....

.....

7. Is your organization/ institute willing to share / provide data to GBIF?

Specify :

.....

.....

.....

8. Other topics and themes you would like to further discuss and know more about ?

.....

.....

.....

9. Other contents on Biodiversity Information you would like to know more ?

.....

.....

10. Do you have any comments for logistics preparation?

.....

.....

.....

Thank you for your evaluation !

BIFA PROJECT "DEVELOPMENT OF THE BIODIVERSITY DATABASE SYSTEM IN VIET NAM"

A PROPOSAL ON ROAD MAP ON PARTICIPATION OF VIET NAM IN GLOBAL BIODIVERSITY INFORMATION FACILITY (GBIF) AND COORDINATION MECHANISM FOR SHARING INFORMATION TO GBIF

Ha Noi, 12/2016

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ABBREVIATION

BCA	Biodiversity of Conservation Agency
CBD	Convention on Biological Diversity
DARD	Department of Agriculture and Rural Development
DONRE	Department of Natural Resources and Environment
HoD	Head of Delegation
IEBR	Institute of Ecology and Biological Resources
GB	Governing Board
GBIF	Global Biodiversity Information Facility
JBIF	Japan Biodiversity Information Facility
MARD	Ministry of Agriculture and Rural Development
MONRE	Ministry of Natural Resources and Environment
MOST	Ministry of Science and Technology
MOU	Memorandum of Understanding
NFP	National Focal Point
PPC	Provincial People Committee
SWOT	Strong- Weak- Opportunity- Threat
VEA	Viet Nam Environment Administration
VBIF	Viet Nam Biodiversity Information Facility

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I. OVERVIEW ABOUT GBIF

1. General introduction

The Global Biodiversity Information Facility (GBIF) is an international open data infrastructure, funded by governments.

It allows anyone, anywhere to access data about all types of life on Earth, shared across national boundaries via the Internet.

By encouraging and helping institutions to publish data according to common standards, GBIF enables research not possible before, and informs better decisions to conserve and sustainably use the biological resources of the planet.

GBIF operates through a network of nodes, coordinating the biodiversity information facilities of Participant countries and organizations, collaborating with each other and the Secretariat to share skills, experiences and technical capacity.

GBIF's vision: "*A world in which biodiversity information is freely and universally available for science, society and a sustainable future*."

Currently, there are 37 Voting participants, 17 Associate Country Participants, 39 other Associate Participants and three GBIF Affiliates (Fig. 1). In Southeast Asia, Indonesia and Philippines became Associate Country Participant from 2004 and 2005, respectively.

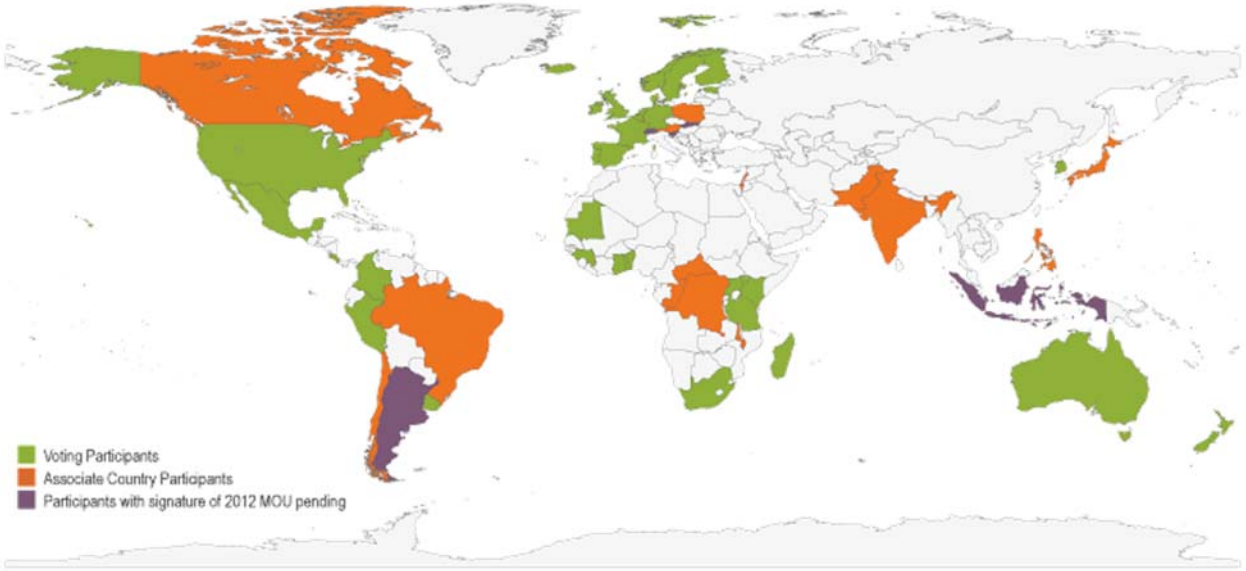

Figure 1. Map of GBIF Country Participants

a) Purpose of GBIF

The purpose of GBIF is to promote, co-ordinate, design, enable and implement the compilation, linking, standardisation, digitisation and global dissemination and use of the world's biodiversity data, within an appropriate framework for property rights and due attribution. GBIF works in close co-operation with established programmes and organisations that compile maintain and use biological information resources. The Participants, working through GBIF, establish and support a distributed information system that enables users to access and utilise considerable quantities of existing and new biodiversity data.

b) Goals of GBIF

It is the intention of the Participants that GBIF:

- be shared and distributed, while encouraging co-operation and coherence;
- be global in scale, though implemented nationally and regionally;
- be accessible by individuals anywhere in the world, offering potential benefits to all, while being funded primarily by those that have the greatest financial capabilities;
- promote standards and software tools designed to facilitate their adaptation into multiple languages, character sets and computer encodings;
- serve to disseminate technological capacity by drawing on and making widely available scientific and technical information;
- make biodiversity data universally available, while fully acknowledging the contribution made by those gathering and publishing these data.

c) Some facts about GBIF

- It provides a single point of access (through this portal and its web services) to hundreds of millions of records, shared freely by hundreds of institutions worldwide, making it the biggest biodiversity database on the Internet.
- The data accessible through GBIF relate to evidence about more than 1.6 million species, collected over three centuries of natural history exploration and including current observations from citizen scientists, researchers and automated monitoring programmes
- More than 1,400 peer-reviewed research publications have cited GBIF as a source of data, in studies spanning the impacts of climate change, the spread of pests and diseases, priority areas for conservation and food security. About one such paper is published each day.
- Many GBIF Participant countries have set up national portals using tools, codes and data freely available through GBIF to better informed their citizens and policy makers about their own biodiversity.

2. Governance (How decisions, advice, management and funding are organized in GBIF)

The GBIF Governing Board

Pursuant to Paragraphs 4.2 and 4.3 of the GBIF MOU, the Governing Board will consist of one Representative from each Participant. The Governing Board is the means by which GBIF Participants make collective decisions. Currently meeting once a year, it consists of one representative from each Participant country and organization. The Governing Board meets in a Participant country that offers to host it. The meeting is organized by the Secretariat in collaboration with the hosting country. The formal proceedings of the Board are associated with a number of other events at the same location, including meetings of nodes, standing committees, training events and the annual Science Symposium.

Only representatives from Voting Participant Countries (those countries making a financial contribution to GBIF's central fund) have the right to vote on the Governing Board. Representatives from Associate Participants, both countries and organizations, are encouraged to attend the Governing Board and take part in its discussions, but may

not vote.

The Secretariat of the Convention on Biological Diversity (CBD) is invited to designate a non-voting representative to the Governing Board.

The Governing Board has established Rules of Procedure, further elaborating on the provisions of the Memorandum of Understanding (MoU) regarding the structure of the board, meetings, requirements for participation and the establishment of subsidiary bodies.

Observers

Countries, organizations or other international bodies that have not signed the MoU, but are interested in the activities of GBIF, may be recognized by the Governing Board as observers. A number of former Participants that have not yet signed the latest MoU are also classified as observers to the Governing Board.

The Executive Committee

The Executive Committee operates on behalf of the Governing Board when the Board is not in session and within the areas of responsibility delegated to it by the Governing Board. Among its functions are monitoring of the performance of the Secretariat in carrying out the decisions taken by the Governing Board including implementation of the Strategic Plan and the Work Programme, and management of the budget.

GBIF's standing committees

As required under its rules of procedure, the GBIF Governing Board has set up three standing committees to act as advisory bodies, each with its own terms of reference and with its officers and membership elected by the Governing Board. They are: the Science Committee, the Budget Committee and the Participant Node Managers Committee (including the Nodes Steering Group) (Fig. 2). The functions and membership of each committee are described hereafter.

- Science Committee: The GBIF Science Committee is an advisory committee that oversees the development and progress of the GBIF work programme and makes recommendations to the Governing Board, the Executive Committee and the Secretariat. Among its other functions, the Science Committee is responsible for the selection of winners of the Ebbe Nielsen Prize and GBIF Young Researchers Award, and of speakers at the annual GBIF Science Symposium.

- Budget Committee: The Budget Committee is an advisory committee dealing with various financial issues relating to the administration of GBIF funds. Among other functions, it oversees the audit of the annual accounts submitted to the Governing Board, and it provides guidance for the selection of GBIF's auditing company. The committee makes recommendations to the Governing Board, the Executive Committee and the Secretariat. Its terms of reference can be found here.

- Participant Node Managers Committee: The Participant Node Managers Committee (also referred to as the Nodes Committee) serves as a forum for sharing information about the status and best practices of GBIF Participant nodes. It also acts as an advisory committee making recommendations to the Governing Board, the Executive Committee, the Science Committee and the Secretariat concerning issues relevant to the nodes. The Nodes Steering Group (NSG), established in 2011, consists

of the Chair and Vice Chairs of the Participant Node Managers Committee, and regional representatives from each of the six GBIF regions (Africa, Asia, Europe, Latin America, North America and Oceania). Among its objectives are to formulate specific recommendations to the relevant GBIF bodies based on feedback provided by Participant nodes, and to provide advice on the GBIF Work Programme relevant to nodes.

GBIF task groups

According to its rules of procedure, the GBIF Governing Board may establish and assign responsibilities to ad hoc committees or task groups. The terms of reference, guidelines and budgets for these groups are set by the Governing Board or by the Executive Committee on its behalf. Current task groups: Task group on accelerating the discovery of bio-collections data; Task group on data fitness for use in agrobiodiversity; Task group on data fitness for use in distribution modeling.

How GBIF is funded

The GBIF Secretariat, advisory committees and work programme are funded by GBIF's Voting Participants through an annual basic financial contribution based on a formula linked to the Participant country's GDP. Countries whose per capita income falls below US$13,000 per year are entitled to a 50 per cent discount on this contribution.

In addition to the basic financial contributions, both Voting and Associate Participants may make supplementary financial contributions to fund specific parts of the work programme or for other purposes agreed to by the Governing Board.

The Secretariat may also accept income from additional sources, such as foundations, agencies, research councils and private companies, for the purposes set out in the Memorandum of Understanding and the GBIF Strategic Plan.

The GBIF budget

The Secretariat budgets, administers and reports on GBIF funds in accordance with a set of financial regulations approved by the Governing Board.

GBIF uses the calendar year as its financial year, and follows a rolling budget in which an adopted budget is amended at intervals to reflect changing circumstances. The Governing Board approves the budget two to three months in advance of the financial year, typically in October. When the draft financial report for the previous year is ready in April/May, the budget is revised by the Executive Committee taking any variations into account.

Each country Participant in GBIF is responsible for funding the establishment of a Participant node, digitization programmes, meetings and workshops at the national or organizational level.

GBIF finances are audited by an international auditing company.

The GBIF Secretariat

The GBIF Secretariat, located at the Natural History Museum in Copenhagen, Denmark, is charged with developing, executing and reporting on the GBIF work programme.

The tasks of the Secretariat include:

- operating the GBIF portal and associated informatics products
- coordinating activities of the network related to data mobilization, publishing and management
- monitoring data gaps and use of GBIF-mediated data for science, and
- operating central communication and collaboration services

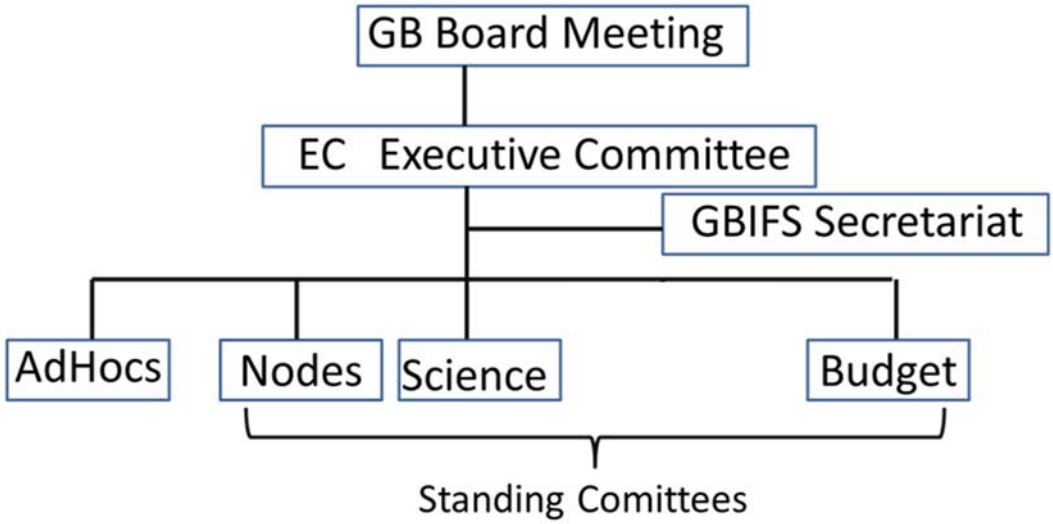

Figure 2. The organization of GBIF

3. Infrastructure (How GBIF works as a global informatics infrastructure)

The GBIF informatics architecture provides an open platform to connect and access biodiversity databases around the world.

The distributed infrastructure spans across the hundreds of institutions participating in GBIF enabling users to discover, access, integrate and help curate the growing content shared on the network.

The GBIF architecture encompasses well-known community-developed data standards and protocols enabling **interoperability at global scale**. As an open infrastructure, a growing number of tools and workflows are able to connect and participate in the GBIF network.

For convenience, the infrastructure can be considered in terms of a number of sequential processes:

- Digitization: The initial capturing of information in electronic form, through imaging, databasing, maintaining spreadsheets etc.

- Publishing: The act of making data sources available in a well known format (standard) and with appropriate metadata for access on the internet.

- Integration: The process of aggregating published data sets, applying consistent quality control routines and normalizing formats.

- Discovery and access: By building network wide indexes, discovery services are offered for users through portals and for machines by extensive web service APIs.

Registry: The registry is a core component of the architecture responsible for providing the authoritative source of information on GBIF Participants (Nodes), institutions (e.g. data publishers), datasets, networks their interrelationships and the

means to identify and access them. As a distributed network, the registry serves a central coordination mechanism to (e.g.) allow publishers to declare their existence and for data integrating components to discover how to access published datasets and interoperate with the publisher.

Occurrences: The network that publishes occurrence records through GBIF spans hundreds of publishing institutions worldwide. Data holders manage content in either spreadsheets or databases and then use specific publishing tools to expose those data for querying and access over the internet. The existence of the dataset and the technical protocols required to access the data are entered into the GBIF registry. Aggregators such as the GBIF global portal and national GBIF data portals, crawl datasets and build sophisticated indexes to allow users to efficiently search and access content across datasets. This page briefly describes the architecture and operations performed in the global GBIF portal when crawling and indexing occurrence data for user search and download.

Occurrence processing: Every single occurrence record in GBIF goes through a series of processing steps until it becomes available in the GBIF portal. Internally the processing is glued together by a messaging system that keeps our processing code independent of each other. The process can be divided up into 3 main parts: crawling datasets into fragments, parsing fragments into verbatim occurrences and interpreting verbatim values.

GBIF Tools Overview: The outcome of each of these steps is available through the API. Every single occurrence record therefore has a raw fragment, verbatim and interpreted view. The corresponding timestamps lastCrawled, lastParsed and lastInterpreted indicate the exact last time each step has run. GBIF makes available several free to use, open-source tools and services. The table below lists GBIF's most widely used and talked-about tools. They span several categories of use, such as data assessment, data cleaning, data publishing, data visualization, and metadata authoring.

Table 1. Lists GBIF's most widely used tools

Categories of use	**Short Description**
Data publishing, Metadata authoring, Data discovery	Publishes primary occurrence data, species checklists and taxonomies, and general metadata about data sources. It can also serve as a repository for data referenced in an article.
Data discovery	Enables participants to establish a simple, GBIF-compliant web presence
Data assessment	Validates that a Darwin Core Archive complies with the Darwin Core Text Guidelines
Data cleaning	Atomizes scientific names, and validates that a scientific name is a well-formed 3-part name

4. Benefit of joining GBIF

a) For researcher

If Vietnam joins GBIF, more Vietnamese researchers will become familiar with GBIF. They can locate more information about species from around the world such as specimens, habitat, distribution and taxonomic status. They can publish their data to

GBIF and use data of GBIF. GBIF tools for web-enabled taxonomy facilitate rapid progress in describing new species, collaborative research and preparing monographs. Data on specimens can be used in research activities such as systematics and building predictive models.

b) For institution or individual with biodiversity data

GBIF offers tools and advice for publishing biodiversity datasets via the Internet, enabling them to be discovered and cited in research and policy applications. This can raise the profile of a project or institution, attract recognition for those involved in digital data gathering and curation, and help users to comply with legal or regulatory requirements for data management.

c) For national government

Participating in GBIF will allow Vietnam to become part of a global network of collaborators, helping Vietnam to meet the country's biodiversity information needs. A range of capacity enhancement activities, including mentoring and training, enable Vietnam to benefit from more than a decade's experience and development of free tools to mobilize biodiversity datasets and make them accessible for research and policy. GBIF supports setting up of a Vietnam national biodiversity web portal. Participation on GBIF will benefit Vietnam in developing NBDS which is just in the first stage. Moreover, it will assist with contributions to data and information requirements for intergovernmental processes such as the Convention on Biological Diversity (CBD).

The important benefits in being a member is that each participant is involved in the community, having engagement in regional or inter-nodal activity, which allows the participant to absorb state-of-the-art information and application of the biodiversity data through the direct communication. This information can be utilize for increased development and access to biodiversity data, predicting and avoiding possible future conflicts (such as licensing issue).

The following table outlines a wide array of actors, stakeholders and sectors that generate, use or need biodiversity data. At present GBIF observes a dispersion and fragmentation of data around the world. GBIF’s work is meant to address this issue at the same time actively work to narrow the digital divide. In fact, GBIF's strategy to provide open access to data, and its distributed architecture, effectively contribute to overcoming these barriers, which are particularly prevalent in many developing countries. GBIF can, in the longer term, provide important contributions to the poverty reduction goals of these countries by providing access to a variety of data necessary to support and address poverty alleviation. This potential lies not only within environmental/biodiversity conservation - but also in relation to development of agriculture and fisheries, health improvement as well as development of higher education and research. The table below illustrates some of the main areas where – over the longer term - fully developed national GBIF nodes will be able to support poverty reduction through improved local livelihoods.

Table 2. Actors, stakeholders and sectors where GBIF activities can make an impact

Beneficiaries	Areas of Interest
GBIF Participants	GBIF provides useful services that make it easier for them to meet their own strategic needs (e.g., implement national biodiversity strategies and action plans, manage and conserve their own biodiversity, promote scientific research, etc.).
Researchers who use natural history or culture collections	GBIF-mediated specimen- and name-level data are used in research activities such as systematics building predictive models and others; GBIF tools for web-enabled taxonomy facilitate rapid progress in describing new species and collaborative research and preparing monographs.
GBIF Data Providers	GBIF data providers are recognized as sources of assistance and tools related to specimen, observational and names data. Data providers get full recognition and are cited in various scientific publications.
Molecular research (e.g. DNA barcodings, phylogenetic analysis)	GBIF-mediated species-level data and information architecture enable seamless integration between gene or other sequence data and voucher specimen data, and from there to ecological context for gene evolution (for example).
Agriculture	GBIF data of use in integrated pest management, measuring the impact of agriculture on biodiversity (and vice versa), locating wild relatives of crop plants, pollinators, etc. and how this in turn address matters to food security and poverty alleviation.
Natural Resource Management (e.g. forestry, fisheries)	GBIF-mediated, easy to access scientific data contribute to good decision-making, support appropriate management of biodiversity resources and address the Millennium Development Goals.
Geospatial / Ecological modelling community (e.g. Climate Change, Spread of Invasive Species, Emergent Diseases)	GBIF's robust data can be used for niche-modelling and other kinds of analyses that address urgent questions and issues which impact the daily lives and quality of life in developing countries.
International biodiversity related conventions (e.g. CBD, Ramsar, CITES, CMS)	GBIF's primary data underpins the kinds of information needed by countries to address the effective implementation of

	Conventions (e.g. 2010 targets to reduce the rate of biodiversity loss, monitoring the status to biodiversity, etc.).
National planning agencies or authorities and other Ecosystem managers	GBIF-mediated data are used to compile lists of taxon occurrences in priority areas and underpin policy and natural resource management decisions at national and regional levels while highlighting the services provided by different ecosystems around the world.
Conservation	GBIF-mediated data used to track species and populations, assess the status, and identify areas for priority action and the CBD 2010 target to decrease the rate of biodiversity loss. GBIF data network is also a means to publish and archive survey data and establish base line data against which monitoring activities can effectively be made.
Sustainable development	Such as ecotourism. GBIF-mediated data can be used to plan and target species and areas to produce value-added products and services
General Public	Will use GBIF to seek answers to all sorts of questions about biodiversity (e.g. via Species Banks and others).

(Source: GBIF, 2006)

By becoming members of GBIF, countries benefit directly in several ways, among them:

- Access to GBIF seed money grants to allow countries to apply for funds to digitize their collections and other biodiversity data sources
- Access to training workshops in biodiversity informatics and financial support to attend and participate in these events are provided by GBIF to representatives of its members.
- Participation at the NODES Committee Meetings: These open fora discuss themes of high relevance to the day-to-day work of Nodes, look at ways on how best to address the technical needs and organisational challenges of the GBIF Nodes, share lessons and promote learning from each other's experiences.
- Immediate access to an international network of experts: These experts in biodiversity informatics can provide advice and support in matters dealing with the establishment of national nodes and/or their respective networks as well as other technical aspects.
- Access to mentors: GBIF members who have more experience and/or knowledge in the establishment of national nodes and their networks can provide mentoring support to those Nodes in greater need. GBIF has a programme to foster these activities.
- Participation in projects that deal with repatriation of data to countries of

origin. Using GBIF and with a simple query, countries can benefit from getting free and open access to biodiversity data housed in different parts of the world.

- Participation in defining the GBIF Work Programme and its budget: All GBIF members actively participate in the discussions regarding the work programme and its budget.

d) For member of the public, educator or wildlife enthusiast

GBIF offers great opportunities to explore and contribute to the global body of evidence documenting the huge diversity of life on our planet. Find out what records are available for our country, region or neighbourhood by exploring the country pages and occurrence data on this portal. Contact your GBIF national node to find out about activities such as bioblitzes and other events that help you to become a 'citizen scientist', and consider sharing your observations or images through networks such as iNaturalist, eBird and the Encyclopedia of Life (EOL).

GBIF.org as a global biodiversity data platform can play an important role in the agrobiodiversity landscape by mobilizing and connecting biodiversity datasets that can support research and development for food security and ecosystem services resilience. As part of a broader global strategy on fitness for use of biodiversity data, GBIF and Bioversity International convened a Task Group on Data Fitness for Use in Agrobiodiversity in March 2015. The Task Group identified the need to bridge ecological and agricultural data that are relevant for agrobiodiversity and agroecology uses. In general, the plant ex situ conservation data are in a good state with developed data and metadata solutions.

5. Terms of use

5.1. Open data

A piece of content or data is open if anyone is free to use, reuse, and redistribute it subject only, at most, to the requirement to attribute and/or share-alike (Open Knowledge Foundation (2012)). In other mean, open data is free access, copyright and redistributable. However, we need to note that free data is not always open data. Free is just one of component. Data owners have Copy Rights. This is sometime to prevent usability. Open data should be re-use not only by owner but also by others. We can re-release open data even in worked data (not only raw data). High usability and accessibility is desirable of open data. Therefore, open data require standard file format and common data platform.

5.2. Data sharing

a) Data sharing agreement – background

The goals and principles of making biodiversity data openly and universally available have been defined in the GBIF Memorandum of Understanding, paragraph 8 (see Annex 1).

The Participants who have signed the MoU have expressed their willingness to make biodiversity data available through their nodes to foster scientific research development internationally and to support the public use of these data.

Data Publishers often participate in several data sharing arrangements at different levels (thematic, community, national, global).

GBIF data sharing should take place within a framework of due attribution.

b) Provisions

When registering their services with GBIF, the Data Publishers agree as follows:

Biodiversity data accessible via the GBIF network are openly and universally available to all users within the framework of the GBIF Data Use Agreement and with the terms and conditions that the Data Publisher has identified in its metadata.

GBIF does not assert any intellectual property rights in the data that is made available through its network.

The Data Publisher warrants that it has made the necessary agreements with the original owners of the data that it can make the data available through the GBIF network.

The Data Publisher makes reasonable efforts to ensure that the data it serves are accurate.

Responsibility regarding the restriction of access to sensitive data resides with the Data Publisher.

The Data Publisher includes stable and unique identifiers in its data so that the owner of the data is known and for other necessary purposes.

GBIF Secretariat may cache a copy and serve full or partial data further to other users together with the terms and conditions for use set by the Data Publisher. Queries of such data through the GBIF Secretariat are reported to the Data Publisher.

Data Publishers are endorsed by a GBIF Participant, if applicable, before their metadata is made available by the GBIF Secretariat.

GBIF Secretariat is not liable or responsible, nor are its employees or contractors, for the data contents or their use; or for any loss, damage, claim, cost or expense however it may arise, from an inability to use the GBIF network.

c) Service levels

GBIF Secretariat

Services provided by the GBIF Secretariat are managed in accordance with the GBIF Work Programme.

GBIF Secretariat's service provision includes software components and updates, interfaces, indexing and registry services, helpdesk, and training to assist the Participants to maintain Internet portals.

GBIF Participants

GBIF Participants keep the GBIF Secretariat informed of their contact and service information.

GBIF Participants maintain services that enable new and existing Data Publishers in their domain to be integrated within GBIF network, and the data owners be identified, as appropriate.

5.3. Data use

a) Data use agreement – background

The goals and principles of making biodiversity data openly and universally available have been defined in the GBIF Memorandum of Understanding, paragraph 8 (see Annex 1).

The Participants who have signed the MoU have expressed their willingness to make biodiversity data available through their nodes to foster scientific research development internationally and to support the public use of these data. GBIF data sharing should take place within a framework of due attribution.

b) Provisions

Using data available through the GBIF network therefore requires agreeing with the following:

The quality and completeness of data cannot be guaranteed. Users employ these data at their own risk.

Users shall respect restrictions of access to sensitive data.

In order to make attribution of use for owners of the data possible, the identifier of ownership of data must be retained with every data record.

Users must publicly acknowledge, in conjunction with the use of the data, the Data Publishers whose biodiversity data they have used. Data Publishers may require additional attribution of specific collections within their institution.

Users must comply with additional terms and conditions of use set by the Data Publisher. Where these exist they will be available through the metadata associated with the data.

c) Citing data

Data retrieved from the GBIF network shall be cited according to the "dataset citation provided by the publisher", as shown on the dataset or occurrence page on the GBIF portal. If the publisher-provided citation is either missing or incomplete, the user shall observe the "default citation" given on the dataset or occurrence page.

5.4. Licenses

a) Licensing for species occurrence datasets published through GBIF

In 2014, the GBIF Governing Board sought to address the need that both data publishers and data users have for greater clarity on how data may be used when shared via GBIF.org. Following the Secretariat's community consultation in 2013 and 2014, the Governing Board established a general policy to:

Ensure that all species occurrence datasets within the network are associated with digital licenses equivalent to one of the following three choices supplied by Creative Commons:

- CC0, under which data are made available for any use without restriction or particular requirements on the part of users
- CC-BY, under which data are made available for any use provided that attribution is appropriately given for the sources of data used, in the manner specified by the owner
- CC-BY-NC, under which data are made available for any use provided that

attribution is appropriately given and provided the use is not for commercial purposes

GBIF strongly encourages data publishers to opt for the most open choice available (CC0). GBIF community member Peter Desmet concisely summarized the rationale in 2012:

For starters, there's very little copyright to be had in our data, datasets and databases. Copyright only applies to creative content and 99% of our data are facts, which cannot be copyrighted. We do hold copyright over some text in remarks fields, the data format or database model we chose/created, and pictures. If we consider a Darwin Core Archive (which is how we are publishing our data) the creative content is even further reduced: the data format is a standard and we only provide a link to pictures, not the pictures themselves.

Figuring out where the facts stop and where the (copyrightable) creative content begins can already be difficult for the content owner, so imagine what a legal nightmare it can become for the user. On top of that different rules are used in different countries. Publishing our data under CC0 removes any ambiguity and red tape. We waive any copyright we might have had over the creative content and our data gets the legal status of public domain. It can no longer be copyrighted by anyone.

Giving credit is a good thing but legally enforcing it can lead to the opposite affect: a user may decide not to use the data out of fear of not completely complying with the license (see paragraph above). As hinted at the beginning of this post, CC0 removes the drastic legally enforceable requirement to give attribution, but it does not remove the moral obligation to give attribution. In fact, this has been the common practice in scientific research for many decades: legally, you don't have to cite the research/data you're using, but not doing so could be considered plagiarism, which would compromise your reputation and the credibility of your work.

Under CC BY-NC, the user cannot use the data(set) for commercial purposes. This seems fine from an academic viewpoint, but the license is a lot more restrictive than intuitively thought. See Hagedorn, G. et al. 2011.

Significantly differing interpretations exist on what is considered commercial or non-commercial use, ranging from straightforward for-profit use, like re-sale of data over use for publications in commercial journals, to works that include websites that display advertisements as a means of cost recovery.

b) The useful of standardized, digital licenses

GBIF's mission is to promote free and open access to biodiversity data, and data limitations introduced at the initial stages of publication multiply as datasets are aggregated to address big questions.

Large-scale research generally requires the foundations of 'big data' to be as free from restrictions as possible. For example, the Global Biodiversity Informatics Outlook identifies the "Open access and reuse culture" as one of the essential foundations for biodiversity informatics. Global initiatives like the Research Data Alliance are addressing these same issues for all research data. Many countries are increasing pursuit of policies to make data (particularly publicly funded data) open and accessible. Given its mission, GBIF has a responsibility and a place in improving understanding of these trends.

Until now, users of GBIF data have agreed to abide by the Data Use Agreement, and data publishers have likewise agreed to the terms of a Data Sharing Agreement. Both of these agreements refer to additional 'terms and conditions' that data publishers may attach to datasets and include in their metadata.

As a result, many GBIF data publishers include their own licensing details in the metadata they provide for each dataset. Submitted in free text and expressed in a wide variety of non-standard formats, these additional terms and conditions make it difficult if not impossible for users of GBIF.org to understand the rights relating to large data downloads, particularly those that include data from multiple institutions. These conditions prove particularly problematic when data are used through web services in automated tools unable to parse usage restrictions outlined only in human-readable text.

c) For data users

For data users, standardizing and limiting the set of potential licenses means that data are easier to use with confidence, thus promoting (re)use of data. This change shifts the burden away from the user, who would have to read through each individual license to determine whether data use is permitted—a situation whose uncertainty could discourage data use. Supported by an appropriate set of filters by information networks like GBIF, users can easily scan and limit downloaded datasets to those whose licenses support the intended use.

Users need to be aware that even for datasets stating CC0, the GBIF data use agreement still applies, meaning, for instance, that proper attribution and citation of sources is required. Those will be supported by a new citation mechanism that provides a persistent reference to the datasets contained in the download), for easy inclusion in e.g. publications.

d) For data publishers

GBIF recognizes that publishers need to document use of their data and wish to receive due recognition for their efforts in collecting, digitizing, curating and publishing species occurrence data.

Complementary to adopting a more transparent and least restrictive licensing approach, therefore, all necessary efforts will be made to support tracking and reporting of data use, and to provide tools that ease and encourage citation by data users. While it is problematic trying to enforce adherence to licenses (see the discussion of their applicability, above, and limited legal leverage), supporting the development of norms and community best practice can help to ensure that the need for attribution is understood, and the practice supported by appropriate tools and procedures.

GBIF is proceeding with a work plan to establish a citation model built upon the Digital Object Identifier (DOI) system. Upon implementation, each dataset (or any object such as imagines) will have a DOI, and all citations will reference the datasets used through persistent DOIs. Under this citation model, data users can be supplied with stable, easy-to-cite source references for their downloads, which will include references to all concerned datasets—a model that will improve publishers' ability to track the use of their data in both print publications and digital applications.

e) Other licenses

Some licenses can be considered almost equivalent to the three listed above. Those include PDDL (very similar to CC0) and ODC-By (equivalent to CC BY). The recommendation for datasets published under those licenses is to consider the corresponding equivalent CC license. The previously cited article discusses and weights of the pros and cons of the other open data licenses. However, data published through GBIF will need to come under one of the three CC versions listed above.

f) 'Commercial use' in the context of GBIF

Interpretations vary widely about how to define commercial use. Some would limit it narrowly if straightforwardly to for-profit practices like re-sale of data in contrast with use for example in publications in commercial journals. Broader constructions would extend it, for example, to websites displaying advertisements as a means of operational cost recovery. We do not expect to propose or impose a resolution to this conversation, but what we hope to describe here is our current practice with regard to 'commercial' and 'non-commercial' designations.

GBIF provides its open access infrastructure to support scientific understanding and improve biodiversity and conservation outcomes. We will continue to promote attribution (CC-BY) as the standard practice for citing GBIF-mediated data, believing that it reflects an established norm across the communities we serve to cite original work.

The new version of our Integrated Publishing Toolkit (IPT) will allow publishers to select CC-BY-NC 4.0 as the most restrictive of the standard machine-readable license by default. Both users and publishers should recognize the grey areas that exist in defining commercial and non-commercial use. We believe that restrictive interpretations of non-commercial use run counter to the spirit and the letter of open access in general and GBIF in particular.

Users who make use of data that carries the CC-BY-NC license should do so in good faith. We strongly encourage them to communicate with publishers if a broad but reasonable interpretation of non-commercial use might construe the benefits they receive as commercial in nature.

GBIF supports publishers' use of CC-BY-NC, and GBIF will make reasonable efforts to honor the intent of such licensing, even where its inheritance extends additional restrictions to other aggregated data that are more freely licensed by themselves.

However, GBIF has neither the interest nor the resources to enforce CC-BY-NC by legal means. If users severely infringe upon these licenses or act in bad faith, publishers may choose to pursue legal actions; GBIF will not participate in them. We would advise publishers uncomfortable with this position either to limit ("narrow") the data elements they share or to remove the data from access through GBIF.org.

5.5. Disclaimer

a) Names and boundaries of countries, territories and islands

Names of countries, territories and islands are based on recommendations made through the ISO-3166 standard.

b) Maps and boundaries

GBIF does not guarantee the accuracy of the maps available through its portal and web services. The boundaries, colors, denominations or other information shown on maps do not imply any judgement on the part of GBIF concerning the legal status of any territory, or the endorsement or acceptance of such boundaries. Users must observe the copyright and licensing provisions included with all maps.

c) Data

GBIF does not guarantee the accuracy of the biodiversity data served through its portal and web services. Use of data accessed through the portal and web services is at the user's own risk. Users must observe the provisions of the Data Use Agreement and data publishers must observe the provisions of the Data Sharing Agreement.

II. HOW TO JOIN GBIF

According to the GBIF Memorandum of Understanding (MoU), a GBIF Participant can be a country, economy, inter-governmental or international organization, other organization with an international scope, or an entity designated by them, that has signed the MoU and expressed its intention to observe its provisions. The process of joining is quite simple. Just follow the steps below:

1. Choose our category

If we wish to join GBIF on behalf of a national government, there are two categories to choose from:

Voting Participants: countries that are willing to observe the provisions of the MoU and to make a financial contribution to the GBIF budget. These Participants have voting rights on the GBIF Governing Board, as well as other benefits.

Associate Country Participants: countries that are not yet making financial contributions to GBIF. Associate Participants may take part in the deliberations of the Governing Board, but may not vote. The category of an Associate Participant Country is a temporary category of up to five years duration from the date when the country signs the MoU. During this period the Associate Participant Country may decide to become either a Voting Participant, or an Observer, or may withdraw from GBIF.

Other Associate Participants are international organizations, intergovernmental organizations, other organizations with an international scope, and economies, that are willing to observe the MoU provisions. These Participants may send representatives to the GBIF Governing Board, may endorse data publishers and take part in collaborations such as regional meetings, mentoring programmes and training events. However, they are not eligible to become Voting Participants, and are not required to make a financial contribution to the GBIF budget.

2. Send a Letter of Intent

In order to become a Participant in GBIF an appropriate government agency, or senior representative of an organization, should send an official Letter of Intent to the Chair of the Governing Board (see below), expressing intent to sign the MoU.

The letter should state that the country/organization is, in principle, in agreement with the intentions listed in the MoU and should, in particular, outline the willingness to establish a Participant Node, share biodiversity data and actively participate in the implementation of the GBIF Work Programme.

Letters of Intent signed by a Minister or ministerial department should include information on the agency or institution that has been designated to sign the MoU and represent the country on the GBIF Governing Board.

If a country wishes to become a Voting Participant it must, in addition, express its willingness to make a financial contribution to GBIF as outlined in Paragraph 9 of the MoU, and establish the details in a financial arrangement with the Secretariat.

The GBIF Executive Committee will consider all petitions for Participant status and will determine if the application meets the requirements of the MoU and GBIF

Rules of Procedure. If a petition is granted, a MoU signature copy will be sent. In the case of Voting Participation, the Secretariat will in addition specify the financial contributions in a financial arrangement.

For further details of the procedure see Article IV – Requirements for Participation in the Rules of Procedure agreed by the Governing Board.

The letter of intent should be addressed to:

Chair of the GBIF Governing Board

GBIF Secretariat

Universitetsparken 15

DK-2100 Copenhagen Ø

Denmark

3. Sign the Memorandum of Understanding (MoU)

Once the petition to join GBIF, expressed in the Letter of Intent, has been received and approved by the Executive Committee, the applicant will be informed and the designated minister, official or other representative may sign the MoU. As soon as the signature is received by the Secretariat, the country or organization becomes a GBIF Participant and will be informed about further procedures such as appointing a Head of Delegation and node manager.

III. INTRODUCTION AND EXPERIENCES FROM SOME COUNTRIES

We selected some GBIF participating countries to learn about their vision, mission, organizational model and operational mechanism. These countries provide a well-organized pattern. In addition, we also choose Tanzania, a new participant of GBIF that possesses biodiversity information facilities similar to Vietnam, and to learn the participation process from this country.

1. Japan

Japan has participated as a voting member of GBIF since its inception (in 2001). Node Managers have included Dr Keiichi Matsuura, National Museum of Nature and Science (2002-2003); Dr Motomi Ito, Tokyo University (2003-2012); and Dr Tsuyoshi Hosoya, National Museum of Nature and Science (2012- present).

Until 2010, the activity in Japan to provide biodiversity information to GBIF was under the jurisdiction of the Japan Science and Technology Agency (JST). After the tenth meeting of the Conference of the Parties of the Convention on Biological Diversity, held in Nagoya, Japan, in October 2010, biodiversity issues that had been under the Ministry of Education, Culture, Sports, Science and Technology (MEXT) were switched to the Ministry of Environment (MOE). This change in governance resulted in a remarkable change in the governance of the Japan Node (JBIF). In 2012, JBIF was renewed and current structure was established.

a) Vision and mission

JBIF's aim is to "promote the collection and application of biodiversity information in Japan and accelerate contribution to the international community", based on the following six major strategies: 1) Raise awareness about biodiversity information, 2) Improve museums' abilities to function as repositories of biodiversity data, 3) Raise awareness within the general public and government agencies about the importance of biodiversity information, 4) Enhance the visibility of the Japan Node in the GBIF community, 5) Promote cooperation with related projects, 6) Assume cooperative leadership in Asian activities.

b) Structure

JBIF has a two-layered structure. There is a higher decision-making group (Node Steering Committee; meeting twice a year) consisting of 16 people from various national institutes, agencies, and local museums, that endorses and directs the activity of the Working Group. The Working Group consists of 09 people from various National Institutes, (meeting on an irregular basis, but at least twice at the occasion of the Node Steering Committee meetings). Some members of Working Group overlap with Steering Committee members in order to enhance communication. All members are participating on a voluntary basis (Figure 3).

The Head of Delegation role is officially assigned to the Ministry of Foreign Affairs. Node manager works as a point person between JBIF and GBIF and manages Working Group. The major supporting agency for GBIF activities in Japan is Ministry of environment (MOE), while the major institutes involved in the activity are under the jurisdiction of MEXT, namely universities, national

institutes, and local and national museums.

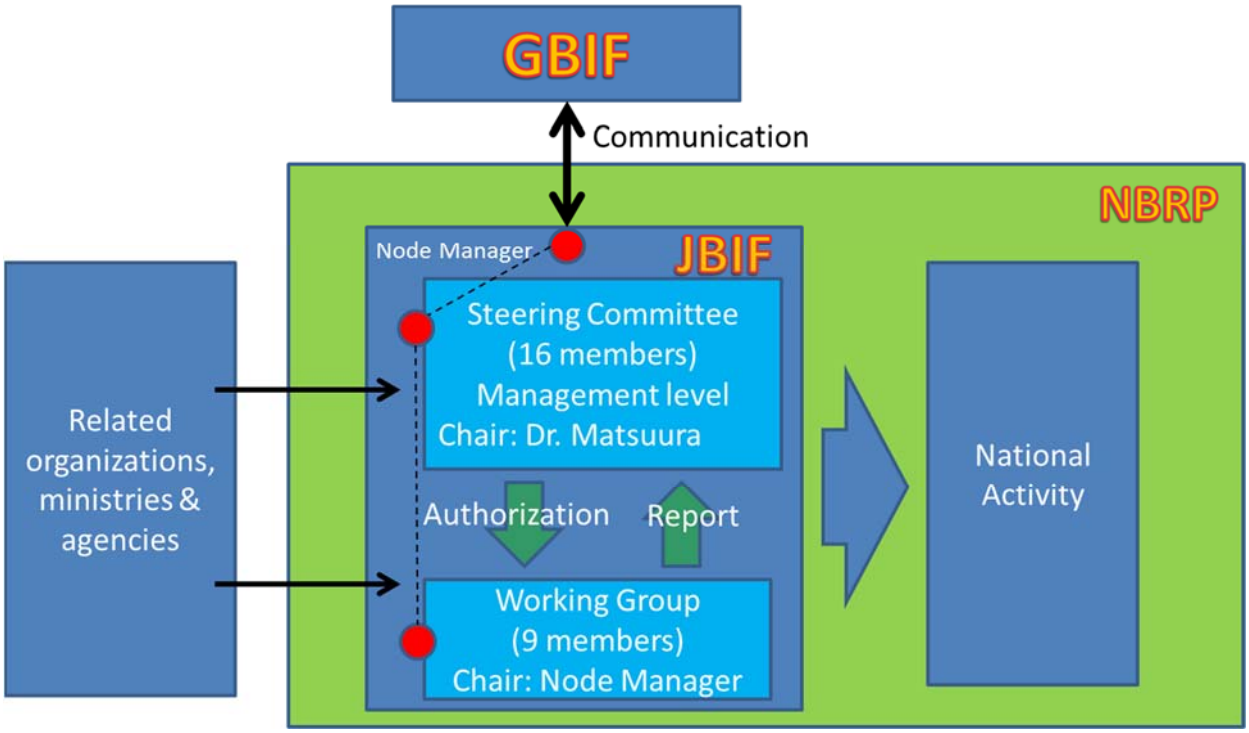

Figure3. JBIF organization structure

c) National funding

The Government provides funding for data management through the National BioResource Project (NBRP), to the National Institute of Genetics, Tokyo University, and National Museum of Nature and Science, and domestic activities concerning GBIF are partially supported. Additional funding is being obtained by the members themselves or through their organizations. The financial contribution to GBIF is made by the Ministry of the Environment of Japan.

d) Data publication flow

Japan provides data to the GBIF from the National Institute for Genetics and the National Museum of Nature and Science. The National Museum of Nature and Science receives specimen data from museums across the country and provides it both domestically and internationally through the GBIF and the Science Museum Net (S-Net). The National Institute for Genetics, in cooperation with the laboratory of Professor Motomi Ito at the University of Tokyo, is engaged in an ongoing effort to assemble the biodiversity information that has already been made public, from article reprints to the results of research projects at various universities and research institutions, and is publishing this information on the GBIF. The Japan Node set strategic targets at the commencement of the third phase of the project (NBRP) in 2012, and improvements in data maintenance and collaboration have been underway since then.

e) Japan Node Activities and web portals

S-Net: integrating and disseminating information from local museums and research institutes

"Science Museum Net", abbreviated as S-Net, is an information portal for natural history and science museums operated by the National Museum of Nature and Science (URL: http://science-net.kahaku.go.jp/). In addition to nature history specimen information provided by 71 domestic museums and research institutions (currently 3.62 million data as of Sept. 2015), you can search for researchers and curators (501 people listed as of Sept. 2015).

To promote the open sharing of data from museums and research institutions abroad, annual workshops are held to exchange views, helpdesk support is offered, and information is aggregated through the Natural History Museum Network of West Japan, a non – profit organization.

Promoting the communication and use of biodiversity information through education

The Japan Node holds training workshops and practice sessions for biodiversity information providers. The training workshops are led by either the National Museum of Nature and Science or the NPO Natural History Museum Network of West Japan and offer providers practical training in high-level analytical techniques through a mix of technical courses, data utilization, and simulation exercises. The goal is to have museum officials from across the country gather several times a year to exchange views and share ideas about GBIF.

Global Biodiversity Information Facility (GBIF) Japan Node (JBIF) web portal

Established by the National Institute for Genetics, this website is the official portal for the Japan Node of GBIF. On this page you can find information regarding events on biodiversity and download guidebooks, manuals (some Japanese translations available), and Gbits (in Japanese) – the official bulletin of the GBIF. The main features of this page are as follow:

- Search for biodiversity information (in Japanese)
- Explanations of GBIF data formats and data registration process
- Latest information on research and events
- GBIF publications (guides and manuals)
- Japanese editions of Gbits bulletin
- Links to other useful sites

"Science Museum Net" web portal

Established by the National Museum of Nature and Science, this website enables us to retrieve information from domestic science and natural history museums. We can search (in Japanese) for natural history specimen data (the same dataset is also available on GBIF) from museums and research institutions across Japan as well as for information on their curators and research staff. Additionally, various tools are provided for data maintenance. The main features of this page as follow:

- Retrieve natural history specimens information
- Search curators and research staff
- Tools to search the Red List and dictionaries of place names
- Formatting tools for GBIF

2. Australia

Australia is voting GBIF participant since 2001. The Atlas of Living Australia (GBIF Australia) was initiated by a group of 14 (now 17) partner organisations. The Atlas was formally established through the National Collaborative Research Infrastructure Strategy (NCRIS), which was originally administered by the Australian Department of Science and Innovation – now the Department of Education. The Atlas is hosted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and has a partner base including Australian Museums, Herbaria and other biological collections.

The intent was to create a national database of all of Australia's flora and fauna that could be accessed through a single, easy to use web site. Information on the site would be used to improve understanding of Australian biodiversity and assist researchers to build a more detailed picture of Australia's biodiversity; and to assist environmental managers and policy makers develop more effective means of managing and sustaining Australia's biodiversity.

a) Vision and mission

The Atlas of Living Australia's core mission is to "share biodiversity knowledge".

The vision is to bring together information on all the known species in Australia - aggregated from a wide range of data providers including at least: museums, herbaria, researchers, community groups, government departments, non-government agencies, consultants, individuals (or citizens) and universities.

b) Structure

The Atlas of Living Australia's Management Committee provides strategic guidance for the project. The committee includes representatives from the partner community (museums, herbaria, CSIRO), as well as other NCRIS capabilities, Federal and State agencies. The committee represents and engages with key partners, data publishers and the overall collection and user community.

c) National funding

Funding for the Atlas of Living Australia was provided by the Australian Government under the National Collaborative Research Infrastructure Strategy (NCRIS) and the Super Science Initiative (SSI), part of the Education Investment Fund. The Atlas partners have provided considerable in-kind contributions.

The basic financial contribution to GBIF is made by Atlas of Living Australia, CSIRO National Research Collections Australia.

3. France

France is voting GBIF participant since 2001. GBIF France has the mandate to promote GBIF activities and tools at the national level and to represent France in the GBIF community. The node provides information on best practices and standards used by GBIF and helps data publishers to connect data to the GBIF network using the tools developed by GBIF. The node also organizes training events and interacts with all the organizations working on biodiversity at national level. GBIF France also provides support to francophone countries to help them to contribute to GBIF.

The GBIF France node was created in June 2006 and hosted by the Muséum

national d'Histoire naturelle (MNHN) in Paris. In the beginning the node was just hosted by the MNHN, but, in 2011, GBIF France was officially integrated into the MNHN and is now under the Direction des collections of the MNHN.

a) Vision and mission

GBIF France's missions are to: collect metadata on primary biodiversity data resources; assist connecting data to the GBIF network using GBIF standards, protocols and tools; organize training sessions (data publishing, data quality, use of GBIF-mediated data); inform on GBIF, tools, activities, calls, training material & opportunities; promote and facilitate the use of GBIF-mediated data and tools by biodiversity data users; collaborate with other national and international facilities on biodiversity, and with the GBIF Secretariat; contribute to the development of common tools with the GBIF community; and contribute to the CEPDEC program.

b) Structure

The GBIF France node includes two part-time coordinators and four full-time positions (node manager, IT specialists and a data engineer).

The node has a board that meets once a year. It includes representation from four Ministries (Education and Research, Foreign Affairs, Environment and Ecology, and Agronomy) and most of the organisations working on biodiversity at national level.

c) National funding

The GBIF France node is funded by the Ministry of Education and Research (Ministère de l'Education nationale, de l'Enseignement Supérieure et de la Recherche, MESR). From 2013 and for four years, GBIF France is funded through a French National Research Agency (L'Agence nationale de la recherche, ARN) project called e-ReColNat.

The basic financial contribution to GBIF is made by the Direction Générale pour la Recherche et l'Innovation (DGRI).

4. United States

United States is voting GBIF participant since 2001. The United States Geological Survey (USGS) hosts the U.S. Node to GBIF since the U.S. joined GBIF in 2001. The USGS-coordinated National Biological Information Infrastructure (NBII) served first as the primary implementation vehicle for the node. Since NBII's cancellation in 2010, the USGS Core Science Analytics, Synthesis and Libraries Program implements the node. The Biodiversity Information Serving Our Nation (BISON) project comprises most node activities.

a) Vision and mission

The U.S. node to GBIF represents an integral part of the U.S. Geological Survey's activities to collect, organize and share biological information. As with other initiatives, the U.S. GBIF node streamlines access to U.S. biodiversity information and links it with broader geoscience data to address critical societal issues.

b) Structure

BISON is the primary project contributing to the node. It provides a specialized view of GBIF records for the U.S. and assists with provision of U.S. records to GBIF.

The White House Office of Science and Technology Policy (OSTP) coordinates EcoINFORMA, a broader U.S. government effort to organize and share data on biodiversity, environmental health and ecosystem services.

The Biological and Ecological Informatics Working Group is made up of representatives from numerous U.S. government agencies. It helps organize and prioritize contributions to both EcoINFORMA and BISON.

c) National funding

Since establishing the node in 2001, the United States Geological Survey has fully funded direct implementation of the U.S. Node to GBIF as a key contribution to its broader biodiversity informatics activities.

The basic financial contribution to GBIF is made by the National Science Foundation, the Smithsonian Institution, the U.S. Department of State and the U.S. Department of Agriculture.

5. Tanzania

The Capacity Enhancement Pilot programme for Developing countries (CEPDEC) has been conducted in Tanzania over three years as a partnership between Global Biodiversity Information Facility (GBIF) and the Tanzania Commission for Science and Technology (COSTECH). The aim of the programme was to build capacity through training, mentoring, and supporting digitalization of primary biodiversity data and information in Tanzanian institutions to make this openly accessible as advocated by the GBIF network. Access to biodiversity information is expected to contribute substantially to sustainable social and economic development in Tanzania allowing for wider exposure of the data for furthering science, conservation and development. In justifying the programme, succinct links were drawn to Tanzania's strategies for growth and the millennium development growth.

CEPDEC in Tanzania was to establish a functional biodiversity data sharing infrastructure integrated in the GBIF framework. To achieve this, the programme followed a road map that highlighted four distinct outputs. As a pilot project to be emulated in other developing countries the process and experiences of the programme summed up as best practises and lessons learnt are consultatively compiled in this report to provide guidance and justification for continued support to the initiative of ensuring open access to biodiversity information globally. For each output a number of activities were projected and the processes of achievement or challenges thereof are documented as the best practise or lesson learnt.

Output 1: Functional GBIF node in the country to provide long-term, unified access to all relevant sources of biodiversity information for Tanzania to be used in science environmental management. This output included the development of the portal, mentoring and the administrative framework for the national node.

Best practices

- Infrastructure for networking developed in accordance with national needs incorporating and/ or utilising existing frameworks enables sustainability
- Appropriate mentor selection considering expertise and capacity (resources) facilitates access to wide variety of supported activities
- Board for oversight of activities affords node acceptance and facilitates

stakeholder contribution

- Technical requirements encourages distribution of responsibilities and expertise among participants
- Host node is neutral with mandate for node functions this enables stakeholder by-in
- Node staff permanently employed by host and node activities incorporated into organisational structure ensures sustainability

Lessons learnt

- IT Capacity of staff is necessary to ensure functionality of the portal
- Mentor contribution requires careful and collaborative planning to meet programme time lines
- Logistics for instituting and organising board meetings are resource intensive
- Capacity, expertise and time for node activities requires careful planning; resource mobilisation in addition to participant contribution is critical for sustainability of activities
- Permanent staffing for secretariat activities requires re-organisation and/ or employing of staff at the host institution
- Node activities best linked to other institutional functions for appropriate impact
- Exploit options for data acquisition e.g. registered research

Output 2: National networks of data providers and users of biodiversity information who are able to access and exploit data for scientific, conservation and development questions. Activities for this output included a data providers survey and needs analysis, some digitalisation initiatives and training in data management and analysis.

Best practice

- To initiate the network an effective communication strategy to engage stakeholders facilitates by-in and participation
- Identification of institutions and organisations with available data (location, format, quantity and utility) establishes basis for sharing
- Aligning needs for data and information with national development policies justifies initiative
- Selecting node host as neutral but competent organisation builds confidence in stakeholders

Lessons learnt

- IT requirement for operations and updating of the portal necessary for maintaining dynamism: local software development will provided tools tailored for national needs
- Mechanisms (logistics and training) for digitalisation of non-digital data needed to ensure wider determine priorities for digitisation; consider options for data entry harmonisation; determine harmonisation modes for effective sharing
- Demonstrated value for open access biodiversity information a key strategy for stakeholder by-in
- A viable strategy for digitalisation is necessary for continued publication of

data through the portal

- Participant mandates need to be linked to TanBIF activities for complementation

Output 3: A set of tools and procedures for developing and sustaining a national Node prepared and communicated to existing and potential GBIF members. The activities included adaptation of training materials and availing these to participants. Furthermore, specific procedures and manuals were to be prepared.

Best practice

- Viable products such as the Q-GIS tool demonstrate the potential impact that TanBIF can have on biodiversity conservation

Lessons learnt

- Products developed for use have to be more than internet based hard copies of some of the products are needed to reach a wider public given the national context for sharing information.

Output 4: Options and partnerships for funding of GBIF capacity enhancement in individual developing countries identified and facilitated. It was intended that a regional workshop would be held and the best practices shared.

Best practice

- Training of participants to utilize tools for sustainable development is an important outreach strategy for biodiversity informatics; tool testing in young nodes, avails learning opportunity for improvement for GBIF

Lessons learnt

- Staffing for outreach is critical for furthering awareness and utility of the tools; digitization requires resources that need to be considered by participants' operational budgets for sustainability
- In Tanzania, external support to CEPDEC amounted to 425,500 Euros provided by the Royal Danish Government through the GBIF secretariat. Internal support was afforded in kind by COSTECH through staff salary, time and infrastructure.

In general, CEPDEC Project in Tanzania has been very successful. Majority of the expected outcomes were realized. A functional GBIF national node, the Tanzania Biodiversity Information Facility (TanBIF) has been established using a participatory approach. TanBIF continued to expand, and its Participants have realized ownership. Networks of experts were formulated, expanded and supported implementation for CEPDEC project. The Government of the Republic of Tanzania participated fully in TanBIF activities and realized the importance of TanBIF in the biodiversity management. Development of tools such as TanBIF Portal and QGIS Software for biodiversity data and information sharing, repatriation and analysis will aid Tanzania to manage biodiversity sustainably through informed scientific evidence base. The launching of TanBIF Portal and QGIS Tool by high-level government officials position TanBIF in a high national and international platform. It is worth concluding that CEPDEC Project opened a new chapter of sustainable biodiversity information and data management system in Tanzania. Biodiversity stakeholders should take

advantage of the tools and infrastructure developed for TanBIF in making sound decision on biodiversity management and its related issues. Additionally, this initiative should be taped and adapted in other developing countries.

6. General comments

By learning from some GBIF participants, we have some general comments:

- Their vision and mission are to collect, organize and share biodiversity information

- Their structure includes key partners in the field of biodiversity data.

- Their major funding for the GBIF activities comes from governmental sources.

- Stable funding is required for sustainable participation in GBIF.

IV. ACHIEVEMENTS AND CHALLENGES IN DEVELOPMENT AND MANAGEMENT BIODIVERSITY DATABASE IN VIETNAM

1. Achievements

Vietnam has become a member country of the Convention on Biological Diversity (CBD). In response to the requirement, the Government of Vietnam (GOV) enacted the Biodiversity Law in 2008, which is followed by the National Biodiversity Strategy to 2020, vision to 2030 (approved in 2013) and the Master Plan on Biodiversity Conservation (approved in 2014). Biodiversity database development was mentioned in the Master Plan. Some schemes have been developed to implement it, which also includes a proposal for building national biodiversity database "*Survey, inventory and building biodiversity database*". The Vietnamese Government shows a strong commitment to achieve biodiversity conservation as well as sustainable development.

In recent years, strong international integration has been contributing to capacity building, awareness raising and management support for biodiversity database development.

The Biodiversity Conservation Agency (BCA), an arm of Vietnam's Ministry of National Resources and Environment charged with the management of the country's biodiversity database, proposes to strengthen national capacity in database management and to promote GBIF in the country as an opportunity for information exchange at the global level.

The National Biodiversity Database System (NBDS) is officially launched in Hanoi in January, 2015. The database system was jointly developed by the Biodiversity Conservation Agency (BCA), the Vietnam Environment Administration (VEA) and the Ministry of Natural Resources and Environment (MONRE), through the "Project for Development of the National Biodiversity Database System" cooperated by the Japan International Cooperation Agency (JICA) since November 2011. NBDS is designed correspondingly to international standards to store nation-wide biodiversity data including lists of species of fauna and flora in taxonomy. The development of NBDS helps BCA implementing effective management on biodiversity by gathering necessary data for assessing, monitoring and reporting the status of biodiversity. NBDS is also expected to provide a base of biodiversity information for decision makers, government officers, researchers and the public as well (http://www.jica.go.jp/). During more than 3 years of implementation, the technical cooperation project has developed numbers of results, such as;

- The first stage of NBDS generation has been established. It is ready for storing, importing, exporting and analyzing biodiversity data. A Master Scheme of NBDS which is an official proposal to GOV for the entire scope of NBDS

development and utilization.

- Prioritized list of required activities and budget.

- Official guideline for developing biodiversity monitoring indications in Vietnam both at national and local level.

- The System Architecture of NBDS that describes every details of structure and design of NBDS. The technical guideline for basic survey and monitoring of coastal wetland based on the basic survey on biodiversity at Xuan Thuy National Park in Nam Dinh province.

- Draft circular for collaboration mechanism on data sharing with other agencies.

- The major stakeholders for the biodiversity information facility been identified including MONRE/VEA/BCA, MOST, PPC (Provincial People's Committee), Department of Natural Resources and Environment (DONRE belong MONRE) and Department of Agriculture and Rural Development (DARD belong to Ministry of Agriculture and Rural Development (MARD)), national parks, protected areas, research institutes, universities, NGOs, international organizations and individuals.

- An informatics infrastructure (of MONRE/VEA) is in place to support the publishing of biodiversity data from the country's institutions to the Internet.

While remarkable achievements have been seen as above, there still exist challenges and remaining works. In order to ensure further NBDS utilization and development, it is essential that MONRE will soon approve the Master Scheme of NBDS to determine necessary activities and budget to operate and upgrade the database's function. Equal importance is the promulgation of the draft circular on collaboration mechanism among data holders, which enables sharing, exchanging and exploiting biodiversity data (http://www.jica.go.jp/).

2. Challenges

Construction and management of biodiversity databases in Vietnam are just in the beginning stages. There are some challenges as follow:

- Biodiversity data is scattered all over the country. A considerable portion of the data is still non-digital (i.e. Paper). Most digital data is in desktop format (MS-Word, Excel, etc.). It is therefore difficult to search/find nation-wide information on biodiversity.

- Biodiversity data are not shared between different organizations. There is not any coordination mechanisms in building, using, and sharing biodiversity data between agencies, research institutes and universities.

- Biodiversity monitoring at the national scale has not yet been done. There is not any standard method for biodiversity monitoring. Human resource and funding for biodiversity research is very limited.

- The importance of biodiversity databases are not fully understood. Awareness of the role of the database of the leaders, officials, scientists working in the field of biodiversity are not high.

- The value of biodiversity is not quantitatively assessed at the national scale.

- Biodiversity information in Vietnam has not been standardized yet, or verified by experts.

- Biodiversity information management is not performed in a uniform way.

- The needs of biodiversity information users have been not yet been assessed at the national level. The currently developed databases have not yet meet the needs of users.

- The ability to manage, exploit and use the biodiversity database is limited by the spontaneous and sporadic training, lack of specialized training staff in IT and on biodiversity database management.

- Although institutions and laws have gradually improved, they are not yet fully addressing the management of biodiversity data. Documents providing guidelines on building and managing of biodiversity data are very few. There are not any human and funding resources in charge of biodiversity databases. Funding for the projects related to a biodiversity database is also not officially mentioned.

- Although the issue of building biodiversity databases has been mentioned in the Master Plan, it did not specifically mention any financial or human resources for this work as well as participation in GBIF.

- A node designated to coordinate biodiversity data sharing activities nationally has not yet been designated.

- The national sources of biodiversity data have not yet been documented. The state of national data holdings has not yet been assessed (e.g. digital/non-digital format, approximate size and scope of collections, use of standards).

- A strategy has been initially developed to assist the biodiversity information facility in mobilizing national biodiversity data sources in a systematic way. Nonetheless, data mobilization priorities for the biodiversity information facility have not yet been discussed and agreed with stakeholders. The strategy to assist data holders in making a case for investment in the mobilization of their data (e.g. through addressing known gaps or targeting specific use cases) is not yet in use.

- A national biodiversity website has been developed. However, there are few

data on the website and it is not ready to serve user needs. In the future, when the website starts to work, it must complement and add value to other available biodiversity information websites to serve the needs of key (defined) user groups for the biodiversity information facility.

V. WORK FLOW FOR DATABASING AND PUBLISHING FROM NATIONAL BIODIVERSITY DATABASE SYSTEM (NBDS) TO GBIF

Under the support from Biodiversity Fund for Asia (BIFA, invested from Ministry of Environment of Japan) project and JICA, NBDS will be continued to develop. The first step of databasing and publishing is the identification of the main national sources of biodiversity data (literatures, specimens). Meanwhile, a national data mobilization strategy is being developed. An infrastructure including Vietnam Biodiversity Information Facility (VBIF) is in place to promote and support national digitization, accumulation and publication activities. The data is digitized according to the Darwin Core standards. The Integrated Publishing Toolkit (IPT) is used to publish and share biodiversity datasets through the GBIF network. Finally, the data is downloaded/analyzed and used by users (Figure 4).

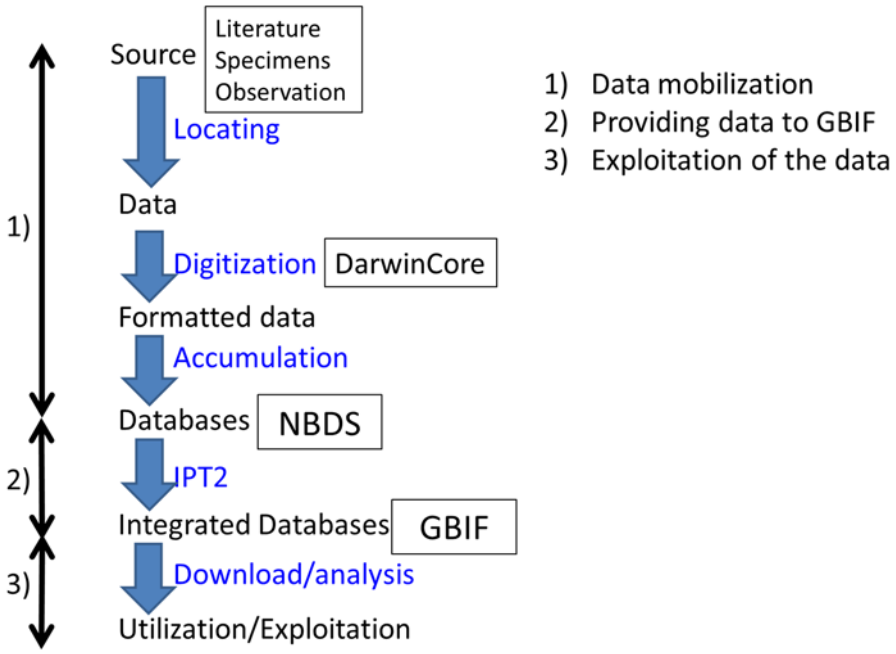

Figure 4. The workflow for databasing and publishing from Vietnam

VI. A ROAD MAP FOR VIETNAM TO PARTICIPATE IN GBIF

1. Legal Framework and Practices

The Law on Biodiversity was passed by the XIIth National Assembly on November 13, 2008 in the fourth session, officially came into force on 1st July, 2009. The Biodiversity Law is the first law to regulate the conservation and sustainable development of biodiversity in Vietnam.

As stipulated in clause 5, Article 71 of the Law " The Ministry of Natural Resources and Environment shall specify basic survey activities and the supply, exchange and management of biodiversity information; and uniformly manage the national database on biodiversity".

Vietnam is the member of several international conventions related to biodiversity conservation, including the Convention on Biological Diversity (CBD Convention), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on the Conservation of Wetlands of International Importance (Ramsar), etc. These international conventions require and emphasize the significance of data and information systematization for biodiversity conservation.

The CBD Convention also affirmed the importance of biodiversity information as "Aware of the general lack of information and knowledge regarding biological diversity and of the urgent need to develop scientific, technical and institutional capacities to provide the basic understanding upon which to plan and implement appropriate measures. The Ramsar Convention mentions that: The Contracting Parties shall encourage research and the exchange of data and publications regarding wetlands and their flora and fauna". Article 20 of the Cartagena Protocol on Biosafety also regulates the sharing of information and the establishment of the Biosafety Clearing-House.

In order to facilitate the database development in the country, enhancing cooperation in database and raising the public awareness on biodiversity, participation in the Global Biodiversity Information Facility (GBIF) is an indispensable requirement.

The participation in GBIF will support the national efforts in biodiversity conservation, especially while the first generation of the National Biodiversity Database System (NBDS) is released. However, it also requires the national focal point and the stakeholders to be prepared in many aspects.

2. Objectives

2.1 The Overall objective

Development of biodiversity database system that meets the management requirements and utilization of biodiversity data and information in Vietnam, interconnection with the Global Biodiversity Information System (GBIF).

Biodiversity information in Vietnam is freely accessed on national and global scale under the close collaboration of stakeholders.

2.2 The Specific objectives

- The National Biodiversity Database System (NBDS) are well functioned, interconnecting with the GBIF to support the biodiversity state management from the central level to local level.

- Promoting the accumulation, digitization, utilization, sharing, updating and development of biodiversity data and information across the country.

- Mobilizing resources and enhancing international cooperation on the development of biodiversity database.

- Strengthening capacity of the NFP/ Head of delegation, Node manager and nodes to operate and maintain the NBDS.

3. Major tasks

3.1 Strengthening the functions, tasks, organization and operation of the national focal point (NFP) and/ or Head of Delegation (HoD), node manager and the nodes

- To strengthen the functions, tasks and operation mechanisms of the NFP, node manager and nodes to GBIF

- To improve functions in terms of data inputting, processing and exporting, meeting the online demands on publishing, updating, exchanging, sharing and managing data on biodiversity.

- Complete the standards and structure of data content at NFP, node manager and nodes

3.2 Upgrading and developing the information technology infrastructure, data management software systems of NFP, node manager and nodes

a) Provide IT infrastructure for connecting NBDS to GBIF. To supplement and upgrade information and telecommunication infrastructure to meet the requirements of operating the system of NFP, node manager and nodes including servers, transmission lines, work stations...ect, in specification as:

- IPT2 will be installed into servers. IPT2 is a GBIF tool to support the connection and update of data from countries member to GBIF;

- Internet bandwidth is steady and sufficient;

- Connection between IPT2 server at Viet Nam's Node manager with GBIF server;

- IPT2 will be installed and operated on server managed by Node manager.

b) Continuously completing the functions of NBDS for nationwide data collection, updating, storage, sharing, and then connecting and sharing data with GBIF:

- Examining and evaluating the effectiveness and stability of NBDS 1st generation.

c) Propose needed activities to upgrade functions, data structures standards and data content for data collecting, updating, sharing and utiliziing and managing in NBDS 1st generation.

- Upgrade the NBDS 1st generation to better adaptation to GBIF

3.3 Human resources training for the need of the operation and development of biodiversity data at NFP/ HoD, node manager and Nodes

- To establish a network of the national focal point, the ministrial focal points and local focal points along with arrangement of appropriate human resources at the central level and local level to satisfy the requirements of biodiversity database development.

- Develop guidelines for surveying, monitoring, biodiversit indicator development and biodiversity reporting; Enhancing the capacity for local staff.

- Implement the capacity building activities regarding to development, updating, management, exploitation and utilization of biodiversity database for people in charge, prioritizing the personnel at in line ministries and organizations at central level and local level

- Study tours in the country and abroad for learning experiences on the development, operation and maintainace of national biodiversity database for central and local officials.

3. 4. Accumulating and setting standardizing biodiversity data and information at NFP/ HoD, node manager and Nodes

- Carry out a number of needed activities such as collection, accumulation, evaluation digitization and input the biodiversity data and information from relevant organizations and individuals. Verify and standardize them in terms of data structure and compatibility at NFP/ HoD, node manager and Nodes

- Update, maintain and manage every existing biodiversitydata in accordance with standard data and software architecture at NFP/ HoD, node manager and Nodes

4. Implementation Solutions

4.1 Promote policy formulation incorporating the establishment, maintenance, update, development, management of biodiversity databases at NFP/HoD, node manager and Nodes

- To accelerate the elaboration of legal documents guiding the construction and development of a biodiversity database.

- To elaborate, promulgate, amend and supplement legal documents, regulations and techno-economic norms related to monitoring, collection, processing and management of the baseline data on biodiversity in unified standard for the

application national wide;

- Develop the regulations to deal with violations related to the provision, exchange and sharing of biodiversity information and data.

- Develop mechanisms to promote and encourage provinces across the country to update baseline data into database systems; Establish coordination mechanism among ministries and agencies. Engage local governments and public in data provision, exchange and sharing. Running NBDS systematically from central level to local level.

- Strengthen the supervision, guidance and training activities regarding to national biodiversity database system for relevant stakeholders.

- Review and formulate the incentive policies, for staff working in management, biodiversity baseline investigation and monitoring, especially for staff working at the remote, isolated, border and island areas.

- 4.2 *Promote international cooperation on the biodiversity database system development at NFP/HoD, node manager and Nodes*

- Enhance bilateral and multilateral cooperation with other countries, foregin organizations and individuals.

- Consider and propose the participation of Viet Nam in international conventions, treaties, forums, networks, new initiatives relating to biodiversity information management and sharing. At the same time, pushing up the implementation of involeved conventions relating to biodiversity data and information.

- Strengthening international cooperation in human resources training, collaborative research projects in terms of advanced technologies for the database system development

- Participate in international training courses on capacity building and biodiversity data and information sharing.

4.3 *Step up research and application of scientific and technological advances in the development of national biodiversity database system at NFP/ HoD, node manager and Nodes*

- Conduct researches and application of scientific and technological advances and software in the development and management of biodiversity databases;

- Promote scientific research, development and application of advanced technologies in investigating, transmitting, processing, managing, analyzing, evaluating and providing baseline biodiversity data and information as well as biodiversity monitoring;

- Strengthening research and development of new technologies to improve the capacity and effectiveness of the biodiversity data providing, updating and exchanging, exploration and utilization.

4.4 Strengthen the communication, education, training and publich awareness raising in information and data on national biodiversity at NFP/ HoD, node manager and Nodes

- Promote awareness raising, increasing accountability and participation of stakeholder in unified management of biodiversity data.
- Strengthening communication to raise public awareness and communities' responsibility in management and sharing of biodiversity data; Facilitate supporting mechanisms to increase community participation in the provision, sharing and exchange of biodiversity data.
- Hold training courses to guide and disseminate the development, exchange, sharing and utilization of biodiversity data.
- Establish a network and mechanisms for the exchange of biodiversity data and information across the country.

4.5 Mobilize and diversify sources of investment to establish, maintain, update, manage and utilize and develop the national biodiversity databases at NFP/ HoD, node manager and Nodes

- Guarantee funding for the establishment, maintenance, update, , management and development of biodiversity databases.
- Create favorable mechanisms for domestic and foreign organizations and individuals to invest and transfer technologies in construction and development of biodiversity databases.
- Apply economic instruments and financial mechanisms to encourage the establishment and development of consultancy services on the collection and supply of data and information on biodiversity.

5. Roadmap for participation of Viet Nam into GBIF

5.1 Proposed roadmap for participation of Viet Nam

The participation of Viet Nam into GBIF should track the guidance of the guidance of GBIF Secretariat. On the other hand, Viet Nam also takes into consideration of typical context of the country. Therefore, a customized roadmap is proposed under 3 key phases, in detail:

Phase I: Discussion prior to participate in GBIF

- Step 1: Establish a core local team to facilitate the participation in GBIF

Study about GBIF. Knowledge exchange about GBIF's participation. Study tour (to Japan) in combination with desk study about the experience of relevant countries who are the member of GBIF.

- Step 2: Understand the motivation of Viet Nam for joining GBIF:

The first task for this group of stakeholders is to define the long term vision, goals and missions for the Participant Node; focus should be on how the Node will

address the needs and priorities of Viet Nam, and how it will complement with other biodiversity-related or information-related initiatives. GBIF vision for biodiversity information is free and universally available. The goals of Vietnam when participating in the GBIF community should be: (1) biodiversity data housed in Vietnam are shared globally on the Internet; (2) enlist the cooperation and international aid to develop NBDS; (3) to coordinate the collection, analysis, reporting and archiving of all kinds of biodiversity related information in Vietnam.

- Step 3: Identify drivers (science: research infrastructure and environment (policy, decision making) and priorities (producing highly processed information, publishing primary data) at highest level for establishing a biodiversity information facility.

The National Focal point for GBIF's participation will assess their own biodiversity data gaps (taxonomic, spatial, temporal, and thematic), to understand data and information needs, to engage new communities (and mobilise new data types), and to devise strategies to effectively respond to those needs. Independently of the drivers or priorities motivating the mobilisation of biodiversity data, well established and fully functional Participant Nodes are instrumental in helping Participants achieve their own biodiversity data-related goals and targets. The Vietnam node will assess biodiversity needs and gaps in order to build strategies for database development.

- Step 4: Organize a meeting with key stakeholders to consult about the participation of Viet Nam, determine their willing as well as possible positions of key stakeholders

- Step 5: Assign formal roles, including: Head of Delegation (potentially BCA/VEA/MoNRE) and temporary Node Manager (potentially Institute of Ecology and Biological Resources (IEBR)).

Phase II- Preparation for participatory process

- Agree roles in the process: BCA and Node will make final recommendation based on consulting with invested stakeholders.

- Preparatory studies: content needs assessment, data holders inventory, stakeholder mapping etc.

- Identify relevant examples from GBIF network such as Japan, Tanzania and some other countries.

- Identify key stakeholders who will be invited to contribute. It is very important for the Head of Delegation to convene a group of representatives from the key biodiversity stakeholder institutions. This will be ensure their ownership of the process from the beginning. Key stakeholders will include BCA, IEBR and Center of Multidisciplinary Integrated Technologies for Field Monitoring (FIMO).

Phase III- Participatory process

- **Scoping the biodiversity information facility and node**

- Define priorities for the biodiversity information facility
- Define key roles for the node in support of the biodiversity information facility. The node's roles are (1) to establish a national data network for biodiversity research & information flow; (2) to train, and disseminate key technology to assist data publishers for sharing data. Once a biodiversity information facility has been scoped, including the long-term vision and goals for the node coordinating it, the group will need to discuss the implementation plans for the node. These should include aspects such as the collaborative framework, infrastructure requirements, governance structure, funding, membership of governing and/or advisory bodies, and the node's roles and responsibilities. The key decision on where to locate the node will also need to be addressed.

- Defining implementation mechanism for the biodiversity information facility and node

- Define formal agreements (data sharing/use agreements) to supports effective collaboration. BCA/VEA/MONRE considers the level of cooperation to sign an official MOU with key stakeholders who are potential to be Node manager or node for future VBIF.
- Discuss internally and with partners to establish necessary mechanisms such as: model for informatics infrastructure; governance and representation model
- BCA/VEA/MONRE in the capacity of the focal point to consider institutional location for the node
- Discuss a team for the node and node manager role
- Discuss funding models for the node

After this process, a node must be designed. The responsibility of coordinating a biodiversity information facility is built into the nodal institution's planning. The major stakeholders for the VBIF are identified. A strategy for the VBIF is agreed with stakeholders. The strategy is resourced. Especially a collaborative framework must be defined and agreed by the relevant stakeholders and partners to form a biodiversity information facility.

5.2 The expected tasks and function of future VBIF

When the VBIF come into operation and support the following tasks:

a) Implementing a national biodiversity data mobilization strategy

The main national sources of biodiversity data are identified. A national data mobilization strategy is developed. The VBIF supports national digitization activities. An infrastructure is in place to support data publishing. The VBIF provides assistance to data holders in publishing data.

b) Meeting biodiversity information needs to the national level

The needs of biodiversity information users are (annually) assessed. The VBIF

analyses the availability of biodiversity data. The VBIF promotes data use. The VBIF maintains a website to support the user community. VBIF service are integrated into research & policy process.

c) Supporting improved management of biodiversity data nationally

The node has a plan to ensure the mobilized data are fit for use. The VBIF supports national data holders in managing their data through the training courses. The node performs quality checks of published data. The VBIF participates in biodiversity information management initiatives.

In general, there are several meetings which must be held with the participation of stakeholder leadership including management agencies, research institutes, universities, museums, non-governmental organizations, publishers, magazines, experts. The objectives of these meetings are: (1) to be aware of as well as the benefits of joining GBIF; (2) to discuss the motives of participation in GBIF, road map, strategy, action plan, detailed activities, stakeholders, human and financial resources; (3) to propose and approve a memorandum of understanding, which clearly defines the roles and responsibilities of the participants, is very important; (4) to assign Head of Delegation, Node Manager, Steering Committee, Working Group.

5.3. Potential data holders and users in Vietnam

Forty-four institutes, universities, museums, editors and publishers of scientific research and non-governmental organization are considered as holding and using biodiversity data (Table 1). In which, the organizations having museum collection are the main holders. Besides, around thirty one national parks, sixty four protected areas and thirteen species protected areas also hold a lot of biodiversity information.

Non-government organizations such as World Wildlife Fund (WWF), BirdLife International, and International Union for Conservation of Nature (IUCN) have conducted many projects on biodiversity in Vietnam. Consequently, they have much biodiversity data on Vietnam. Vietnamese and foreign experts working with biodiversity in Vietnam must be also included as data holders.

In 64 provinces and cities throughout Vietnam, Department of Natural Resources and Environment (DONRE belong Ministry of Natural Resources and Environment) and Department of Agriculture and Rural Development (DARD belong to Ministry of Agriculture and Rural Development) possess biodiversity information.

The list of data holders and provider can be seen at the ANNEX A.

5.4 . Proposal for organization and coordination mechanism of future VBIF

5.4.1 Proposal for organization of future VBIF

In the beginning, VBIF will including key stakeholders as BCA, IEBR and Center of Multidisciplinary Integrated Technologies for Field Monitoring (FIMO). However, when VBIF fully established, it will include two layers, a steering committee and a working group (Fig. 5).

The Steering committee is a team of 6-7 people nominated by stakeholders to

represent them in GBIF decision making, under the leadership of the Head of the Delegation (HoD). The steering committee should include representatives of the major stakeholders. The steering committee actively engages in guiding and implementing the node's work and helps to ensure that the relevant actors feel ownership of the node's work.

HoD is the person officially assigned by BCA to act as its representative to the GBIF Governing Board (GB), taking part in the global-level decision making. Node manager is the person nominated by BCA to manage the activities of the node to coordinate a biodiversity information facility. He/she works between VBIF and GBIF. HoD manages Working Group as well as consulting the relevant stakeholders about GB's issues

The Working Group consists of 16 people (younger generations) from various organizations (agencies, institutes, universities and museums) (Table 2). They are usually focused on specific areas such as user support, scientific liaison or technical development.

Some members of Working Group overlap with Steering Committee members in order to enhance communication. The major supporting agency for GBIF activities in Vietnam is BCA (MONRE). VBIF will also seek support from JICA, BIFA and other organizations to provide funds and technical support. However, the basic financial contributions to VBIF need to be identified as soon as possible.

Node team will come from several host situations such as management agencies (BCA, Department of Nature Conservation of MARD) and research institutes (Vietnam Academy of Science and Technology (VAST) (Ecological and Biological Resources (IEBR), Institute of Oceanography (IO), Institute of Marine Environment and Resources (IMER), The Institute of Biotechnology (IBT), Institute of Genome Research (IGR) and Vietnam National Museum of Nature (VNMN)). They will be key biodiversity stakeholder institutions. Of course, the Node should include other members: Faculty of Biology of University of Science (HUS), Forest Inventory and Planning Department (FIPI, MARD), Vietnam National University of Agriculture (VNUA, MARD), Informatics organization (such as Center of Multidisciplinary Integrated Technologies for Field Monitoring (FIMO)). It is necessary to consider that Node's members not only work for VBIF but also work for NBDS. Because, the node team is divided among several host institutions, one institution must be designated to coordinate node activity and act as the main contact point for interactions with the GBIF Secretariat and the global network.

The highly potential node manager can be IEBR, under the Vietnam Academy of Science and Technology (VAST). At the Workshop Introducing GBIF, BCA and some relevant stakeholders such as Institute of Ecology and Biological Resources (IEBR), Vietnam National Museum of Nature (VNMN), Vietnam National University of Forestry (VNUF), Faculty of Biology of University of Science (HUS) showed their willingness to participate in GBIF in the future. Especially, the initial consensus reached between the leaders of BCA and IEBR. Director of IEBR, Pr. Nguyen Van Sinh, agreed that IEBR can become the coordinator of the node of Vietnam.

IEBR is the leading agency in the field of biodiversity research of Vietnam. It is holding a large amount of biodiversity information with experienced experts.

Ministry of Natural Resources and Environment (MONRE) will recommend with VAST in order to IEBR become a key stakeholder of VBIF. Another alternative is Vietnam node is integrated into the IEBR. In this case, the node will have a minimal formal organizational structure.

It is must be assured that cooperation between management agencies, research institutes and other related organizations can overcome the challenges and ensure the Node's role as facilitation/coordination.

The proposed organization structure as well as the coordination is presented in the Fig 5.

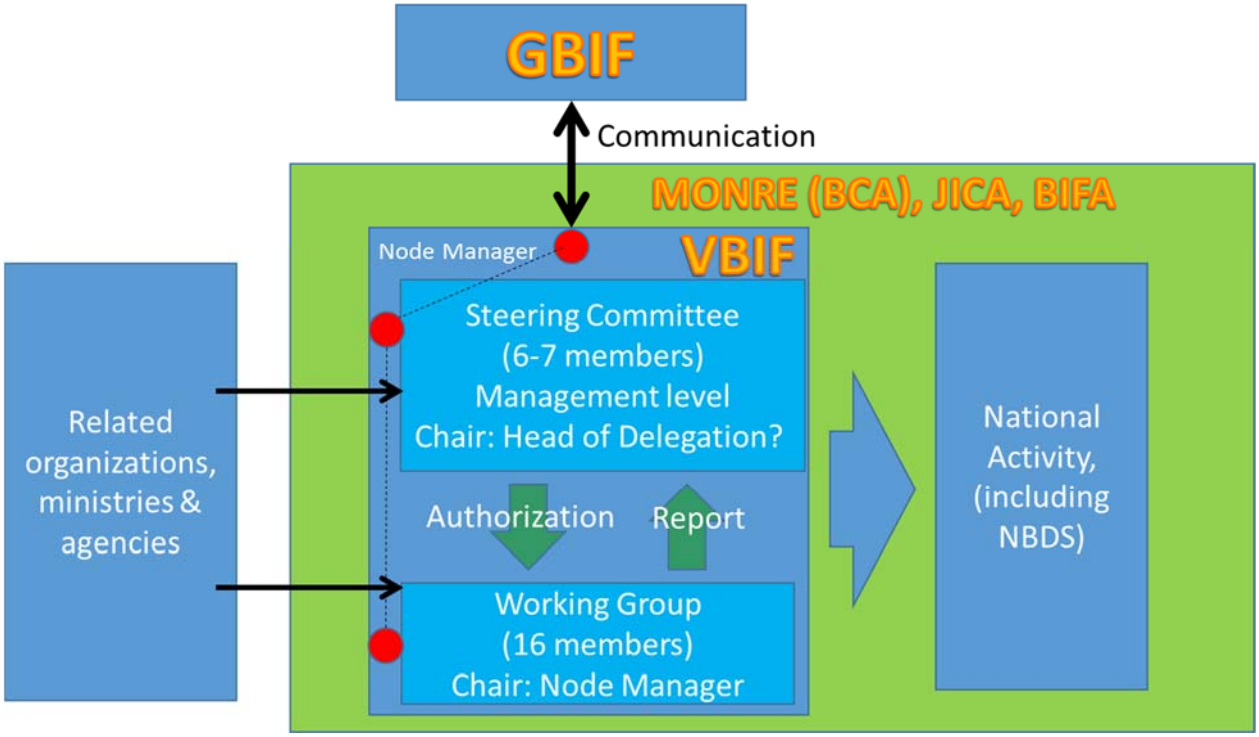

Figure 5. The organization of Vietnam Biodiversity Information Facility (when it is fully established)

Align with the setting up of the 2 main layers for running VBIF, consideration of potential nodes or potential members of future VBIF also have been taken via consultation with national stakeholders.

The list of potential members of VBIF is shown in the Table 1 below.

Table 3. The list of potential members of Vietnam Biodiversity Information Facility

Nº	Layer	Affiliation

1	Steering Committee	BCA (VEA/MONRE) (HoD)
2		Department of Nature Conservation (MARD)
3		Institute of Ecology and Biological Resources (IEBR, VAST)
4		Institute of Oceanography (IO, VAST)
5		Institute of Marine Environment and Resources (IMER, VAST)
6		Institute of Genome Research (IGR, VAST)
1	Working Group	BCA (VEA/MONRE)
2		Institute of Ecology and Biological Resources (IEBR, VAST)
3		Institute of Oceanography (IO, VAST)
4		Institute of Marine Environment and Resources (IMER, VAST)
5		The Institute of Biotechnology (IBT, VAST)
6		Institute of Genome Research (IGR, VAST)
7		Vietnam National Museum of Nature (VNMN, VAST)
8		Southern Institute of Ecology (SIE, VAST)
9		Institute of Tropical Biology (ITB, VAST)
10		Faculty of Biology, Ha Noi National University of Education (HNUE)
11		Faculty of Biology, University of Science (HUS)
12		Forest Inventory and Planning Department (FIPI, MARD)
13		Vietnam National University of Agriculture (VNUA, MARD)
14		DONRE
15		Informatics organization (Center of Multidisciplinary Integrated Technologies for Field Monitoring (FIMO))
16		Vietnam National University of Forestry (VNUF)

5.4.2 Proposed Mechanism of Coordination for VBIF

In the early stages of joining GBIF, BCA/VA/MONRE need to establish one task force working to understand and grasp GBIF standards, protocols, and data transfer tools. Experts will be sent abroad to visit and learn from the experience. Launch a project to proceed to collect and transmit data to NBDS and GBIF. The training will also be conducted to disseminate widely to stakeholders in Vietnam on how to develop and share biodiversity database in line with international standards.

Data sources will be initially identified. Data will come from two main sources. The first source is through the Department of Conservation Department's diversity collected from national parks, nature reserves and provinces. The second source comes from a number of topics from the Institute of Ecology and Biological Resources, specialized institutes, universities and museums. These data are contained in specialized literature, reports, articles of survey, survey, or sample collection programs, etc. The data collected will be checked by experts, digitized in Darwin Core

format and included in the NBDS. Then, some data will be selected for inclusion in GBIF through the second edition of ITP2. VBIF as well as the BCA will make recommendations to GBIF in support of business to digitize biodiversity collections and information, as well as provide consultancy, training programs, Manipulate, manage and publish data.

VBIF is a system or network of individuals and agencies, coordinated by a focal point, forming a common infrastructure to build and share biodiversity information for Party involved. NBDS is the national database on biodiversity. Therefore, VBIF's activities need to help further developing NBDS, build connections with national and international databases. Through it, biodiversity information will be digitized, shared and used with maximum efficiency. VBIF is established with the primary objective of meeting the demand for information on biodiversity in the country. The Executive Board of VBIF is also a key member of the NBDS. Therefore, VBIF's activities will always be associated with the NBDS.

The BCA is the IEBR, the two key bodies in the VBIF, whose cooperation is based on consensus of the two sides' leaders or on legally binding documents that may be developed in the future.

5.4.3. Potential node in Vietnam

The choice of a node is very important for GBIF participation. In Vietnam, there are many agencies working in the field of biodiversity. However, based on the conditions of capacity, knowledge, human resources as well as willingness to participate, only BCA and some institutes of VAST can become the node of Vietnam. The following analysis shows the strengths and weaknesses of each organization.

Potential Nodes in Vietnam with their advantages and disadvantages can be seen at ANNEX B.

6. SWOT analysis to evaluate participation of Vietnam in GBIF

SWOT analysis is an acronym for strengths, weaknesses, opportunities, and threats—and is a structured planning method that evaluates those four elements of a project. It involves specifying the objective of project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective.

- Strengths: characteristics of project that give it an advantage over others
- Weaknesses: characteristics that place project at a disadvantage relative to others
- Opportunities: elements that project could exploit to its advantage
- Threats: elements in the environment that could cause trouble for project

Identification of SWOTs is important because they can inform later steps in planning to achieve the objective. First, decision makers should consider whether the objective

is attainable, given the SWOTs. If the objective is not attainable, they must select a different objective and repeat the process.

SWOT analysis aims to identify the key internal and external factors seen as important to achieving an objective. SWOT analysis groups key pieces of information into two main categories:

- Internal factors – the strengths and weaknesses internal to the organization
- External factors – the opportunities and threats presented by the environment external to the organization

A SWOT analysis will allows participants to creatively brainstorm, identify obstacles and strategize possibly solutions/way forward to these limitations. The use of a SWOT analysis by a organization are as follows: to organize information, provide insight into barriers that may be present while engaging in social change processes, and identify strengths available that can be activated to counteract these barriers.

A SWOT analysis is used here to (1) identify barriers that will limit goals of participation in GBIF; (2) explore the solutions to problems of participation in GBIF.

Table 4. SWOT analysis to evaluate participation of Vietnam in GBIF

	Positive/Pros	**Negative/Cons**
Internal elements	Strengths • The Biodiversity Conservation Agency (BCA) was proposes to strengthen national capacity in database management and to promote GBIF in the country as an opportunity for information exchange at the global level. • BCA is recognized at the national level as responsible for coordinating biodiversity data sharing activities nationally. • Human resources: Four staffs have been trained about GBIF; BCA staffs. • Physical resources: VN has NBDS already. A portal of NBDS has been developed. • A circular on collaboration mechanism among data holders, which enables sharing, exchanging and exploiting biodiversity data, has been drafted.	Weaknesses • Except BCA, there is not any institution responsible for coordinating biodiversity data sharing activities nationally and built this obligation into its planning and function. • Human resources: Lack of staff can work full time for biodiversity database in stakeholders. • Physical resources: NBDS is on the first generation. It's functions and interface has not been yet finalized. Few data are housed in NBDS. • Financial resources: There is not specific funding for NBDS as well as other biodiversity databases. • Activities: There are very few activities and process in terms of biodiversity databases such as symposiums, meetings, education and training that have been organized.

	Positive/Pros	Negative/Cons
	• Financial resources: Vietnam government may be support limited funding? • Activities: Some activities related to NBDS will be held. The Sustainable Natural Resources Management Project – by JICA (NBDS phase II) will be implemented from 2015 to 2020. • Some "open-minded" Data Holders already identified. • As a result of NBDS project, the main major stakeholders for the biodiversity information facility been identified including MONRE/VEA/BCA, MARD, MOST, PPC, DONRE, DARD, national parks, protected areas, research institutes, universities, NGOs, international organizations and individuals. • Vietnam has became a member country of the Convention on Biological Diversity • Government of Vietnam enacted the Biodiversity Law in 2008 • National Biodiversity Strategy to 2020, vision to 2030	• Experience: Lack of experience on how to establish and operate a Node; how to develop cooperation between related stakeholders in Vietnam • Motivation, drivers and priorities for joining GBIF need to be made clearer. • Data is scattered across a multitude of sources and formats (museum collection specimens, reports, published literature, researchers' own computers). Sources of biodiversity data (documents, specimens) have not yet been completely located. • More data holders need to be identified. Sources of biodiversity data (documents, specimens) have not yet been completely located. • The needs of biodiversity information users have not been assessed at the national level. • The gaps in the available biodiversity data (taxonomic, spatial, temporal, and thematic) have not yet fully identified. • The state of national data holdings has not yet been comprehensively assessed (e.g. digital/non-digital format, approximate size and scope of collections, use of standards). Almost biodiversity data has not yet digitized. Most digital data is on desktop format (MS-Word, Excel, etc.). Digital data were not followed Darwin core. • There is little contact among management agencies, data users and data holders. • Collaboration and support between stakeholders is weak. • The coordination team or node have not yet been designed in order to have a communications

	Positive/Pros	Negative/Cons
		operational and a comprehensive plan for the biodiversity information facility. • Inter-institutional agreements have not yet in place to support stakeholder engagement in the biodiversity information facility. • A strategy / set of priority activities for the node and biodiversity information facility has not yet been described, agreed and adopted by stakeholders. Long-term purpose of the node with plans for the medium and short term has not yet been stated. • A strategy has not yet been developed to assist the biodiversity information facility in mobilizing national biodiversity data sources in a systematic way. Consequently, data mobilization priorities for the biodiversity information facility have not yet been agreed with stakeholders. The strategy assist data holders in making a case for investment in the mobilization of their data (e.g. through addressing known gaps or targeting specific use cases) not yet in use.
External elements	Opportunities • Economy: Vietnam's economy is growing and the government is concerned with building a national database. There will be more resources for building biodiversity database. • Legislation: Policies, decisions may be issued in order to facilitate providing, exchanging and managing biodiversity information. A circular on collaboration mechanism among data holders, which enables sharing,	Threats • Economy: The economic development is unsustainable and does not ensure a stable budget for building national biodiversity database system. • Legislation: Policies, decision may be not issued. • Funding sources: Funding is not available now. In the future, the funding may be very limited and unstable. • Future trend in the field of biodiversity database: Biodiversity is not an

	Positive/Pros	Negative/Cons
	exchanging and exploiting biodiversity data will be issued in this year. • Funding sources: A proposal for BIFA funding maybe accepted. • Future trend in the field of biodiversity database: The construction of biodiversity database is increasingly regarded by the agencies and organizations. • The trend of cooperation: between national agencies and international is increasing. This will give Vietnam the chance to participate in GBIF.	institutional priority. The important of biodiversity database do not fully understand. There is not a specific strategy for biodiversity database at national level. • The trend of cooperation: A collaborative framework may be not defined and agreed to by the relevant stakeholders and partners. There is not any coordination mechanisms between agencies, research institutes, museums and universities in building, using and sharing biodiversity data. • The resources for coordinating biodiversity data sharing has not been allocated to the team or node. No staff members are assigned to the node yet. In addition, whether or not the node or coordinating team has sufficient staff members and stable funding sources to implement the strategy has not yet been guaranteed. • There is not any mechanism in place for national biodiversity data holding institutions to share experience and expertise relating to digitization; to promote incentives for data publishing (e.g. through data management policies attached to public research grants, data paper publishing, use of licenses to share biodiversity information). • Limited human resources in charge of biodiversity databases from stakeholders. • Biodiversity data have not yet been shared between different organizations. Data holders are not willing or reluctant to share their data. • Biodiversity data is scattered all

	Positive/Pros	Negative/Cons
		over the country. • Biodiversity monitoring at national scale has not yet been done; lack of human resource and funding; no standard survey methods for biodiversity. • The ability to manage, exploit and use the database is limited due to lack of training. • Few people have an understanding about GBIF. The use of biodiversity data available through the GBIF network and other institutions has not yet promoted. • Biodiversity data and services have not yet well recognized and used by research and national agencies (to deal with economic sectors, for example in spatial planning, environmental impact assessment, agricultural policy and public health).

SWOT analysis displayed some main tasks for Vietnam before joining in GBIF as follow:

- A node for participation in GBIF must be established. Human and financial resources for the node's activity must be identified to ensure its sustainability.
- A MOU for participation in VBIF must be proposed and approved by key members.
- A collaboration framework in building, using and sharing biodiversity data between relevant stakeholders should be built.
- The activities in terms of biodiversity database (building, sharing, using) must be conducted more and more.
- It is vital that there should be a national funding for activities relative to biodiversity database.

7. Prioritized Activities

- Identify sources of biodiversity data and develop strategies to mobilize these sources of data.

- Carry out need assessment for biodiversity data, analyzing available biodiversity data to promote the provision and utilize of data. Ensure the compatibility between the accumulated data to the needs of utilization, contributing to the maintenance of the NBDS.

- Secure a stable, long-term financial resource for data collection, development and use of biodiversity data

- To promote the activities of digitization, saving, utilization, exploitation and sharing (following international standards) information on bio-diversity in research institutes, universities, museums and related organizations.

- Conduct training and dissemination of advanced technologies and tools in data process and sharing. Supports data holders parties in the country in data verification, management and quality assurance

- Raise awareness about the importance of biodiversity data for management agencies/ organizations and community.

- Develop a mechanism for cooperation and support stakeholders in the development and sharing of biodiversity data.

8. Budget for Implementation

- The budget for implementation of the roadmap shall be allocated from the State budget on the basis of programs and projects, specifically, from annual budget line for environment, budget line for business, budget line for investment, science and technology, and other sources of budget.
- For the annual State budget for implementing the roadmap allocating for in line ministries and agencies, the focal management agency shall have to elaborate detailed budget estimates and submit Ministry of Finance to consider and allocate to the focal management agency.
- Other funding sources: Creat the favourable conditions to attract resources from domestic and foreign organizations as well as different international sources.
- Diversify investment resources from businesses, organizations and individuals inside and outside the country. At the same time, it is needed to establish a mechanisms and incentive policies to mobilize investment in maintenance, update and development of biodiversity databases at National Focal Point (NFP) and nodes

VII. CONCLUSIONS AND RECOMMENDATIONS

Vietnam has seen the benefits of joining GBIF. The country wishes to become a member of GBIF before the next Asia Region meeting in June 2017. A temporal core team for VBIF is identified for further establishment. The country now needs to prepare the participatory process such as such as identification of objectives, activities, action plan and institutional arrangement, financial and human resources, infrastructure for participation in GBIF. Now, the most important tasks are establishment for a participant node, including its mandate, institution allocation, governance structure and funding model. Therefore, a launch project is necessary to establish a node and start to publish Vietnamese biodiversity data following global standards, protocol and tools of GBIF.

The node needs to be designed in order to have communications operational and a comprehensive plan for the biodiversity information facility. Inter-institutional agreements on information sharing and resources supporting is essential to support stakeholder engagement in the biodiversity information facility. A board and other governance structure must be established to support the work of the node with its stakeholders. The node's governance structure will provide the necessary expertise to guide the development of the biodiversity information facility. A strategy/set of priority activities for the node and biodiversity information facility must be described, agreed upon and adopted by the stakeholders. The resources for coordinating biodiversity data sharing must be allocated to the team or node. The staff members should be assigned to the node. The node or coordinating team need must have sufficient staff members and stable funding sources to implement the strategy. Node manager and his/her staffs' missions must be incorporated into their organizational functions.

VBIF organization should include representatives of the authorities (BCA (MONRE), Nature Conservation Department (MARD)), some related institutes of Vietnam Academy of Science and Technology (VAST), Center of Multidisciplinary Integrated Technologies for Field Monitoring (FIMO) and other university departments and organizations. This organization must ensure the participation of key members in the field of management, research and use of biodiversity information. They not only work for VBIF but also effort for NBDS.

National Biodiversity Database System (NBDS) is a hub (center bridge) where linking to other biodiversity databases in the country and globally. Meanwhile, VBIF's role in building and developing the relationship between NBDS with other databases. After all, national biodiversity information facilities are networks of people and institutions that produce, manage and use biodiversity data, together supporting the

needs of the country for biodiversity information. This network has not yet been built and developed in Vietnam and there are much work that must be done to realize this function.

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ANNEX A. INTELLECTUAL PROPERTY

GBIF Memorandum of Understanding - Paragraph 8: Intellectual property

1. Applicable Law

Nothing in this MOU should be read to alter the scope and application of Intellectual Property Rights and benefit sharing agreements as determined under relevant laws, regulations and international agreements of the Participants.

2. Access to Data

To the greatest extent possible, GBIF is an open-access facility. All users, whether GBIF Participants or others, should have equal access to data in databases affiliated with or developed by GBIF.

3. Intellectual Property Rights to Biodiversity Data

GBIF promotes the free dissemination of biodiversity data and, in particular:

a. should not assert any proprietary rights to the data in databases that are developed by other organisations and that subsequently become affiliated to GBIF;

b. should seek, to the greatest extent possible, to make freely and openly available, with the least possible restrictions on reuse, any data commissioned, created or developed directly by GBIF; and

c. should respect conditions set by Data Publishers that affiliate their databases to GBIF.

When establishing affiliations or linkages with other databases, GBIF should seek to ensure that the data so made available will not be subject to limitations on the further non-commercial use and dissemination of those data, apart from due attribution of their source.

4. Attribution

GBIF should seek to ensure that the source of data is acknowledged and should request that such attribution be maintained in any subsequent use of the data.

5. Access to Specific Data

Nothing in this MOU should be read to restrict the right of owners of databases affiliated with GBIF to block access to any data.

6. Validity of Data

It should be a condition of access to and use of GBIF that users acknowledge that the validity of the data in any databases affiliated with GBIF cannot be assured. GBIF should disclaim responsibility for the accuracy and reliability of the data as well as for the suitability of its application for any particular purpose.

7. Legitimacy of Data Collection

Where the collection of new data has entailed access to biodiversity resources, GBIF should ask for reasonable assurances from the Data Publisher that such access was consistent with applicable laws, regulations and any relevant requirements for prior informed consent.

8. Intellectual Property Rights to Biodiversity Tools

GBIF may claim appropriate Intellectual Property Rights available within applicable national jurisdictions over any tools, such as search engines or other software products that are developed by GBIF while carrying out the GBIF Work Programme.

9. Technology Transfer

The Participants acknowledge that, subject to any relevant Intellectual Property Rights, GBIF should seek to promote the non-exclusive transfer, on mutually agreed terms, to research institutions, particularly in developing countries, of such informatics technology as it has available, especially in conjunction with training and capacity development programs.

ANNEX B. LIST OF POTENTIAL DATA HOLDERS IN VIET NAM

No	Data holder	Specimens data	Observation records	Note
	Vietnam Academy of Science and Technology (VAST)			
1	Institute of Ecology and Biological Resources (IEBR) http://www.iebr.ac.vn/	X	X	Arthropods, vertebrate, mammal, invertebrates, reptiles & amphibians, fishes, mollusks, parasite, aquatic invertebrates, bird, plants, nematode, DNA, remote sensing, etc.
2	Institute of Oceanography (IO) http://www.vnio.org.vn/	X	X	Marine fauna and flora of Vietnam
3	Institute of Marine Environment and Resources (IMER) http://www.imer.ac.vn/		X	Marine fauna and flora of Vietnam
4	The Institute of Biotechnology (IBT) http://www.ibt.ac.vn/			DNA data on DNA of fauna and flora of Vietnam
5	Institute of Genome Research (IGR) http://www.igr.ac.vn/			DNA data on DNA of fauna and flora of Vietnam
6	Vietnam National Museum of Nature (VNMN) http://vnmn.ac.vn/en/	X	X	Fauna and flora of Vietnam
7	Institute of Highland Central (Viện Nghiên cứu Khoa học Tây Nguyên) http://www.tni.ac.vn/	X	X	Fauna and flora of Vietnam's Central Highlands
8	Southern Institute of Ecology (SIE) http://sie.vast.vn/	X	X	Fauna and flora of South Vietnam; 20000 specimens (60% digitalized)
9	Institute of Tropical Biology (ITB) http://itb.ac.vn/		X	Fauna and flora of South Vietnam; fish collection; Herbarium
10	Mientrung Institute for Scientific Reseach (MISR) http://misr.com.vn/		X	Fauna and flora of Central Vietnam
11	Institute of Resource, Environment and Development in Hue City		X	
	Ministry of Natural Resources and Environment (MONRE)			
12	Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE) http://isponre.gov.vn/			
13	Ha Noi University of Natural Resources and Environment (HUNRE)		X	Data on diversity of land snails in Vietnam

No	Data holder	Specimens data	Observation records	Note
	http://hunre.edu.vn/			
14	Ho Chi Minh University of Natural Resources and Environment (HCMUNRE) http://www.hcmunre.edu.vn/		X	
	Ministry of Education and Training (MOET)			
15	Thai Nguyen University of Agriculture and Forest (TUAF) http://tuaf.edu.vn/			
16	Thai Nguyen University of Education http://dhsptn.edu.vn/			Fauna and flora of Northeast Vietnam
17	Thai Nguyen University of Science http://us.tnu.edu.vn/			
18	Vinh University http://vinhuni.edu.vn/		X	Data on fish diversity of Central Vietnam
19	Hue University of Agricultural and Forestry (HUAF) http://huaf.edu.vn/			Fauna and flora of Central Vietnam
20	Hue University of Science (HUSC) http://www.husc.edu.vn/			
21	The University of Da Nang – University of Education http://ued.udn.vn/			
22	Can Tho University (CTU) (Colleague of Aquaculture and Fisheries (CAF)) https://www.ctu.edu.vn/		X	Data on fish in South Vietnam
23	Ho Chi Minh Nong Lam University (NLU) http://hcmuaf.edu.vn/			Data on fish South Vietnam
24	Ha Noi National University of Education (HNUE) http://hnue.edu.vn/		X	Fauna and flora of Vietnam
25	Hanoi Pedagogical University 2 http://www.hpu2.edu.vn/		X	Fauna and flora of Northeast and Northwest Vietnam
26	Da Lat University http://www.dlu.edu.vn/			
27	Tay Bac University (UTB) http://www.utb.edu.vn/		X	Data on land snail in Northwest Vietnam
	Vietnam National University, Ha Noi			
28	University of Science (HUS) (Faculty of Biology) http://hus.vnu.edu.vn/	X		Fauna and flora of Vietnam
	Vietnam National University, Ho Chi Minh			

No	Data holder	Specimens data	Observation records	Note
29	University of Science (HCMUS) http://www.hcmus.edu.vn/		X	Fauna and flora of South Vietnam
	Ministry of Agriculture and Rural Development (MARD)			
30	Forest Inventory and Planning Department (FIPI) http://www.fipi.vn/	X	X	Data on plant biodiversity in the forests of Vietnam
31	Vietnam National University of Agriculture (VNUA) http://www.vnua.edu.vn/		X	Data on insect
32	Vietnam National University of Forestry (VNUF) http://www.vfu.edu.vn/		X	Data on plant
33	Vietnamese Academy of Forest Sciences (VAFS) http://vafs.gov.vn/		X	Data on plant
34	Research Institute of Marine Fishery (RIMF) http://www.rimf.org.vn/		X	Data on marine fish diversity
35	Research Institute for Aquaculture No1 (RIA1) http://ria1.org/ria1/		X	Data on fish
36	Research Institute for Aquaculture No2 (RIA2) http://vienthuysan2.org.vn/		X	Data on fish in the South Vietnam
37	Research Institute for Aquaculture No3 (RIA3) http://www.ria3.vn/			Data on fish in the Central Vietnam
38	Institute of Coastal and Offshore Engineering (ICOE) http://www.icoe.org.vn/			
	Editors and publishers of scientific research			
39	Journal of Marine Science and Technology (VAS) http://vjs.ac.vn/index.php/jmst			Articles on marine fauna and flora of Vietnam
40	Journal of Biotechnology (VAST) http://vjs.ac.vn/index.php/vjbt			Articles on DNA
	Journal of Biology (VAST) http://vjs.ac.vn/index.php/vjbio			Articles on fauna and flora of Vietnam
41	**Non-governmental organization (NGO)**			
42	International Union for Conservation of Nature (IUCN) https://www.iucn.org/			Report of threatened species Vietnam
43	World Wildlife Fund (WWF) http://www.worldwildlife.org/			Report of fauna and flora of Vietnam
44	Birdlife http://www.birdlife.org/			Report on bird of Vietnam

ANNEX C. POTENTIAL NODES IN VIETNAM AND ANALYSIS OF THEIR POTENTIALITY

Type of host/designated institution	Positive	Negative
Biodiversity Conservation Agency (BCA)	• Very strong mandate, capacity to influence and support policy and decision making • Easily aligned with national biodiversity policies, strategies, and programme	• Challenges to operate at the technical level, and to provide technical support (e.g. to the scientific community) • Easily affected by political changes • May find difficulties in addressing needs from other ministries (e.g. from science or economic).
Institutes of Vietnam Academy of Science and Technology (VAST), such as: Institute of Ecological and Biological Resources (IEBR), Institute of Oceanography (IO), Institute of Marine Environment and Resources (IMER), The Institute of Biotechnology (IBT), Institute of Genome Research (IGR) and Vietnam National Museum of Nature (VNMN).	• Potential for developing capacity on biodiversity informatics easily and quickly • Full knowledge of the biodiversity-research realm • Knowledge of the challenges and requirements to digitize and manage natural history data	• Lack of mandate (a strong and clear institutional mandate in terms of biodiversity database), institutional supports and funding; difficulty to formally engage with government institutions • May not be perceived as neutral by all stakeholders, depending on how the institute fits within the Participant's overall institutional landscape (for example if there is overlap or competition for resources). It may need big efforts to demonstrate neutrality (e.g. if it is not competing for funds, etc.). Neutrality is essential to build trust in the data sharing activities at all levels • It may find difficulty to engage with other communities holding other types of biodiversity data (e.g. observations, ecological data, etc.) • In some cases it makes it difficult for the Node to serve the needs of users outside the scientific community (e.g. policy makers) • Require some external investments to get the capacity to provide technical support (including knowledge, technologies (e.g. software, hardware), staff (enough

		experienced personnel to cover all the relevant areas as defined in the Node's work plan, and mandate (the Participant Node should be empowered to perform its duties at the appropriate level) • May become very science-driven, putting less emphasis on supporting policy and decision making for the conservation and sustainable use of biodiversity • May become very dependent on funded projects • The Node's staff may get heavily involved in the institution's internal activities

BIFA PROJECT "DEVELOPMENT OF THE BIODIVERSITY DATABASE SYSTEM IN VIET NAM"

A REPORT ON THE COMPATIBILITY OF NATIONAL BIODIVERSITY INFORMATION SYSTEM IN VIETNAM (NBDS) AND RECOMMENDATION FOR DEVELOP A MECHANISMS TO SHARE INFORMATION ON BIODIVERSITY OF VIETNAM TO GBIF

Hanoi, 12/2016

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I. INTRODUCTION

This document reports the compatibility of Vietnam National Biodiversity Database System (NBDS) and Global Biodiversity Information Facilities (GBIF) in data sharing machenism. Our conclusion is that NBDS of Vietnam is ready to connect and share data with GBIF.

Our approach is follows:

- In Chapter II, we analyze the system architecture and Data Structure Standards of NBDS.
- In Chapter III, we emphaseze the data standards and data exchange standard of GBIF. These are keys for connecting NBDS and GBIF. Both data structures of GBIF and NBDS are adopted international standard for biodiversity data, so we can eassily see the high compatibility of two systems.
- In Chapter IV, we carefuly compare each data element of the NBDS and GBIF, then make list of common data element of NBDS and GBIF. The result shows that NBDS's data structure is compatible with GBIF.
- In Chapter V, we descibe 5 tools of GBIF for supporting data exchange between data providers and GBIF. NBDS plays a role as a data provider to GBIF.
- In Chapter VI, we conclude the high compatibility of NBDS and GBIF.

II. NBDS: SYSTEM ARCHITECTURE AND DATA STRUCTURE STANDARDS

2.1 NBDS Architecture

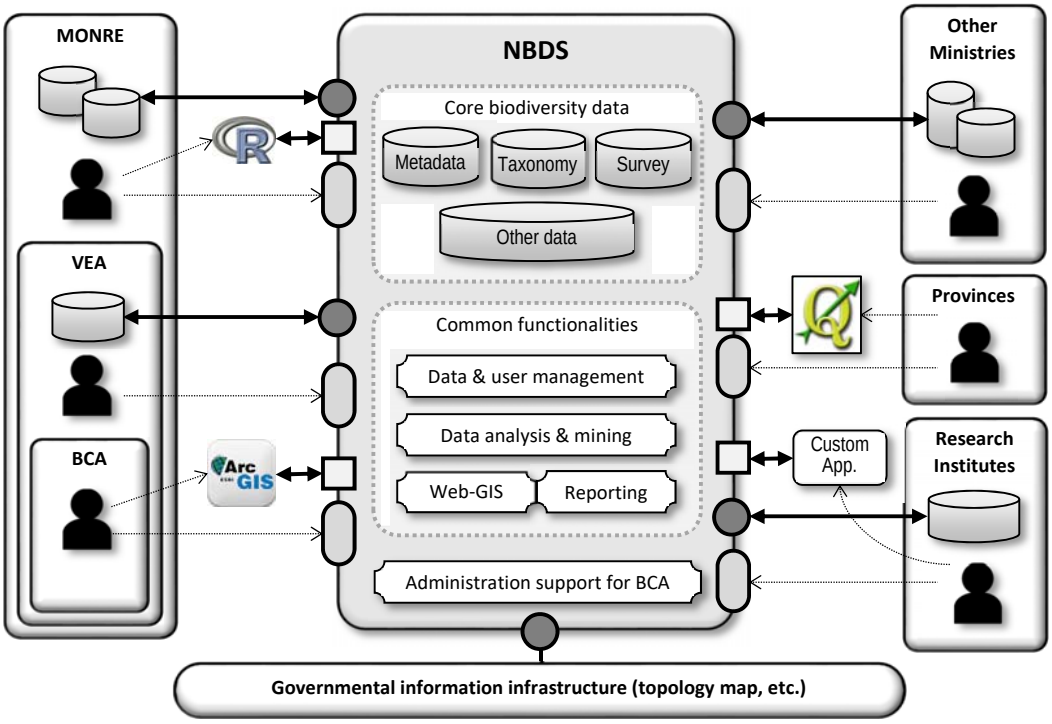

Figure 1 NBDS Architecture

The above figure describes the architecture of NBDS. It has 3 layers:

- Data layer: includes metadata, tanonomy data, survey data and other data
- Common functionaliies:
  - Data and user management
  - Data analysis and mining
  - Reporting system
  - Web-GIS
- Administration support for BCA

NBDS was designed to be able to:

- Serve people not only inside MONRE (VEA, BCA) but also from other ministries, provinces and research institutes,
- Connect to other database systems in VEA, MONRE and other minitries, research institutes.

2.2 NBDS Data Structure Standards

2.2.1 Data structure standards and references

NBDS adopts the existing standards and references on biodiversity data structure according to the following strategies.

1. If there is an existing Vietnamese national standard for a biodiversity data structure, it should be adopted. NBDS complies with the following Vietnamese law for the NBDS system architecture.

- MONRE circular 07/2009/TT-BTNMT … For the collection, management, exploitation and use of data and resources.
- The Geo (Spatial) Data Standards issued by MONRE … These standards have been adapted from ISO-TC211 and Open GIS Consortium (OGC)[1] ones including that of metadata for geo-data

2. If there is no existing Vietnamese standard for a data structure, and if there is an international standard for that, it should be adopted. NBDS adopted several international standards such as the followings. Each

- GBIF[2] Darwin Core (DwC) … For metadata, taxonomy, occurrence, image profile, etc.
- EML[3] … For data notation and sharing format in XML
- UNESCO, NOAA, Ramsar …For ecosystems classifications
- Protected Planet WDPA (World Database on Protected Areas) data standard[4] … For protected area information

3. If it is neither 1 nor 2, the data structure should be determined based on the user's requirements. NBDS contains data structures based on the user's requirements such as the followings.

- Data related to environmental analysis (climatic data, water/soil quality, etc.)

[1] http://www.opengeospatial.org/standards/is
[2] http://en.wikipedia.org/wiki/Darwin_Core_Archive
[3] https://knb.ecoinformatics.org/#external//emlparser/docs/index.html
[4] http://www.unep-wcmc.org/resources-and-data/world-database-on-protected-areas-wdpa-data-standards

- Administration supporting information (for BCA)

2.2.2 Flexibility and expandability of data structure

Data structure of NBDS should have flexibility and expandability in order to accommodate any future addition of data elements to NBDS

1. Users should be able to setup their own data structure through user-customizable data format, based on the available internal data structure of NBDS. This means that NBDS should contain comprehensive range of data elements internally, and then let each user pick some of them to create their own customized data format. User-customizable data format will be described in detail in **Error! Reference source not found.**.

2. In order for users to easily browse and pickup available data in NBDS, the NBDS should provide "Data Dictionary" that contains the list of available data elements in NBDS with descriptions and example values of each element.

2.3 Internal data structures of NBDS

Table 1 is the list of 10 groups of data structure of NBDS and data standard used for each group. Group 1->5 are on biodiversity data and have international standards. Group 6-10 are additional data.

Table 1 Internal data structures of NBDS

No.	Group of Data Structure	Data Description	Data Standards
1	Metadata for Biodiversity Information	Information on existing dataset both in NBDS and in other organizations	DwC
2	Species (Taxon)	Scientific and practical use information on the species of life	DwC
3	Occurrence (Survey)	Information on every occurrence (findings, specimen, records) of species in surveys, collections, and literatures.	DwC
4	Ecosystems Diversity	Information on the type of ecosystems and their distribution in Vietnam	UNESCO, NOAA, Ramsar
5	Genetic Diversity	Information on the variety and diversity of gene on the selected species.	Genomic Standard Consortium, Biodiversity Genomics Working Group
6	Socio-Economic data	Socio-economic information that are related to biodiversity and its monitoring indicators	VN regulations
7	Data for provinces	Biodiversity-related data for each province in Vietnam	VN regulations
8	Data for Biodiversity Policy and Administration (for BCA)	Data and references used for creating biodiversity-related policies and their implementation / monitoring for BCA.	VN regulations
9	Data for System Management	Data for management of NBDS as computer system (such as user accounts and roles, etc.)	NBDS regulation
10	Other data	Other data stored and managed by NBDS	NBDS regulation

III. GBIF: SYSTEM ARCHITECTURE AND DATA MANAGEMENT

3.1 GBIF Architecture

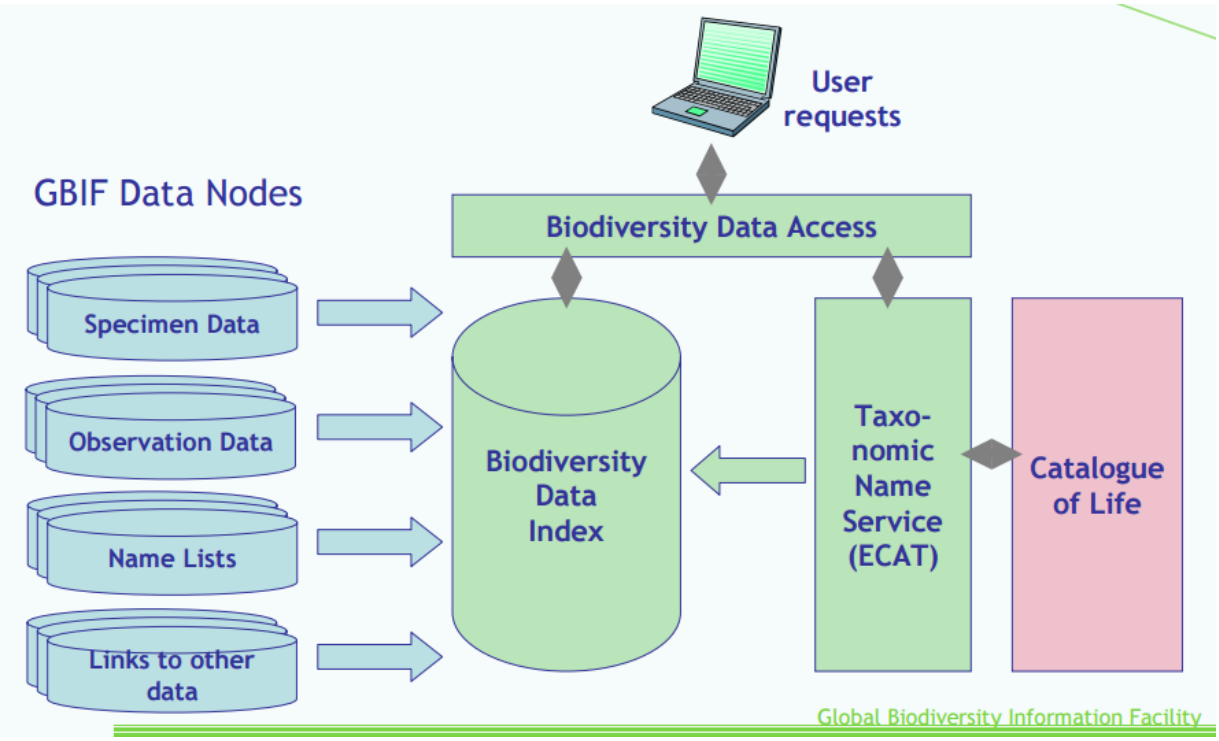

Figure 2 GBIF Architecture

The Global Biodiversity Information Facility (GBIF) is an international open data infrastructure, funded by governments. It allows anyone, anywhere to access data about all types of life on Earth, shared across national boundaries via the Internet.

By encouraging and helping institutions to publish data according to common standards, GBIF enables research not possible before, and informs better decisions to conserve and sustainably use the biological resources of the planet.

GBIF operates through a network of nodes, coordinating the biodiversity information facilities of Participant countries and organizations, collaborating with each other and the Secretariat to share skills, experiences and technical capacity.

3.2 GBIF Data Exchange Standards

GBIF includes the following data as described in Figure 3:

- Specimen data
- Observation data
- Name, taxon
- Institutions, data providers, collections

Data standards used in GBIF include:

- Darwin Core

- DiGIR, ABCD, BioCASE, Dubline Core

Data Exchage Standards used in GBIF include:

- SOAP
- Grid OGSA

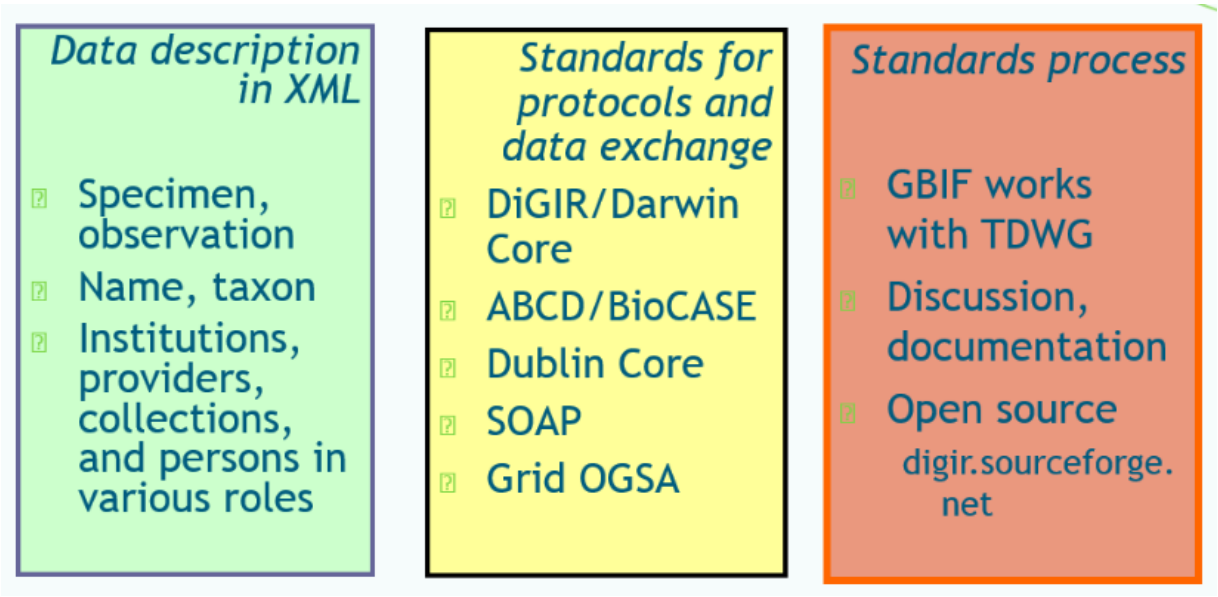

Figure 3 GBIF Data Exchagne Standards

IV. THE COMPATIBILITY OF NBDS AND GBIF

In this chaper, we carefuly compare each data element of the NBDS and GBIF, then make lists of common data element of NBDS and GBIF. The result shows that NBDS's data structure is compatible with GBIF.

Data elements are divides to 5 groups:

- Metadata
- Data for Biodiversity monitoring indicators
- Species data
- Occurrnce data
- Ecological data

For each kind of data, we check it in NBDS and GBIF to see they are compatible or not. We summarize the result in tables which include 4 collums as follows:

- Data element ID
- Data element in NBDS
- Description of data element
- Compatble with GBIF of not (YES/NO)

The below are results of each kind of data: metadata, biodiversity indicators, species, occurrence, ecosystem.

4.1 The compability in Metadata

Table 2 The compability in Metadata

ID No.	Data Element in NBDS	Description	Compatible with GBIF
1*	Data set type	The type of data set	
2*	Title	A description of the resource of the dataset that is long enough to differentiate it from other similar resources. Multiple titles may be provided, particularly when trying to express the title in more than one language	YES
3*	Publication date	The date that the resource was published. The format should be represented as: CCYY, which represents a 4 digit year, or as CCYY-MM-DD, which denotes the full year, month, and day. Note that month and day are optional components. Formats must conform to ISO 8601.	YES
4*	Language	The language in which the resource (not the metadata document) is written. This can be a common language name, or one of the ISO language codes to be more precise. (http://vocabularies.gbif.org/vocabularies/lang)	YES
5	Series	The serial number or description of series if the dataset is a part of larger a collection of datasets.	
6	Abstract	A brief overview of the resource that is being documented	YES
7	Additional information	Information regarding omissions, instructions or other annotations that resource managers may wish to include with a dataset. Basically, any information that is not characterized by the other resource metadata fields.	YES
8	Intellectual rights	Description of copyrights and other rights and declaration of intellectual properties of the dataset.	
9	Distribution	Distribution of the data in Vietnam in terms of regions, provinces, and districts.	
10	Web site URL	URL of the origin of dataset which can be a Web site or direct link if the dataset can be accessed directly (such as PDF file, etc.)	YES
11	Logo URL	URL of the logo image of the belonging organization or project of the dataset.	
12	Web service URL	URL of Web service (if the data set supports it) with placeholder notation for semi-automatic search from NBDS	
13	Citation[5]	The citation for the dataset.	YES
14	Geographic description	A short text description of a dataset's geographic areal domain. A text description is especially important to provide a geographic setting when the extent of the dataset cannot be well described by the bounding coordinates.	YES
15	Keyword	Keywords or key phrases that concisely describe the resource or are related to the resource. There can be multiple keywords for a dataset, but each keyword must be clearly separated in the database.	YES
16	Keyword thesaurus	The name of the official keyword thesaurus from which keyword was derived. If no thesaurus was used, leave it blank.	YES
17	Date range of data	The beginning and ending date of data collection contained in the dataset.	YES

[5] http://www.gbif.org/resources/2381

ID No.	Data Element in NBDS	Description	Compatible with GBIF
18	Taxonomic coverage	Taxonomic information about the dataset. It includes a list of species names (or higher level ranks) from one or more classification systems. A description of the range of taxa addressed in the data set or collection. Use a simple comma separated list of taxa.	YES
19	Geographic location	A bounding rectangle for overall coverage of the dataset in latitudes and longitudes, represented by North, East, West, and South boundary coordinates.	YES
20	Data owner	Owner of the data set. It can be the name of organization, province, project, or a person.	

4.2 The compatibility in Data for Biodiversity monitoring indicators

NBDS stores all required data elements for Biodiversity Monitoring Indicators developed by its Core Group. Some data elements are related to species or survey measurements, so they can be covered by internal data structures of NBDS such as Species, Occurrence, etc. Other data (such as "Forest coverage") are originated from other Ministries or organizations, and NBDS should store those data as "local copy" or "cache" of original data from external data sources.

By using User-customizable data format with Data Dictionary, these data elements for Biodiversity Monitoring Indicators can be stored in NBDS as flexible (multiple) formats. For example, you can store these data by using either DPSIR6 categorization or PSRB7 categorization, or both, and can compare them in tables, graphs or on Web-GIS. In any case, all data elements for these formats will be stored only once in NBDS, and these different data formats will act as a reference to the single data stored in NBDS.

Therefore, NBDS's Biodiversity monitoring indicators data is compatible with GBIF.

4.3 The compability in Species Data (Taxon)

Species is one of the core information for biodiversity database. The species data should be referenced by any biodiversity data that required information on the forms of life.

The data structure design of species data in NBDS is divided into following data categories. All these elements are prepared in NBDS for each (single) species record.

- Identification (8 elements)
- Taxonomy information (29 elements)
- Vernacular names information (4 elements)
- Additional information on species (18 elements)
- Images and photos (13 elements)

The compatinility in Species Data Structructure between NBDS and GBIF is summarized as follows.

[6] Driver, Pressure, State, Impact, Response
[7] Pressure, State, Response, Benefit

4.3.1 Identification

Table 3 The compatibility in Identification/Taxon

No.	Data Element in NBDS	Description	Compatible with GBIF
1*	Taxon ID	An identifier for the set of taxon information (data associated with the Taxon class). May be a global unique identifier or an identifier specific to the data set.	YES
2	Scientific name ID	An identifier for the nomenclatural (not taxonomic) details of a scientific name.	YES
3	Accepted name usage ID	An identifier for the name usage (documented meaning of the name according to a source) of the currently valid (zoological) or accepted (botanical) taxon.	YES
4	Parent name usage ID	An identifier for the name usage (documented meaning of the name according to a source) of the direct, most proximate higher-rank parent taxon (in a classification) of the most specific element of the scientific name.	YES
5	Original name usage ID	An identifier for the name usage (documented meaning of the name according to a source) in which the terminal element of the scientific name was originally established under the rules of the associated nomenclatural code.	YES
6	Name according to ID	An identifier for the source in which the specific taxon concept circumscription is defined or implied. See nameAccordingTo.	YES
7	Name published in ID	An identifier for the publication in which the scientificName was originally established under the rules of the associated nomenclaturalCode.	YES
8	Taxon concept ID	An identifier for the taxonomic concept to which the record refers - not for the nomenclatural details of a taxon.	YES

4.3.2 Taxonomy Information

Table 4 The compatibility in Tanonomy Information

No.	Data Element	Description	Compatible with GBIF
1*	Scientific name	The full scientific name, with authorship and date information if known. When forming part of Identification, this should be the name in lowest level taxonomic rank that can be determined. This term should not contain identification qualifications, which should instead be supplied in the IdentificationQualifier term.	YES
2	Accepted name usage	The full name, with authorship and date information if known, of the currently valid (zoological) or accepted (botanical) taxon.	YES
3	Parent name usage	The full name, with authorship and date information if known, of the direct, most proximate higher-rank parent taxon (in a classification) of the most specific element of the scientificName.	YES
4	Original name usage	The taxon name, with authorship and date information if known, as it originally appeared when first established under the rules of	YES

No.	Data Element	Description	Compatible with GBIF
		the associated nomenclaturalCode. The basionym (botany) or basonym (bacteriology) of the scientificName or the senior/earlier homonym for replaced names.	
5	Name according to	The reference to the source in which the specific taxon concept circumscription is defined or implied - traditionally signified by the Latin "sensu" or "sec." (from secundum, meaning "according to"). For taxa that result from identifications, a reference to the keys, monographs, experts and other sources should be given.	YES
6	Name published in	A reference for the publication in which the scientificName was originally established under the rules of the associated nomenclaturalCode.	YES
7	Name published in year	The four-digit year in which the scientificName was published.	YES
8	Higher classification	A list (concatenated and separated) of taxa names terminating at the rank immediately superior to the taxon referenced in the taxon record. Recommended best practice is to order the list starting with the highest rank and separating the names for each rank with a semi-colon (";").	YES
9	Kingdom	The full scientific name of the kingdom in which the taxon is classified.	YES
10	Phylum	The full scientific name of the phylum or division in which the taxon is classified.	YES
11	Class	The full scientific name of the class in which the taxon is classified.	YES
12	Order	The full scientific name of the order in which the taxon is classified.	YES
13	Family	The full scientific name of the family in which the taxon is classified	YES
14	Genus	The full scientific name of the genus in which the taxon is classified	YES
15	Subgenus	The full scientific name of the subgenus in which the taxon is classified. Values should include the genus to avoid homonym confusion.	YES
16	Species	The name of the first or species epithet of the scientificName.	YES
17	Infra species	The name of the lowest or terminal infraspecific epithet of the scientificName, excluding any rank designation.	YES
18	Taxon rank	The taxonomic rank of the most specific name in the scientificName. Recommended best practice is to use a controlled vocabulary.	YES
19	Verbatim taxon rank	The taxonomic rank of the most specific name in the scientificName as it appears in the original record.	YES
20	Scientific name authorship	The authorship information for the scientificName formatted according to the conventions of the applicable nomenclaturalCode.	YES

No.	Data Element	Description	Compatible with GBIF
21	Vernacular name	A vernacular name.	YES
22	Common name	Common names with transliteration. Multiple common names can be stored for single taxon, and each common names should be	
23	Common		
24	Nomenclatural code	The nomenclatural code (or codes in the case of an ambiregnal name) under which the scientificName is constructed. Recommended best practice is to use a controlled vocabulary.	YES
25	Taxonomic status	The status of the use of the scientificName as a label for a taxon. Requires taxonomic opinion to define the scope of a taxon. Rules of priority then are used to define the taxonomic status of the nomenclature contained in that scope, combined with the experts opinion. It must be linked to a specific taxonomic reference that defines the concept. Recommended best practice is to use a controlled vocabulary.	YES
26	Nomenclatural status	The status related to the original publication of the name and its conformance to the relevant rules of nomenclature. It is based essentially on an algorithm according to the business rules of the code. It requires no taxonomic opinion.	YES
27	Taxon remarks	Comments or notes about the taxon or name	YES
28	Taxon ID	An identifier for the set of taxon information (data associated with the Taxon class). May be a global unique identifier or an identifier specific to the data set.	YES
29	Scientific name ID	An identifier for the nomenclatural (not taxonomic) details of a scientific name.	YES

4.3.3 Vernacular names information

Table 5 The compatibility in Vernacular names information

No.	Data Element	Description	Compatible with GBIF
1*	Common name	A common name	YES
2	Transliteration	A transliteration of the common name (description of pronunciation of the common name). This element must be stored as a pair with a common name.	
3	Language	The language of the common name in ISO 639-1 language code[8]	
4	Country	The country that use the common name in ISO 3166-1 country code[9]	

[8] http://en.wikipedia.org/wiki/List_of_ISO_639-1_codes
[9] http://en.wikipedia.org/wiki/ISO_3166-1

4.3.4 Additional information on species

Table 6 The compatibility in Additional information on species

No.	Data Element	Description	Compatible with GBIF
1	Vietnamese law	Vietnamese law to protect species	
1	CITES	CITES Appendices. Enter I, II, III, or "NE" if unknown	
2	Provenance in Vietnam	A short description of provenance of the species. Possible values are: Native, Exotic, Hybrid, Unknown "hybrid" species is the mixture of plural species, which is a growing problem in the world. If an abnormal species is observed, which cannot be categorized into any existing species, or observed as the mixture of several species in morphological features, it can be categorized as the hybrid species.	
3	Invasive status	Invasive status of the species.	
4	Use	Use of the species for human.	
5	Morphological description	Morphological description of the species	
6	Classification of behavioral features	Classification of behavioral features of the species whether it	
7	Distribution in Vietnam	Description on the distribution status of the species in Vietnam	
8	Distribution in the world	Description on the distribution status of the species in the world	
9	Protection measures	Description of protection measures under implementation for the species	
10	Reproductive time	The time of reproduction for the species.	
11	Reproductive form	The form of reproduction of the species	
12	Reproductive condition	Reproductive condition of the species	
13	Development time	The time required for the development of the species.	
14	Food	The food for the species	
15	Other biological characteristics	Description of other biological characteristics	
16	Habitat	Description of the species' habitat.	
17	Ecological characteristics	Description of ecological characteristics of the species	
18	Other information related to species	Description of other information related to species	

4.3.5 Images and photos

Table 7 The compatibility in Images and photos information

No.	Data Element	Description	Compatible with GBIF
1*	Identifier	A URL that shows the image or its metadata.	YES
1	References	An html webpage that shows the image or its metadata. This link should be used for html based image viewers like FSI and should be used as a source link wherever the image is shown.	YES
2	Title	The image title	YES
3	Latitude	The WGS84 latitude in decimal degrees of the location the image was taken.	YES
4	Longitude	The WGS84 longitude in decimal degrees of the location the image was taken.	YES
5	Format	The format the image is exposed in	YES
6	Created	The date and time this image was taken	YES
7	Creator	The person that took the image	YES
8	Contributor	Any contributor in addition to the creator that helped in taking the image	YES
9	Publisher	An entity responsible for making the image available.	YES
10	Audience	A class or description for whom the image is intended or useful	YES
11	License	License for this image. Can be text or a url like creative commons uses	YES
12	Rights holder	A person or organization owning or managing rights over the image.	YES

4.4 The compatibility in Occurrence Data (Survey Data)

Occurrence is the data of specific observation or findings of a life form in the field or in the preserved collections. It is different from taxon data because a taxon data should refer to single species (thus there should be only 1 data stored in the database), but occurrence data can be any number of data for a single species based on every observed record or every piece of specimen. Therefore, occurrence data is best used for storing records in field surveys, collection at museums or research institutes, and so on. Occurrence data is also one of the important basis of biodiversity status of certain area such as in a Protected Area or in a Province. Thus occurrence data should be able to be flexibly grouped by various criteria such as the location, geographical location, event of survey, belonging organization or province, etc.

The data structure design of occurrence data in NBDS is quite complex, and is divided into following data categories. All these elements are prepared in NBDS for each (single) occurrence record.

- General information (19 elements)
- Species information (18 elements)
- Occurrence information (22 elements)
- Event information (15 elements)

- Location information (44 elements)
- Geological context (18 elements)
- Identification (8 elements)
- Additional information on occurrences (11 elements)
- Images and photos (13 elements)

4.4.1 General Information

Table 8 The compatibility in General Information

No.	Data Element	Description	Compatible with GBIF
1	Type	The nature or genre of the resource. For Darwin Core, recommended best practice is to use the name of the class that defines the root of the record.	YES
2	Date last modified	The most recent date-time on which the resource was changed. For Darwin Core, recommended best practice is to use an encoding scheme, such as ISO 8601:2004€	YES
3	Language	A language of the resource. Recommended best practice is to use a controlled vocabulary such as RFC 4646 [RFC4646].	YES
4	Rights	Information about rights held in and over the resource. Typically, rights information includes a statement about various property rights associated with the resource, including intellectual property rights.	YES
5	Rights holder	A person or organization owning or managing rights over the resource.	YES
6	Access rights	Information about who can access the resource or an indication of its security status. Access Rights may include information regarding access or restrictions based on privacy, security, or other policies.	YES
7	Bibliographic citation	A bibliographic reference for the resource as a statement indicating how this record should be cited (attributed) when used. Recommended practice is to include sufficient bibliographic detail to identify the resource as unambiguously as possible.	YES
8	References	A related resource that is referenced, cited, or otherwise pointed to by the described resource.	YES
9	Institution ID	An identifier for the institution having custody of the object(s) or information referred to in the record.	YES
10	Collection ID	An identifier for the collection or dataset from which the record was derived. For physical specimens, the recommended best practice is to use the identifier in a collections registry such as the Biodiversity Collections Index	YES
11	Dataset ID	An identifier for the set of data. May be a global unique identifier	YES

No.	Data Element	Description	Compatible with GBIF
		or an identifier specific to a collection or institution.	
12	Institution code	The name (or acronym) in use by the institution having custody of the object(s) or information referred to in the record.	YES
13	Collection code	The name, acronym, coden, or initialism identifying the collection or data set from which the record was derived.	YES
14	Dataset name	The name identifying the data set from which the record was derived.	YES
15	Owner institution code	The name (or acronym) in use by the institution having ownership of the object(s) or information referred to in the record.	YES
16*	Basis of record	The specific nature of the data record - a subtype of the dcterms:type. Recommended best practice is to use a controlled vocabulary such as the Darwin Core Type Vocabulary	YES
17	Information withheld	Additional information that exists, but that has not been shared in the given record.	YES
18	Data generalizations	Actions taken to make the shared data less specific or complete than in its original form. Suggests that alternative data of higher quality may be available on request.	YES
19	Dynamic properties	A list (concatenated and separated) of additional measurements, facts, characteristics, or assertions about the record. Meant to provide a mechanism for structured content such as key-value pairs.	YES

4.4.2 Species Information

Species information of the occurrence. This data structure is the same as 4.3.2. In other words, species information of occurrences will be the reference to taxon data structure.

4.4.3 Occurrence Information

Table 9 The compatibility in Occurrence Information

No.	Data Element	Description	Compatible with GBIF
1	Occurrence ID	An identifier for the Occurrence (as opposed to a particular digital record of the occurrence). In the absence of a persistent global unique identifier, construct one from a combination of identifiers in the record that will most closely make the occurrenceID globally unique.	YES
2	Catalog number	An identifier (preferably unique) for the record within the data set or collection.	YES
3	Occurrence remarks	Comments or notes about the Occurrence.	YES
4	Record number	An identifier given to the Occurrence at the time it was recorded. Often serves as a link between field notes and an Occurrence record, such as a specimen collector's number.	YES

No.	Data Element	Description	Compatible with GBIF
5	Collector	A list (concatenated and separated) of names of people, groups, or organizations responsible for recording the original Occurrence. The primary collector or observer, especially one who applies a personal identifier (recordNumber), should be listed first.	YES
6	Individual ID	An identifier for an individual or named group of individual organisms represented in the Occurrence. Meant to accommodate resampling of the same individual or group for monitoring purposes. May be a global unique identifier or an identifier specific to a data set.	YES
7	Individual count	The number of individuals represented present at the time of the Occurrence.	YES
8	Sex	The sex of the biological individual(s) represented in the Occurrence. Recommended best practice is to use a controlled vocabulary.	YES
9	Life stage	The age class or life stage of the biological individual(s) at the time the Occurrence was recorded. Recommended best practice is to use a controlled vocabulary	YES
10	Reproductive condition	The reproductive condition of the biological individual(s) represented in the Occurrence. Recommended best practice is to use a controlled vocabulary.	YES
11	Behavior	A description of the behavior shown by the subject at the time the Occurrence was recorded. Recommended best practice is to use a controlled vocabulary.	YES
12	Establishment means	The process by which the biological individual(s) represented in the Occurrence became established at the location. Recommended best practice is to use a controlled vocabulary.	YES
13	Occurrence status	A statement about the presence or absence of a Taxon at a Location. Recommended best practice is to use a controlled vocabulary.	YES
14	Preparations	A list (concatenated and separated) of preparations and preservation methods for a specimen.	YES
15	Disposition	The current state of a specimen with respect to the collection identified in collectionCode or collectionID. Recommended best practice is to use a controlled vocabulary.	YES
16	Other catalog numbers	A list (concatenated and separated) of previous or alternate fully qualified catalog numbers or other human-used identifiers for the same Occurrence, whether in the current or any other data set or collection.	YES
17	Previous IDentifications	A list (concatenated and separated) of previous assignments of names to the Occurrence.	YES
18	Associated media	A list (concatenated and separated) of identifiers (publication, global unique identifier, URI) of media associated with the Occurrence.	YES

No.	Data Element	Description	Compatible with GBIF
19	Associated references	A list (concatenated and separated) of identifiers (publication, bibliographic reference, global unique identifier, URI) of literature associated with the Occurrence.	YES
20	Associated occurrences	A list (concatenated and separated) of identifiers of other Occurrence records and their associations to this Occurrence.	YES
21	Associated sequences	A list (concatenated and separated) of identifiers (publication, global unique identifier, URI) of genetic sequence information associated with the Occurrence.	YES
22	Associated taxa	A list (concatenated and separated) of identifiers or names of taxa and their associations with the Occurrence.	YES

4.4.4 Event information

Table 10 The compatibility in Event Information

No.	Data Element	Description	Compatible with GBIF
1	Event ID	An identifier for the set of information associated with an Event (something that occurs at a place and time). May be a global unique identifier or an identifier specific to the data set	YES
2	Sampling protocol	The name of, reference to, or description of the method or protocol used during an Event.	YES
3	Sampling effort	The amount of effort expended during an Event.	YES
4	Event date	The date-time or interval during which an Event occurred. For occurrences, this is the date-time when the event was recorded. Not suitable for a time in a geological context. Recommended best practice is to use an encoding scheme, such as ISO 8601:2004(E).	YES
5	Time of day	The time or interval during which an Event occurred. Recommended best practice is to use an encoding scheme, such as ISO 8601:2004(E).	YES
6	Start day of year	he earliest ordinal day of the year on which the Event occurred (1 for January 1, 365 for December 31, except in a leap year, in which case it is 366).	YES
7	End day of year	The latest ordinal day of the year on which the Event occurred (1 for January 1, 365 for December 31, except in a leap year, in which case it is 366)	YES
8	Year collected	The four-digit year in which the Event occurred, according to the Common Era Calendar.	YES
9	Month collected	The ordinal month in which the Event occurred.	YES
10	Day collected	The integer day of the month on which the Event occurred.	YES
11	Verbatim event date	The verbatim original representation of the date and time	YES

No.	Data Element	Description	Compatible with GBIF
		information for an Event.	
12	Habitat	A category or description of the habitat in which the Event occurred.	YES
13	Field number	An identifier given to the event in the field. Often serves as a link between field notes and the Event.	YES
14	Field notes	One of a) an indicator of the existence of, b) a reference to (publication, URI), or c) the text of notes taken in the field about the Event	YES
15	Event remarks	Comments or notes about the Event.	YES

4.4.5 Location information

Table 11 The compatibility in Location information

No.	Data Element	Description	Compatible with GBIF
1	Location ID	An identifier for the set of location information (data associated with dcterms:Location). May be a global unique identifier or an identifier specific to the data set.	YES
2	Higher geography ID	An identifier for the geographic region within which the Location occurred. Recommended best practice is to use an persistent identifier from a controlled vocabulary such as the Getty Thesaurus of Geographic Names.	YES
3	Higher geography	A list (concatenated and separated) of geographic names less specific than the information captured in the locality term.	YES
4	Continent	The name of the continent in which the Location occurs. Recommended best practice is to use a controlled vocabulary such as the Getty Thesaurus of Geographic Names or the ISO 3166 Continent code.	YES
5	Water body	The name of the water body in which the Location occurs. Recommended best practice is to use a controlled vocabulary such as the Getty Thesaurus of Geographic Names.	YES
6	Island group	The name of the island group in which the Location occurs. Recommended best practice is to use a controlled vocabulary such as the Getty Thesaurus of Geographic Names.	YES
7	Island	The name of the island on or near which the Location occurs. Recommended best practice is to use a controlled vocabulary such as the Getty Thesaurus of Geographic Names.	YES
8	Country	The name of the country or major administrative unit in which the Location occurs. Recommended best practice is to use a controlled vocabulary such as the Getty Thesaurus of Geographic Names.	YES
9	Country code	The standard code for the country in which the Location	YES

No.	Data Element	Description	Compatible with GBIF
		occurs. Recommended best practice is to use ISO 3166-1-alpha-2 country codes.	
10	Province	The name of the next smaller administrative region than country (state, province, canton, department, region, etc.) in which the Location occurs.	YES
11	District	The full, unabbreviated name of the next smaller administrative region than stateProvince (county, shire, department, etc.) in which the Location occurs.	YES
12	Municipality	The full, unabbreviated name of the next smaller administrative region than county (city, municipality, etc.) in which the Location occurs. Do not use this term for a nearby named place that does not contain the actual location.	YES
13	Locality	The specific description of the place. Less specific geographic information can be provided in other geographic terms (higherGeography, continent, country, stateProvince, county, municipality, waterBody, island, islandGroup). This term may contain information modified from the original to correct perceived errors or standardize the description	YES
14	Verbatim locality	The original textual description of the place.	YES
15	Verbatim elevation	The original description of the elevation (altitude, usually above sea level) of the Location.	YES
16	Minimum elevation (m)	The lower limit of the range of elevation (altitude, usually above sea level), in meters.	YES
17	Maximum elevation (m)	The upper limit of the range of elevation (altitude, usually above sea level), in meters.	YES
18	Verbatim depth	The original description of the depth below the local surface.	YES
19	Minimum depth (m)	The lesser depth of a range of depth below the local surface, in meters	YES
20	Maximum depth (m)	The greater depth of a range of depth below the local surface, in meters.	YES
21	Minimum distance above surface (m)	The lesser distance in a range of distance from a reference surface in the vertical direction, in meters. Use positive values for locations above the surface, negative values for locations below. If depth measures are given, the reference surface is the location given by the depth, otherwise the reference surface is the location given by the elevation	YES
22	Maximum distance above surface (m)	The greater distance in a range of distance from a reference surface in the vertical direction, in meters. Use positive values for locations above the surface, negative values for locations below. If depth measures are given, the reference surface is the location given by the depth, otherwise the reference surface is the location given by the elevation.	YES
23	Location according to	Information about the source of this Location information. Could be a publication (gazetteer), institution, or team of	YES

No.	Data Element	Description	Compatible with GBIF
		individuals.	
24	Location remarks	Comments or notes about the Location.	YES
25	Verbatim coordinates	The verbatim original spatial coordinates of the Location. The coordinate ellipsoid, geodeticDatum, or full Spatial Reference System (SRS) for these coordinates should be stored in verbatimSRS and the coordinate system should be stored in verbatimCoordinateSystem.	YES
26	Verbatim latitude	The verbatim original latitude of the Location. The coordinate ellipsoid, geodeticDatum, or full Spatial Reference System (SRS) for these coordinates should be stored in verbatimSRS and the coordinate system should be stored in verbatimCoordinateSystem.	YES
27	Verbatim longitude	The verbatim original longitude of the Location. The coordinate ellipsoid, geodeticDatum, or full Spatial Reference System (SRS) for these coordinates should be stored in verbatimSRS and the coordinate system should be stored in verbatimCoordinateSystem.	YES
28	Verbatim coordinate system	The spatial coordinate system for the verbatimLatitude and verbatimLongitude or the verbatimCoordinates of the Location. Recommended best practice is to use a controlled vocabulary.	YES
29	Verbatim srs	The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which coordinates given in verbatimLatitude and verbatimLongitude, or verbatimCoordinates are based. Recommended best practice is use the EPSG code as a controlled vocabulary to provide an SRS, if known. Otherwise use a controlled vocabulary for the name or code of the geodetic datum, if known. Otherwise use a controlled vocabulary for the name or code of the ellipsoid, if known. If none of these is known, use the value "unknown".	YES
30	Latitude	The geographic latitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are north of the Equator, negative values are south of it. Legal values lie between -90 and 90, inclusive.	YES
31	Longitude	The geographic longitude (in decimal degrees, using the spatial reference system given in geodeticDatum) of the geographic center of a Location. Positive values are east of the Greenwich Meridian, negative values are west of it. Legal values lie between -180 and 180, inclusive.	YES
32	Geodetic datum	The ellipsoid, geodetic datum, or spatial reference system (SRS) upon which the geographic coordinates given in decimalLatitude and decimalLongitude as based. Recommended best practice is use the EPSG code as a controlled vocabulary to provide an SRS, if known. Otherwise use a controlled vocabulary for the name or code of the geodetic datum, if known. Otherwise use a controlled	YES

No.	Data Element	Description	Compatible with GBIF
		vocabulary for the name or code of the ellipsoid, if known. If none of these is known, use the value "unknown".	
33	Coordinate uncertainty in meters	The horizontal distance (in meters) from the given decimalLatitude and decimalLongitude describing the smallest circle containing the whole of the Location. Leave the value empty if the uncertainty is unknown, cannot be estimated, or is not applicable (because there are no coordinates). Zero is not a valid value for this term.	YES
34	Coordinate precision	A decimal representation of the precision of the coordinates given in the decimalLatitude and decimalLongitude.	YES
35	Point radius spatialfit	The ratio of the area of the point-radius (decimalLatitude, decimalLongitude, coordinateUncertaintyInMeters) to the area of the true (original, or most specific) spatial representation of the Location. Legal values are 0, greater than or equal to 1, or undefined. A value of 1 is an exact match or 100% overlap. A value of 0 should be used if the given point-radius does not completely contain the original representation. The pointRadiusSpatialFit is undefined (and should be left blank) if the original representation is a point without uncertainty and the given georeference is not that same point (without uncertainty). If both the original and the given georeference are the same point, the pointRadiusSpatialFit is 1.	YES
36	Footprint WKT (Well-Known Text)	A Well-Known Text (WKT) representation of the shape (footprint, geometry) that defines the Location. A Location may have both a point-radius representation (see decimalLatitude) and a footprint representation, and they may differ from each other.	YES
37	Footprint SRS (Spatial Reference System)	A Well-Known Text (WKT) representation of the Spatial Reference System (SRS) for the footprintWKT of the Location. Do not use this term to describe the SRS of the decimalLatitude and decimalLongitude, even if it is the same as for the footprintWKT - use the geodeticDatum instead.	YES
38	Footprint spatial fit	The ratio of the area of the footprint (footprintWKT) to the area of the true (original, or most specific) spatial representation of the Location. Legal values are 0, greater than or equal to 1, or undefined. A value of 1 is an exact match or 100% overlap. A value of 0 should be used if the given footprint does not completely contain the original representation. The footprintSpatialFit is undefined (and should be left blank) if the original representation is a point and the given georeference is not that same point. If both the original and the given georeference are the same point, the footprintSpatialFit is 1.	YES
39	Georeferenced by	A list (concatenated and separated) of names of people, groups, or organizations who determined the georeference (spatial representation) for the Location.	YES
40	Georeferenced date	The date on which the Location was georeferenced.	YES

No.	Data Element	Description	Compatible with GBIF
		Recommended best practice is to use an encoding scheme, such as ISO 8601:2004(E).	
41	Georeference protocol	A description or reference to the methods used to determine the spatial footprint, coordinates, and uncertainties.	YES
42	Georeference sources	A list (concatenated and separated) of maps, gazetteers, or other resources used to georeference the Location, described specifically enough to allow anyone in the future to use the same resources	YES
43	Georeference verification status	A categorical description of the extent to which the georeference has been verified to represent the best possible spatial description. Recommended best practice is to use a controlled vocabulary.	YES
44	Georeference remarks	Notes or comments about the spatial description determination, explaining assumptions made in addition or opposition to the those formalized in the method referred to in georeferenceProtocol.	YES

4.4.6 Geological context

Table 12 The compatibility in Geological context

No.	Data Element	Description	Compatible with GBIF
1	Geological context ID	An identifier for the set of information associated with a GeologicalContext (the location within a geological context, such as stratigraphy). May be a global unique identifier or an identifier specific to the data set	YES
2	Earliest eon or lowest eonothem	The full name of the earliest possible geochronologic eon or lowest chrono-stratigraphic eonothem or the informal name ("Precambrian") attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
3	Latest eon or highest eonothem	The full name of the latest possible geochronologic eon or highest chrono-stratigraphic eonothem or the informal name ("Precambrian") attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
4	Earliest era or lowest erathem	The full name of the earliest possible geochronologic era or lowest chronostratigraphic erathem attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
5	Latest era or highest erathem	The full name of the latest possible geochronologic era or highest chronostratigraphic erathem attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
6	Earliest period or lowest	The full name of the earliest possible geochronologic period or	YES

No.	Data Element	Description	Compatible with GBIF
	system	lowest chronostratigraphic system attributable to the stratigraphic horizon from which the cataloged item was collected.	
7	Latest period or highest system	The full name of the latest possible geochronologic period or highest chronostratigraphic system attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
8	Earliest epoch or lowest series	The full name of the earliest possible geochronologic epoch or lowest chronostratigraphic series attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
9	Latest epoch or highest series	The full name of the latest possible geochronologic epoch or highest chronostratigraphic series attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
10	Earliest age or lowest stage	The full name of the earliest possible geochronologic age or lowest chronostratigraphic stage attributable to the stratigraphic horizon from which the cataloged item was collected.	YES
11	Latest age or highest stage	The full name of the latest possible geochronologic age or highest chronostratigraphic stage attributable to the stratigraphic horizon from which the cataloged item was collected	YES
12	Lowest biostratigraphic zone	The full name of the lowest possible geological biostratigraphic zone of the stratigraphic horizon from which the cataloged item was collected.	YES
13	Highest biostratigraphic zone	The full name of the highest possible geological biostratigraphic zone of the stratigraphic horizon from which the cataloged item was collected.	YES
14	Lithostratigraphic terms	The combination of all litho-stratigraphic names for the rock from which the cataloged item was collected.	YES
15	Group	The full name of the lithostratigraphic group from which the cataloged item was collected.	YES
16	Formation	The full name of the lithostratigraphic formation from which the cataloged item was collected.	YES
17	Member	The full name of the lithostratigraphic member from which the cataloged item was collected.	YES
18	Bed	The full name of the lithostratigraphic bed from which the cataloged item was collected.	YES

4.4.7 Identification

Table 13 The compatibility in Identification

No.	Data Element	Description	Compatible with GBIF
1	Identification ID	An identifier for the Identification (the body of information associated with the assignment of a scientific name). May be a global unique identifier or an identifier specific to the data set.	YES
2	Identified by	A list (concatenated and separated) of names of people, groups, or organizations who assigned the Taxon to the subject.	YES
3	Date IDentified	The date on which the subject was identified as representing the Taxon. Recommended best practice is to use an encoding scheme, such as ISO 8601:2004(E).	YES
4	Identification references	A list (concatenated and separated) of references (publication, global unique identifier, URI) used in the Identification.	YES
5	Identification verification status	A categorical indicator of the extent to which the taxonomic identification has been verified to be correct. Recommended best practice is to use a controlled vocabulary such as that used in HISPID/ABCD.	YES
6	Identification remarks	Comments or notes about the Identification.	YES
7	Identification qualifier	A brief phrase or a standard term ("cf.", "aff.") to express the determiner's doubts about the Identification.	YES
8	Type status	A list (concatenated and separated) of nomenclatural types (type status, typified scientific name, publication) applied to the subject.	YES

4.4.8 Additional information on occurrences

Table 14 The compatibility in Additional informatino on occurrences

No.	Data Element	Description	Compatible with GBIF
1	Preservation method of reference	Method of preservation of collected sample for further reference.	
2	Air temperature	Ambient air temperature when the species was found / observed.	
3	Water temperature	Water temperature when the species was found / observed (in the water).	
4	Weather	Weather conditions when the species was found / observed.	
5	Water pH	pH of water when the species was found / observed (for species in water).	
6	Water DO	DO value of water when the species was found / observed (for species in water)	
7	Water conductivity	Conductivity of the water	
8	Water salinity	Salinity of the water in percentage of salt or the word of	

No.	Data Element	Description	Compatible with GBIF
		salinities.	
9	Water orp		
10	Soil pH	pH of soil when the species was found / observed (for plants).	
11	Soil moisture	Moisture of the soil where the species was found / observed (for plants)	

4.4.9 Images and photos

The data structure of images and photos of occurrence is the same as 4.3.5. It should be possible to store multiple images per each occurrence data.

4.5 The compatibility in Ecosystems Diversity Data

The data structure of ecosystems diversity is basically the list of certain areas in Vietnam (such as protected areas, districts, geographical ranges, or sub-areas inside them) and their containing ecosystems. NBDS has the following data structure for the ecosystems information. This data should be accumulated for any occurrence of ecosystem in Vietnam, typically for protected areas but are not limited to it.

Table 15 The compatibility in Ecological data

No.	Data Element	Description	Compatible with GBIF
1	Ecosystem type	Short description of the type of ecosystem	YES
2*	Name	Name of the ecosystem	YES
3	Area	Covering area of the ecosystem	YES
4	References	Any reference materials for the ecosystem	YES
5	Description	Detailed description of the ecosystem	YES
6*	Ecosystem classification	Standard ecosystem classification according to UNESCO, NOAA, and Ramsar (See below)	YES
7	Sites	Reference to survey or monitoring sites in the ecosystem	YES

In this data structure, ecosystem classification is an important element NBDS adopts the following international standards for ecosystems classification.

- UNESCO Vegetation classification system .. For terrestrial ecosystems classification
- NOAA CMECS (Coastal and Marine Ecological Classification Standard) … For marine ecosystems classification
- Ramsar Convention Classification System for Wetland Type … For wetland ecosystems classifications

V. GBIF TOOLS FOR DATA EXCHANGE BETWEEN DATA PROVIDERS AND GBIF

To facilitate data providers to facilitate data providers to upload their data to GBIF. Explanations for these tools are as follows.

5.1 Integrated Publishing Toolkit (IPT2)

5.1.1 Introduction to IPT2

The GBIF Integrated Publishing Toolkit (IPT) is a freely available open source web application that makes it easy to share four types of biodiversity-related information:

- primary taxon occurrence data
- taxon checklists
- sampling event data
- general metadata about data sources.

An IPT instance as well as the data and metadata registered through the IPT are connected to the GBIF Registry, are indexed for consultation via the GBIF network and portal, and are made accessible for public use. Several factors have provided motivation for GBIF to lead the development of the IPT:

- limitations of previous publishing tools (DiGIR, TAPIR, BioCASE) to easily publish and transfer large datasets;
- the need to reduce the load on both the publisher's server, and GBIF's server during indexing. The reason being that indexing from DiGIR, TAPIR, or BioCASE caused heavy loads due to repeated HTTP request-response interactions.
- the need to speed up the process of indexing biodiversity occurrence datasets;
- the need to offer additional benefits and services to the data publishers to encourage data publication;
- the lack of appropriate tools to publish certain types of biodiversity data, such as names checklists and data set metadata.

5.1.2 Main funtions of IPT2

The guiding design principles of the IPT were to support how data publishers actually use their own databases, and to facilitate the public sharing of datasets with the fewest possible obstacles. As a result of these goals, the IPT was built to support simple publisher workflows, including the following feature and steps that publishers need to complete:

- Support multiple users with distinct permissions to administer the software and to manage the resources it hosts.
- Upload source data as a delimited text file or connect to a database.
- Map the terms (*e.g.*, fields or headers in a database or spreadsheet) from the source dataset to the terms in the Darwin Core standard.

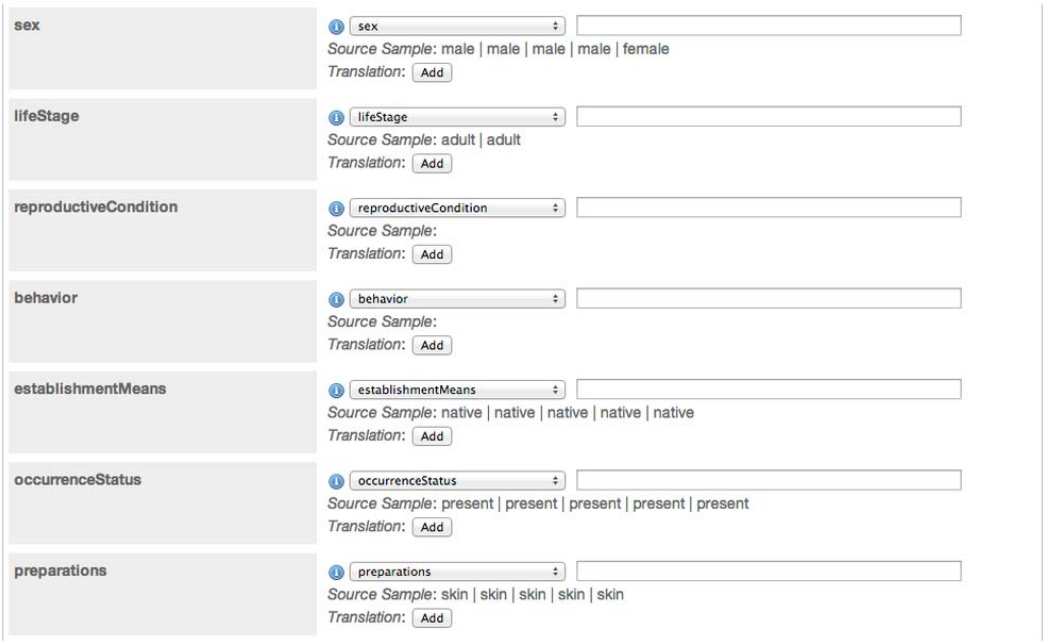

Figure 4 Maping local field headings to Darwin Core terms

In the Figure 4, The Darwin Core term names are on the left and terms loaded from a database or spreadsheet on the right, which are selected using dropdown menus. Fields that have the same name string in both Darwin Core and the publisher dataset are matched automatically, while those that do not match must be selected manually (via adrop-down list) by the “data publisher”

- Enter dataset metadata that specify scope, methodology, ownership, rights, etc.
- Produce a Darwin Core Archive and a publicly accessible web page that shows the metadata and links to the archive and other documents that were created.

Cowan Tetrapod Collection - Birds

The Cowan Tetrapod Collection avian holdings of 1,803 species represent 160 families is comprised of over 16,500 study skins, 820 skeletons, 600 mounts, and 7,735 egg clutches. The oldest specimens date from the late 1840s and several extinct taxa are represented. Global in scope, the collection is especially strong in specimens collected from Western Canada, Mexico (especially Ilsas Tres Marias), and the former Transvaal region of South Africa. The collection was founded by Dr. Ian McTaggart-Cowan and his father-in-law Kenneth Racey. Notable collections include those of H.R. Macmillan, W.S. Maguire, A.C. Brooks, and W.J. Plowden-Wardlaw. The avian collection is housed at the University of British Columbia Beaty Biodiversity Museum which contains approximately 2 million natural history specimens.

Summary	**Date Published**	May 4, 2013
	Version	11 (Latest)
	Darwin Core Archive	download (1,295 KB) 18,970 records
	EML	download (8 KB)
	RTF	download (7 KB)
	GBIF Registration	ba0c046d-52bb-4262-a495-652988c9f3f7
	Organisation	University of British Columbia
	Endorsing Node	Canada
Language	**Metadata Language**	English
	Resource Language	English
External Links	**Resource Homepage**	http://www.beatymuseum.ubc.ca/collections/vertebrate
Resource Contact	**Name**	Ildiko Szabo
	Position	Assistant Curator
	Organisation	University of British Columbia Beaty Biodiversity Museum
	Address	2212 Main Mall, Vancouver, BC, CANADA, Postal Code: V6T 1Z4
	Contact	ildiko@zoology.ubc.ca
	Home Page	http://beatymuseum.ubc.ca/collections/vertebrate

Figure 5 Example of an IPT summary page displaying some of the metadata provided for the dataset hosted by VertNet for the Cowan Tetrapod Collection of birds

- Register datasets with the GBIF registry (http://www.gbif.org/dataset) so they are discoverable and can be harvested for indexing by GBIF and others.

5.1.3 Simple Darwin Core and Extensions

The IPT supports the publication of two types or "cores" of Darwin Core Archives. The first and most common type is the Occurrence Core, which consists of occurrence records (*e.g.*, museum specimens or observations). The second type is the Taxon Core, which is used for checklists, and contains taxon records (*e.g.*, a record of the occurrence of a species, as opposed to the occurrence of an individual organism of that species in nature). Darwin Core Archives created for taxon checklists have the same advantages as archives for occurrence datasets – easy mobilization, aggregation, and interoperability.

The majority of occurrence and taxon data can be represented as Simple Darwin Core (http://rs.tdwg.org/dwc/terms/simple/): a flat file specification with rows and columns. Both the Occurrence Core (http://rs.gbif.org/core/dwc_occurrence.xml) and Taxon Core (http://rs.gbif.org/core/dwc_taxon.xml) are Simple Darwin Core representations with their own subset of Darwin Core terms.

However, the data are often richer than can be structured in a flat, Simple Darwin Core

record, thus data publishers needed a way to represent that richness. The mechanism in the IPT for adding this richness to a Darwin Core Archive is known as an "extension". GBIF maintains a registry of such extensions (http://rs.gbif.org/extension/) that can be used in the IPT. Extension records are meant to be related many-to-one to core records, constituting a star (http://www.dwhworld.com/dwh-schemas/) in Darwin Core Archives. In this way, data such as multiple images, measurements, or identifications, can be associated many-to-one with a single occurrence record. Information within a Darwin Core Archive, from linked extension data all the way up to the metadata for the entire dataset, provide a semantically rich aggregation that lends itself well to the notion of a reusable and linkable Research Object [22].

Prior to Darwin Core Archives and extensions, related information of this nature in Darwin Core (but not in other data standards such as ABCD [23]), relied on multiple entries concatenated into a single field. For example, Darwin Core offers the term *dwc:associatedMedia*, in which links to all media associated with a specimen can be added, with each link separated by a delimiter. Media objects themselves, however, are complex, having their own title, description, and rights. For the example of media, the Simple Multimedia Extension (http://rs.gbif.org/extension/gbif/1.0/multimedia.xml) now provides the means to share this richer information. In a Darwin Core Archive, this is done by relating a key identifying field in the extension to the unique id of a record in the core, whether an Occurrence Core or a Taxon Core.

Unlike the Simple Multimedia extension, which can be related to either an Occurrence Core or a Taxon Core, some extensions are specific to one core data type. The Germplasm extension (http://rs.gbif.org/extension/germplasm/20120911/), for example, is a means to relate Darwin Core Occurrence records with Multi-Crop Passport descriptors (http://www.bioversityinternational.org/uploads/tx_news/1526.pdf) through a distinct vocabulary maintained by the plant genetic resources community. For taxonomic checklists, the IPT provides a set of extensions, constituting the Global Names Architecture (GNA) profile (http://www.gbif.org/resources/2562), which links species to vernacular names, geographic distributions represented as ranges, type designations, and bibliographic references. Extensions allow a specialized subset of the broader community to expand upon the capabilities for biodiversity data sharing within their domain.

Main steps for describing the extension creation process are:

- Create initial vocabularies and make terms available via the GBIF resource registry,
- Properly encode the terms in XML format so that they can be parsed by vocabulary management tools that GBIF maintains
- Load the extension into the GBIF resource registry.

GBIF and the community of developers provide some oversight to assure that extensions provide useful services. The most difficult part of the creation of a new extension is in the management of vocabularies and the assurance that terms used within extensions are developed according to best practices, such as the Simple Knowledge Organization System (SKOS) framework (http://www.w3.org/2004/02/skos/) for describing and resolving concepts and terms.

5.2 GBIF Excel Templates

The GBIF Excel Templates are MS Excel spreadsheets that support biodiversity data entry in a standardized format. There is one template for each of the three classes of biodiversity data: Checklist data, Occurrence Data, Sampling Event Data. To publish the data through the GBIF network, upload the templates to the GBIF Integrated Publishing Toolkit (IPT). To enter dataset metadata, use the IPT's built-in metadata editor.

5.3 Darwin Core Archive Assistant

The Darwin Core Archive Assistant is a web application that presents a simple interface for describing the data elements a data publisher wishes to serve to the GBIF network as basic text files and composes the appropriate XML descriptor file as defined in the Darwin Core Text Guidelines to accompany them. It communicates with the GBIF registry to provide an up-to-date listing of all relevant Darwin Core terms and available extensions and presents these in a simple checklist format.

The Darwin Core is a body of standards that include a set of terms relating to taxa and their occurrence in nature, and a set of practices regarding the use of these terms in the publication of biodiversity data and information. GBIF has adopted a text-based solution for using Darwin Core that both simplifies and extends the publication of species and species-occurrence data. This format is referred to as a Darwin Core Archive (DWCA) and provides a relatively non-technical option for publishing biodiversity data that does not require complicated installations of data publication software. Darwin Core Archives can be published via a simple web address or URL.

Darwin Core Archives support the publication of enriched data types that extend the core terms while retaining the relatively simple, text-based data format. These extensions, however, require the inclusion of an XML descriptor file (meta.xml) that serves as a map to the different files and data elements in the archive. Many biologists and data managers find working with XML challenging while otherwise finding the technical threshold for producing Darwin Core Archives quite low.

5.4 Darwin Core Archive Validator

The validator is a tool to test Darwin Core Archives as specified in the Darwin Core Text Guidelines. Due to the simplicity of the archives GBIF encourages publishers to create them using simple custom scripts. Therefore the need arises to provide a testing framework for developers to make sure GBIF and others can read the information as expected.

The validator uses the official XML schema to validate the meta.xml descriptor, but additionally it uses the Darwin Core Archive Reader java library to validate the content against the known extensions and terms registered within the GBIF network for sharing biodiversity data. GBIF runs a production and a development registry that keeps track of extensions, both of which are used by this validator.

GBIF recommends to bundle an Ecological Markup Language (EML) xml file with an archive. As EML is a rather large and complex schema GBIF has specified a GBIF profile that uses a subset of EML 2.1.1 and also declares specific additions to EML within the generic additionalMetadata section of EML. Every valid GBIF profile document should therefore always be valid according to the official EML schema. The EML validation is done according those two xml schemas.

5.5 Name Parser

A simple html form using the ECAT name parser webservice. The parser is written in java and based on regular expressions to disect name strings into its components. It does only keep name parts required to reconstruct a full 3-parted name with an optional subgenus, but ignores additional infraspecific parts such as the subspecies given for varieties.

VI. CONCLUSIONS

This document reports the compatibility of Vietnam National Biodiversity Database System (NBDS) and Global Biodiversity Information Facilities (GBIF) in data sharing machenism. Our conclusion is that NBDS of Vietnam is ready to connect and share data with GBIF.

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