Disaster and Biodiversity

IUBS Triennial Program"DAB"
in cooperation with
Biodiversity Network Japan

International Symposium
&
Workshop

Abstract

国際生物科学連合・生物多様性JAPAN 主催
国際シンポジウム ＆ ワークショップ

大規模自然災害と生物多様性

Tohoku University, Katahira Campus, Building D04,
6-9 September, 2014

Organized by
International Union of Biological Sciences (IUBS)
Biodiversity Network, Japan (BDNJ)

Supporters
International Union for Conservation of Nature (IUCN)
Japan Association of Botanical Gardens (JABG)
Center for Ecological Adaptability, Tohoku University (CEATU)
Ministry of Environment, Japan
IUBS Committee of Science Council of Japan

Financially supported by: Japan Fund for
Global Environment of the Environmental Restoration and Conservation Agency

IUBS/BDNJ Joint International Symposium and Workshop on Disaster and Biodiversity

IUBS Triennial Program DAB 2014
in cooperation with Biodiversity Network, Japan

Main Symposium and Workshop at Tohoku University, Katahira Campus
plus field excursion in Fukushima area
Date: 6-9 September, 2014

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「災害と生物多様性」国際シンポジウム・ワークショップ

主催：国際生物科学連合（IUBS）
　　　生物多様性 JAPAN（BDNJ）
後援：国際自然保護連合（IUCN）
　　　公益社団法人日本植物園協会（JABG）
　　　東北大学生態適応センター（CEATU）
協力：環境省
　　　日本学術会議 IUBS 分科会
資金協力：独立行政法人環境再生保全機構地球環境基金
　　　　　IUBS

Contents

Greetings from BDNJ

Kunio Iwatsuki
Representative, Biodiversity Network Japan

This symposium is open at Sendai, one of the cities seriously attacked by the Great East Japan Earthquake on March 11th, 2011. The reconstruction project is managed by great efforts of the government of Japan as well as of all the local governments concerned in addition to the activities of the local people themselves, and we hope the daily lives of the people in this area will come up more comfortable day by day.

Just after the Great East Japan Earthquake, Biodiversity Network Japan (BDNJ) hurriedly held a symposium entitled 'The Disaster and Biodiversity' on July 10th, 2011. Biodiversity under natural disasters has been surveyed from various viewpoints, and a resolution of the symposium to seriously consider the recovery of biodiversity on the way of general recovery project from the earthquake was proposed and handed to the Minister of the Environment at that time, Mr. Satsuki Eda. As we have as yet no full information on the biodiversity in relation to natural disasters, it is a pity to note that biodiversity recovery is not very seriously considered even in the case of the recovery project from the Great East Japan Earthquake.

In this symposium, it is designed that we should learn 1) the facts on biodiversity how it is influenced by natural disasters, 2) management of natural history specimens to be damaged by disasters, and 3) introduction of ever-made successful or even unsuccessful examples of biodiversity recovery procedures from different types of damages by natural disasters. I sincerely hope that we will enrich our information on biodiversity in relation to natural disasters, especially concerning to the above items, and, based on rich information we will have in this symposium, we would propose constructive ideas to recovery projects from any natural disasters, in the past and/or in future.

I cordially thank IUBS and Japan Fund for Global Environment for collaboration and financial support, and Tohoku University for providing conference facilities. Deep gratitude is also extended to all the supporters and contributors.

Aims and perspectives of IUBS Current Program DAB

Harufumi Nishida
DAB Leader
IUBS Committee SCJ Member
BDNJ Secretary General

The Great East Japan Earthquake that occurred on 11 March, 2011 followed by the collapse of the Fukushima Atomic Power Plant not only destroyed local human life and properties, but also seriously damaged biodiversity and primary industry of the area. Furthermore, many local museums and biological specimens were also lost or damaged. The local biodiversity and biological records are a part of global biological resources that insure future sustainability, and best be inherited to the next generation as good as possible. Japan has paid large attention to biodiversity, e.g., renewing four times the National Biodiversity Strategy since 1995. However, the 3.11 disaster clarified the lack of national academic and social systems that could continuously monitor local biodiversity and biological information to provide necessary data for urgent rescue activities of various aspects and fields. It is also an urgent need to establish a protocol for precautious measures in case of future disasters. Based on the experience in Japan the DAB project aims to accumulate similar problems worldwide in order to present a standard measures and policy from various aspects for minimizing disaster influences.

Objectives

The Japanese Tsunami and Earthquake disaster and further collapse of the Fukushima Atomic Power Plant in March 2011 evoked national movement to monitor the loss and recovery of biodiversity and related biological resources in local (affected) environments. The disaster also damaged many local museums and preserved biological specimens, including type specimens. Various natural disasters and related human-invoked chain disasters, such as one in Fukushima, and even wars, not only influence local biodiversity and bio-resources, but also damage biological records which should be kept safely for the future generations. The biological communities have never taken an international action to discuss about the influence of such disasters, recovery process, and future precautional approaches.

DAB intends to summarize recent disaster-related biodiversity loss, influence on the primary production (agriculture, fishing .. etc.), damages to biological information and records, their rescue and recovery process, then tries to establish an international protocol for establishing an effective logistics to minimize disaster influences based on precautional risk management.

DAB background

One of the peculiar features of the current human and earth history is that human activities have reached to the level that could cause disasters. Possibly originated from human activities, huge storms, sea-water raise, and other unpredictable climate fluctuations caused serious biodiversity loss which is disadvantageous to the local as well as global life and economy. Recent natural disasters that have occurred worldwide, though incidental, even caused human-based second disasters such as the Fukushima atomic pollution. Disasters, irrespective of natural or anthropogenic, destroy local biodiversity, ecosystems that provide ecological services and human life and culture. The 3.11 earthquake and subsequent disasters in Japan in 2011 gave us an opportunity to think and act seriously and globally on this issue. Similar disasters have recently occurred in many countries. It is time that international academic societies should deal with this issue cooperatively.

Action plan for the IUBS triennium 2013-1015

The IUBS Committee of the Science Council of Japan, Term 22nd, had its first meeting on April 22, 2012, where the first discussion on proposing the DAB program to IUBS was opened. The proposal was accepted by IUBS at the IUBS General Assembly in China in July, 2012. The DAB action was planned as below. The present program for the first year of triennium started in 2013 to organize an international working group to summarize recent information related to DAB worldwide in order to address the activities for the next two years. Details of the project plan can also be referred to at the IUBS web site: http://www.iubs.org/prg/dab.html

Proposed Action Plan

2013: Start a DAB Working Group (WG) consisting of Japanese members and up to five selected international members. To start with, one workshop meeting will be held in Japan.

2014: Organize at least one workshop and one international symposium. The frequency of the workshops and the meeting places will be decided in 2013 workshop. The symposium can be held either in Japan or other countries depending on national fund-raising results and the amount of IUBS funding.

2015: At least one workshop for editing a publication of the results. The final goal of this triennium is to issue a publication on DAB at the end of 2015.

Articles published on DAB topic at the time of DAB proposal in 2012:

As the topic is rather novel based on recent incidents, only a limited number of articles are published in Japanese.

Iwatsuki, K. and Domoto, A. (eds.) 2012. Saigai to Seibututayousei (Disaster and Biodiversity). Biodiversity Network of Japan, Tokyo. 150 pp. (in Japanese, partial English translation published in 2013)

Harufumi Nishida. 2011. Why we should take care of museums and specimens after the catastrophic disaster? In: Academic response to the Great East Japan Earthquake. Trends in the Sciences 16(12): 34-35, Japan Science Support Foundation, Tokyo. (in Japanese)

According to the action plan the first domestic workshop was held in December 2013 at Chuo University, Tokyo. The international workshop gathered at the same place in January 2014. Present international symposium is planned and organized based on discussions at these workshops. I sincerely hope that the present meeting would be fruitful, and contributive to any future activities aiming biodiversity monitoring, conservation and resilience against catastrophic disasters.

DAB: Disaster and Biodiversity Program 2014

DAB International Symposium

Date: September 6 -9, 2014
Venue: Tohoku University (Katahira Campus), Sendai, Japan
at Lecture Room, Graduate School of Life Science Project Building (D04), 1st Floor
東北大学片平キャンパス　生命科学研究科プロジェクト棟１階講義室
Language: English

Organizers:
International Union of Biological Science (IUBS) and Biodiversity Network, Japan (BDNJ)
Supporting Organizations:
IUCN (International Union of Conservation of Nature)
JABG (Japan Association of Botanical Gardens)
CEATU (Center for Ecological Adaptability, Tohoku University)
Ministry of the Environment
I UBS Committee of Science Council of Japan

Financially Supported by
IUBS
Japan Fund for Global Environment of the Environmental Restoration and Conservation Agency
Leaders: Prof. Harufumi Nishida, Chuo University and Prof. Jun Yokoyama, Yamagata University

Program (subject to change)

Day 1 (Sept. 5)
Arrival to Sendai (Airport or JR Sendai Sta.), Hotel check-in and registration

Day 2 (Sept. 6) General workshop

11:00-12:00 Registration
12:00-13:00 Lunch (Registration continues)
13:00-13:05 Opening greetings: Prof. Hiroyuki Takeda, University of Tokyo; IUBS Secretary General; Chair of IUBS Committee, SCJ
13:05-13:10 Greetings: Dr. Kunio Iwatsuki, BDNJ Representative
13:10-13:30 Purpose and scope of DAB project: Prof. Harufumi Nishida; Chuo University, IUBS DAB Leader, BDNJ Secretary General
13:30-13:45 Addressing the workshop: Prof. Jun Yokoyama, Yamagata University

13:45-14:30 WS1 : Disasters influence to biodiversity: Prof. Jun Yokoyama, Yamagata University

14:30-15:15 WS2 : The importance of natural history collections and disaster preparedness and response for museums: Dr. Mahoro Suzuki, Iwate Prefectural Museum, and Dr. Makoto Manabe, National Museum of Nature and Science

"Salvage and restoration of natural history collections damaged by tsunami in Japan 2011"

(15:15-16:00 Break)

16:00-17:00 General Discussion*

*WS3 : Biodiversity-harmonious disaster recovery process: Dr. Satoquo Seino, Kyushu University: Members of WS3 will also visit field in Sendai coast in the morning and in the afternoon on 6th

18:30-20:00 Dinner Hana 波奈（予定） http://r.gnavi.co.jp/t060002/

Tel: 05057984715

<u>**Day 3 (Sept. 7) Open public symposium "Disaster and Biodiversity"**</u>

Speakers may change due to entire program schedule

08:30- Audience registration

09:00-09:05 Welcome speech Akiko Domoto (Member of BDNJ)

09:05-09:10 Welcome speech Toru Nakashizuka (Tohoku University)

09:10-09:15 Welcome speech Naoki Nakayama (Ministry of Environment)

09:15-09:30 Opening address Harufumi Nishida (IUBS DAB Leader)

09:30-09:45 Aims of the Symposium Jun Yokoyama (Yamagata University)

(09:45-10:00 Break)

Disasters influence to biodiversity (WS 1): Chaired by Jun Yokoyama

10:00-10:30 Steven Wagstaff (New Zealand: Landcare Research): Impacts of natural disaster on biodiversity in New Zealand

10:30-11:00 Kaiyun Guan (China: Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences): "Disasters and biodiversity in China"

11:00-11:30 Patricio Lopez (Chile: Department of Botany, University of Concepción): "Natural disaster in Chile, effects on Chilean biodioversity"

11:30-12:00 Discussion 1

(12:00-13:00 Lunch)

The importance of natural historical records and collection preservation (WS2): Chaired by Masahiro Ôhara

13:00-13:30 Masahiro Ôhara, Naoki Inari (Japan: Hokkaido Univerity) & Norio Kobayashi (Japan: Saitama Prefectural University): "Importance of museum specimen collections and monitoring of local biodiversity"

13:30-14:00 Chris Collins and Clare Valentine (UK: Natural History Museum): "Building a Disaster Recovery Team – What happens when the lights go out?"

14:00-14:30 Paul Callomon (USA: Academy of Natural Sciences of Drexel University) and Catharine Hawks (USA: National Museum of Natural History, Smithsonian Institution): "Why we keep these things: specimen data and meaning"

(14:30-14:45 Break)

Biodiversity-harmonious disaster recovery process (WS3): Chaired by Satoquo Seino)

14:45-15:00 Naoya Furuta (Japan: IUCN): "Setting the scene: global policy trend on Eco-DRR"

15:00-15:30 Ho Dac Thai Hoang (Vietnam: Hue University of Agriculture and Forestry): "Sand dunes, the natural sea wall – the Eco-DRR in Central Coast region of Vietnam"

15:30-16:00 Kateryna Wowk (USA: NOAA): "Enhancing Disaster Resilience by Valuing Nature's Defenses"

16:00-16:15 Satoquo Seino (Japan: Kyushu University): "Huge Sea Wall Construction after the Great East Japan Earthquake and Tsunami - Conflicts and Lessons Learned"

16:15-16:45 Discussion 2

Day 4 (Sept. 8) Workshops and General Discussion

09:00- Registration

09:30-12:00 Parallel workshops

WS 1 Disasters influence to biodiversity

Chaired by Jun Yokoyama and Steven Wagstaff

Speakers:

- Dedy Darnaedi (Indonesia: Indonesian Institute of Sciences): "The Aftermath of Disaster in Ring of Fire Indonesia"
- Osamu Miura (Japan: Kochi University), Gen Kanaya, Shizuko Nakai, Wataru Makino and Jotaro Urabe: "Ecological and genetic monitoring of the Asian mud snail, *Batillaria attramentaria*, after the 2011 tsunami"
- Gen Kanaya (Japan: National Institute of Environmental Studies), Takao Suzuki, Waka Sato-Okoshi and Eisuke Kikuchi: "Ecological consequences of the tsunami disaster in a shallow brackish lagoon (Gamo Lagoon) in Sendai Bay, Japan"
- Srikantha Herath and Ngoc Mai Kim (United Nations University): "Ecosystems services for disaster risk reduction"

Continues to Discussion

WS2 Establishment of networks among museums and experts for collection preservation in disasters

Chaired by Masahiro Ôhara

Speakers:

- Mariko Kageyama (USA: Independent Museum Consultant): "Disaster preparedness and response: Best practices, training, and networking to protect natural heritage collections in North America"
- Makoto Manabe (Japan: National Museum of Nature and Science) and Martin Janal (USA: formerly American Museum of Natural History): "Importance of local museums and of their networks for sustainability"
- Daisuke Sakuma (Japan: Osaka Museum of Natural History): "What has to be done before the next disaster? – Biodiversity Heritage in Museums needs multi-core network, social supports and legitimate frameworks"

Continues to Discussion

WS3 Biodiversity-harmonious disaster recovery process

Chaired by Satoquo Seino

Speakers:

- Jun Nishihiro (Japan: Toho University): "Vegetation heterogeneity was increased by a tsunami but decreased by reconstruction works: a case study in a coastal forest near Sendai city"
- Naoki Nakayama (Japan: Ministry of the Environment): "Policy development on Eco-DRR in Japan after the GEJE"
- Hajime Chiba (Tohoku Gakuin University): "Folklore of Personification and Gift for "Stay with The Ocean" focusing on the case of Maehama, Motoyoshicho, Kesennuma City"

(12:00-13:30 Lunch)

13:30-14:30 Parallel discussion at each WS

(14:30-14:45 Break) Room change for joint meeting

14:45-16:45 Workshop report by chairman of each workshop, and general discussion, How to distribute our results

16:45-17:00 Closing address and Excursion guide: Jun Yokoyama

<u>**Day 5 (Sept. 9) One-day excursion to Fukushima area**</u>

Invited members only

<u>**Day 6 (Sept. 10) Return trip from either Sendai AP or JR Sendai Station**</u>

Symposium Presentations

Impacts of natural disaster on biodiversity in New Zealand

Steven J. Wagstaff

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WagstaffS@landcareresearch.

New Zealand is an isolated island archipelago found in the pacific ring of fire[1]. The islands lie on both the Pacific and Australian continental plates and are tectonically active. The steep mountain ranges that dominate the South Island extend to the southern two thirds of the North Island, and several active volcanos are found on the North Island. Partly because of its isolation, environmental extremes and unique plants and animals, New Zealand is internationally recognized as a hotspot of biodiversity. Biodiversity is defined "as variability of living things at all levels of biological organization" [2,3].

New Zealand was initially colonized by Polynesians about 900 years ago, but was claimed by British explorers almost 700 hundred years later[4]. Representatives of the British crown and 40 Māori chiefs signed the Treaty of Waitangi on 6 February 1840. The treaty is a broad statement of governing principles and the founding document of New Zealand. However Māori understanding of the original spirit of the treaty is at odds with those negotiating for the Crown. Contentious debate remains about treaty violations. There are approximately 5 million people currently living in New Zealand, but the population density is low[5]. Most New Zealanders live in the five population centres, Auckland, Hamilton, Wellington, Christchurch and Dunedin. The primary industries, dairy, wool, timber, and fishing, are resource based.

Throughout most of its history New Zealand evolved in isolation. Much of the New Zealand landscape has been dramatically altered by human activities. The extensive use of fire to clear land for agriculture and hunting have had a significant impact on the natural vegetation. Shortly after the arrival of the first humans, the moas were hunted to extinction[6]. European colonists cleared almost all of the productive land for agriculture or urban development. The loss of suitable habitat and the introduction of exotic plants and animals have driven many of the native species in New Zealand to the edge of extinction.

Natural geological and meteorological processes played an important role in shaping the land of New Zealand and its biota. Geological evidence of earthquakes, volcanic eruptions, and tsunamis is well documented by oral histories and published records. Tropical cyclones are common in the Pacific, but are usually downgraded to tropical storms before they reach New Zealand. Nonetheless these storms are associated with high winds, intense rainfall and flooding. These processes pose natural hazards that have significant impacts on social and biological systems.

However, it is nearly impossible to anticipate the impacts of natural hazards on biodiversity. Like the “The Great Wave of Kanagawa”, natural hazards can trigger a cascade of events whose impacts are unpredictable and far greater than the initial calamity. For instances earthquakes often trigger tsunamis, landslides, open huge cracks in the landscape, and may cause fires or flooding. The subsequent release of deadly environmental pollutants that often accompany a disaster may lead to disease epidemics and human suffering. A natural disaster is a major adverse event that results from this unpredictable cascade. A natural disaster can cause human hardship, property damage or loss of life, and typically leaves significant economic damage in its wake. The severity of a natural disaster depends on the affected people's resilience and ability to recover.

The impacts of natural disasters are generally measured in terms of the loss of life and economic costs. The impacts on biodiversity and ecosystem function are complex and poorly understood. Biodiversity is needed to maintain a stable supply of ecosystem goods and services[7]. The functional characteristics of species strongly influence ecosystem properties. Natural disasters disrupt nutrient cycles, energy flow and food webs. The feedback loops and interactions are complex. Species replacement through the invasion of exotic plants and animals may be difficult, expensive or impossible to fix with technology. Human intervention following a disaster may actually contribute to a greater loss of biodiversity and could prolong the natural recovery process. This is especially true of societies that rely upon biodiversity for their livelihood.

In New Zealand disaster research is focused primarily on quantifying the risks associated with natural hazards and evaluating how New Zealand society is addressing these risks[8,9,10]. Educational programs have been developed that alert the public to risks, precautions and the steps to take in the course of a natural disaster. However there is little information available on the impacts of natural disaster on biodiversity or sustainable long-term recovery following a disaster. The interplay between humans and the natural environment is influenced by economics and government policy. The traditional paradigms of human dominance, shaping the land to suite human needs and resource extraction should be replaced with notions of living in harmony, resilience and sustainability. Many aspects of ‘traditional knowledge’ such as food security, cooperation, settlement factors and environmental knowledge systems may have helped to offset the effects of natural disasters on social systems. Finally we must assist the victims of natural disasters with urgency and compassion, but it is vital we consider the impacts of natural disaster on biodiversity during the recovery process.

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Disasters and Biodiversity in China

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China is one of the most frequent natural disasters happened countries in the world. The country is also the most abundant biodiversity country in the northern hemisphere and it is considered as one of the megadiversity countries in the world. Natural disasters such as earthquake, drought, inundation, desertification, mud-rock flow, forest fire, hailstone, sand and dust storm, frost rain or extremely cold weather happened very frequently in recently years in China. Natural disasters can not only bring great loss of human life and properties but also may cause enormous destruction to the ecological environment. Natural disasters also can seriously threaten the survival of living things and biodiversity. However, attention has been mainly paid to the life and economic loss created by natural disasters, cause or origin of disasters, forecasting and prevention of disasters in the past. Very few scientific researches on the destruction or influence of natural disasters to biodiversity had been done in China. And nearly none publications related to the topic were published in Chinese. Natural disasters happened in China in recent years and their possible destruction to biodiversity are summarized and discussed.

Top ten natural disasters in China from 1950 to 1985 were: 1. The Huaihe River inundation happened in July 1950 in Henan province and northern part of Anhui province. Over 2.3 million hectares of land were flooded and 13 million people were suffered. 2. The Changjiang River and the Huaihe River inundation happened in July 1954. Over 3.17 million hectares of land were flooded and 18.88 million people were suffered. 3. Three-year natural disaster from 1959 to 1961, most part of China suffered by continuously drought and late spring cold. Agricultural and industrial productions were greatly affected and food supplies were seriously shortage. The population of the whole country decreased 10 million only in the year of 1960. 4. Hubei province had five torrential rains in August 1963. The total rainfall was over 2000 mm within 7 days in some areas. Over 104 counties and 22 million people were affected. 5. Xingtai (Hebei province) earthquake happened on March 8, 1966 and 8,182 people died, 51,395 people injured and more than 5 million building collapsed. 6. Tonghai (YunETBT1 052 Tf1 (8)6(,)-4(90.88

over 10 billion Yuan (RMB). 8. Tangshan earthquake happened on 28 July, 1976 and 242,769 people died, 435,556 people injured, 5.3 million buildings collapsed. 9. From 1978 to 1983, north, northeast and northwest China had continuously serious drought. Only in 1981, 26 million hectares of farmland affected by drought, more than 12 million hectares of farmland had no any harvest, nearly 23 million people were lack of water. 10. In August 1985, heavy rainfall caused more than 4000 dikes breaching along the Liaohe River. The flood affected 60 counties, 12 million people and 4 million hectares of farmland.

The most influenced disasters from 2008 to 2013 were: 1. On 12 May, 2008, Sichuan Wenchuan had a severe earthquake (8.0 Ms). It caused 69,227 people died, 374,643 people injured and 17,923 people missing. 2. Extremely large low temperature and frost rain and snow affected 21 provinces in early 2008. 3. Severe tropical storm Hagupit affected Guangdong and Guangxi in 2008. 4. Xizang heavy snow happened in 2008 and 100,000 people affected. 5. In 2009, nine provinces of north, northeast and northwest China drought in winter and spring affected millions of of sand and dust storm happened in the 60s, 13 times in 70s, 14 times in 80s, 20 times in 90s. One severe sand and dust storm happened in 2002 which lasted 49 hours and affected a total area of 1.4 million square kilometers and 1.3 hundred million people.

The most frequently happened disasters in China are inundation, earthquake, drought, typhoon, storm and hail. These disasters might cause directly destruction or influence to biodiversity or the secondary disasters might cause more serious influence to biodiversity. Earthquake may cause landslide and barrier lakes. Species from the earthquake affected areas might be destroyed directly or affected by losing their living habitats or food sources. One typical example from China was that many giant pandas had to move to other places because of the earthquake happened in Wenchuan, Sichuan in 2008, which caused bamboos starting to flower and then died and pandas lost their main food resources. Inundation can directly destroy many species especially domestic animals and cultivated plants. Many cultivated plants and domestic animals in remote areas of China are very important genetic resources for breeding purpose. Humankind won't be able to get them back again once we lost them. It can be understood easily that drought will lead to the death of many plants and animals. Drought happens in China very frequently but nobody knows the exactly actual destruction of drought to biodiversity in China. Drought might be changed the ecological environment critically and many species might disappear forever. The destruction of mud-rock flow and landslide to biodiversity depend on the scale of the disaster. However, some species would become extinct if such disaster happened in a habitat where an extreme small population of a species lives in the area. Extremely low temperature and frost rain happened often in China in recently years. These disasters could directly destroy many species especially in the areas of subtropical and tropical areas of south China. Forest fire might be the most or one of the most critical disasters lead to destroy biodiversity. Major forest fire happened every year in China. However, very few studies on how many species had been destroyed, threatened, or some new species might appear after a forest fire. Desertification is a significant factor leading to the deterioration of western China's environment, which manifests itself in the loss of stabilizing vegetation cover and nutrients and the destruction of the soil's structure and moisture-holding capacity. All these changes would directly influence the present status of biodiversity in these areas. One severe sand and dust storm happened in 2002 in China which lasted 49 hours and affected a total area of 1.4 million square kilometers and 1.3 hundred million people. Nobody knows that how big influence of these disasters could be to biodiversity.

It is certain that disasters not only destroy our human life and properties but also influence greatly to biodiversity. However, very few studies on the influence of disasters to biodiversity had been done in China as well as in the whole world. It is time for us to take international action to discuss about the influence of disasters and to establish an international protocol for future precautional approaches to minimize disaster destruction to biodiversity.

It is suggested that the following points should be paid attention for the researches of disasters and biodiversity (DAB): 1. Understanding the importance of DAB; 2. Basic data or information gathering and accumulating; 3. Long term monitoring; 4. Methodology for the research of DAB; 5. Stable and long term funds support to the research of DAB; 6. Personal training; 7. International cooperation and exchanges and 8. Governments support.

Natural disasters in Chile, effects on Chilean biodiversity and scientific collections

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Natural disasters in Latin America include earthquakes, volcanic eruptions, flooding, high wind events, landslides, and drought (Biles & Cobos 2004). Due to its location in the contact zone of two active plates, Nazca and Southamerican, Chile is considered one of the most seismic regions in the world, where 91 active volcanoes are also present along the Andes mountain (SERNAGEOMIN 2014), some of them with a high eruptive frequency. Thus, Chilean natural history is linked to earthquakes and volcanic eruptions because both have helped to shape the current landscape.

Among the most significant earthquakes is that of Valdivia in 1960, with a magnitude of 9.5 Mw, which is considered one of the most powerful seismic events in the history of the planet. On February 27th, 2010, another earthquake Mw 8.8 occurred in south-central Chile, producing a rupture area of around 500 km. A few minutes after the earthquake, a tsunami affected the coast of Chile from Valparaiso to Valdivia (700 km approx.), as well as reaching the Juan Fernández Archipelago. In the last 55 years volcanic activity has been prevalent, highlighted by the eruptions of volcanoes Puyehue (1960), Lonquimay (1988-1989), Lascar (1993), Llaima (1994), Chaitén (2008) and Cordón Caulle (2011). All of them caused numerous environmental impacts due to lava flows and volcanic ash.

One of the global biodiversity hotspots (Myers et al. 2000) is located in Chile, extending from 25º to 47º S and from the Pacific coast to the Andes Mountains. In addition, there is a narrow strip of coastal land between 19º and 25º S (Arroyo et al. 1999). The entire hotspot covers a total area of 397,142 km2. Some of the biggest natural disasters (earthquakes, tsunamis and volcanic eruptions) have affected this zone. The effects of these events on biodiversity in this hotspot, and in other priority areas, have been only partially evaluated, in part due to the lack of previous data and the stochasticity of all of the events.

Among the numerous effects that the earthquake of 1960 had on the flora and fauna, highlights are the creation of wetlands in Rio Cruces (Valdivia), which today are considered as Ramsar wetland sites (Jaramillo et al. 2012). Scientific papers regarding the effect of a recent earthquake (2010) on biodiversity are concerned mainly with abundance changes in the fauna of the coastal area. These studies have been concerned with the appearances and local extinctions of marine invertebrates (Crustacea) associated with sandy beaches (Jaramillo et al. 2012), with how the drying of intertidal wetlands Tubul-Raquil has caused major losses in aquatic fauna (i.e. estuarine crustaceans and bivalves), with recolonization by terrestrial invertebrates and with changes in the abundance of some typical plant species of these wetlands (i.e. Spartina densiflora) (Valdovinos & Sandoval 2001, Valdovinos et al. 2011). Other effects were changes in the epibenthic macrofaunal community of Coliumo Bay (Hernández et al. 2013), and death of the intertidal biota, especially Litothamnium sp. as a product of changes in the coastal relief (Quezada 2012).

Regarding volcanism, the effects of ash, debris, avalanches, landslides, and mudflows, are numerous, and have caused many impacts on flora and fauna, mainly on habitat loss and fragmentation, changes in abundance, species composition and disappearance of local populations. (Ghermandi & Gonzalez 2012, Miserendino et al. 2012, Villagra & Jaramillo 2012, Vázquez-Prada et al. 2013).

Previous evidence shows the need to increase efforts to promote scientific research on the effects of natural disasters on biodiversity, and with it the development of a knowledge base for better understanding their effects on the biota, both over short and long term temporal scales.

In a very real sense, the scientific collections have a fundamental role in the documentation of existing biodiversity (Gonzalez et al. 2009). Currently in Chile, there are 33 collections in various institutions, consisting of a total of approximately 1,400,000 samples. (CEA 2012). Half (50%) of them are deposited in the University of Concepción. The effect of natural disasters on these collections has been variable, including the associated costs. However, assessing the loss of scientific collections is complex, not only because of their intrinsic value, but also their historical value because they are reflections of the constant efforts and dedication of different generations of scientists throughout history.

As a result of the recent earthquake, the Museum of Zoology of the University of Concepción lost part of the fish and bryozoan collections. Fortunately the largest Herbarium in Chile (CONC), which belongs to the same University, only suffered minor damage. Unfortunately, the Herbarium of the University of Talca (UTALCA) did not fare nearly as well because the building collapsed and 20% of the herbarium folders were lost. The rest of the material is waiting for a proper and definitive place for safekeeping.

Finally, we must have a focused search for financial support for better implementation, maintenance and security of the scientific collections.

Importance of Museum Specimen Collections and Monitoring of Local Biodiversity

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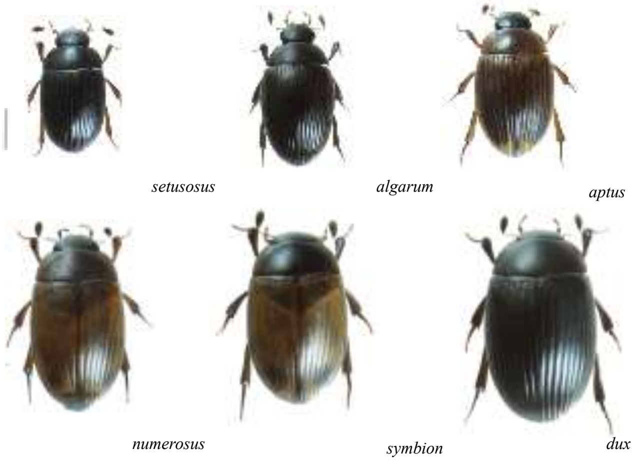
Importance of museum specimen collections

Local museums usually possess good specimen collections from the local area. Past records reporting on local biodiversity of an area are kept in local museums as part of their specimen collections. Rikuzen-takata City Museum was the oldest natural history museum in Tohoku, Japan; it had an impressive specimen collection illustrating the biodiversity of its area. Unfortunately, the museum's collections were seriously damaged by the 2011 tsunami. We have experience in recovering specimens from damaged conditions into a preserved condition. Sixty-six people from Hokkaido University Museum worked to recover the specimens over 11 days and recovered 1,001 beetle specimens.



Importance of monitoring in the field

Museums need to continually monitor research and collect specimens of local biodiversity, as we can never know when disasters will strike. In the Tohoku area, the coastlines were seriously damaged by the 2011 tsunami. We can reconstruct the species composition of the beach beetles fauna before the tsunami by analyzing the rescued specimens of the Rikuzen-takata City Museum. We have been collecting data regarding the beach beetles in the area since 2010 and have continued to monitor the coastlines after the 2011 tsunami. Comparing the species composition of the beach beetle fauna before and after the tsunami indicates how seriously the tsunami damaged these coastal environments. After the tsunami, some of the coastal environments were exposed to the construction of seawalls. Consequently, the museum specimen collections are important as they offer data on the biodiversity in the area before and after the tsunami as well as before and after the construction of the seawalls.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Building a Disaster Recovery Team – What happens when the lights go out?

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Natural History Collections are a unique resource providing a focus for science to learn about and explore the natural world. When a major disaster occurs, even if a recovery team is well-prepared, collections are frequently structured in a way that restricts the team's ability to quickly access, assess and recover priority collections. A good recovery plan should be tailored to your institution and is a product of understanding your collections, your buildings and day-to-day business alongside well-trained teams and accessible resources. Development of a thorough and well-practiced recovery plan, integrated with those of the emergency services does mean that specimens and their associated information can be triaged and recovered, efficiently and effectively. This talk will review the critical steps in setting up a large scale museum plan, standards in disaster planning, approaches to training and effective triage of natural history objects.

Why we keep these things: specimen data and meaning

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Natural history collections embody information of many different kinds. Basic specimen data – the place and date of collection – are only part of the total body of knowledge that a well-organized collection represents. The recording, organization and preservation of specimen data creates a framework for larger, cross-collection information gathering that enhances the value of all an institution's collections and archives.

Specimen data and related information should be organized to allow the widest possible access via media such as the Internet. At the same time, regular backups and offsite storage are essential safety measures that require relatively little investment. A solid data management plan acknowledges the importance of an institution's collections as global cultural assets.

Looking ahead, the increased adoption of common file formats across all platforms will enhance collaborations between and among projects in different institutions.

Finally, we present three cases that demonstrate how the data associated with specimens has enhanced their importance with the passage of time.

Setting the scene: global policy trend on Eco-DRR

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The number of natural disasters has increased over past decades worldwide. Especially, meteorological, hydrological and climatological disasters have been on the rise. In the meantime, the number of deaths due to these natural disasters shows a declining trend. It is considered that these trends signify the improvement of knowledge about and preparedness for disasters. On the other hand, the economic damage shows an exponentially increasing trend. A disaster is defined by the United Nations International Strategy for Disaster Reduction (UNISDR) as "A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources." Disaster risk is considered to consist of three independent elements, namely hazards (hazardous events), exposures and vulnerabilities.

According to a trend analysis of the respective elements, hazards occur almost constantly and periodically. Vulnerability to the disasters such as capacity for coping with disasters, improvement of architectural standards and increase of economic affluence is on a recovering trend. The problem is the concentration of humans and assets in areas where hazards occur. This element of exposure is caused by population increase and urbanization on a global scale, and it is also pointed out as a crucial factor in the global increase of natural disasters. The Hyogo Framework for Action (HFA) adopted at the World Conference on Disaster Reduction in 2005, in Kobe, Japan, is the world's first framework placing disaster risk reduction (DRR) at the core of the concept. Disaster Risk Reduction is based on the idea of how the disasters occurring from hazards could be minimized, on the assumption that hazards occur regularly.

The HFA consisting of 5 elements is a comprehensive framework. According to the mid-term review of the HFA, it has been found that progress in the fourth element "addressing underlying risks" is the most stagnant. In fact, ecosystem management is integrated into the fourth element "addressing underlying risks" It is obvious that sound management of ecosystems and biodiversity assists the reduction of disaster risk. Healthy forests prevent hazardous events such as landslides. Also, healthy ecosystems mitigate vulnerability: it can temporarily provide water and fuels in response to urgent demands just after disasters. Land use management through designating hazardous places as protected areas also makes a contribution to the reduction of exposure. In addition, ecosystem-based DDR measures are often cost-effective compared to the use of artifacts like concrete, and have merit in providing adherent benefits in case there is no hazard. Accordingly, a number of ecosystem-based DRR activities have been conducted all over the world.

In 2008, the Partnership for Environment and Disaster Risk Reduction (PEDRR) was established by more than 10 international institutions and NGOs including the International Union for Conservation of Nature (IUCN). PEDRR integrates worldwide knowledge in order to focus on the positive roles of ecosystems and biodiversity in DRR, provides training courses, and makes policy recommendations. Recently, the 2nd International Science-Policy Workshop 2014 was held in Indonesia. Some 100 researchers, policy makers and practitioners participated in this workshop and shared experiences.

At the same time, discussions about the relationship between natural disasters and climate change have been activated internationally. Meteorological, hydrological and climatological disasters have increased in the past, and the recently published IPCC 5th Assessment Report on Climate Change (AR5) also expects that these disasters will increase due to the influence of climate change. Accordingly, arguments about integrated approaches to Disaster Risk Reduction and Climate Change Adaptation (CCA) are growing more than ever. Actually, most parts of DRR and CCA show considerable overlap, while DRR is a short-term issue, and CCA is a long-term issue. However, when considering practical measures, these two issues should not be considered separately as one measure often contributes to both issues.

The UN World Conference on Disaster Risk Reduction (WCDRR) will be held in March 2015, in Sendai, Japan. In the 3rd Conference in Sendai, the Hyogo Framework for Action 2 (HFA2), the post HFA, will be adopted. Based on the experiences of the Great East Japan Earthquake, IUCN deepened worldwide discussion about ecosystems and biodiversity, DRR and CCA at the 1st Asia Parks Congress in November 2013 co-hosted by the Japan's Ministry of the Environment and the IUCN. These discussions will be further deepened at the IUCN World Parks Congress to be held in Sydney, Australia in November 2014. We hope we will be able to reflect the fruitful results of these discussions at the 3rd UN WCDRR in March 2015.

Sand dunes, the natural sea wall – the Eco-DRR in Central Coast region of Vietnam

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Central coast region of Vietnam were identified as the most risk location from natural disaster where, every year, is destinations of about 10 tropical typhoons from the East Sea. According to FAO (2007), typhoons were recorded as more than 60% of disaster events that hit to this areas from 1953-1991, in which, some 78% of the killed and missing people are recorded by typhoons. This presentation focuses on coastal forest protection along the sea shore to mitigate vulnerability of natural disaster.

Historically, coastal areas of Central Vietnam were covered by natural flora system with multilayer tropical forest structure. Large size tree timber play an important role in structure of the forest. Viet people migrated from the North to South by sea line created peace village behind the sand dunes under the forest.

Sand dune locates along the sea shore, plays the roles of windbreak and natural barriers against tsunamis and other disaster from the oceans, biodiversity, water resources, food security, local culture and tourist assessment. After the war, 1975, Vietnamese sank in to dramatic economic crisis, large areas of flora system in the sand dune were cleared cut for fire wood consumption. Forest system in the sand dune area were clear cut for fuel wood and construction and became bare land and cause strong damage of natural disaster, annual tropical typhoons. Local people have been facing with risk from the sea by annual tropical typhoons.

Many researches proved that trees and coastal forests can help in mitigating the impacts of tsunamis, cyclones, heavy rains and typhoons. Moreover, narrow protection coastal forests have minimal effects on storm surge height and inland flooding and, are efficient in reducing wind and storm wave impacts up to a certain level. The sand dune forests can also prevent moving sand dune by monsoon wind and landslide.

Six criterion of coastal protection forest along the sea shore of Thua Thien Hue province were identified with support of local communities and other stakeholders. Coastal protection forest should be built base on i, layer structure of coastal sand areas; ii, socio-economic of local communities; iii, areas of coastal sand and sand dune areas (100 ha); iv, community vulnerability areas by moving sand; v, livelihood and generation income vulnerability areas by natural disaster; and vi, flora system on the coastal sand areas.

Local communities understand well that, coastal protection forest on the sand dune along the sea shore can protect them from natural risk disaster and also can create fresh water resources and food security issue. Moreover, coastal protection forests on the sand dune play the roles of soft and flexible sea wall that local people can access to the sea easy.

Tree composition of coastal protection forests are important issue to restore the forest. In recent year, Acacia spp, Casuarina equisetifolia and some Eucalyptus spp. were introduced to recover the sandy bare land in study site. In fact, those tree species meet the need of local people in fuel wood consumption but create stranger forest ecosystem from indigenous site condition. The need come to local tree species for coastal forest restoration.

Results of flora system in sand dune areas in Central Coast region of Vietnam identified more than 50 natural flora species of 25 families in forests with 16 tree species beside exotic timber tree species such as Acacia auriculiformis, A. crassicarpa and Casuarina equisetifolia, that created stable population ecology on the dunes.

Large size timber tree species such as Shorea falcata, Vatica mangachapoi, Litsea glutinosa were recorded as indigenous tree species that may play an important roles in forest restoration in the study site. Community based forest restoration with participatory of local communities and local authorities were carried out to set up plan to restore the forests with indigenous tree species.

A case study of Dragon villages was introduced as example of reconstruction of natural disaster coastal vulnerability by sand dune forest restoration. In 1999, the historical typhoon cause heavy rain came to 6 provinces of Central Vietnam. Some 2288 mm rainfall poured to Hue areas in 6 days cause great flood and created new estuary and damage the sea shore. One villages were hitched to the sea. Ecological base forest restoration to rejoin the coast. Casuarina equisetifolia were introduced as pioneer tree species were planted along the new rejoined road then indigenous tree species were introduced to create the sea shore. The coastal protection forest can rejoin the estuary after about 10 year.

In conclusion, coastal protection forests and sand dunes in Central coast of Vietnam play an important roles in windbreak, protection from natural disasters, food, water resources, and safety. Because of many reasons, forest areas along the coastal areas of the study site were clear cut cause serious natural disaster risk. Many exotic tree species were introduced but indigenous tree species were recommended by local community. Flora system in the dunes is diversity with more than 50 species of 25 families, some of them are large timber tree species. Restoration forest in the sand dunes with indigenous tree species with participatory of local communities is appropriate strategy in study site.

Enhancing Disaster Resilience by Valuing Nature's Defenses

Kateryna Wowk

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To meet the challenges posed by increased pressure on the coasts, particularly in the face of a changing climate, it is becoming increasingly apparent that we must better value and manage our natural ecosystems in order to protect communities and economies. Better decisions for the long-term resilience of our coasts will be possible if we incorporate the benefits derived from natural infrastructure into decision-support tools. Thus, it is crucial to more fully understand the benefits and the value, as well as the design, of natural infrastructure.

Following Hurricane Katrina in 2005 and the tragedy that ensued, there was a great deal of discussion about the dramatic loss of coastal wetlands in the Gulf of Mexico and the corresponding loss of coastal protection from storm surge. Then, in 2012 the devastation of Superstorm Sandy, and the $65 billion in damages it caused, served as yet another reminder that natural events can profoundly disrupt families, livelihoods, and economic well-being. Superstorm Sandy reinvigorated the conversation on coastal protection at the highest levels.

In December 2012, President Obama established the Hurricane Sandy Rebuilding Task Force, led by the Secretary of Housing and Urban Development to provide cabinet-level, government and region-wide coordination to help communities recover and rebuild. Then in January 2013, Congress appropriated a $50 billion disaster relief package to communities affected by Sandy. The Task Force released the Hurricane Sandy Rebuilding Strategy in August 2013, which further established guidelines for the investment of the Federal recovery funds with a focus on ensuring a region-wide approach to rebuilding with communities that strengthens long-term resilience to climate change. A key component of the Rebuilding Strategy centered on environmentally sustainable and innovative solutions that include considering biodiversity, or, natural infrastructure options in all Sandy infrastructure investments. Whereas in the past built infrastructure, including sea walls, levees, culverts, and other structures have dominated thinking about coastal protection, these approaches are prohibitively expensive, of limited effectiveness, and often replace natural habitat including wetlands, dunes, sea grasses, coral or oyster reefs, and mangroves, which themselves provide protection from storms. Preserving or restoring this natural infrastructure, in combination with carefully considered built infrastructure, can strengthen the sustainability of our coasts, prevent the loss of life and property and meet multiple societal, economic and ecological goals.

Since the Strategy's release the agencies charged with implementing recommendations on natural infrastructure, in concert with the White House Council on Environmental Quality, have been working to create opportunities for natural infrastructure investment with a view to enhancing the resilience of our coasts.

Natural infrastructure has entered the dialogue as a way to rebuild safer, more resilient coasts, particularly when considering needs for storm surge protection. However, as decision-makers look at their investment options, and whether natural, built, or some mix of the two (hybrid) best meets their needs, the issue of cost quickly arises, and not only the cost of building and maintaining the infrastructure, but the cost avoided in terms of damages from rising sea levels and future storms. Data exist on the protection received from various types of built infrastructure, as well as the value of those services (though many of these data have not been updated since the 1990s). Yet when it comes to natural infrastructure, do we have reliable data on the benefits received? When looking to protect our coasts, can we say that, in some cases, natural infrastructure will give society a higher return on investment? The U.S. National Oceanic and Atmospheric Administration (NOAA) is conducting a study to answer this question. Without confirming the information needs we cannot move to the next step, i.e., toward robust and standardized data on the benefits derived from natural infrastructure as well as accepted methods for valuing and applying those benefits in a decision-making context.

This presentation will focus on U.S. experiences with natural disasters, and in particular with Hurricanes Katrina and Sandy, and through lessons-learned, will describe how the government and partners are working to promote biodiversity-harmonious disaster recovery processes and policies. It will then posit that the critical next step is toward valuation of the benefits received from this biodiversity, such that market forces may be aligned with its conservation, and will propose critical next steps toward that end.

Coastlines, home to 44 percent of the world's population, are centers of commerce, and are vital to national economies and global gross domestic product. We need to think differently about how we develop and conserve coastlines around the world. We must plan and prepare for sea level rise and increasingly intense storms by building and restoring coastlines that are more resilient. This includes moving away from a concrete-only mentality and using a combination of natural and built infrastructure that will both strengthen the sustainability of our coasts and prevent the loss of life and property, while meeting multiple societal, economic and ecological objectives. Now, before the next big event, is the time to develop regional and national strategies for coastal risk reduction. We know our coasts are at risk, but we also know we have a lot of tools at our disposal. Now is the time to design, test, research, develop and apply the most effective natural and hybrid technologies for protecting our communities and strengthening coastal resilience.

Huge Sea Wall Construction after the Great East Japan Earthquake and Tsunami - Conflicts and Lessons Learned

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Workshop Presentations

Salvage and restoration of natural history collections damaged by tsunami in Japan, 2011

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The earthquakes and subsequent tsunami on March 11, 2011 in Eastern Japan killed 18,000 people and destroyed a lot of towns in the coastal area of Tohoku region, northeastern Japan. Museums, libraries, and cultural and natural heritage collections were also heavily damaged.

In the tsunami-hit area in Iwate Prefecture, there were three museums that possessed natural history collections, which consisted of 236,000 biological and 3,500 geological specimens, and 37% of them were lost. In Miyagi Prefecture, also, more than 1,000 specimens in museums were lost. In Fukushima and Iwate Prefecture, respectively, more than 4,000 and 10,000 specimens in personal collections were washed away by the tsunami as well.

Some of the staff members of these museums perished or were missing because of the tsunami, and most of the collection items sank into the mud and got buried under rubble. These collections included a lot of type specimens, historic ones and invaluable natural records of the tsunami-damaged area. In Japan, however, museums and their associations haven't had well-established strategy for salvaging and recovering their collections after such a huge disaster.

The staff members of damaged museums managed to launch a "collection rescue" operation within three weeks after the tsunami. That was made possible with the help offered by other museums and researchers all over Japan. Salvaging all the collection items from the museums and transporting them to safe inland places took 1-3 months. There was no special financial support for these tasks in the first month. A governmental task force was established in the beginning of April 2011, and began to provide financial and physical support for the salvage activities by late April or May.

The tsunami-damaged items were contaminated with dirt sea salt and various organic substances, and got moldy. The curators (including the author Suzuki) of Iwate Prefectural Museum, Morioka, made and released protocols for cleaning damaged specimens of plants, insects and shells, and asked nationwide networks of museum curators for help. Since they had enough offers to help, they transferred 23,000 specimens to more than 40 museums and research institutions all over Japan via delivery service. Researchers and volunteers of each museum finished the task within one year, and sent the specimens back to Morioka. Moreover, they discussed, tested and improved the protocols, and shared them with their colleagues.

Rikuzentakata City Museum had more than 3,000 geological specimens. They were too heavy to be sent out to other museums. Therefore, the organizer from Iwate Prefectural Museum asked geological researchers and curators to come to Rikuzentakata for cleaning, identifying, classifying the damaged specimens and making a catalog of them. They were partly funded by the Geological Society of Japan and the Paleontological Society of Japan. Additional funding was provided by the National Museum of Nature & Science, Japan, and the Tokyo Geographical Society.

In this talk, by learning from these cases, we will discuss strategies for salvage and restoration of natural history collections in museums in case of huge disasters.

The Aftermath of Disaster in Ring of Fire, Indonesia

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Volcanoes in Indonesia

Indonesia Archipelago is dominated by volcanoes that are formed by subduction zones between the Indo-Australian plate and the Eurasian plate. Volcanoes in Indonesia are part of the Pacific Ring of Fire. More than 150 volcanoes have been listed, scattered from Sunda Arc trench system, volcanoes of Halmahera and volcanoes of Sulawesi to Sangihe Island. Some of the volcanoes are notable for their eruption, such as Krakatau for its global effects in 1883. Lake Toba for its supervolcanic eruption estimated to have 74,000 years ago which was responsible for six years of volcanic winter, and Mount Tambora for the most violent eruption in recorded history in 1815. Two most active volcanoes are Kelut and Merapi on Java Island which have been responsible for thousands of deaths in the region, Kelut has been erupted more than 30 times, while Merapi has erupted more than 80 times. The International Association of Volcanology and Chemistry of the Earth's and Chemistry of the Earth's Interior has named Gunung Merapi as a Decade Volcano since 1995 because of its high volcanic activity. In the last five years, Indonesia has 127 active volcanoes with about 5 million people have activities within the danger zone. The earthquake and tsunami event of 26 December, 2004 in Aceh is thought to bring disruption to the volcanoes eruption pattern. The eruption of Gunung Sinabung, Sumatera in 2010, which has no recorded eruption since the 1600s. *after lying dormant for more than four centuries, remind us the event the dormant montain still can active again.*

Disaster and geo-biodiversity

The first well document disaster was the eruption of Mt Krakatau in August 1883, a small island lied between Java and Sumatera. It killed 36,000 people with a strong wave up to India and Africa. Geological process and monitoring the biological succession after the eruption were the exiting studies in Krakatau. *The Krakatau: Changes in Century since Catastrophic Eruption in 1883,* was the subject of the discussion during the 100 years commemorated of the eruption. Hundreds of scientists gathering to discussed various issues related to geology, biology and social issues. Natural vegetation of Krakatau island was completely destroyed (Treub, 1883), no biological organism left after the big eruption. There was no information on biological diversity before the eruption, so we do not know the biological extinction in the island. Natural process of recovery of the sterile island is a main subject. Botanical survey after the eruption started by Treub (1883, 1886, 1897), Earnst (1908), Backer, (1908) and followed by

Docter van Leeuwen (1911-1932). Reported by Tagawa, et al (1985) that in Rakata Besar, the first dominant species were *Casuarina equisetifolia* (1897) follow by *Terminalia catappa* (1897), *Timonius compressicaulis* (1928), *Neonauclea calycina* (1905), *Dysoxylum caulostachyum* (1931) and *Schefflera polybotrya* (1951). In Rakata Kecil, the first three species are dominant one year later in (1896) follows by *Neonauclea calycina* and *D. caulostachyum*. In Sertung island almost the same with Rakata besar, but no record of *T. compressicaullis* , *D. caulostachyum* and *S. polybotrya.* A new volcano, anak Krakatau appeared in 1928 and growing gradually by repeating eruption and flowing lava streams. During 21 years anak Krakatau increase in size 55,75 ha and in high 85,13 or increase 2,65 ha/year in size and 4,05m/year in high (Suhadi et al., 2008).

Disaster wicked up government and public attention

The biggest tsunami in Indonesia was the Aceh Tsunami, August 2004 killed almost 310,000 people. Aceh Tsunami waked up the government and public in Indonesia that the country with milliard of people along the ring of fire is in high risk from any disaster. Indigenous local knowledge as showed by Simeuleu people in a small island close to center of Earth Quake in Aceh is important to maintain. It was reported that when the sea level going down, all people ran away to the hill. Most people save, only 7 of 78.128 people living in the island died by Tsunami. They learn from their ancestors that a big wave (tsunami) will come after the sea level going down, just run to the mountain without looking at the back. Collective memory of the local people, they learn from *"Smong 07"* a big tsunami in 1907.

Increase awareness and improve preparedness

Our attention to the destruction of nature, important industries, public facilities, and in particular to the loss of human wellbeing, are increase and put it as priority. However, our attention to the loss of biodiversity and any other important scientific documents such as reference collections, herbarium specimens, artefacts and others are still neglected behind. Botanical explorations that initiated by Indonesian Institute of Sciences (LIPI) with local authorities to active volcanos such as to Mts Sinabung, Merapi, Kelud and Merapi have to be appreciated and it need supports to increase our attention to the importance of biodiversity information. Our scientific discovery and new technology have to be concentrated to the reduce impact from any disasters in the future. We should more attention to mitigation and improve preparedness to deal with bigger disasters.

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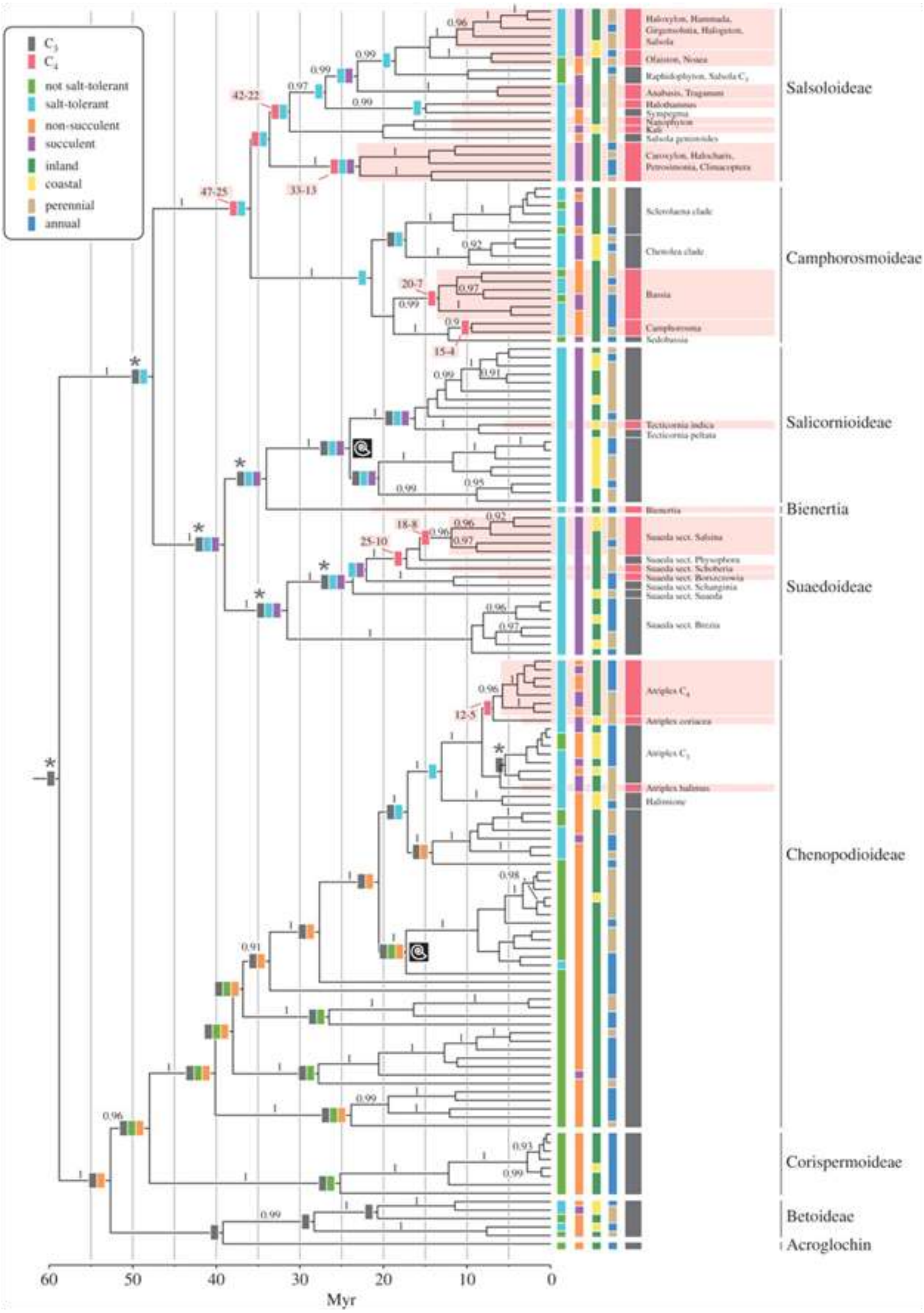
Figure (next page)

Maximum clade credibility phylogenetic tree from BEAST analysis (branch lengths proportional to time; median values for node heights presented) with node support (Bayesian PP; BEAST) above the branches and ancestral states subtending selected nodes. Ancestral states that were unambiguous under FP but equivocal under RJ-MCMC are indicated with an asterisk. Clades of exclusively C4 species are highlighted and ages (millions of years; 95% CI) are given for deeper nodes inferred to be ancestrally C4. The nodes constrained to calibrate the relaxed-clock analyses are indicated with an ammonite symbol.



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Ecological and genetic monitoring of the Asian mud snail, *Batillaria attramentaria*, after the 2011 tsunami

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On March 11, 2011, an undersea earthquake off the coast of the Tohoku district created tsunami waves, which hit the Pacific coastline of northeastern Japan. This large tsunami would be expected to lead to a significant disturbance of the benthic communities. To evaluate the biological damage caused by the tsunami, we studied the ecology and genetics of the Asian mud snail, *Batillaria attramentaria* which is one of the most abundant components in the mudflat in Tohoku district. We found severe population destructions in *B. attramentaria* one year after the tsunami, while snail populations were slightly recovered in following years at some study sites. This severe disturbance may decrease the genetic diversity of *B. attramentaria* due to a population bottleneck. To investigate in detail the change in genetic diversity, we compared the genetic diversity of *B. attramentaria* before and after the tsunami using 14 microsatellite DNA markeBT1 0 0 NA ells mar an88 Tmhrd h ivert aosatellite

Ecological consequences of the tsunami disaster in a shallow brackish lagoon (Gamo Lagoon) in Sendai Bay, Japan

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Study sites

Impacts of the 2011 tsunami disaster were investigated in a shallow brackish lagoon (Gamo Lagoon) in Sendai City, Japan (Fig. 1). The lagoon was nominated for the National Wildlife Protection Area by Ministry of the Environments (MOE) in 1987. The intertidal flats were important habitats for migratory shorebirds and macrozoobenthos including polychaetes, amphipods, bivalves and decapods. Reed *Phragmites australis* vegetated densely along the lagoon edge, which was a resting place for migratory ducks and geese. Sand dune vegetation well developed on the sand bar. Inner subtidal zone was covered densely by the red alga *Gracilaria vermiculophylla* and the green alga *Ulva intestinalis*.

Topography, vegetation, and sediment characteristics

Tsunami (> 7.2m height) caused distinctive changes in the topography and vegetation. GPS-based vegetation mapping in 2011 showed that sand dune vegetation decreased from 8.6 to 0.1 ha, and reed marsh from 7.8 to 1.2 ha, while the area of bare tidal flat increased from 4.7 to 5.3 ha due to the disappearance of reed marsh (Fig. 1). Marsh and sand dune vegetation have not been recovered yet in 2013, while sand dune vegetation had partly grown in 2014. Muddy sediment was flushed away and the sediment became courser all over the lagoon. Lagoonal averaged silt-clay content decreased from 33.2 ± 31.9 % (n = 45) in 1997 to 4.1 ± 4.6 % in 2011 (n = 63). Organic matters and sulfides in the muddy sediment had also been washed away by the tsunami.

Macrozoobenthos

Qualitative survey in 2011 found that 47 of 79 macrozoobenthos species were nearly extirpated, while 6 species including opportunistic polychaetes and amphipods rapidly recovered their population size within 5 months. Statistical analyses on quantitative data sets of macrozoobenthos in 2005 to 2011 demonstrated that Shannon's diversity index (H'), evenness (J'), and density of infaunal bivalves decreased after the tsunami, while density of total macrozoobenthos, polychaete *Pseudopolydora* spp., and amphipod *Monocorophium* sp. significantly increased. In Gamo Lagoon, therefore, newly created sandy bottoms would provide the opportunistic species with a preferable “empty habitat” to colonize densely. In 2012 and 2013, some of the disappeared species including bivalves, amphipods, and decapods recruited and increased their population sizes. However, several species had not recovered their population even in 2014 (Fig. 2).

Shorebirds

We compiled data from a 5-year survey at 10 monitoring sites along the Pacific coast of Japan, including Gamo Lagoon (data were provided by the Monitoring Sites 1000 Project, MOE, ShorebirdsDatapackage2012.zip, http://www.biodic.go.jp/moni1000/ findings/data/index.html). Results showed that the effects of tsunami disaster on individual number and species diversity of shorebirds were inconspicuous in these sites. These suggest that the population of migratory shore birds was hardly affected by the tsunami disaster.

Problems for future management

Sharp increase in lagoon salinity in 2012-2013 caused the invasion of stenohaline marine species and limited growth of the marsh reed *Phragmites australis* after the tsunami. Lagoon salinity should necessary be regulated to restore the reed-dominated brackish marsh and associated biota in this lagoon. Ongoing construction of huge sea walls is another potential threat to the lagoon ecosystem. Care should be taken to conserve coastal habitats such as tidal flats, salt marsh, sand dune, as well as their backside landward areas during the restoration.

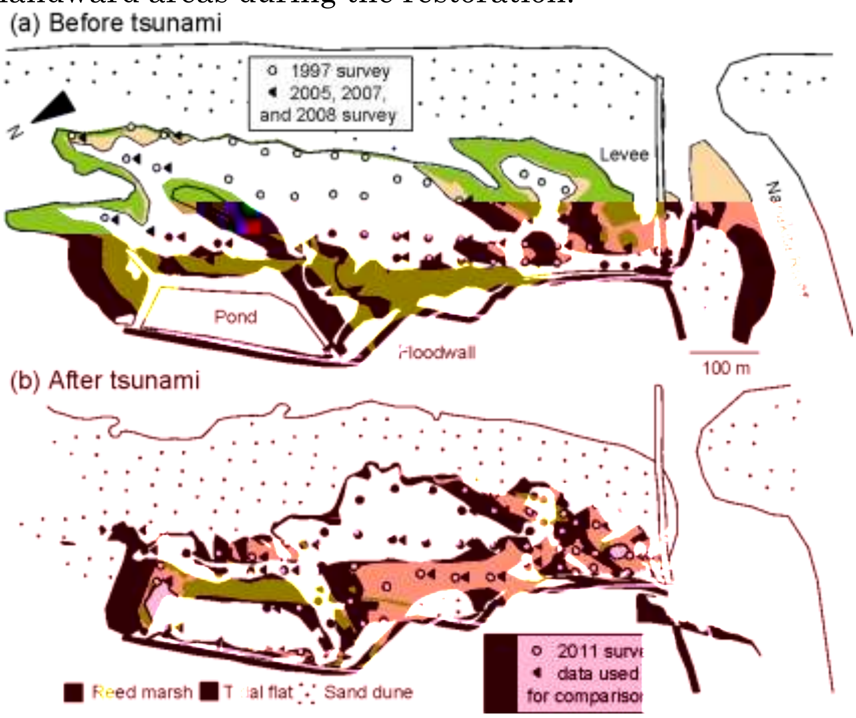

Fig. 1. Tsunami-induced changes in topography and vegetation of Gamo Lagoon. Sampling points are shown.

Fig. 2. Species disappeared or nearly disappeared after the tsunami in Gamo Lagoon. Several species recruited again in 2011 (yellow-colored) and in 2012-2013 (orange-colored) are indicated. Modified from Kanaya et al. (in press).

Ecosystems services for disaster risk reduction

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Disaster risk reduction has made tremendous advances based on technological developments that enabled infrastructure construction to withstand higher levels of hazard intensities. This has been very effective in geo hazards such as earthquakes. On the other hand managing environmental extremes such as floods and cyclones with technology based hazard reduction had mixed results. While technological solutions helped immensely in reducing losses from medium and small levels of flood disasters, losses from extremes have increased several folds when the hazards exceed preventive measures. Urgent measures are necessary to address them, as extremes would increase fuelled by climate change. Introducing ecosystem services in combination with infrastructure solutions provide such an approach. The presentation will introduce case studies on how urbanization effects can be offset with water retention and infiltration functions of nature to enhance resilience of urban areas against floods. It will also discuss how rapid recovery of ecosystems in the aftermath of natural disasters such as that seen in aftermath of 2004 Indian ocean tsunami can be used to provide a safety valve for hazards that exceed the design level of protective structures.

Disaster preparedness and response: Best practices, training, and networking to protect natural heritage collections in North America

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In keeping with the societal framework in which heritage collections have been historically acknowledged and developed in America for the last century, today emergency preparedness and response planning has been an important part of museum operations in the United States. Heritage collections including natural history collections are held in trust for the public, and museums are responsible for minimizing foreseeable and unforeseeable risks to those cultural and scientific assets. Indeed, the American Alliance of Museums, the largest museum professional organization in the country that sets national standards in the museum community, treats a disaster preparedness and emergency response plan as one of the five core documents required for a museum to achieve the Alliance's Accreditation status. Yet not until very recently had the practices of disaster planning gained broader support in the collection preservation field as is indicated by a nationwide survey conducted by the Heritage Preservation in 2004, which revealed that as much as 80% of collection-holding institutions in the U.S. were at serious risk as they lack a disaster plan for safeguarding their collections with staff trained to carry it out in an emergency.

An increasing number of natural and man-made disaster incidents have alerted not only collection caretakers but also administrators to an urgent need for an emergency preparation for irreplaceable collections. Fortunately, relatively abundant literature, resources and opportunities are available to museum personnel today in the forms of staff education, community training and networking with a primary focus on disaster planning. Advocacy for emergency preparedness has been active especially in natural disaster-prone regions, because numerous cultural and scientific institutions in these areas had real experiences in their recent memories and had to learn painful lessons from loss and damages caused by major disasters like hurricanes, tornados, earthquakes, and wildfires.

Generally, disaster planning can be viewed as a circular continuum of several major steps of actions encompassing mitigation, preparedness, response and recovery. Without having an institutional emergency plan in written documents or regularly testing and exercising those plans as a whole team, disaster planning would remain incomplete and ineffective, which in turn renders such institutions vulnerable to any future crisis. In principle, disaster response must be swiftly initiated with life safety first followed by stabilization of the incident and affected infrastructure, usually led by first responders dispatched from a local municipality. Once an inspection is conducted and safe access to the museum premise and collection storage facilities is approved, it is finally the time to mobilize a well-trained emergency response team of museum professionals to carry out a series of property recovery actions. An emergency response team's activities include assessment, stabilization, and salvage of both undamaged and damaged collection items according to preplanned response procedures and salvage priorities. At the same time, the response team is expected to follow directions that come down through an incident command system, which takes charges of the overall situation of the institution immediately following an incident. Stabilizing damaged specimens and artifacts within 48-72 hours of an event is considered to be the most effective and desirable response time from a standpoint of object conservation best practices. However, in reality, each incident can occur under a new different scenario, posing a unique set of challenges for which one may not be fully prepared. However, as long as disaster planning is in place and regular testing has been done beforehand, decisions-making processes and appropriate actions will be executed promptly and smoothly, enabling the institutions to get back to their normal essential operations in the shortest time possible.

The most notable among the organizations with demonstrated leadership in disaster preparedness and response planning, as well as successful training and networking in North America are the Heritage Preservation's nation-wide initiatives (e.g. Heritage Emergency National Taskforce, Alliance for Response); the American Institute for Conservation of Historic and Artistic Works' Collections Emergency Response Team (AIC-CERT), the Western States and Territories Preservation Assistance Service (WESTPAS) training programs, with funding support from such federal agencies as the Institute of Museum and Library Services (IMLS) and the Federal Emergency Management Agency (FEMA), to name a few. Additionally, large institutions like the Library of Congress and the Getty Conservation Institute have spearheaded this field and their programs have been modeled after by a number of other cultural institutions. Specifically in regard to natural history collections, the Society for the Preservation of Natural History Collections (SPNHC) has also played a significant part in advancing the field, including best practices in health and safety issues for collection care professionals. What is common across these exemplary cases is a recognition that disaster planning involve face-to-face dialogues with colleagues and local partners in order to engage in collaborative planning, drilling, and resource sharing, and all these activities need to happen and be ongoing during a non-emergency time period.

Importance of local museums and of their networks for sustainability

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Among some 3000 geological specimens formerly housed in the Rikuzentakata City Museum, about 200 are fish fossils. The catalogue was lost in the tsunami in March, 2011, and there were only a few pieces of paper stating the name of the donor. The donor was a former high school teacher in Iwate Prefecture who studied Miocene fish fossils from Gunma Prefecture. Most of his collection is housed at the Gunma Prefectural Museum of Natural History and Tohoku University. He donated some of his fish fossils to Rikuzentakata City Museum before he passed away. The collection at Rikuzentakata was not known to fossil fish workers such as Dr. Yoshitaka Yabumoto of Kitakyushu Museum of Natural History and Human History. Increasing the number of specimens alone is usually important in natural history contexts in order to understand intraspecific variation, for example, not even to mention the use of statistic analysis. Yabumoto went through the collection and found potentially important specimens and he is currently studying them. Similar examples are also seen in invertebrate fossils.

An online database, possibly with images, should be created to spread backup copies so that precious catalogues cannot be lost by one single disaster. The database will make the presence of potentially important specimens more readily available to a wider community. For palaeontological specimens, this may not be good enough. Many of the specimens need preparation before being catalogued, and many sit in boxes for years and years waiting to be prepared. We believe that enhancing communication among curators and scientists is the only solution to becoming aware of potentially important specimens. It may be a good idea to try to bring meetings of specialized societies, associations and science clubs to local museums and coordinate this activity with schools and even universities. If one could organize a specimen identification day, not only local curators but also the public could bring in specimens. This can give the public some idea of what expertise is, while not opening the museum collections themselves to untrained hands. Such meetings also have the potential of tracking changes in biodiversity, for example, the presence of invasives or of changes in distribution.

Most of the collections at Rikuzentakata City Museum came from donations from citizens over many generations. They therefore include many once common things in their times in the area. These common things are easily forgotten and their importance is hard to pass down to future generations, as they are often given low priority. Maintaining a public museum requires quite high expenses for the local authorities. The museum may be regarded by them as a financial burden because it is expensive to maintain in proportion to the small number of visitors the museum may receive. We believe, on the other hand, that a museum is our commitment to future generations. Recent studies in Japan suggest that the presence of museums enhances real estate values by about 3.5%. A museum can be seen as an economic investment for the community.

What has to be done, before the next disaster? -Biodiversity Heritage in Museums needs multi-core network, social supports and legitimate frameworks

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Lessons from 3.11

As Ôhara et al mentioned in this symposium, local museums possess good natural history collections of their area. And Rikuzen-takata City Museum is the typical one. Not only 24,000 specimens of entomological collection, but 15,000 sheets of vascular-plants collections and lichens, algae, vertebrate, shells, photos, etc. together with other historical and ethnological collections, and were all suffered Tsunami in 2011.3.11, half of them soaked with muddy sea walter. What we, curators of Japanese museums did in recovering these Tsunami-suffered specimens, was so simple and primitive to share the muddy specimens to each museum (29 museums and labs for plant, 19 for insects see Suzuki 2011) to wash and repair them. We did try to do best for conservation of specimens, but we did not have the prepared protocols for restoration, systematic rescue network, nor special funds. Some of the activities like Japanese GBIF network, Natural History Museums Network of Western Japan, Entomological curators association, were mediated the personal and museums communications for the specimen salvage and restoration activities. The basis of the activities was voluntary, based on private networks of museum professionals. We had hardly this important basis for carrying out the cooperative emergency tasks. We had some chance of review of our activities in technical aspects, and talked more concrete basis such as some plans of nation-wide cooperative networks.

Further tasks to prepare for the next disaster

In Japan, we have certain risks of huge earthquakes in Nankai trough in coming 30yrs. To prepare for the possible next disaster, we still have some fundamental problems for the protection of natural history collection. There should be multi-layer for emergency rescue. First, the voluntary works of museum professionals are still important. And associations of museum professionals should not be closed within the museums but need more relation with public to gather public supports. In 2nd, national governmental action plans for protection of natural history collections. In Japan, we do not have legitimate frameworks for natural history collections. The Cultural heritage law does not cover the natural history collections in literary, so that we have no national headquarter in the time of disaster, different from history and art collections. We have National museum of science and nature (Kahaku), but the task is too big for Kahaku alone. At least, multi-core network of some national and exemplary local museums should govern in association. If we try to change the legitimacy, we need more wide ranges of public supports for the museum professionals' activities and more clear visions about the importance and social values of natural history collections, which can be told only by museum professionals.

Vegetation heterogeneity was increased by a tsunami, but decreased by reconstruction works: a case study in a coastal forest near Sendai city

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Policy development on Eco-DRR in Japan after the GEJE

Naoki Nakayama

Ministry of the Environment, Japan

Folklore of Personification and Gift for "Stay with The Ocean" focusing on the case of Maehama, Motoyoshicho, Kesennuma City

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