

**CONNECTION OF BIODIVERSITY COLLECTION AND RESEARCH  
THROUGH THE GLOBAL NETWORK AMONG MUSEUMS AND  
UNIVERSITIES**

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**ABSTRACT**

For the comprehensive understanding of the Asian biodiversity, Asian network of specimens, research, researchers, and information on the basis of equal and multilateral partnership is indispensable. Infrastructure to connect research and collection is also important to be formed and the Asian view will greatly contribute for its establishment. Future face-to-face meeting and discussion and young researchers' development is important to strengthen and sustain the Asian network in the field of biodiversity.

**KEYWORDS:** Asian network, information, species diversity, specimens, researchers,

**INTRODUCTION**

Biodiversity is important research key issue in biology and environmental science. Challenges to understand biodiversity in animals and plants are carrying out worldwide. East and Southeast Asia is one of the most important regions for the biodiversity study and its conservation, where include high number of species and many biodiversity hotspots like Japan and the Philippines. Comprehensive understanding of the biodiversity must be done covering the East and Southeast Asian regions. Studies for each specific taxonomic group should be carried out for the first stage, and such studies may include finding of the undescribed species with giving name as new species, as well as taxonomic statuses' reevaluation for the current confused taxonomy in given taxa. During conducting these studies, fieldwork-based survey and research are indispensable, and collecting specimens and samples together with distribution data should actually be conducted through such intensive fieldworks. As well, the reference to specimens used in the previous studies, including re-examination of type specimens, are important process in most taxonomic studies to define and confirm stable taxonomic statuses. This process also means that, newly collected specimens will also turn to be the previous study's specimens for the future studies when the target research results have been published. For the role to deposit and conservation of the specimens used in the biodiversity and taxonomic studies, museums should play

important mission in the present and the future. Especially, university museums where very active research by the university researchers have been carried out, should deposit and conserve also archival research material and information together with specimens in keeping relations between specimens and archival material / information. In this paper, I introduce my ideas about the current situation and future challenge for biodiversity research and collection in East and Southeast Asian region, with emphasis on my research experience for small mammals in East Asia. I also discuss about necessary roles of the university museum's network in Asia on the basis of equal and multilateral partnership.

### **HIGH SPECIES DIVERSITY OF EAST AND SOUTHEAST ASIAN MAMMALS**

I have studied the species diversity of mammals in East Asia mainly in countries of Japan, Korea, China, Taiwan, and Vietnam. Species diversity of small mammals in such areas are so high, probably because of various and complex geomorphology and climates, that had led many speciation events to have occurred and contributed to form unique regional species diversity. I study mammals for several reasons: 1. Mammals are important element of the fauna and found in various habitats, such as in air for bats, underground for moles, on trees for squirrels, in freshwater for water shrews, and many groups on the ground, and so on; and in wide range of elevation from sea level to more than 5,000 m in altitude as in Qinghai-Tibetan Plateau (pikas, hamsters, and so on, Motokawa et al., 2010). 2. Mammals has strong relationships with humans; sometimes mammals give great damage to human with agriculture and forest damage, disease transmission, and so on, while mammals are effected from human by hunting, resource use, and habitat development, and so on; and related to such human-mammal relationships, several species might have been influenced with human as dispersal history, e.g., Pacific rat *Rattus exulans*, house mouse *Mus musculus*, and Ryukyu mouse *M. caroli* (Motokawa et al., 2003, 2004b; Lai et al., 2008). 3. Mammals can be affected by environmental changes such as glacial time climate and forest changes; and at the same time, mammals could have changed environment such as developing forests as seed disperser. To summarize, I believe that the study for mammal species diversity in East and Southeast Asia is important for biodiversity knowledge and also to understand human history and to explore the way for human sustainable future with facing to the drastically changing world. For well understanding of the mammal species diversity, taxonomic approaches for the correct species understanding must have priority, although studies from various approaches and interdisciplinary frameworks are also important.

In 1993, I started the study of mammal fauna and biogeography of Ryukyu Islands in Japan, and also connecting to the study of Taiwan. In those studies,

importance of the land bridge formation and collapse in islands, that had led to dispersal and isolation of the island populations could be important for mammal fauna formation (Motokawa, 2000). At the time, I had been interested in the divergent pattern of Taiwan versus continent and studied morphological and karyological features of several small mammal species. Obtained results were interesting that Taiwan population were diverged from the continent ones, but at the same time, divergence among continental populations were also significant in a shrew *Episoriculus caudatus* group (Motokawa and Lin, 2005; Motokawa et al., 2008, 2009) where I have reclassified populations previously recognized as a single species *E. caudatus* into four species *E. caudatus*, *E. soluensis*, *E. umbrinus*, and *E. sacratu*, in addition to Taiwan *E. fumidus*; a mole shrew *Anourosorex squamipes* group (Motokawa and Lin, 2002; Motokawa et al., 2004a); and a shrew *Crocidura attenuata* group (Motokawa et al., 2001c). In the past, Taiwan *E. fumidus* and *A. yamashinai*, as well as *C. tanakae* were thought to have been produced by isolation in the islands, but our studies suggested that isolation of populations is commonly occurred also in the continent especially in mountain region, so-called Himalayan subregion including Himalayas to southwestern provinces Sichuan and Yunnan in China (Corbet and Hill, 1992), where such species are mainly distributed in the continent. The long distance between southwestern China (Sichuan Province) and Taiwan also has been stressed as the geomorphological barriers for causing long isolation between populations in the continent and Taiwan, especially for *Episoriculus* and *Anourosorex*, but we recently found new more eastern continent populations in the genus *Anourosorex* in mountains of Guangdong (Wu et al., 2011). The prevailed story of Taiwan versus continent divergence with emphasis on island isolation of Taiwan should be reconsidered and reconstructed; and future detailed and careful fieldwork survey of continental fauna especially in the isolated mountains both in western and eastern continental part of China should be carried out. These examples also suggest the necessity of reconsideration of island fauna formation that is currently greatly depend on events of the land bridge formation and collapse. Based on the recent studies of us and other groups, Motokawa (2009) suggested that only the land bridge formation and collapse cannot explain recent evidence of within-island intraspecific complicated divergence in several mammals in Japanese main-islands; and the Japanese large field mouse provides a good example (Suzuki et al., 2004; Shintaku et al., 2012).

From my research experience, I have come to believe that comprehensive study of mammal species diversity over the country borders including both the continental areas and islands is the only way to correctly understand the species diversity of mammals in East and Southeast Asia. And this comprehensive understanding only will give us to know what is the continent species diversity?, what is the island species diversity?; and then what is the whole Asian species

diversity?

Of course, the detailed study for each area or country is primary important. Based on this well-surveyed knowledge, I want to suggest the way for bridging those areas will provide us more fruitful insight for the species diversity of mammals. This alternative way for understanding is focusing wide ranged areas. Until the beginning of this century, many important information of each country has been summarized in languages of the country such as Japanese, Chinese, Korean, and Vietnamese languages. Mainly due to the economic background, previous challenges for understanding species diversity across country borders in Asia were very limited and had been made mainly by developed countries' researchers. Their studies had been mostly based on the old specimens deposited in such countries, with less field surveys, and primarily based on insufficient literature survey mostly relied on English written books and papers. I felt deep knowledge gap even for Japanese mammals between Japanese and other developed countries' mammalogists, especially before the publication of English written "Wild Mammals of Japan" (Ohdachi et al., 2009), although most Japanese mammalogists had very good enough knowledge about Japanese mammal species diversity before the publication of that book in reflecting studies and knowledge of Japanese mammalogists almost for a century. Some researchers told us that non-English, especially Asian language written, literatures have no value in scientific community; but I believe that Asian researchers, of course, should understand the importance of English, but also can understand the importance of previously published knowledge even written in Asian language.

For the better understanding of East and Southeast Asian species diversity, I believe that Asian researchers' collaboration and network must be important; and field survey and specimen survey in such countries must be conducted with collaboration. The research center or network core of Asian biodiversity should be located in Asia, and should be organized by equal and multilateral partnership of researchers primary from Asia. With economic development, multi-countries framework's Asian collaboration has become possible more easily since the last decade; and we should 1. focus on the understanding the species diversity of each country or specific area, and 2. in relation to the taxonomic problem existed, expand collaboration and network with other Asian countries or areas to bridge the knowledge and solve the problems together. We should also try to incorporate the previous knowledge written both in English and Asian languages, because I regarded them the knowledge treasures produced with very hard works of proceeded researchers. In conclusion, network of researchers for Asian biodiversity understanding must be formed with strong mind and effort of Asian researchers themselves.

**COMPREHENSIVE FAUNA UNDERSTANDING AND IMPORTANCE OF SPECIMENS**

In mammal species diversity in Asia, research has been well conducted for the small ranged relict species. On the other hand, terrible confused situation for taxonomic understanding is continuing for wide ranged species over many countries and very common species, such as rat species of the genera *Rattus*, *Niviventer*, *Maxomys*, *Berylmys*, and *Leopoldamys*. Among the neighboring countries in Asia, same taxonomic names sometimes refer to different species; and different taxonomic names refer to same species. And similar situation is also occurred not only among countries, but also within countries and among researchers. Recent DNA barcoding studies provided many data with erroneous identification; and such data have been reused for the further studies and reproduced the erroneous identification and taxonomic confusion.

I am doing study based mainly on newly collected specimens with fieldworks especially in China and Vietnam to make comprehensive analyses of traditional and modern morphology, karyotype, DNA, and so on; keep such specimens in the country of origin (China or Vietnam). Analyses are conducting together with the counter country or multi-countries framework, such as Japan–China–Vietnam for the study of southern China and Hainan Island. This may be the new model for the collaboration. This is different from many previous developed countries' researchers, because they collected specimens and return them back to their country; and in most cases they put counter country researchers as co-authors of the publication. This way, however, sometimes formed unhappy situation that the Asian country researchers did not have reference specimens in their own countries and need to fly to Europe, USA, Japan, and so on, to check the type specimens and important specimens for the taxonomic studies. There is debate by several developed countries' researchers that the specimen depositing condition and researchers' mind is sometimes insufficient in Asian countries, and deposition of the specimens there will mean destroy or waste of specimens. My opinion is that such situation has been changed already, or has not been existed even in the before; and will more improve with equal collaboration relationships and development of young researchers in Asian countries for the continuous and sustainable framework. Unfortunately, no-changing of the previous situation (or such debate in spite of the exact situation) was also responsible for researchers from developed countries, who wanted to focus only on gathering specimens, and not provide any support and education for the specimen deposition in such Asian countries. Anyway, it is the time to change the system and we form Asian multi-countries researchers collaboration or network with equal and multilateral partnership. Of course, because the research has always competition, so this network should be formed involving both collaboration and competition.

**EAST ASIAN VERTEBRATE SPECIES DIVERSITY PROJECT**

Supported by Japan Society for Promotion of Science (JSPS), I coordinates 3 years project (FY2011–2013) of JSPS Asia Africa Science Platform Program “Research Platform for East Asian Vertebrate Species Diversity and Formation of Specimen Network”. The Kyoto University Museum is core institute in cooperation with the foreign core institutes of Seoul National University in Korea, Guangzhou University in China, and Vietnam Academy of Science and Technology, Institute of Ecology and Biological Resources in Vietnam. Form such 4 countries (Japan, Korea, China, and Vietnam), a total of 137 researchers join this program including professors, researchers, as well as master and PhD students. This program targets the formation of above mentioned Asian vertebrate researchers network and collaboration, as well as young researchers training and development.

Every year, we organized international symposia for academic exchanges among participating countries researchers. The first symposium in Guangzhou, China (August 2011) more focused on the formation of the partnership and network among core researchers in the countries; the second symposium in Kyoto, Japan (July 2012) expand the network and focused on development of the young researchers; and the third and the last symposium in Hanoi, Vietnam (September 2013), with strength the network and developing young researchers, therefore, most of the oral presentations were open to young researchers. For the purpose of fostering young researchers, these three symposia awarded Young Researchers Best Presentation Award to encourage next generation to be developed and to be the core members of Asian network.

In addition, for more specific topics, several one-day seminars were organized as this project with attending two or more countries project members. Even the time when internet was so developed over country borders, face to face meeting and discussion must be necessary and productive, and only the way to produce real and effective researchers’ network and collaboration, at least in Asian countries where English is not mother language in most researchers involved.

Young researchers training program was also conducted in 2012 and 2013. In July 2012, 10 days young researcher program was carried out with attendance of 3 Japanese, 2 Korean, 2 Chinese, and 2 Vietnamese, totally 9 young researchers. With the supervision of me, they conducted field survey in Nagano prefecture in Japan, and the data analyses, making report, and presentation have been made in Kyoto University after the field survey. In my opinion, in the Asian countries, it is important to make collaborative field survey and exchange and learn the field techniques, as well as developing communication skills even with so-called

“Asian English”. My focus is not only that they learn simply how to write scientific papers, but also that they learn the importance and hardness to prepare and keep the specimens in good condition, and deposition and curation of specimens is hard, but very important task of the researchers of species diversity research. Through these activities, I hope that young researchers can understand that researchers should not just use specimens, but they should be responsible for collect, prepare, use, keep, deposit specimens for the hopeful future of Asian species diversity comprehensive understanding.

### **BUILDING COLLECTION NETWORK AND ROLE OF UNIVERSITY MUSEUMS**

Some Asian researchers questioned the situation that most Asian specimens are still deposited in the European and USA museums. Deposition of the specimens in the country of origin must become possible and should be expected in Asian countries. In reflecting the history, the quantity of specimens deposited in such Asian countries will be smaller than developed countries’ museums that had focused on the Asian research in the past time. I propose that Asian museums should develop new strategy to enhance not only the quantity of specimens, but also the quality of specimens. Each newly collected and deposited specimens should carry basic information such as collect data, person, locality, species, sex, measurements, habitat, and so on. And recently, in addition to the traditional specimens (stuffed skins and skulls in mammals), chromosome samples, genetic samples, and DNA sequencing samples will have great importance.

With advancing the research based on specimens, such specimens will have more information incorporated from research outcome. Such information that could enhance the value of specimens, however, is not well organized and incorporated, because the publication outcome do not have system to be tied with the basing specimens. As the minimum connection to improve this current situation, relationships between the research paper (publication) and each specimen used in the publication should be labeled. This system is not be organized with each museum and university; and that should be constructed as global scientific infrastructure as proposed by Motokawa et al. (2014). I hope that various Asian languages can be incorporated as information of each specimens with the advanced information technology; and new science infrastructure of the “Connection between Collection and Research” (CCR) database will be launched from Asia based on Asian multilateral biodiversity network of specimens, researchers, and information to global science community.

For formation and expanding the Asian network, long-history and leading university must have great roles, because they have relatively large collection and research history. For the network formation of such university museum, APRU

(Association of Pacific Rim Universities) Research Symposium on University Museum is one of the important face-to-face activities: the first symposium was made in Kyoto University in 2012 (Kyoto University, 2012), and the second is planned to be made in National Taiwan University in May 2013. University museums should be the center of collection and collection-based research in the university and science community; and university museum Asian network should be the center of borderless species diversity research in Asian countries based on the network of specimens, research, researchers, and information.

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