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Environmental Specimen Bank (*es*-BANK) of Ehime University, Japan —Current Status and Future Perspectives—

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Abstract—Since the 1960s, the Environmental Specimen Bank (*es*-BANK) at the Ehime University, Japan has archived a large number of biological and environmental samples collected from various parts of the world. The samples from our *es*-BANK have been used for environmental monitoring and ecotoxicological studies on various contaminants such as organohalogen compounds, trace elements, etc. Herein we describe the history of the *es*-BANK at Ehime University, its current status, selected results and our future perspectives.

Keywords: Environmental Specimen Bank, *es*-BANK, Ehime University, global monitoring, organohalogen compounds

INTRODUCTION

With the emergence of a growing number of potentially hazardous contaminants in the environment, the significance of determining past exposure patterns and temporal trends in concentrations of these contaminants is gaining importance. The need for better environmental information was the starting point for the development and establishment of scientific specimen banks, and the concept of archiving environmental samples for retrospective analysis has been recognized by the international scientific community as an integral part of environmental monitoring and research. The history of specimen banks goes back to the 1960s when the first bank was established in Sweden, since then specimen banking has made progress and a number of specialized specimen banks have been established in different countries.

Specimen banking is defined as the systematic collection and long-term storage of specimens sampled from the abiotic environment, such as air, water, soil and sediment, and biological samples collected from human, animal and plant populations. The archived samples can be used for monitoring the state of the environment, examining the cause and effect relationships with respect to contaminants and for retrospective analyses, when new or improved analytical

Picture 1. The building (left) and a freezer room (right) of *es*-BANK at Ehime University.

techniques become available or a new interest arises in the contaminants that were not considered important in the past (Olsson and Bignert, 1997; Utriainen, 2006).

HISTORY OF ENVIRONMENTAL SPECIMEN BANK (*es*-BANK) AT EHIME UNIVERSITY

Archiving environmental samples at the Faculty of Agriculture, Ehime University had started in the 1960s, when the Department of Agricultural Chemistry began its work on the regional contamination by pesticides like dichlorodiphenyltrichloroethane and its metabolites (DDTs), hexachlorocyclohexane isomers (HCHs), etc. in collaboration with other universities/institutes in Japan. Environmental samples, i.e. air, water and soil, and biological samples after preliminary analysis were stored at –20°C at the Faculty of Agriculture, Ehime University. After the establishment of the Center for Marine Environmental Studies (CMES) at Ehime University in 1999, the environmental and biological samples stored previously at the Faculty of Agriculture were transferred to the newly established CMES. With active support and funding from the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT) and the Japan Society for the Promotion of Science (JSPS), the Environmental Specimen Bank (*es*-BANK) for Global Monitoring was established at CMES in 2005 as a permanent facility for the systematic collection, characterization and storage of environmental samples from marine, fresh water and terrestrial ecosystems (Picture 1).

CURRENT STATUS AND FACILITIES AT *es*-BANK OF EHIME UNIVERSITY

The *es*-BANK has archived a large number of biological and environmental samples collected from various parts of the world over a period of nearly forty years. The *es*-BANK of the CMES stands unique in several aspects when compared with many other specimen banks. Unlike many of the specimen banks, which are regional and mostly archive specific organism(s), the *es*-BANK of CMES, apart from specimens from developed nations, has a large collection of

Table 1. Environmental specimens archived at *es*-BANK (as of December 2008).

Specimen	No. of species	No. of samples
Fishes	765	17511
Reptiles	9	2237
Birds	364	28287
Aquatic mammals		
Cetaceans	50	29913
Pinnipeds	16	9355
Terrestrial mammals	39	3332
Human	1	7514
Others	50	9571
Total	1294	107720

specimens from developing countries in the Asia-Pacific region. Today, the *es*-BANK is in possession of about 110,000 samples collected from about 1300 species. The approximate number and types of specimens stored in the *es*-BANK of CMES are shown in Table 1.

The *es*-BANK with state-of-the-art facilities houses two –25°C freezer rooms (8 m × 11 m; 14 m × 14 m) for the storage of samples, a dissection room and a room for cryogenic storage equipped with four ultra cold –80°C electric freezers and three liquid nitrogen vapor –196°C freezers with continuously monitored security systems to store tissues at temperatures low enough to ensure their viability for biochemical/molecular analyses. In order to use the facilities and resources at the *es*-BANK as effectively as possible in both national and international perspective, we share and exchange samples with many scientific institutions for mutual benefit.

SELECTED RESULTS OBTAINED USING THE SAMPLES ARCHIVED IN *es*-BANK

Over the years our research group has conducted numerous studies on the contamination status, temporal trends and fate of legacy persistent organic pollutants (POPs) and emerging contaminants in the environment. For example, archived tissues of marine mammals from Japan were used to evaluate temporal trends of legacy and emerging POPs (Fig. 1). Our group has also addressed questions on the human exposure to these contaminants and the potential health risks associated with these contaminants. Some of our recent studies have been reviewed and the detailed information on the sampling, analytical methods and results can be found in the cited papers (Tanabe, 2007; Tanabe *et al*., 2008).

CONCLUSIONS AND FUTURE PERSPECTIVES

As we expand our specimen banking activities we plan to collect and archive samples from various ecosystems around the world in order to address questions regarding the cycling of contaminants, their fate and environmental impact. The archived samples at our *es*-BANK may be useful to assess the influence of climate

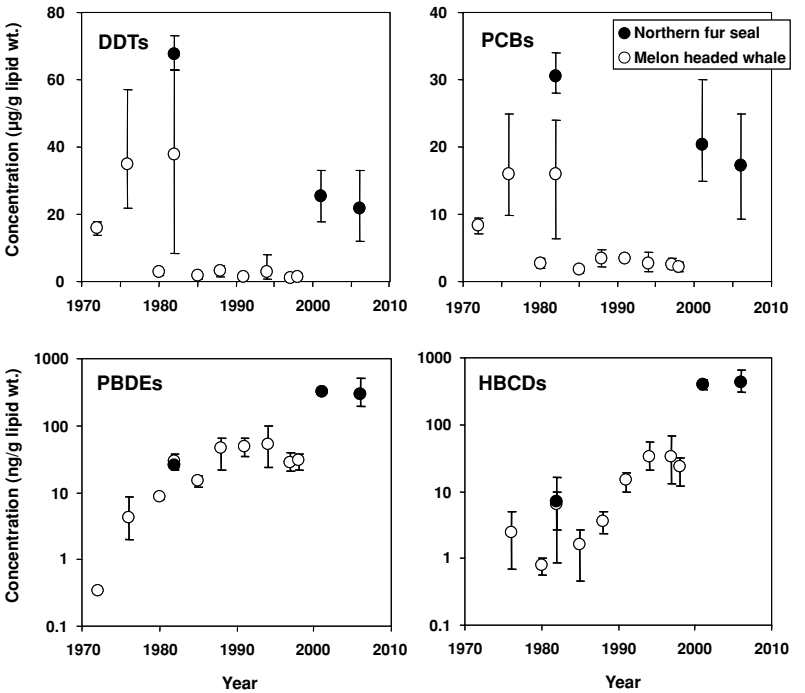

Fig. 1. Temporal trends of legacy and emerging POPs observed in archived tissues of marine mammals from Japan. DDTs, dichlorodiphenyltrichloroethane and its metabolites; PCBs, polychlorinated biphenyls; PBDEs, polybrominated diphenyl ethers; HBCDs, hexabromocyclododecanes.

change on the global patterns of contaminant transport, deposition and bioaccumulation mechanisms. Currently, studies on biological responses at the molecular level have become an essential component in environmental monitoring programs. Therefore, our efforts are also focused on archiving fresh tissues and organs for genomics research, in addition to banking new kinds of specimens.

Our studies using the archived samples from *es*-BANK suggest that environmental problems are no more regional issues and, thus, environmental specimen banking should not be limited to national boundaries, but should have a global outlook. To further enhance and improve our environmental banking activities, we have plans to establish satellite *es*-BANKs in some Asian countries in the near future.

There is a need for global coordination in environmental research in the best interests for both the present and future generations. The current "International Symposium on Environmental Specimen Bank (ESB Symposium 2009)—Exploring Possibility of Setting up ESBs in Developing Countries" was conducted by our center at Ehime University with the objective to create a forum to exchange

ideas and information on ESBs. It is anticipated that such a gathering will have a profound influence on the development and direction of ESBs.

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