20-Year Comprehensive Report of KOREA-JAPAN Co-operative Joint Research on POPs and Other Relative Chemicals

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Contents

Publication Remarks (Republic of KOREA)

Currently, over 200 million types of chemicals are used worldwide. However, as much as they are used widely, many people raise concerns over their adverse effects on human health and the environment.

Korea and Japan have been conducting cooperative joint researches for two decades to address the growing concerns of people and implement chemicals-related international treaties in a joint manner. The report "20 Years of Research Cooperation on Chemical Substances Between Korea and Japan" is a valuable achievement that demonstrates our continuous efforts to make progress and deal with challenges, and our aspirations for sound management of chemicals in the future.

After the leaders of both countries agreed to invigorate bilateral cooperation in 1998, the Korea-Japan cooperation on chemical researches was initiated in 2001 based on the MOU signed by Ministers of Environment of both countries. Since the first joint research on endocrine-disrupting chemicals (EDCs), Korea-Japan joint researches accumulated scientific and policy achievements over the past 20 years. In particular, joint researches on persistent organic pollutants (POPs), mercury (Hg) and contaminants of emerging concerns (CECs) contributed greatly to standardizing environmental monitoring and analysis technology, and addressing regional issues on hazardous chemicals.

This report is more than a simple enumeration of past achievements. It underscores the importance of international environmental cooperation, and illustrates emerging challenges for the sustainability. Above all things, this report presents a vision for educational, scientific and policy contributions of Korea-Japan cooperation by playing a leading role together in addressing environmental issues in the East Asian region, which will benefit future generations.

I hope that this report serves as a best practice guidance of intergovernmental environmental researches and international cooperation, inspiring future generations with the dedication and passion shown by researchers from both countries. In addition, I hope that this report provides readers with an opportunity to contemplate the seriousness of hazardous chemicals and the possible solutions from collective efforts at the regional and global level.

The researches in this report has been made possible by collaborative efforts from researchers and policymakers of Korea and Japan. I would like to extend my sincere appreciation to them, and all stakeholders who put forth efforts for this project. Lastly, I hope that this report would be a new milestone of Korea-Japan cooperation for chemical management and environmental protection.

Dr. Yeonjae PARK
Director-General, Environmental Health Bureau
Ministry of Environment, Republic of Korea

Publication Remarks (JAPAN)

It is with great pride that we present this commemorative report, which marks the culmination of two decades of dedicated collaboration between Japan and Korea under the framework of the “Japan-Korea Co-operative Joint Research on POPs and Other Relative Chemicals”.

Over the past 20 years, our two nations have worked tirelessly together to monitor, analyze, and address the environmental challenges posed by POPs pollutants in East Asia. This long-standing partnership has allowed us to make substantial progress in understanding the sources, impact, and distribution of harmful substances in the environment.

The research and data collected throughout this period are not only a testament to the hard work and commitment of the scientists and researchers involved but also a reflection of both countries’ deep commitment to safeguarding the environment for future generations. Through the joint efforts, we have been able to create a robust framework for monitoring environmental pollutants, and we continue to strive for innovative solutions to mitigate their effects.

This report highlights significant findings from the collaborative efforts, providing a comprehensive overview of progress, challenges, and the lessons learned over the past two decades. We hope that the insights gained will not only inform future research in the two countries but also contribute to international efforts in combating environmental pollution on a global scale.

As we look forward, we remain committed to strengthening our partnership and continuing works together to protect the environment and promote sustainability. The future of environmental protection depends on continued collaboration, and we are confident that the shared dedication will lead to even greater achievements in the years to come.

On behalf of the Government of Japan, I would like to thank all those who have contributed to this remarkable journey. Your dedication and hard work have made these achievements possible.

Dr. Mitsuya MAEDA
Director-General, Environmental Health Department
Ministry of the Environment, Japan

Researcher Greetings

Dear Esteemed Colleagues and Partners,

As we mark the remarkable milestone of 20 years since the inception of the Cooperative Joint Research (CJR) on Endocrine Disrupting Chemicals (EDCs) and Persistent Organic Pollutants (POPs) between Korea and Japan in 2001, I am honored to extend my heartfelt congratulations to each and every one of you who have contributed to this outstanding collaborative effort.

The research journey we embarked upon two decades ago has been nothing short of extraordinary. Through unwavering dedication, rigorous scientific inquiry, and the spirit of cooperation, we have collectively achieved the publication of more than 70 joint research papers. These papers stand as a testament to the worth of our professionality and the depth of knowledge we have generated together. No matter how small their contribution is, I am sure it will serve as the foundation for researching related policies and future environmental issues.

In addition, what's remarkable is the fact that we have been together for the past 20 years. The joint symposiums we have convened annually have not only served as platforms for disseminating our research findings but also a venue for harmony that promotes mutual development. Your expertise, passion, and collaborative spirit have been the driving force behind our shared success. Here, I extend my deepest gratitude to each researcher who has been an integral part of this CJR journey.

In the future, environmental pollution problems will continue not only by EDCs and POP, but also by emerging pollutants. However, with the foundation we have built together, I am confident that we are well-positioned to address these challenges head-on and contribute to a healthier and more sustainable quality of future environment.

May our collaboration continue to thrive, and may the next 20 years be marked by even greater achievements and advancements in our shared mission. Congratulations to all researchers of both countries, and here's to the continued success of the Cooperative Joint Research by the Young Scientists!

Warm regards,

On behalf of the Korean researchers
who have participated in the CJR.
Dr. Samcwan KIM
ex-President of National Institute of Environmental Research, Republic of Korea

Researcher Greetings

Dear distinguished colleagues, collaborators and partners,

It is my greatest honor to have this opportunity to celebrate fruitful advances and achievements of Cooperative Joint Research (CJR) on Endocrine Disrupting Chemicals (EDCs) and Persistent Organic Pollutants (POPs) between Japan and Korea in the past 20 years.

Pollutant Research experienced a drastic paradigm shift in late 20th century when some pollutants, represented by dioxins and EDCs, were found to disrupt information transfers within living organisms specifically. Toxic effects of such chemicals tend to appear in later stage, sometimes after a couple of decades, in highly integrated life functions controlled by complicated gene regulations, such as endocrine, immune and nerve systems. Their control measures, including Act on special measures against dioxins and SPEED (Strategic programs on environmental endocrine disruptors) '98, were set upped rapidly in Japan in FY1998, while urgent needs to develop and establish scientific basis to support their proper control and management were recognized. The joint research on EDCs between Japan and Korea started as one of key scientific activities for the purpose.

In the following 20 years, various cooperative researches have been conducted successfully. Among them were harmonizations of testing and analytical methods of EDCs and other priority pollutants, including POPs under the Stockholm Convention. Harmonized methods have been promoting identification and regulation of EDCs and other chemicals of concern in both countries, and prioritization of their regulation in each country by comparing the monitoring results. Furthermore some of developed methods were proposed and used internationally. An example is harmonized POPs monitoring and analytical method, which is now used in the monitoring supported by Japan and training supported by Korea within the framework of POPs monitoring in East Asian countries (POPsEA project), which is a key subregional activity to support effectiveness evaluation of the Stockholm Convention.

Cooperative researches have been expanding their scope, including use of isotopes as tracer of mercury and other pollutants and analysis and risk assessment of currently unregulated chemicals. Sound management of chemicals and wastes is now given top priority together with climate change and biodiversity among global environmental problems. As leading industrialized countries in East Asia, Japan and Korea are expected to play key roles to implement and support sound chemical management system in the region. We expect and believe that this cooperative project will continue to play pivotal roles to support the activity.

On behalf of the Japanese researchers
who have participated in the CJR.

Dr. Yasuyuki SHIBATA
Emeritus Researcher, National Institute for Environmental Studies, Japan

20-year Footprint of Korea-Japan cooperative research with photos

2008

2009

2010

2011

2013

2014

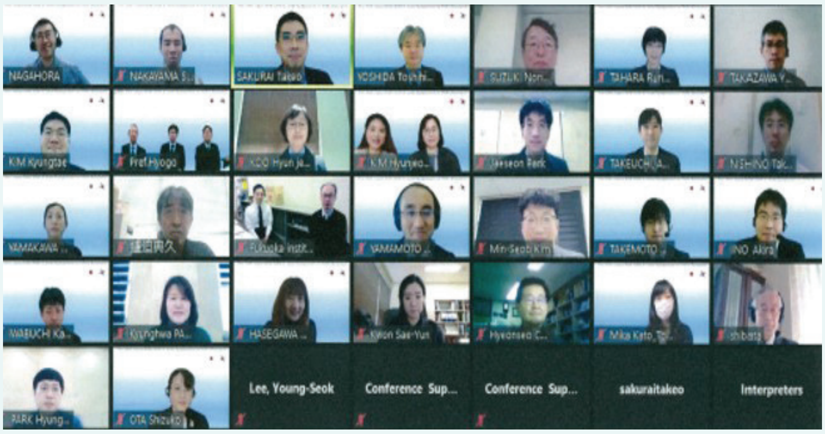
2015

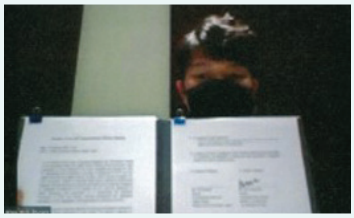
2016

2017

2018

2020





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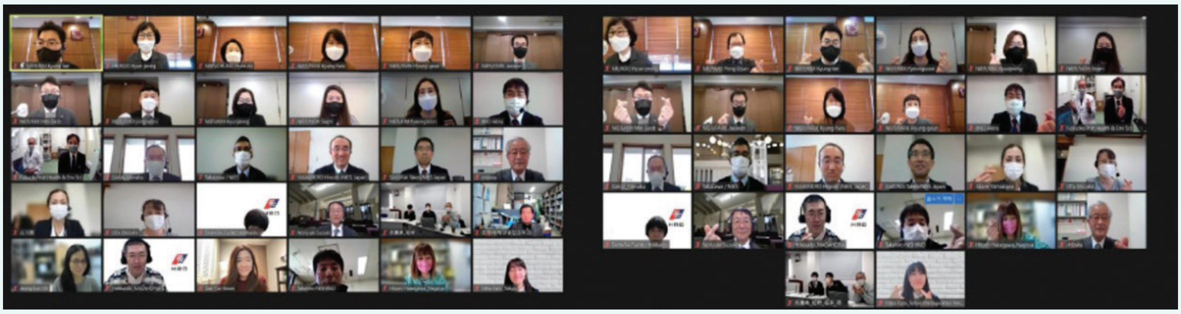

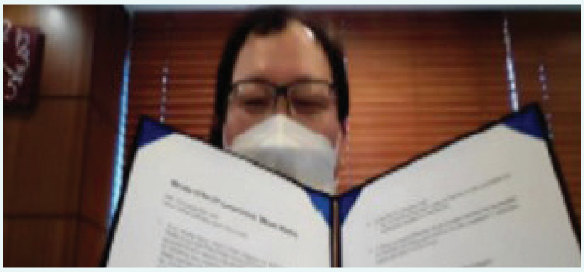

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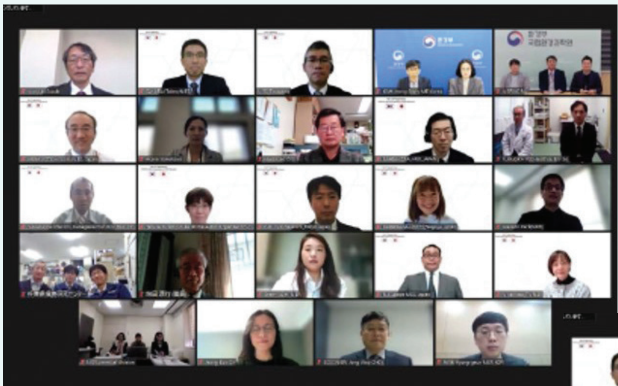

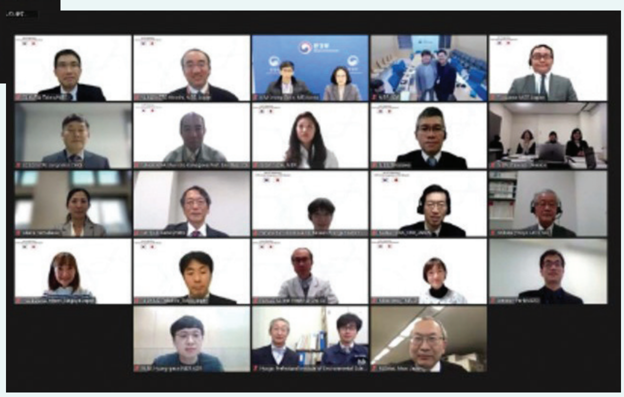

Chapter 1

Introduction

1. Introduction

Most of environmental pollution we face today is caused by numerous chemicals. Currently, there is estimated to be more than tens of millions of chemical compounds made by human so far, whether intentionally or unintentionally. As of July 2023, the Chemical Abstract Service (CAS) Registry Number by the American Chemical Society amounts to 204 million,[1] including organic substances, alloys, and polymers with 15,000 substances added every day.[2] In addition, at least millions to tens of millions of man-made organic compounds have been synthesized, and it is expected to continue their increase in the future.

While intentionally-made chemicals such as pharmaceuticals, pesticides, and insecticides certainly have benefits, they also coexist in harm's way like the 'double-edged sword.' Diethylstilbestrol had been used for a specific purpose until it was banned from use by the U.S. Food and Drug Administration in the early 1970s,[3] or beneficial insects are also killed by pesticides sprayed for the control purpose of harmful pests. From an economic point of view, materials, chemicals, or technologies can have the positive effects such as productivity, efficiency, or economic growth, but at the same time have the unintended negative consequences such as environmental pollution, health risks, or social-cost increase.

In a three-year (1988~1990) study of environmental conditions of the Great Lakes,[4] zoologist Theo Colborn1) clearly warned the harmfulness of man-made persistent chemicals, which were transferred to the offspring of apex predators and causing developmental disorders in their youngsters' organs before they are born or hatched. In 1991, Colborn gathered 21 international scientists from 15 different disciplines, including medical and pharmaceutical toxicology, in Wingspread, Wisconsin, to identify and share the knowledge and information on the trans-generational health impact [5] of persistent chemicals. The Wingspread Statement [6] was issued that man-made chemicals as well as natural substances could disrupt the endocrine system of animals, including humans. The term of Endocrine Disrupting Chemicals (EDCs) was first coined at this conference.

The statement aroused a lot of interests and concerns around the world, and the environmental pollution caused by human-made persistent chemicals was recognized as a problem that the world should solve together, not limited to any one country. Since the late 1990s, many countries around the world, including the United Nations (UN) and the Organization for Economic Cooperation and Development (OECD), have established and promoted the management policy and measure for EDCs, while enacting and implementing the related laws.

1) Theodora Emily Colborn. Our Stolen Future (1996).

The Japan Environment Agency released 'the SPEED 98'[2] in May 1998,[7] which included specific countermeasures to be pursued in the future on the issue of endocrine disruptors, based on an interim report by 'the Research Group on Exogenous Endocrine Disruptors' in July 1997. It has been pushing for responses such as listing 67 chemicals suspected of having endocrine disruption and conducting a nationwide survey based on these substances. A group of experts, comprising members from the National Institute of Environmental Research (NIES) and universities, was formed to carry out an in-depth investigation for this nationwide survey.

In addition, eight out of 67 chemicals, including tributyltin, nonylphenol, 4-octylphenol, butyl phthalate, dicyclohexyl phthalate, ethylhexyl phthalate, benzophenone, and octachlorostyrene, which showed the peak concentration at the environmental survey in the 1998 National Environmental Emergency Survey or whose impact on endocrine organs was recognized in research literature, were selected as substances to be evaluated first for risk assessment.

For more details, please refer to the contents of Japan, a joint research party and co-author country.

In Korea, in line with the international trend, the EDCs Countermeasure Committee was formed in May 1998 with 23 members, including the Ministry of Environment, the Ministry of Agriculture and Forestry, the Food and Drug Administration, the Ministry of Labor, Academia, and Environmental Organizations. At the same time, a Research Council specializing in EDCs was formed with 28 experts, including the National Institute of Environmental Research (NIER), the NIAST[3], Academia, and Industrial and Environmental Organizations in order to begin the cooperative research in this project.[8]

Also, as a survey result of the domestic use on 67 kinds of EDCs prescribed by the WWF[4] in June 1998, the four chemicals, including bisphenol A, alkyl phenols (pentyl to nonyl), diethylhexyl phthalate, and benzyl butyl phthalate, were considered harmful and designated as observation substances under the Hazardous Chemicals Control Act. Thus, when manufacturing and importing them, the regulation was strengthened to mandate the reporting of manufacturing volume and purpose of use.[9]

In December 1998, the Medium-and-Long Term Promotion Strategy and Research Project Plan for EDCs ('99~'08) was established, whereby testing methods for target items and survey points were confirmed with reference to Japan's SPEED 98. From the year of 2000, the survey on the ecological impact had been conducted on fishes and amphibians living in rivers, lakes, and wetlands, along with the survey on the residual status of EDCs in

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[2] Strategic Programs on Environmental Endocrine Disruptors 98.

[3] National Institute of Agricultural Science and Technology.

[4] World Wildlife Fund.

environmental media, such as river and lake water, soil, sediment and atmospheric air.[10]

Meanwhile, the management of EDCs, which are ultimately evaluated based on their 'medical and pharmaceutical toxicity' to human health, often faces difficulties and disputes over scientific evidence. In some cases, proving endocrine disorders may require a lengthy observation period spanning generations and significant research costs.

On the other hand, the management of Persistent Organic Pollutants (POPs), which are evaluated based on the physical and chemical properties of the substances, offers advantages such as fewer scientific debates, shorter timelines to establish evidence, and lower research costs.

Consequently, many countries, particularly in Europe, have shifted their hazardous chemical management policies from a primary focus on EDCs to POPs. To comply with international environmental agreements such as the Stockholm Convention[5)], regulatory and research efforts globally have increasingly prioritized POPs.

[5)] Stockholm Convention on POPs is an international environmental treaty, signed on 22 May 2001 and effective from 17 May 2004. As of September 2022, there are 186 parties to the convention. Notable non-ratifying states include the United States, Israel, and Malaysia.

Chapter 2

History of Korea-Japan GOM and CJR

2. History of Korea-Japan GOM and CJR[6)]

Social interests on EDCs increased from July 1998 when the imposex phenomenon caused by tributyltin was reported by domestic media, along with the controversy that the dimer and the trimer of styrene were detected in disposable noodle containers.

Amid growing interests on EDCs at home and abroad, Korea-Japan summits[7)] announced 'the Joint Declaration of a New Korea-Japan Partnership in the 21st Century' on October 8, 1998, laying the foundation for cooperation between two countries. At this time, a joint research on EDCs was initiated so that the Korea-Japan environmental authorities agreed to hold a cooperative meeting in October 1998, to investigate the EDCs such as alkylphenols, bisphenols A, and phthalates, to verify the OECD test guidelines, and to alternately hold joint workshop or symposium (Seoul in 1999 and Japan in 2000).

On November 25, 1999, the Korea-Japan Joint Seminar was first held at the NIER in Korea. Korea introduced measures, research status and prospects on EDCs, while Japan introduced analysis methods in environmental media, biological monitoring and organotin contamination of gastropods. The following year, on November 9, 2000, the 2nd Japan-Korea Joint Symposium on Endocrine Disorders was held at the NIES in Japan. Each country's research activities were published, including promotion status and future plan on EDCs, and survey results in environmental media and on ecological impacts. Also, there were a lot of discussions, including future plans, activation of information exchange, holding of the next symposium.

Until then, the research cooperation had been at the level of presenting the management trend and the contamination status at joint seminars by policy managers and several related researchers from both countries.

On April 7, 2001, the Korea-Japan Research Cooperation Agreement on EDCs was signed by ministers[8)] of both countries. As a follow-up measure, two countries agreed to carry out the Cooperative Joint Research (CJR) projects, which were approved and adopted at the Government Official Meeting (GOM), and present the results at the joint symposium.[11]

A. Early Stage of CJR (2001-2006)

Under the minister-level implementation agreement, the 1st GOM and Joint Symposium were held at the NIER in Korea on December 7, 2001. The main contents agreed at the GOM were to form a consultative body between two governments, to regularize its meetings,

6) the President of Korea, Daejung KIM and the Prime Minister of Japan, Keizo OBUCHI.

7) the President of Korea, Daejung KIM and the Prime Minister of Japan, Keizo OBUCHI.

8) Myungja KIM in Korea and Yoriko KAWAKUCHI in Japan

to prepare detailed action plans, and to approve and adopt the CJR projects. In addition, it was also agreed that the policy introductions and the CJR results would be presented at the fourth quarter of each year by holding Joint Symposiums alternately.[12]

A total of eight people from the Ministry of Environment (MOE) of both countries, the NIER, the NIES, and the related universities attended the 1st Joint Symposium, presenting the implementation and management status on EDCs, testing and monitoring methods, environmental residual status, etc.[13]

The 2nd GOM and Joint Symposium was held in Tsukuba, Japan on December 6, 2002. The GOM agreed to form a director-general or division-director level consultative body in order to implement the agreement, and approved a total of six CJR projects proposed by three from each country.[14] It was also agreed that the GOM would designate the experts for managing the each task, and that the CJR results would be released at the fourth quarter of each year.

The 3rd GOM and Joint Symposium was held in Jeju Island, Korea on January 16, 2004. Among the six tasks proposed at the 2nd GOM, five were presented excluding the task of Harmonization of POPs Monitoring. From this Joint Symposium it could be thought that the de facto CJR between two countries began, and thereby six tasks proposed at the 2nd GOM and adopted at the 3rd GOM were the beginning of the Korea-Japan CJR. At this time, it was agreed that research results would be presented at the following year's joint symposium and included in the annual report.[15]

The six items proposed at the 2nd GOM

1. Development of EDCs Testing Method using Medaka Fish.
2. Harmonization of POPs Monitoring.
3. Comparison of Dioxin Level in In-land Fish.
4. Standardization of Wildlife Monitoring Methodology.
5. Study of EDCs Fate Modeling Technique.
6. Comparative Study for Dioxin Inventory Technique.

* 1~3: Japan's proposal, 4~6: Korea's proposal

The six Workplans & Designated Experts adopted at the 3rd GOM

1. Development of the examination method using medaka.
   Korea: Dr. Moonsoon LEE (NIER)
   Japan: Dr. Norihisa TATARAZAKO (NIES)
2. Comparison of Dioxin Levels in In-Land Fish.
   Korea: Prof. Giho JEONG (Pusan National University)
   Japan: Dr. Kiwao KADOKAMI (Kitakyushu City Inst. of Environ. Sci.)
3. Standardization of wildlife monitoring methods.
   Korea: Prof. Kyuhyuck CHUNG (Sungkyunkwan University)
   Japan: Prof. Shinsuke TANABE (Ehime University)
4. Research on fate modeling of endocrine disrupters in aquatic system.

Korea: Prof. Dongsoo LEE (Seoul National University)
Japan: Dr. Hiroaki SHIRAISHI (NIES)

5. Comparative study of dioxin and dioxin like compounds Inventory of Korea and Japan.
   Korea: Prof. Gon OK (Pukyong National University)
   Japan: Dr. Noriyuki SUZUKI (NIES)
6. Harmonization of Analytical Methods for Dioxin and other POPs between Korea and Japan.
   Korea: Dr. Samcwan KIM (NIER)
   Japan: Dr. Yasuyuki SHIBATA (NIES)

At the 4th joint symposium held in Fukuoka, Japan on January 28, 2005. The same six projects as those, which were adopted at the 3rd GOM, were presented at the 4th Joint Symposium.[16] However, these six tasks were reduced to four at the 5th Joint Symposium (Busan, January 19, 2006), and to three at the 6th Joint Symposium (Tsukuba, January 17, 2007).[17-19]

As a result, out of the six CJR projects proposed during the 2nd GOM, all three projects submitted by Korean universities were eliminated in the early stages.[19] This was mainly because the Korean universities were unable to secure the necessary research funds, which led to the discontinuation of their joint research efforts. To strengthen collaborative research between the two countries, it is crucial to establish a dedicated budget and provide adequate support for research teams.

B. Setting Period of CJR (2007-2012)

On March 19, 2008, the 7th Joint Symposium was held in Gyeongju, Korea. The relevant policy tasks of both countries were introduced, and followed by the four CJR tasks, i.e. three carry-over tasks and one new task of perfluorinated chemicals.[20] Since then up to now, the Korea-Japan CJR has been established as a four-task system centered on NIER in Korea and NIES in Japan, which institutes are somewhat easy to secure research funds required.

The CJR tasks presented through the 8th to 12th Joint Symposium were the four carry-over tasks with the same titles. [21-25] That is, the first was 'Harmonization of analysis methods of dioxin and other POPs', the second, 'Fate models on POPs', the third, 'POPs levels in-land fish', and the fourth, 'Monitoring data of perfluorinated chemicals'. Except for the 'Fate models on POPs', the remaining three were related to analysis methods and contamination surveys, which were difficult to regard as academic tasks.

It should be noted that designated experts who led these four tasks from the early days to the setting period include Dr. Samcwan KIM (NIER), Dr. Kyunghee CHOI (NIER), Professor Giho JEONG (Pusan National University), Dr. Yasuyuki SHIBATA (NIES), Dr. Norihisa TATARAZAKO (NIES), Dr. Noriyuki SUZUKI (NIES), and Dr. Kiwao KATOKAMI (Kitakyushu

Environmental Research Institute).

C. Changing Period of CJR (2013-2022)

On March 7, 2014, the 13th Korea-Japan CJR Joint Symposium was held in Yeosu, Korea. Along with the four CJR carry-over tasks, two policy tasks were introduced: Korea's POPs management and Japan's monitoring activities.[26] The isotope analysis method on mercury, supporting the Minamata Convention[9)] was first introduced at the 15th CJR symposium held in Busan in March 2016.

Since then, the Joint Symposium alternated between Korea and Japan until the 19th Symposium held in Seoul, in February 2020. With the outbreak of the COVID-19 pandemic worldwide, the results of Korea-Japan CJR collaborations were presented online until the 22nd Joint Symposium, hosted by Japan in February 2023.

The main characteristics of the Korea-Japan CJR during the changing period was summarized as follows: First, the same four carry-over tasks system as before. Second, research titles were the same one, but research contents were different from each other. Third, task researchers in both countries often changed into new researchers, focusing on short-term tasks in which analysis items were only changed. Fourth, Joint Symposiums were held on the web due to the global COVID-19 crisis. [26-34]

One of the major challenges from the beginning of the Korea-Japan CJR has been the necessity for each country to secure its own dedicated budget. This has made it difficult to pursue more in-depth collaboration and has impacted the continuity of the projects. Additionally, most of the CJR projects presented, which were a part of tasks funded by each country's own budget, were undertaken as repetitive. These included tasks such as developing analysis methods for existing or new POPs, and monitoring the environmental or biological contamination of specific chemicals. Emphasized once again, securing a dedicated budget for the CJR is important in order to enable more in-depth project execution, ensure the continuity of ongoing initiatives, and develop cooperative solutions for emerging issues between the two nations.

Note that those who led the CJR throughout the Setting and Changing Periods include Dr. Jongwoo CHOI (NIER), Dr. Junheon YOON (NIER), Dr. Kyunghwa PARK (NIER), Professor Hyunseo CHO (Jeonnam National University), and Professor Jeongeun OH (Pusan National University) in Korea, and Dr. Akinori TAKEUCHI (NIES), Dr. Takeo SAKURAI (NIES), Dr. Yoshikatsu TAKAZAWA (NIES), Dr. Katsumi IWABUCHI (Iwate Prefectural Research Institute for Environmental Sciences and Public Health) in Japan.

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9) Minamata Convention is an international treaty on Mercury. The convention was adopted and signed on 10 October 2013 at a diplomatic conference held in Kumamoto, Japan. As of October 2024, there are 128 signatories to the treaty and 151 parties.

Chapter 3

Achievement of Korea-Japan CJR

3. Achievement of Korea-Japan CJR

The GOM and CJR have been an opportunity to gauge the level of policy and research in two countries, and are believed to have been directly or indirectly influenced by the exchange of information, knowledge, and researcher. It is very difficult to accurately estimate the CJR's contribution to the development and change of both countries' related policies and research fields about EDCs and POPs over the past 20 years.

Nevertheless, some meaningful achievements though the CJR are as follows.

First, the platform formation for sharing knowledge and exchanging researcher: For young researchers in both countries, the platform is considered to have served as a foundation for sharing expertise and strengthening research capabilities through cooperative initiatives. These knowledge sharing and researcher exchanging can lead to a better understanding and deeper cooperation on environmental issues between two countries, and are also expected to be of considerable help for solving the environmental problems reasonably.

Second, supporting the policy makers: Cooperative efforts such as joint research are considered to be a good opportunity to refer to Japan's policy and research system, which are thought to have helped Korean policymakers prepare or improve the relevant management systems.

Third, the establishment of partnership and networks: The Korea-Japan CJR have served as an opportunity to strengthen ties and cooperation between officials, researchers, and institutes. And the partnership and network between them is expected to contribute to solving environmental problems not only in Northeast Asia but also on a global scale.

The Korea-Japan CJR, which began in the year of 2000 when Korea just began to investigate the environmental residual status and the ecological impact of EDCs, is considered to have a direct or indirect impact on Korean environmental authority. When the CJR began, NIER had a few or insignificant facilities, equipment, and manpower for ecological or animal toxicity tests. The perception changes of MOE officials in Korea toward the EDCs' toxicity, caused by the GOM and CJR with Japan, might have led to the modernization of research equipment and facilities, such as the establishment of an ecological and animal toxicity-test building and a national environmental specimen bank, along with the expansion of research manpower.[35]

The following is the summary of the research achievements of the CJR. Table 1 provides an overview of the 31 projects carried out between 2001 and 2022, followed by brief descriptions of these projects.

Table 1. List of projects by research areas

Research area†	Research period	Project No.	Project name‡
EDCs	I	1	Research on fate modeling of endocrine disrupters in aquatic system
EDCs	I	3	Standardization of the monitoring method of wildlife
EDCs	I	5	Development of the examination method using medaka
EDCs	I	6	Research on effects of organotin pollution to shellfish populations in Korea and Japan: current status and a mode of action of organotins
POPs (model)	I	4	Comparative study of dioxin and dioxin like compounds inventory of Korea and Japan
POPs (model)	II	2	Cooperative research on fate models on POPs
POPs (analytical methods)	I	7	Harmonization of analytical methods for dioxins and other POPs between Korea and Japan
POPs (analytical methods)	II	1	Harmonization of analytical methods for dioxins and original/new POPs between Japan and Korea
POPs (analytical methods)	III	1	Harmonization of analytical methods for dioxins and POPs/new POPs between Japan and Korea
POPs (analytical methods)	IV	1	Harmonization between Japan and Korea of analytical methods for dioxins and existing/new POPs
POPs (analytical methods)	V	3	Cooperative research on environmental monitoring of POPs and other priority pollutants
POPs (analytical methods)	VI	3	Cooperative research on environmental monitoring of POPs and other priority pollutants
POPs (analytical methods)	VII	3	Cooperative research on innovative monitoring technique of POPs and other priority pollutants
POPs (bio-accumulation)	III	2	Cooperative research on bioaccumulation on POPs and related chemicals
POPs (bio-accumulation)	IV	2	Cooperative research on bioaccumulation on POPs and related chemicals
POPs (bio-accumulation)	V	2	Cooperative research on bioaccumulation of emerging contaminants in fishes
POPs (bio-accumulation)	VI	2	Cooperative research on bioaccumulation of emerging contaminants in fishes
POPs (bio-accumulation)	VII	2	Cooperative research on the behavior and bioaccumulation of POPs-related and POPs-alternative chemicals in the aquatic environment
POPs (monitoring)	I	2	Comparison of dioxin levels in in-land fish
POPs (monitoring)	II	3	Comparison of POPs levels in freshwater fish (crucian carp) between Korea and Japan
POPs (monitoring)	III	3	Comparison of polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecanes (HBCDs) levels in freshwater fish (crucian carp) between Korea and Japan
POPs (monitoring)	IV	3	Comparison of the amount of perfluoroalkyl substances (PFASs) accumulation in freshwater fish (crucian carp) and the surrounding environmental media between Korea and Japan

Research area†	Research period	Project No.	Project name‡
POPs (monitoring)	II	4	Environmental monitoring and risk assessment of perfluorinated compounds
POPs (monitoring)	III	4	Comparison of monitoring data for perfluorinated chemicals between Japan and Korea
POPs (monitoring)	IV	4	Comparison of monitoring results and toxicological data for perfluorinated chemicals between Japan and Korea
POPs (monitoring)	V	4	Cooperative research on analytical methods and environmental monitoring of emerging contaminants in water and sediments
POPs (monitoring)	VI	4	Cooperative research on environmental status of PPCPs in both countries
POPs (monitoring)	VII	4	Cooperative research on the monitoring of contaminants of emerging concern (CECs) in the environment
Mercury	V	1	Mercury isotope analysis as a new tool to support Minamata Convention on Mercury
Mercury	VI	1	Mercury isotope analysis as a new tool to support Minamata Convention on Mercury
Mercury	VII	1	Mercury isotope analysis as a new tool to support Minamata Convention on Mercury

†Research areas are categorized by the project names.

‡Some project names changed during research period. Only the representative one is shown.

Research periods: I, 2001–2005; II, 2006–2008; III, 2009–2011; IV, 2012–2014; V, 2015–2017; VI, 2018–2020; VII, 2021–2023.

3-1. Early Stage of CJR(2001~2006)

I-1 <2002~2004>

Research on fate modeling of endocrine disrupters in aquatic system

Japan - Hiroaki SHIRAISHI
Korea – Dongsoo LEE

1. Background

Environmental fate models that predict the environmental distribution of EDCs are widely used in USA, Canada and Europe, while monitoring studies have been emphasized in Japan and Korea to assess the level of exposure to EDCs. The development of models applicable to the Asian region is expected for the assessment of EDCs exposure so that the models can be used to complement the environment monitoring.

The researchers will collect the monitoring datasets, the information on physical and chemical properties of used EDCs, and social and geographical characteristics of monitored locations, develop new fate models, and evaluate the existing models.

2. Research Plan

1) The basic design and coding of an inner bay and a river water model.

2) Creation of statistics model by multiple regression analysis of the EDCs concentration and environmental, social and geological factors.

3) Substances examined will be E2 and its metabolites, EE2, BPA, NP, and OP.

4) Compare and exchange the information about the EDCs in both countries, including the data concerning physical and chemical properties, the production and release inventory, domestic studies on aquatic fate, and environmental quality standards and guidelines.

5) Organize the monitoring data on EDCs in the environment, and social and geographical factors that possibly affect the fate of EDCs.

6) Conduct sensitivity analysis and uncertainty analysis on the fate models.

7) Fate modelling of EDCs in aquatic systems (bay and that in river that flows to bays)

3. Major Outcomes

<Japan>

Following 4 environmental fate models (river, bay, multi-media and lake) had been developed.

1) River model

For the purpose of early risk detection, a one-dimensional unsteady flow model for prediction of substance concentration in a river has been developed, and sensitivity was analyzed (2002).

We applied the model for bisphenol A in Tokyo Bay. Each cell is 1 km square and is divided into 10 layers in the depth direction. Behaviors considered include biodegradation, sedimentation, and adsorption. Inflows from 6 major rivers and 24 sewage treatment plants were considered (2003).

2) Coupled 3D Water Quality and Ocean Model

The ocean model, the Princeton Ocean Model (POM), has been extended to include river inflow, heat, wind, tides, etc. so that it can be applied to coastal areas. The calculation method is based on the finite difference method, which is separated from the ocean model so that any ocean model can be used. The model equations can be easily replaced. The three-dimensional water quality and ocean model has been applied to Tokyo Bay (2002).

After modification of Princeton Ocean Model, prediction of Bisphenol A concentration in Tokyo Bay was performed, and was validated with monitoring concentrations (2003). The second validation study was performed on NP using measured concentrations in Tokyo Bay surface and bottom waters, river waters and sewage effluents. Simple case study for nonylphenol (NP) reduction was tried using Tokyo Bay model to demonstrate the use of model in management process.

3) Multi-Media Model: MuSEM

We have ported USES, which is common risk assessment tool in EU, to a spreadsheet (Excel). Physical properties of the chemicals listed in SPEED'98, and the PRTR emission data were compiled into a database (2003).

Finally, we have developed MuSEM, multimedia simple-box environmental model programmed in Excel Spread Sheet, Japanese and Korean environmental and geological parameters, and linkage to the Japanese PRTR and/or Production Amount and Monitoring Data Database. We added sensitivity analysis and batch module to MuSEM, and calculations were made on Japanese PRTR substances, and validated using environmental monitoring data (2004).

4) Lake Model with Ecosystem

Lake Model with loading model in watershed has been developed, and evaluated for vertical circulation, accumulation, outflow to downstream of chemicals. The purpose of model is impact analysis for ecosystem, and use as a predictive tool for management of water and sediment in lake. Employed hydrodynamic is laterally averaged 2 dimensional model, and ecological model consisted of five categories in water and three categories in sediment. Physical and chemical processes including degradation, sedimentation, adsorption, desorption are considered.

<Korea>

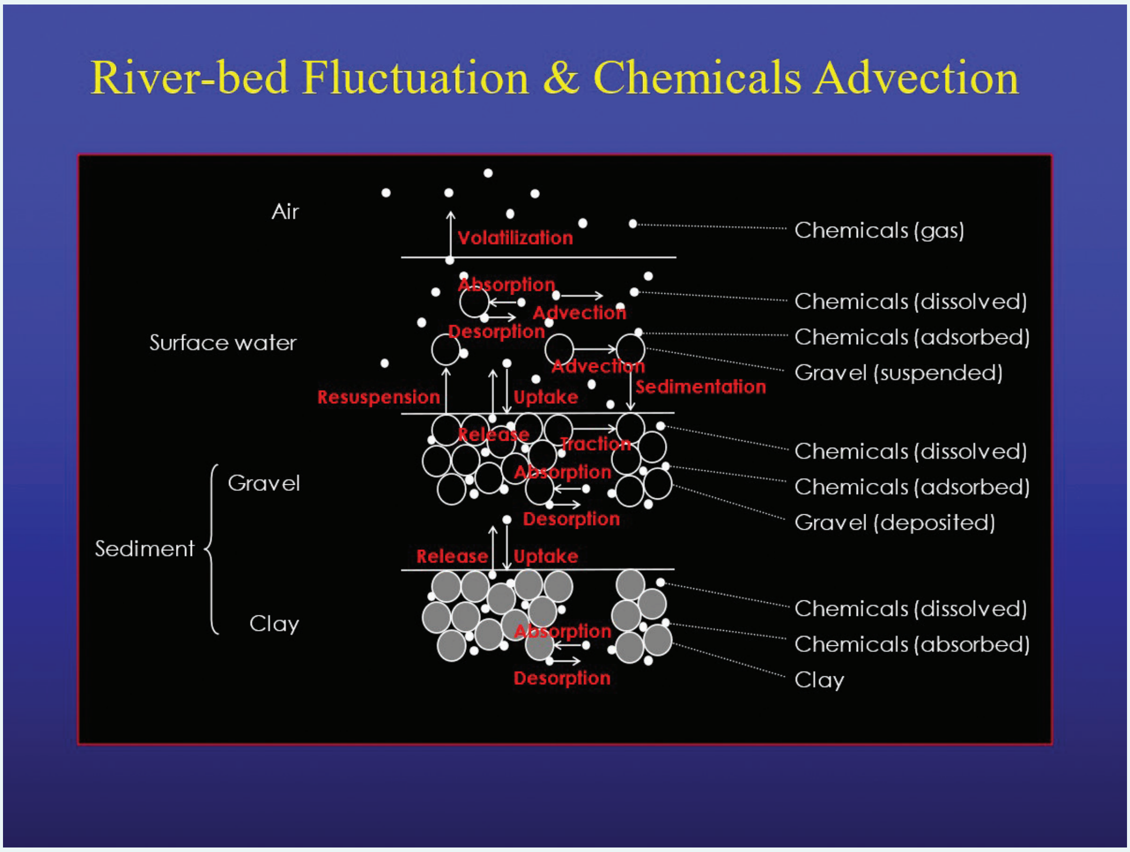
1) It has been found in Korean past field studies that partitioning of endocrine disrupting chemicals (EDCs) between the dissolved and suspended solids (SS)/sediment phases deviated significantly from the equilibrium status predicted by widely accepted equations involving organic carbon fraction and octanol-water partition coefficient.

2) The observed partition coefficients were often greater by 101 to 103 than those predicted by the equations (e.g., Kd=0.41 x foe x Koc). Such a large disparity causes significant errors in predicting the concentrations in the aquatic system, which in turn

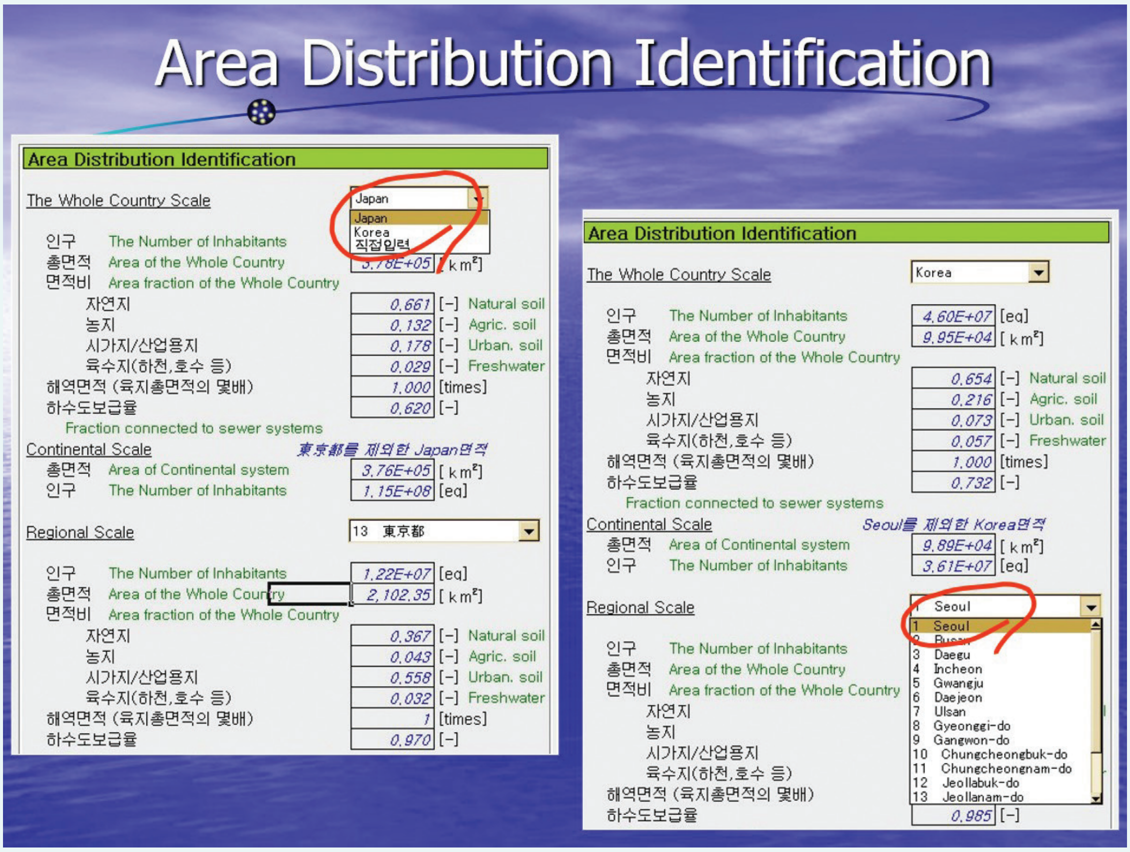
would lead to the bias to the same extent in the aquatic eco-risk assessment.

3) For polycyclic aromatic hydrocarbons (PAHs), model simulations indicate that the disparity in Kd causes greater errors particularly for the dissolved phase than the other aquatic media. Extensive analyses of field data showed that the partitioning is strongly influenced by the characteristics of sorbents (carbon). The important sorbents include carbons of different nature such as those in airborne particles, soil particles, and waterborne particles and dissolved organic carbon. The contribution of each type also varies principally with weather or season and land use in the area surrounding the water body. Characteristics of chemicals and their emission mode are also an important consideration. For instance, prediction of the partition equilibrium coefficient could substantially be improved for PAHs by taking into account the contribution of soot carbon in addition to the conventional one by organic carbon.

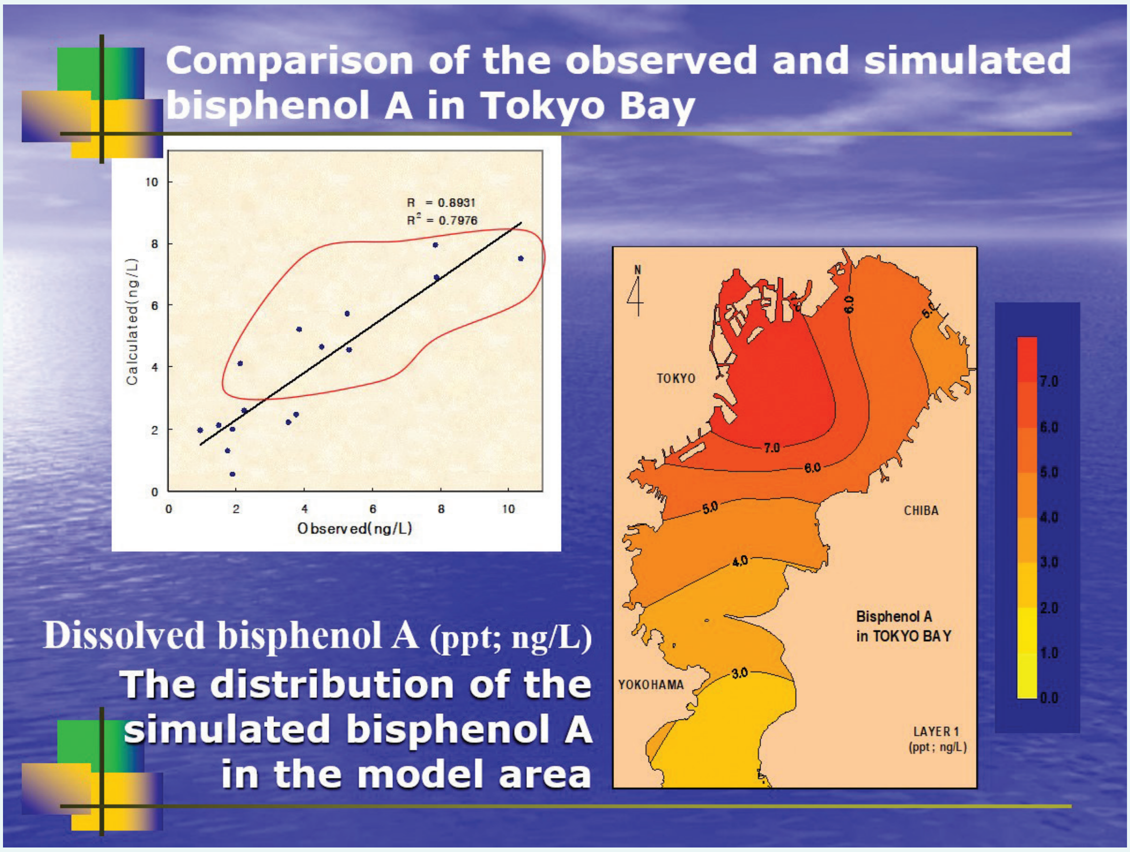
4) Recent modeling efforts in Korean research team were introduced that had been made for better risk assessment of aquatic ecosystems. The impact of model grid size was assessed on the eco-risk assessment. A new model (ECORAME) was developed adopting improved modeling techniques.



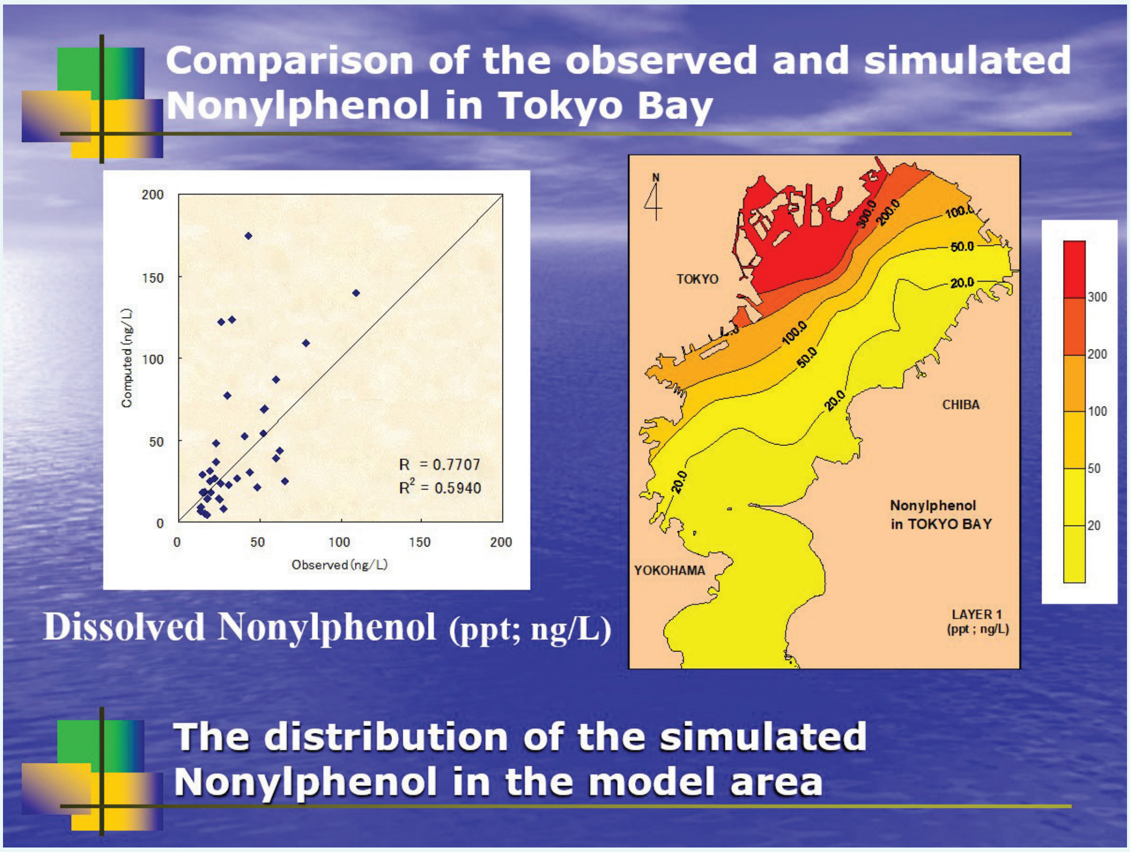
* Various river and chemical dynamics have been considered for River model



*MuSEM included Japan and Korea Area Identification



*3D modeling of Bisphenol A in Tokyo Bay, and comparison observed and predicted values



*3D modeling of NonypPhenol in Tokyo Bay, and comparison observed and predicted values

Model (EDCSeoul)

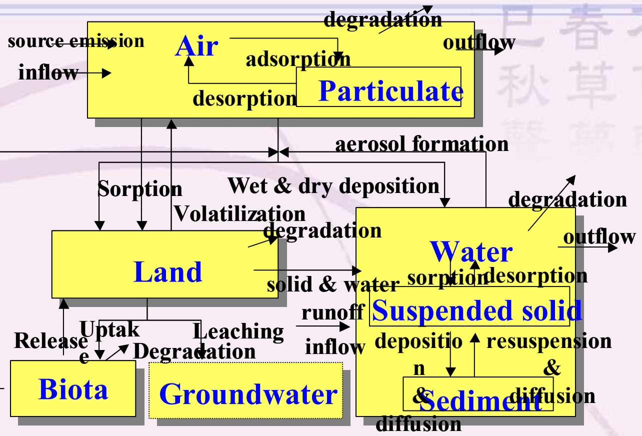
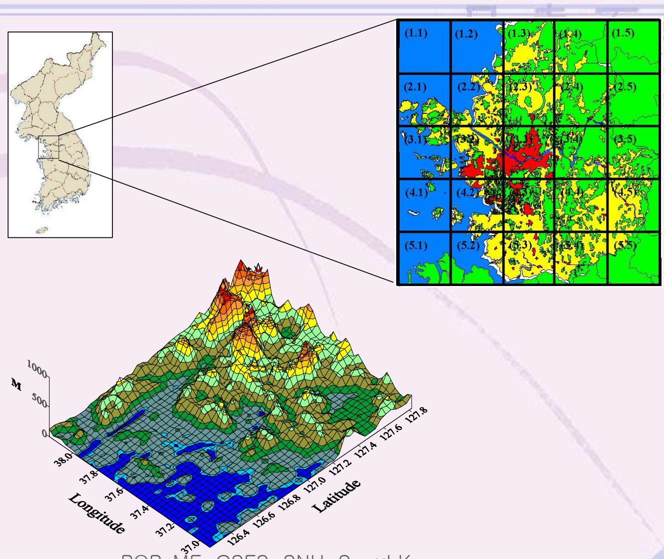


Fig. Schematic Diagram of This Model.

POPsME, GSES, SNU, Seoul Kores

Area of Concern



POPsME, GSES, SNU, Seoul Kores

Fig. Geomorphological feature and defined cells of the simulated area.

Recent Modeling Efforts for Aquatic Eco-risk Assessment

1. Determination of optimum grid size of MMMs for aquatic eco-risk assessment

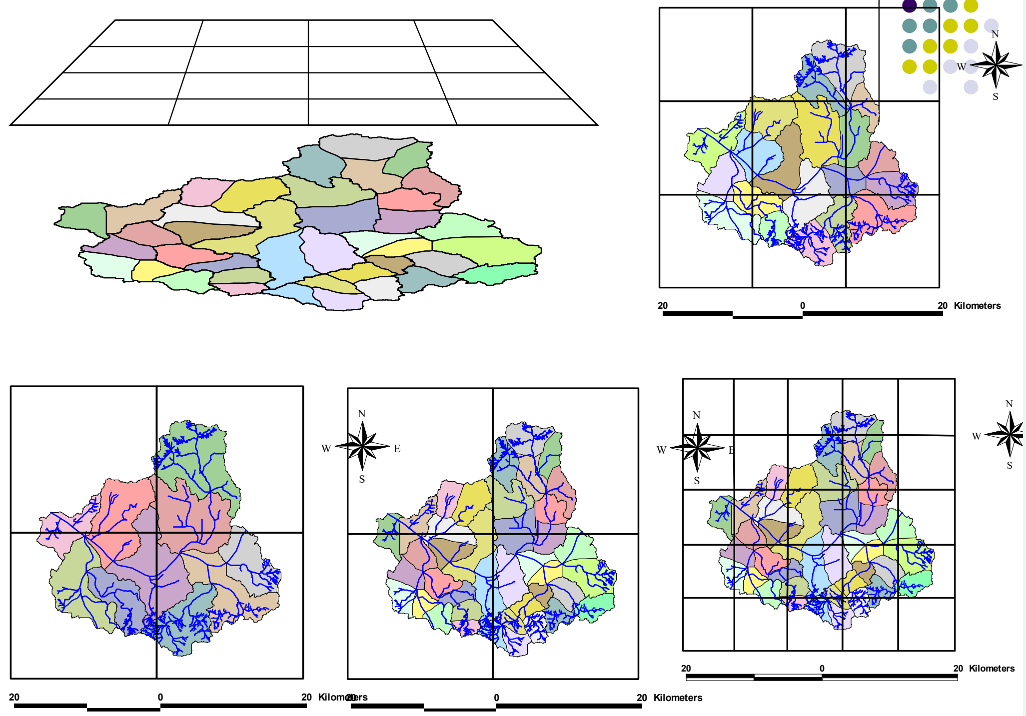
2. Improved techniques for city/industrial complex scale model (ECOlogical Risk Assessment in Multimedia Environment)

-GIS,

-watershed based, urban run-off

-water body from compartment to cell,

-independent air grid size, eddy dispersion



I-2 <2003~2005>

Comparison of dioxin levels in in-land/freshwater fish (Crucian carp), 2003-2005

Japan - Kiwano KADOKAMI,
Yoko KAJIWARA
Korea - Giho JEONG

1. Background

Dioxins (polychlorinated dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs) and coplanar polychlorinated biphenyls (co-PCBs)) are persistent organic pollutants with a global distribution. Dioxins are easily transported over long distances and are mostly anthropogenic. The main sources of dioxins are combustion in waste incinerators and other sources, as well as PCBs and herbicides used in the past. However, the contamination status of dioxins in the environment is considered to be different between Japan and Korea because waste treatment is mainly incinerated in Japan and landfilled in Korea, and the amounts of herbicides and PCBs used differ greatly between the two countries. Dioxins released into the environment also migrate to the aquatic environment and accumulate in fish, but information on the bioaccumulation and congeners distribution of PCDD/Fs and co-PCBs in freshwater fish species in both countries is very limited. In this study, we compared the accumulation of dioxins in freshwater fishes of the two countries using crucian carp, a typical freshwater fish that is widely found in both countries. The accumulation of dioxins varies greatly depending on the fish species, sex, age, collection time, collection location, and individual fish. Therefore, this joint study was conducted with strict unification of the factors affecting the accumulation levels.

2. Research Plan

Work plan for the year 2003-2005:

1) Target analytes: 2,3,7,8-substituted dioxins/furans, co-PCBs.

2) Target species is Crucian 4-5 years old or 20-30 cm in body size collected from summer to fall.

3) Composite samples that consist of more than 10 individual fish.

4) Body portion for analysis is muscle.

5) Quality control follows the guideline of each country.

3. Major Outcomes

<KOREA>

1) 1,2,3,4,7,8,9-HpCDF was not found at all above the detection limit. The number of sites and isomers detected in the first two years (2000 - 2001) was much larger and the detected concentration values were much higher than in the last three years (2002 - 2004). In the last 3 years, only one or two of the seven isomers of 2,3,7,8-substituted PCDDs and three or four

of the ten isomers of 2,3,7,8-substituted PCDFs were detected. 2,3,7,8-substituted PCDD/Fs with six or more chlorine atoms were consistently below the detection limit, except for 2,3,4,6,7,8-HxCDF in 2002.

2) The 5-year wet weight concentrations of PCDDs and PCDFs were below the detection limit and were 1.2 and 2.9 pg-TEQ/g (average 0.04 and 0.22 pg-TEQ/g), respectively. However, the last three years were much lower, ranging from below the detection limit to 0.27 pg-TEQ/g (average 0.02 pg-TEQ/g) for PCDDs and 2.0 pg-TEQ/g (average 0.11 pg-TEQ/g) for PCDFs. appeared. Total co-PCBs concentration ranged from 0.02 to 1.9 pg-TEQ/g (average 0.28 pg-TEQ/g). The total co-PCBs concentration over the three years from 2002 to 2004 was 4.86, 4.91, and 3.52 pg-TEQ/g wet wt, respectively. The proportions of PCDDs, PCDFs, and co-PCBs to total dioxin concentration were 4.1%, 27.0%, and 68.9%, respectively.

3) The regulatory standard for feed and food in the European Union (EU) is 3 pg-WHO-TEQ/g wet wt. In 2000 and 2003, the standards were exceeded three times at Point-4 and Point-5 of the Nakdong River basin, mainly due to PCDFs. Including PCDD/Fs and co-PCBs, it is 1.2 pg-TEQ/g in the body of most crucian carp (95th percentile), which is less than half of the EU standard. In this study, dioxin concentrations detected in carp muscles tended to decrease during the period 2000-2004, and co-PCBs concentrations remained at similar levels for three years.

<JAPAN>

1) Mean dioxins concentration in Crucian carp (*Carassius auratus* (*gibelio*) *langsdorfii*) at 14 sites was 0.57 pg-TEQ/g (wet wt), which was higher than in Korea.

2) The proportion of PCDDs, PCDFs, and co-PCBs to the total TEQ were 34.9%, 12.4% and 52.7%, respectively.

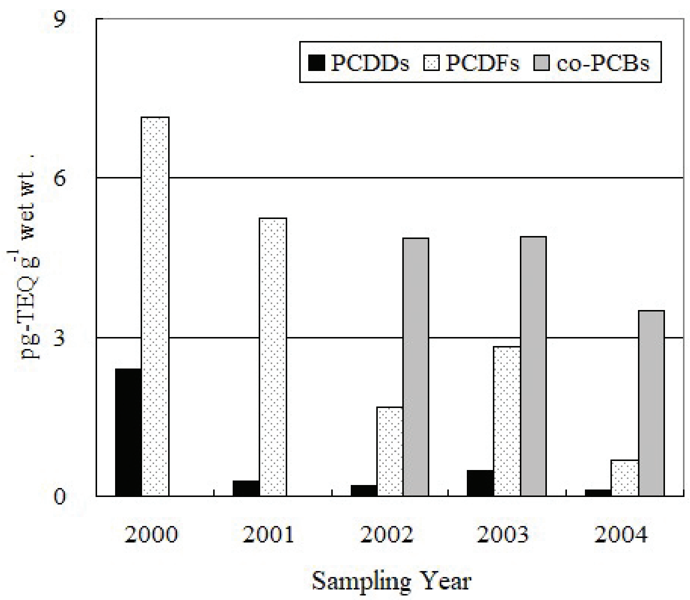
3) Except for three remote sites, there were no significant differences in concentrations among the 11 sites: three in large cities, four in agricultural areas, and four in small cities.

4) The survey areas can be divided into 4 classes: combustion, herbicide, their mixed and remote type. Congener pattern of PCDD/DF and co-PCB in the remote area located a cold district was different from those in other areas.

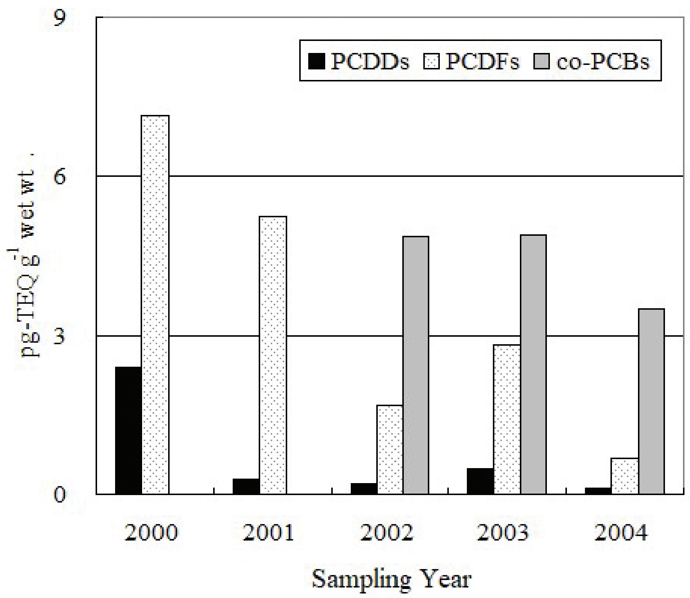
5) Sex differences in dioxins concentration were found during the breeding season due to maternal transfer from mother to their eggs.

Highlight Slides, KOREA

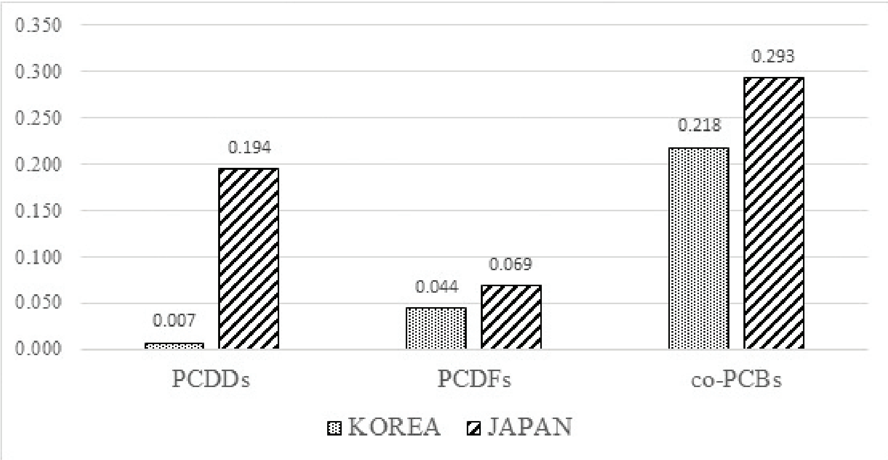
Site-specific total concentrations of PCDD/Fs and co-PCBs in crucian carp during the year 2000-2004



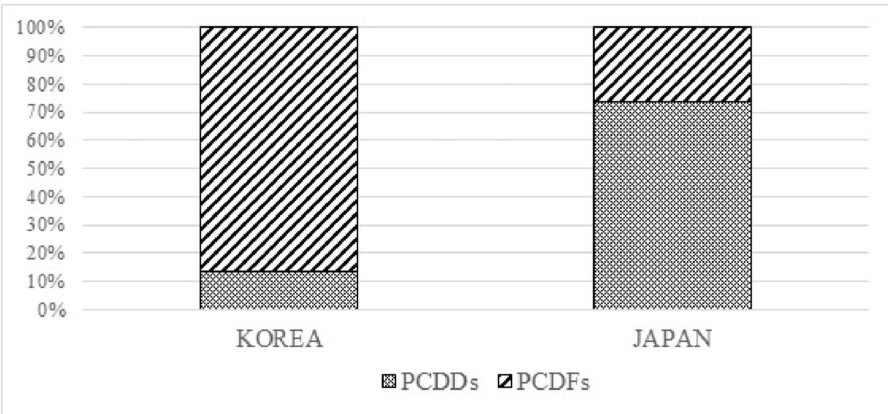
PCDDs, PCDFs, and co-PCBs levels in crucian carp during the year 2000-2004
(summed from 16 sampling sites)



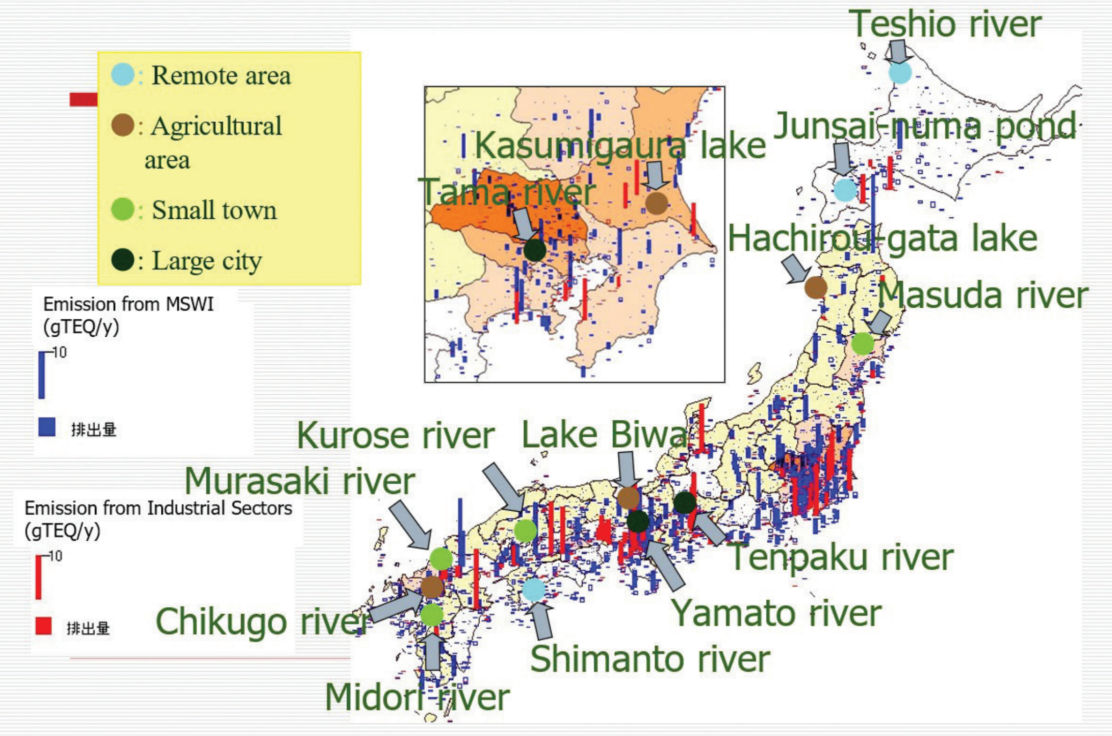
Average levels of PCDDs, PCDFs, and co-PCBs accumulated in Crucian carp from Korea and Japan, pg TEQ/g wet weight
(data from all the sampling sites, 2004)



Relative ratio of PCDDs and PCDFs accumulated in Crucian carp from Korea and Japan
(data: average level obtained from all the sampling sites, 2004)



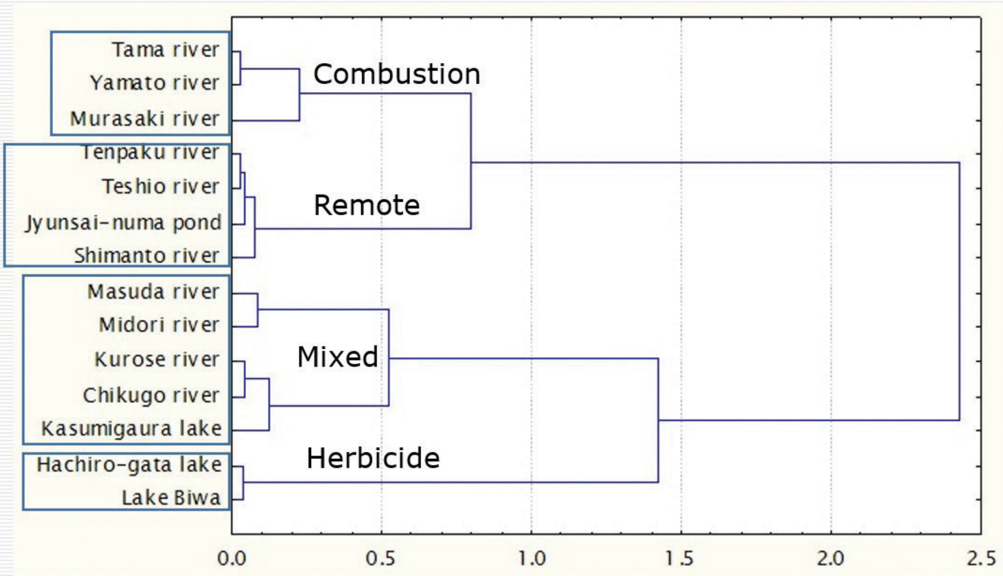
Location of Sampling Sites in Japan



Summary of TEQ Concentrations in Japan

Item	Area	pg-TEQ/g wet wt			pg-TEQ/g fat wt		
		Mean	SD	Interval estimation of mean (95%CL)	Mean	SD	Interval estimation of mean (95%CL)
PCDD	All	0.19	0.16	0.098-0.28	15.2	10.1	9.4-21.1
	Except remote	0.23	0.16	0.13-0.34	18.3	9.2	12.2-24.5
PCDF	All	0.074	0.045	0.048-0.100	6.2	3.3	4.3-8.1
	Except remote	0.089	0.038	0.062-0.11	7.4	2.7	5.6-9.2
Co-PCB	All	0.30	0.16	0.21-0.39	26.0	13.9	18.0-34.0
	Except remote	0.36	0.10	0.30-0.43	31.6	9.5	25.2-38.0
Total	All	0.57	0.32	0.38-0.75	47.5	23.1	34.1-60.8
	Except remote	0. 69	0.25	0.52-0.85	57.3	14.0	47.9-66.7

Dendrogram of Cluster Analysis of PCDDs/DFs (Euclidean Distance, Ward Method)



Sexual Difference in Dioxins Concentration During the Spawning Season at Murasaki River

Sex	TEQ pg/g wet wt	TEQ pg/g fat wt	Conc. (fat wt) ratio of female to others
Male	1.21	83.7	1.23
Female	0.77	68.0	1.00
Egg	1.95	40.1	0.59

I-3 < 2001~2005>

Standardization of the monitoring method of wildlife

Korea - Kyuhyuck CHUNG
Japan - Shinsuke TANABE, Hisato IWATA

1. Background

Studies on the contamination and effects of EDCs on wildlife in the adjacent seas of Korea and Japan were planned. First, the contamination of wildlife by EDCs such as dioxin, organochlorine compounds and organotin compounds was studied for skipjack tuna and cetaceans caught in the Sea of Japan, the East China Sea and the western North Pacific. Secondly, research was carried out to standardize bioassay methods for monitoring wildlife in order to identify the hazards associated with EDCs. Specifically, research focused on environmental impact assessment through monitoring of contaminants using in vitro bioassays, such as the EROD assay and the E-Screen assay. Based on the preliminary research initiated in fiscal 2001, full-scale research began in fiscal 2002.

In Korea, the project titled "*Standardization of Wildlife Monitoring Methodology for Assessing the Ecological Effects of Endocrine Disruptors* (2001–2002)" aimed to establish standardized survey methods. This was followed by the project "*Investigation of Ecological Effects in Areas of Concern with Endocrine Disruptors* (2003–2004)", which conducted preliminary assessment of the Korean wildlife ecosystem. Additionally, the study "*Dose-Response and Species Sensitivity of Indigenous Carp Species* (Carassius auratus) *Inhabiting Domestic River Waters*" was carried out from 2004 to 2005 to determine whether the observed abnormalities were a result of natural variation or the effects of endocrine disruptors.

2. Research Plan

1) Chemical contamination levels in wildlife from adjacent seas will be monitored.

2) Information exchange on wildlife monitoring by combining systemic evaluation, eco-epidemiological reports and hazard identification strategy in both countries will be done.

3) Mutual informative study on differences in species-specific susceptibility to exposure to dioxin-like chemicals will be attempted.

<KOREA>

1) An investigation was conducted to identify sentinel species suitable for monitoring the ecological effects of endocrine disruptors in the survey areas. Additionally, wildlife monitoring methodologies were established for assessing endocrine-disrupting effects.

2) A survey was conducted in areas of concern related to the "Ecological Effects of Endocrine Disruptors." This study investigated the causal relationship between potential contamination with endocrine disruptors (nonylphenol, phthalates, DEHA, bisphenol A,

atrazine, DDT) and the ecological effects on sentinel species (carp and bullfrogs) in three domestic river basins.

3) A study was conducted to investigate the dose-response relationship and species sensitivity of the indigenous carp species (*Carassius auratus*). Additionally, experimental research was carried out by administering 17α-ethinylestradiol (EE2), 4-nonylphenol (4-NP), and Aroclor 1254 to cultured juvenile carp and the Arylhydrocarbon receptor (AhR) gene was cloned.

<JAPAN>

1) The availability of skipjack tuna as a bioindicator species was investigated. Geographical distribution of levels of DDTs, HCHs, HCB, PCBs, chlordanes, and PBDEs were clarified and compared.

2) To understand the present status of contamination and the specific accumulation of PBDEs, their accumulation levels were determined in the archived cetacean samples from the Environmental Specimen Bank (es-BANK) at Ehime University. The blubber of cetaceans found stranded along the coasts of Japan, Hong Kong, the Philippines, and India during the period from 1990 to 2001 were employed for chemical analysis. Additionally, temporal trend of PBDE contamination was investigated by analysis of northern fur seal samples collected during the period from 1972 to 1998 from the Pacific coast of northern Japan.

3. Major Outcomes

<KOREA>

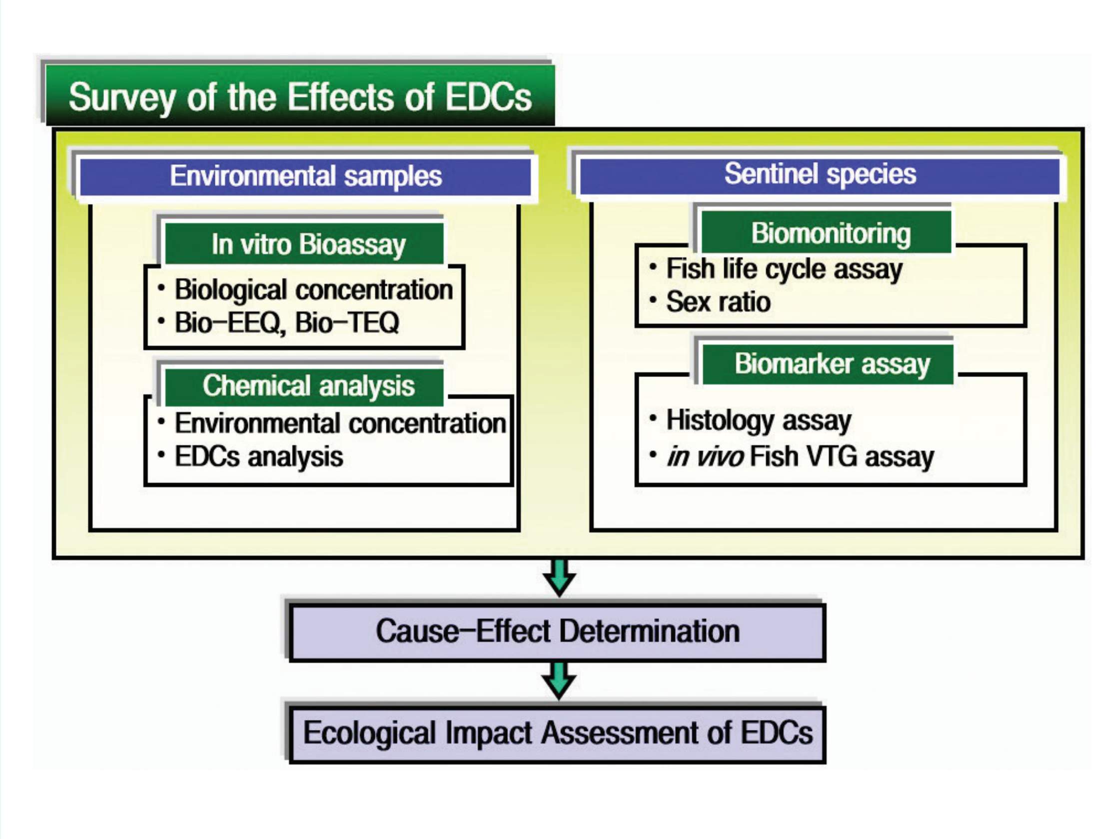
1) Methods for wildlife monitoring using sentinel species to assess the ecological effects of endocrine disruptors were standardized, and comprehensive guidelines were developed. Bioassay techniques, including the E-SCREEN assay and EROD assay, along with quantitative methods such as Bio-EEQ, Bio-MEQ, and Bio-TEQ, were established to evaluate the biological impact of endocrine disruptors in environmental samples. Additionally, vitellogenin ELISA kits were developed to measure vitellogenin levels in the blood of sentinel species (carp and bullfrogs). Using these methods, investigations were conducted in selected river basins identified as areas of concern. These studies confirmed a causal relationship between the concentrations of potential endocrine disruptors, such as nonylphenol, phthalates, DEHA, bisphenol A, atrazine, and DDT, in environmental samples and their ecological effects.

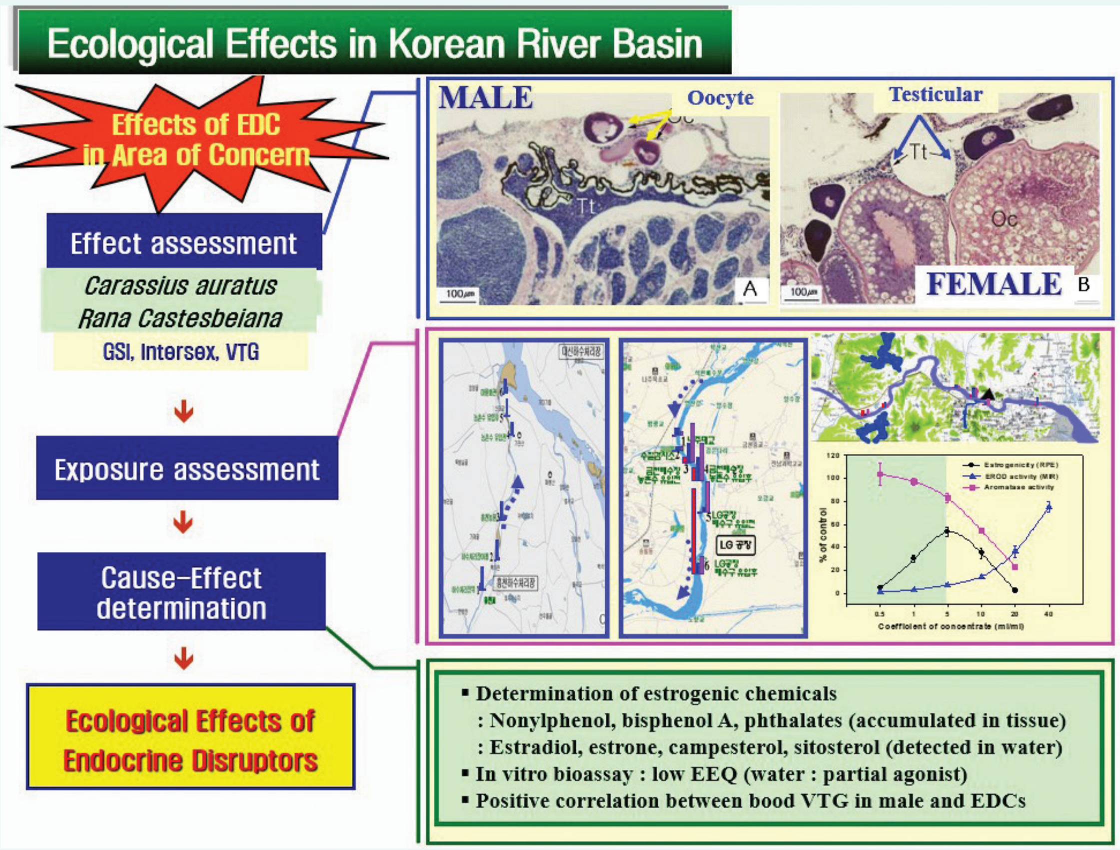
2) Native fish species were surveyed to identify a suitable sentinel species and it was confirmed that several carp species, including *C. auratus langsdorfii*, *C. auratus grandoculis* and *Carassius cuvieri* (crucian carp), inhabit Korean river basins. To evaluate the dose-response relationship and species-specific sensitivity to endocrine disruptors, juvenile carp were cultured in a laboratory and exposed to 17α-ethinylestradiol, 4-nonylphenol (4-NP), and Aroclor 1254. The results showed a concentration-dependent increase in vitellogenin levels in male carp. Furthermore, cloning of the AhR2 (aryl hydrocarbon receptor 2) gene in carp revealed a high sequence homology with zebrafish and other dioxin-sensitive species.

<JAPAN>

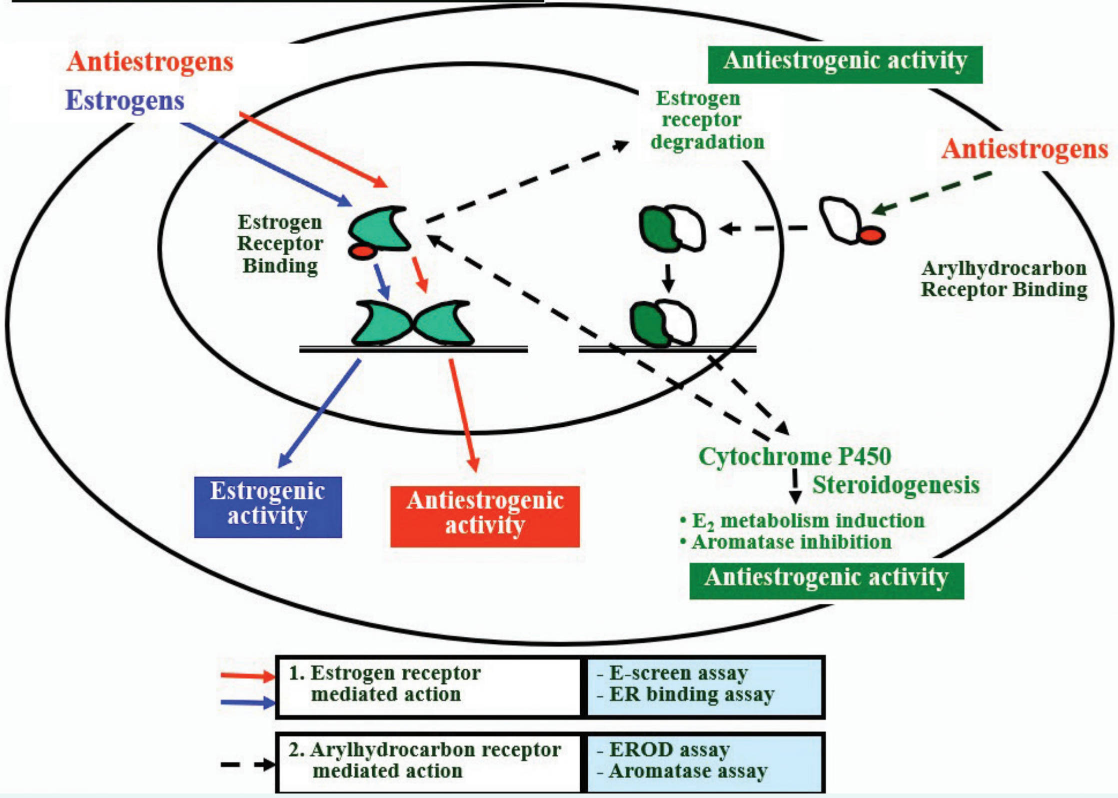
1) There was no correlation between body length and OC levels in tuna muscle, indicating that body length differences in skipjack tuna appear to be negligible for monitoring OC contamination. The geographical distribution pattern of OC levels found in skipjack tuna was similar to that reported in seawater. Thus, skipjack tuna is a suitable bioindicator for monitoring OC pollution in offshore waters. DDT pollution levels in the open sea were low, while the distribution pattern was highly localized in the southern offshore waters. HCHs, HCB, PCBs and chlordanes showed relatively higher levels in Japanese and Korean offshore waters. PBDEs as an emerging contaminant were detected in almost all skipjack tuna collected from offshore waters and open seas, indicating widespread contamination with PBDEs. Higher concentrations of PBDEs were found in skipjack tuna from the East China Sea, suggesting that sources of PBDEs pollution exist not only in Japan and Korea, but also in some developing countries. Comparison of PBDE congeners between locations suggested that lower brominated congeners (2~4 Br) appear to be preferentially transported even to remote oceans. Thus, PBDEs should be classified as new POPs.

2) PBDEs were detected in all cetacean samples analyzed and were one to two orders of magnitude lower than PCBs and DDTs. Concentrations of PBDEs ranged from 6.0 ng/g lipid weight in spinner dolphin (*Stenella longirostris*) from India to 6000 ng/g lipid weight in Indo-Pacific humpback dolphin (Sousa chinensis) from Hong Kong. The highest concentrations were found in animals from Hong Kong, followed by Japan, and much lower levels were found in the Philippines and India, suggesting that developing countries may also have pollution sources of PBDEs. The geographical distribution of PBDEs in Asian waters was different from that of PCBs, but more similar to that of DDT. With regard to northern fur seal samples, the lowest PBDE level was found in fur seals collected in 1972, the peak concentration occurred around 1991-1994, and then decreased to about 50% in 1997-1998. Since the peak concentrations of PBDEs occurred later than those of POPs, further studies are needed to follow the patterns of PBDE contamination, which may be of great concern in the future.


Survey of the Effects of EDCs
Environmental samples
In vitro Bioassay
• Biological concentration
• Bio-EEQ, Bio-TEQ
Chemical analysis
• Environmental concentration
• EDCs analysis
Sentinel species
Biomonitoring
• Fish life cycle assay
• Sex ratio
Biomarker assay
• Histology assay
• in vivo Fish VTG assay
Cause-Effect Determination
Ecological Impact Assessment of EDCs


Ecological Effects in Korean River Basin
Effects of EDC in Area of Concern
Effect assessment
Carassius auratus
Rana Castesbeiana
GSI, Intersex, VTG
Exposure assessment
Cause-Effect determination
Ecological Effects of Endocrine Disruptors
MALE
Oocyte
Testicular
Tt
Oc
A
FEMALE
B
LG 공장
% of control
Coefficient of concentrate (ml/ml)
▪ Determination of estrogenic chemicals
: Nonylphenol, bisphenol A, phthalates (accumulated in tissue)
: Estradiol, estrone, campesterol, sitosterol (detected in water)
▪ In vitro bioassay : low EEQ (water : partial agonist)
▪ Positive correlation between bood VTG in male and EDCs

In vitro Bioassay Methods

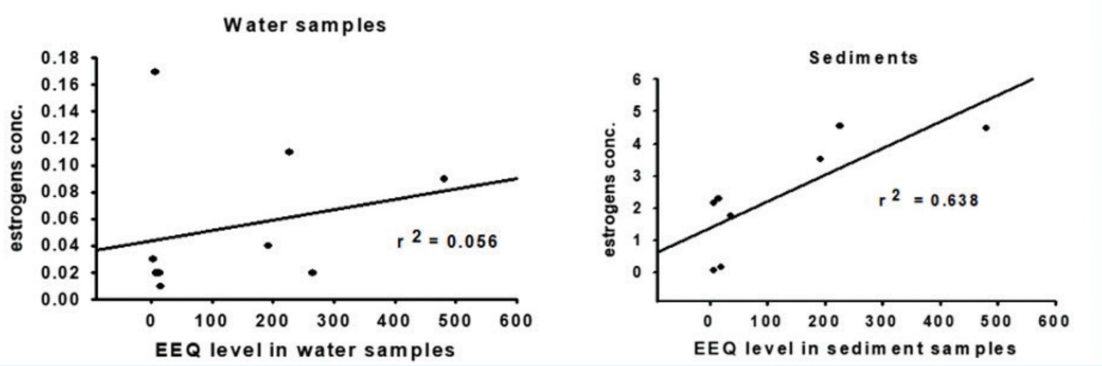


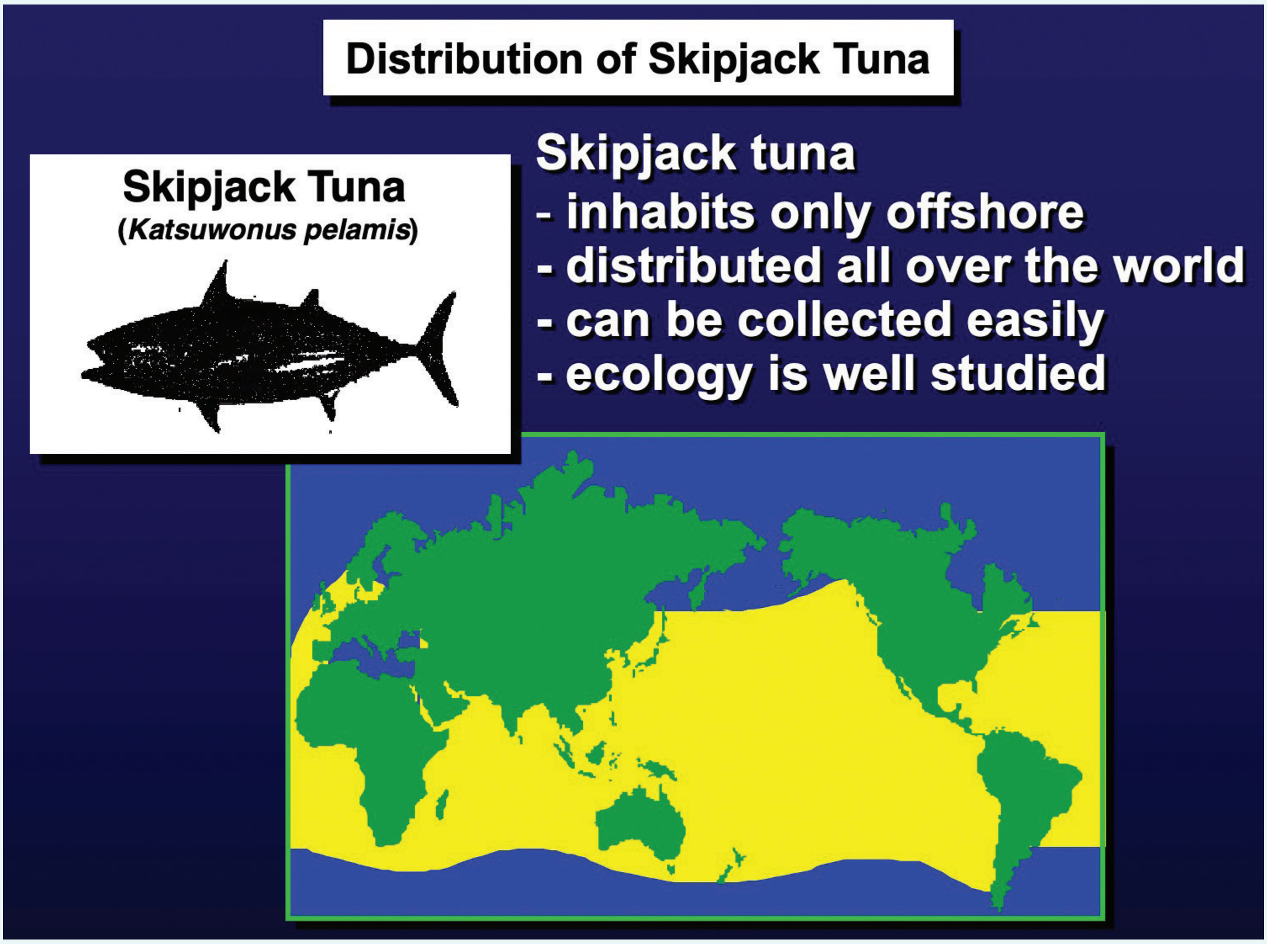
Estrogenic Effects of Korean River Basin

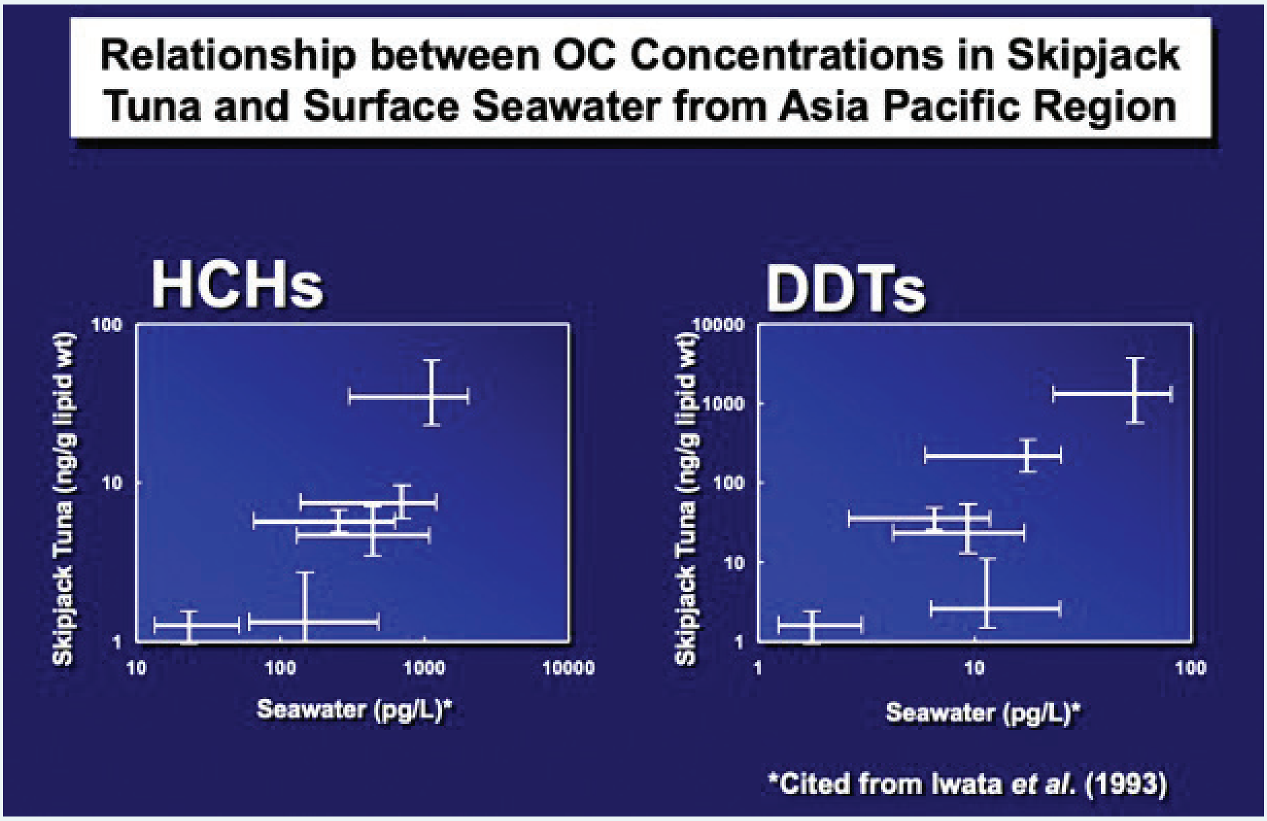
Quantification of estrogenic effect of river water, sediment and pore water samples according to the E-SCREEN assay[a]

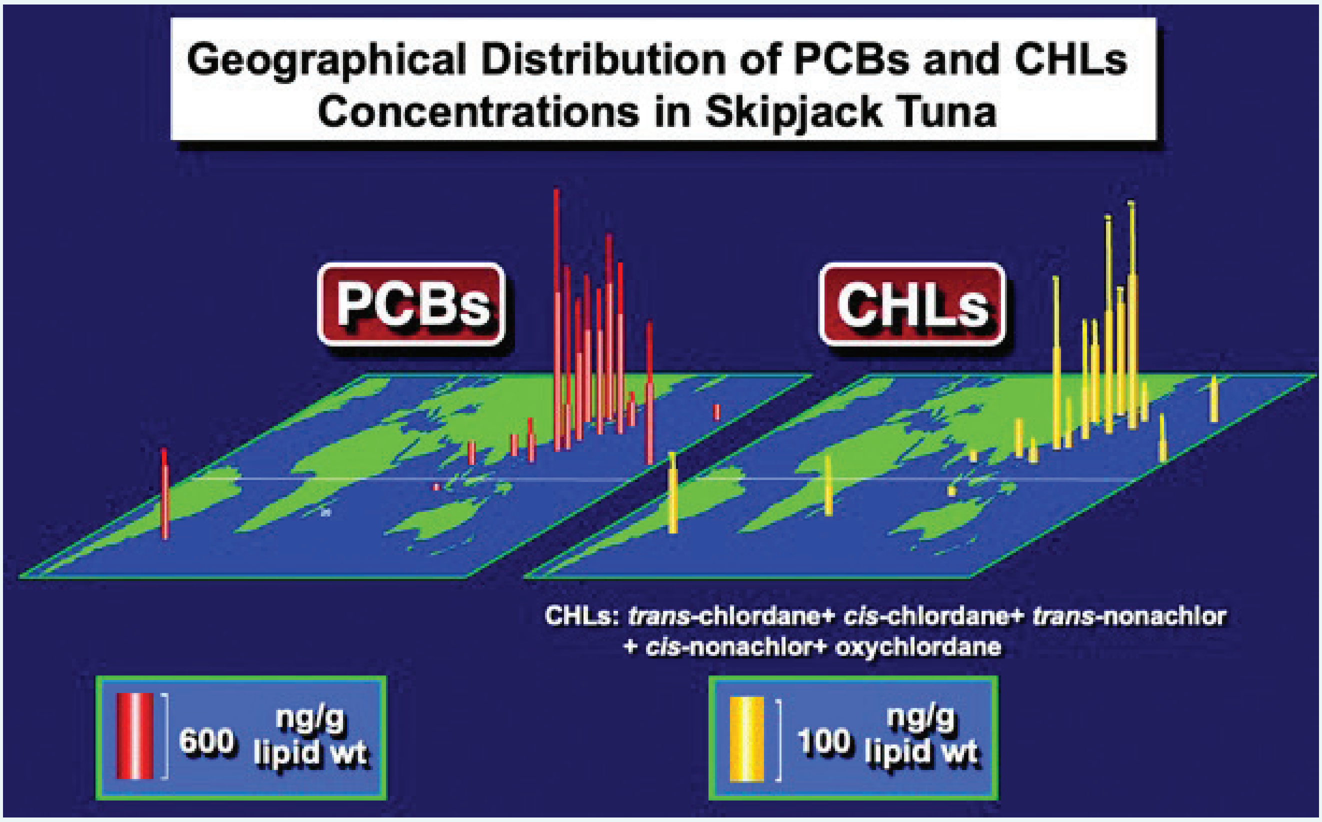
Sample		Water	Sediment		
		(pg EEQ/l)[b]	DC extracts (pg EEQ/g)	Water extracts (pg EEQ/g)	Pore water (pg EEQ/g)
Kumho	Upstream	24.05	–	–	–
	Downstream	7431.68	3.27	0.10	0.02
Kum	Upstream	2046.86	–	–	–
	Downstream	0.91	8.04	0.05	0.04
Mankyung	Upstream	0.66	–	–	–
	Downstream	10.74	10.60	0.08	0.02
Miho	Upstream	6.04	–	–	–
	Downstream	0.50	4.96	0.11	0.03

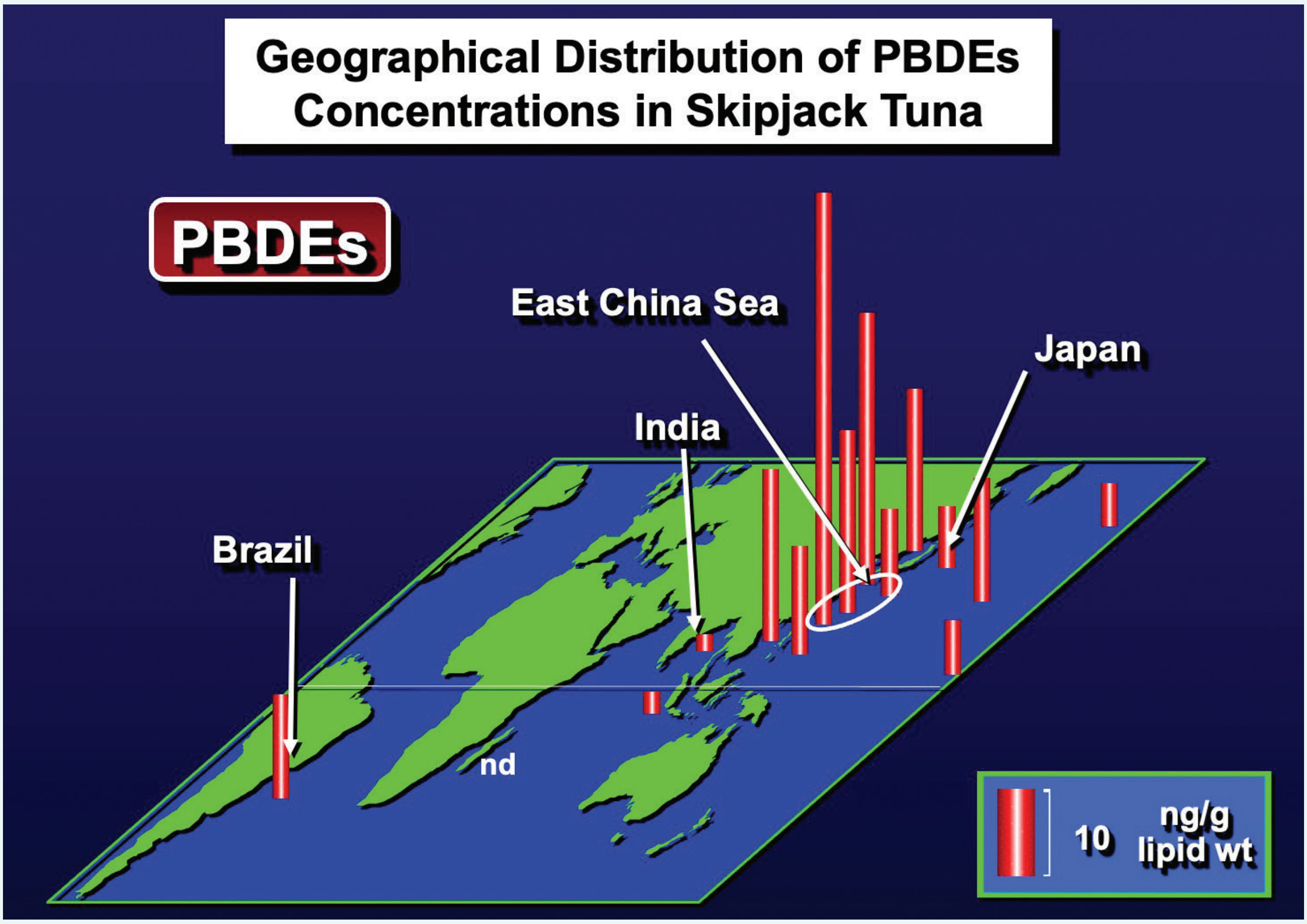
[a] Values represent mean ± S.D.
[b] The 17-estradiol equivalent concentration(EEQ) is calculated with E_2 and the test compound.




Distribution of Skipjack Tuna
Skipjack Tuna
(Katsuwonus pelamis)
Skipjack tuna
- inhabits only offshore
- distributed all over the world
- can be collected easily
- ecology is well studied


Relationship between OC Concentrations in Skipjack Tuna and Surface Seawater from Asia Pacific Region
HCHs
Skipjack Tuna (ng/g lipid wt)
100
10
1
10
100
1000
10000
Seawater (pg/L)*
DDTs
Skipjack Tuna (ng/g lipid wt)
10000
1000
100
10
1
1
10
100
Seawater (pg/L)*
*Cited from Iwata et al. (1993)


Geographical Distribution of PCBs and CHLs
Concentrations in Skipjack Tuna
PCBs
CHLs
CHLs: trans-chlordane+ cis-chlordane+ trans-nonachlor
+ cis-nonachlor+ oxychlordane
600 ng/g lipid wt
100 ng/g lipid wt


Geographical Distribution of PBDEs
Concentrations in Skipjack Tuna
PBDEs
East China Sea
Japan
India
Brazil
nd
10 ng/g lipid wt

I-4 <2002~2005>

Comparative study of Dioxin and dioxin like compounds Inventory of Korea and Japan

Korea - Gon OK
Japan - Noriyuki SUZUKI

1. Background

Endocrine disrupting substances include 12 Persistent Organic Pollutants (POPs) that are persistent, highly toxic, bio-accumulate and long range transfer in the environment. Among these chemicals, some POPs such as dioxins, furans, polychlorinated biphenyls (PCBs), and hexachlorobenzene (HCB) are unintentionally created byproducts of manufacturing, industrial processes, and they are difficult to be traced in their movement, accumulation, and change. In response to this situation, the Stockholm Convention was adopted in May, 2001 to reduce POPs in a comprehensive, systematic way. The Convention seeks to investigate the source and transport route of released POPs and to disintegrate them chemically. The article 5 of the Convention specifies the measures that the parties of the Convention should take to achieve a goal of continuing reduction and ultimate elimination of the unintentionally produced POPs. This research will be necessary to evaluate comparison continuously about dioxin inventory and in terms of the sources, quantities, and causes of released dioxins. After a comprehensive investigation of dioxin inventories made by the two nations, make a suggestions: 1) to complement merits and demerits through a cooperative relationship between the two nations; 2) to establish a joint research foundation for the two nations to conduct studies on endocrine disrupting chemicals, including dioxins; and 3) to protect people's health and the environment.

2. Research Plan

Korea and Japan should make joint efforts to manage major POPs (Co-PCB, HCB) as well as existing chlorinated dioxins and to share related information in a continuous basis.

1) Review and up-data of dioxin and dioxin like compounds emission inventory. In addition, it will be necessary to adopt GIS system to secure a connection with PRTR and use data effectively through joint investigation and technical cooperation.

2) Exploration of inventory with geographical resolution. More detailed major study items were exchange the information about the present methods for estimating the dioxin inventory in both countries.

3) Analyze the information needed to estimate dioxin inventory, including industrial categories, emission factors, and congeners. Review the estimation method applicable to the inventory of EDCs in addition to the dioxin.

3. Major Outcomes

We had the results on comparisons between emission inventories and sectors employed in the inventories of Japan and Korea. Table 1 summarized the comparison of dioxin emission inventories between Korea and Japan, based on the shared source categories.

Unit source categories for which specific emission factor or measurement is to be applicable were compared. Source categories may be different among countries, which is often the most difficult problem of emission estimation of chemicals. Dioxin is somewhat special case, because major sources are relatively limited and could be identified and measured, but essentially the problem should be common. Table 2 summarized the comparison of sectors employed in Japan and Korea inventories. Major sectors were common, but there may be some discrepancies among two countries.

Table 1. Comparison of dioxin emission inventory among Korea, USA and Japan, segregated by source categories

Main source	Korea 2001	USA[1] 1995	Japan[2] 2001
Waste Treatment	1,079.2 (86.1%)	1,759.1(67.3)	1,538.5 (88.7)
Ferrous Metal	113.5	95.0	160.3
Non-Ferrous Metal	19.9	316.8	28.8
Mineral products	3.6	184.2	Include waste incineration
Chemical	0.6	13.5	1.1 (Estimation)
Power generation	11.0	237.2	2.0 (Estimation)
Non-point source	20.6	Include waste incineration	Include waste incineration
Other-crematory	5.1	9.1	3.5
Total	1,253.5	2,614.9	1,734.2

Table 2. Part of comparison of sectors employed in dioxin emission inventories of Japan and Korea

		Japan						Korea	
Waste Treatment	Incinerator	Municipal	(Normal)	a	w	⇕	a	Municipal	Large
							a		Medium
							a		Small
		Industrial	(Normal)	a	w	⇕	a	Industrial	Large
							a		Medium
			Small	a			a		Small
							a	Hazardous	Large
							a		Medium
							a		Small
		Ladfill			w	⇕	w?	Landfill	Controlled
							w?		Non-controlled
		Crematory		a		⇔	a	Crematory	
Iron/Steel production		Electronic Furnace		a		⇔	a	Electronic Arc Furnace	
		Sinter Furnace		a		⇔	a	Singer Furnace	
						?	a	Pig iron	
						?	a	Steel casting	
Non-ferrous metal production	Zinc	Smelting, refining		a		Zn+Pb	a	Lead and Zinc	smelting, refining and alloy
		recovery		a		?			
	Aluminum	Alloy production		a	w	⇔	a	Aluminum	smelting, refining and alloy
		Rolling process	7 subcategories	a	w	⇔	a		Rolling, compressing and elongatir
	Copper	Smelting, refining		a		⇔	a	Copper	smelting, refining and alloy
		recovery		a		?			
		cable production		a		?			
	Lead	Smelting, refining		a			a		
		recovery		a		?			
Mineral industry	Glass	Flat glass		a		⇔	a	Glass	Flat glass
		glass fiber and other 4 subcategories		a		?	a		Industrial glass
	Ceramic	refractory	2 subcategories	a		⇔	a	Ceramic	refractory
		imbrices, tiles, etc.	5 subcategories	a		?	a		non-refractory
	Cement	Cement		a		⇔	a	Cement & Lime	Cement
	Lime	Lime		a		⇔	a		Lime
							a	Other	Asphalt

Purpose of the study

- Comparison of dioxin emission inventory system between two countries
  - Major goal is to get consistent reporting data on the emission of chemicals
- Major study items
  - Exchange the information about the present methods for estimating the dioxin inventory in both countries
  - Analyze the information needed to estimate dioxin inventory, including industrial categories, emission factors, and congeners
  - Review the estimation method applicable to the inventory of EDCs in addition to the dioxin

National Institute for Environmental Studies

Scope of the work item (5)

- To find out a possible way of consistent emission inventory of dioxin in both countries
  - Description of estimation protocol/system/program
  - Compilation of field and experimental survey data
  - Data compilation and exploration of inventory with geographical resolution
- To give a possible implication to the future inventory system for EDCs including PRTR or other framework
  - Information sharing for other chemicals such as POPs and brominated compounds
  - Discussion on source categorizing and emission estimation methodology, for example mobile source estimation

National Institute for Environmental Studies

◆ Classified dioxin inventory sources

◈ KOREA Dioxin Inventories are,

- Constructed by reflecting the Korea Standard Industry Classification System and the Atmospheric Preservation Policy.
- Incorporate the characteristics and emission sources of UNEP classification system and existing inventories of other countries.
- Classified into 10 main categories and further divided into semi-sub and sub categories.

◈ JAPAN Dioxin Inventories are,

- Constructed for emission sources that are currently believed to have si gnificant emission to the environment.
- Classified into two main categories—emissions into the air and water.
- Potential emission industries are further classified into smaller categories.

부경대학교 PUKYONG NATIONAL UNIVERSITY Dioxin Research Center

◆ Summary of Dioxin Inventories

	Korea	Japan
Responsible Organization	Ministry of Environment	Ministry of Welfare, the Environment Agency, the Chamber of Commerce and Industry → Ministry of Environment
Estimation Method	Measurement, Emission factor	Measurement, Emission factor
Revision Frequency	Non fixed	Yearly revision based on actual measurement

부경대학교 PUKYONG NATIONAL UNIVERSITY Dioxin Research Center

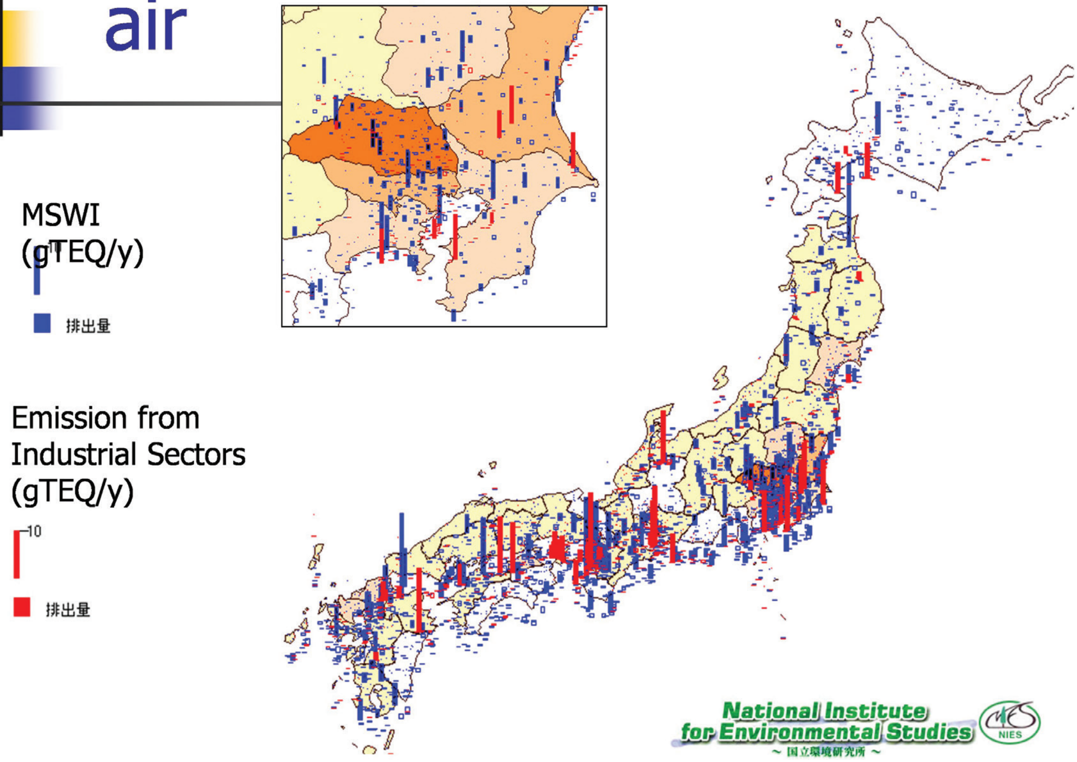
Comparison of classification system used in emission estimation of dioxin inventory (1)

		Japan						Korea	
Waste Treatment	Incinerator	Municipal	(Normal)	a	w	⇕	a	Municipal	Large
							a		Medium
							a		Small
		Industrial	(Normal)	a	w	⇕	a	Industrial	Large
							a		Medium
			Small	a			a		Small
							a	Hazardous	Large
							a		Medium
							a		Small
		Ladfill			w	⇕	w?	Landfill	Controlled
							w?		Non-controlled
		Crematory		a		⇔	a	Crematory	
Iron/Steel production		Electronic Furnace		a		⇔	a	Electronic Arc Furnace	
		Sinter Furnace		a		⇔	a	Singer Furnace	
						?	a	Pig iron	
						?	a	Steel casting	
Non-ferrous metal production	Zinc	Smelting, refining		a		Zn+Pb	a	Lead and Zinc	smelting, refining and alloy
		recovery		a		?			
	Aluminum	Alloy production		a	w	⇔	a	Aluminum	smelting, refining and alloy
		Rolling process	7 subcategories	a	w	⇔	a		Rolling, compressing and elongatin
	Copper	Smelting, refining		a		⇔	a	Copper	smelting, refining and alloy
		recovery		a		?			
		cable production		a		?			
	Lead	Smelting, refining		a			a		
		recovery		a		?			
Mineral industry	Glass	Flat glass		a		⇔	a	Glass	Flat glass
		glass fiber and other 4 subcategories		a		?	a		Industrial glass
	Ceramic	refractory	2 subcategories	a		⇔	a	Ceramic	refractory
		imbrices, tiles, etc.	5 subcategories	a		?	a		non-refractory
	Cement	Cement		a		⇔	a	Cement & Lime	Cement
	Lime	Lime		a		⇔	a		Lime
							a	Other	Asphalt

Comparison of classification system used in emission estimation of dioxin inventory (2)

Chemical production	(Chlorinated comp.)	Chlorobenzene		a	w	⇕	a	Chloride compounds	EDC, VCM
		Vinyl chloride		a	w				
		4-chlorophthalic			w	?			
		2,3,-dichloro-1,4-naphthoquinone			w	?			
		caprolactam		a	w	?			
	(other)	Potassium sulfate		a	w				
		Aluminum fiber		a	w				
		Acetylene			w				
		dioxane violet			w				
		yellow pigment			w				
Pulp industry		pulp		a	w	⇔	a	pulp	
Power		power generation		a		⇕	a	power generation	solid fuel
							a		liquid fuel
							a	area heating facility	solid fuel
							a		liquid fuel
Transport		vehicle		a		⇔	a	vehicle	
Sewage		sewage treatment plant	2 subcategories		w	⇔	w?	sewage treatment plant	
Heating							a	combustion of manufacturing industry	
							a	residence facility	
Micellaneous		tobacco smoke		a					

Dioxin Emission data into air



Comparison of dioxins amount other countries

unit : WHO-TEQ

Main source	Korea 2001	USA[1] 1995	Japan[2] 2001
Waste Treatment	1,079.2 (86.1%)	1,759.1(67.3)	1,538.5 (88.7)
Ferrous Metal	113.5	95.0	160.3
Non-Ferrous Metal	19.9	316.8	28.8
Mineral products	3.6	184.2	Include waste incineration
Chemical	0.6	13.5	1.1 (Estimation)
Power generation	11.0	237.2	2.0 (Estimation)
Non-point source	20.6	Include waste incineration	Include waste incineration
Other-crematory	5.1	9.1	3.5
Total	1,253.5	2,614.9	1,734.2

- USA : Not include Co-PCB (only PCDD/PCDF)

I-5 <2001~2005>

Development of the examination method using medaka

Korea – Moonsoon LEE, Kwangsik PARK, Kyunghee CHOI, Hyunmi KIM
Japan - Norihisa TATARAZAKO

1. Background

Endocrine disruptors (EDCs) are being studied using fish worldwide. Medaka (*Oryzias latipes*), fathead minnow (*Pimephales promelas*) and zebrafish (*Danio rerio*) have been identified as potential test fish for EDC studies in the OECD test method. In particular, the vitellogenin test using medaka has been well studied in Japan as an early screening method for EDC. Histological observation of testis-ova developing in males is also considered an important endocrine disrupting endpoint, and at the OECD Technical Workshop on Gonad Histology of Small Laboratory Fish as a Tool for EDC Screening and Testing held in September 2002, a histological outline of a gonadal observation scheme has been agreed. Meanwhile, studies such as the induction of choriogenin (oocyte precursor) genes in the medaka liver are being conducted by Korean researchers. Therefore, this study aims to harmonize EDC test methods using medaka between Japan and South Korea, to develop and implement more advanced test methods while complementing each other's techniques, and to harmonize and accumulate data between Japan and South Korea.

Specifically, the project aims to develop and implement more advanced test methods while complementing each other's techniques, and to harmonize and accumulate data between Japan and Korea, including the validation of ELISA-based methods for measuring medaka vitellogenin (2001), surveys of medaka inhabiting Japan and Korea (2002), international coordination of histological evaluation methods and technical exchange of sex determination methods using the DMY gene (2003), and the development of a new method to determine the sensitivity for EDC of two species of medaka inhabiting Japan and South Korea. The differences in sensitivity of two species to EDC (2004), and a survey of wild medaka in the environment were conducted in collaboration with other research groups (2005).

2. Research Plan

1) Confirmation of EDC screening test procedure using medaka

2) Confirmation and validation of the medaka vitellogenin assay by ELISA.

3) Analysis and comparison of several genes (e.g. DMY, DMRT etc.) required for EDC detection, including sex-determining genes, in Japanese medaka (*Oryzias latipes*) and Chinese medaka (*Oryzias sinensis*).

4) Distinction between laboratory Japanese medaka, wild Japanese medaka and Chinese medaka in terms of external characteristics.

5) The study was carried out to identify the habitats of Japanese medaka and Chinese medaka in South Korea.

6) Comparison of sensitivity of Japanese and Chinese medaka to EDC and confirmation of sex identification methods.

7) Report on survey on EDC effects on wild Japanese and Chinese medaka collected in Japan and South Korea.

3. Major Outcomes

1) The Chinese medaka is a subspecies of the Japanese medaka and is found in the western part of South Korea, while the Japanese medaka was found in the eastern part. Only the Japanese medaka inhabits in Japan (note: at this time, the Chinese medaka was considered a subspecies of the Japanese medaka, but it is now recognized as a separate species and its scientific name has been changed. The current scientific name has been corrected here).

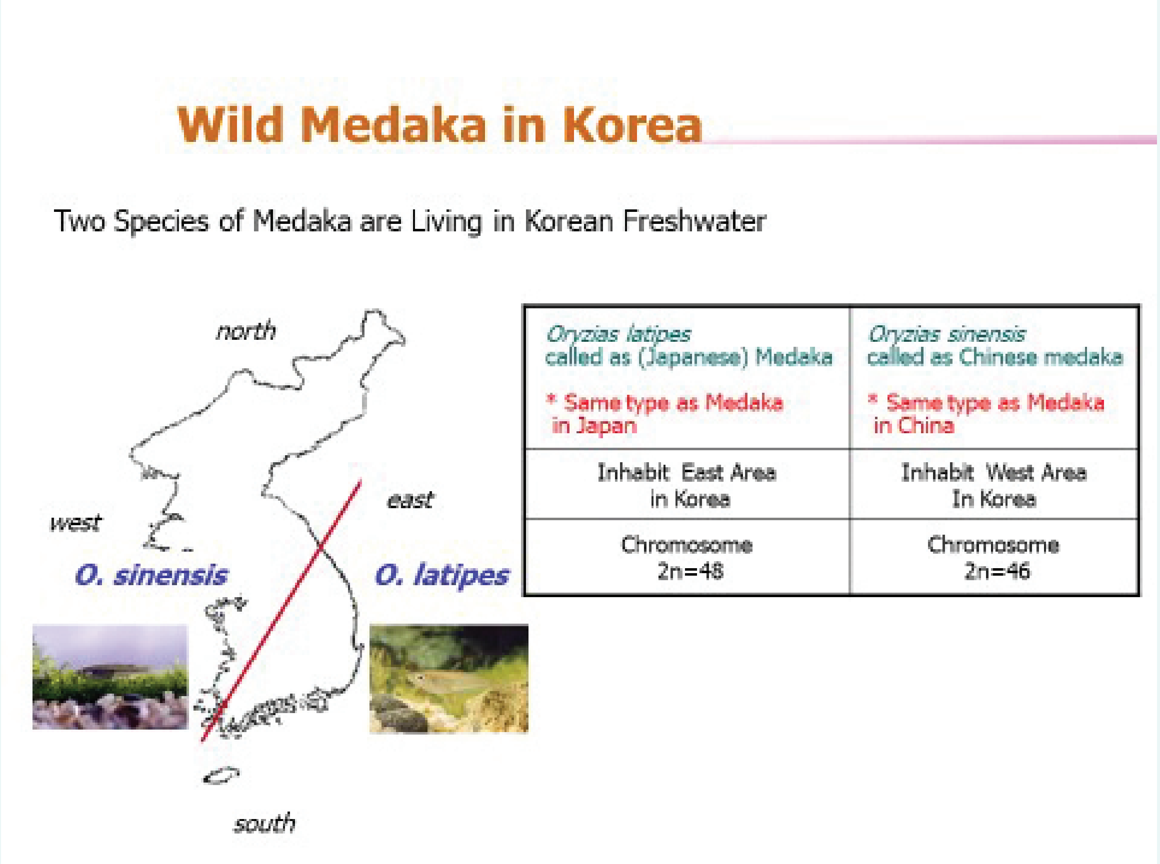
2) The sensitivity of both medaka species to EDC is similar and common biomarkers can be used as indicators of effects.

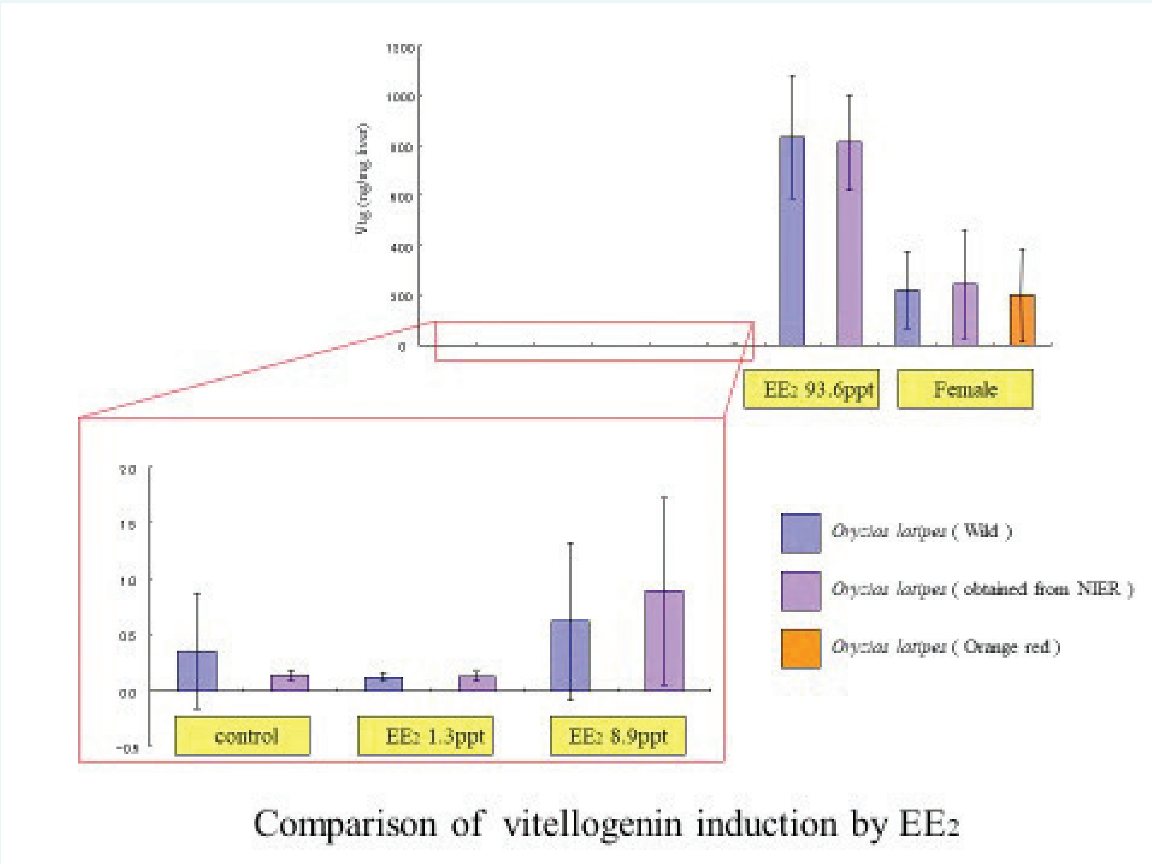
3) Genetic analysis of the two species showed that they are more than 99% similar, but differ in chromosome number, with 46 in the Chinese medaka and 48 in the Japanese medaka.

4) A method for determining the genetic sex of medaka using the DMY gene was shared between Japan and Korea at National Institute of Environment Research (NIER) of Korea.

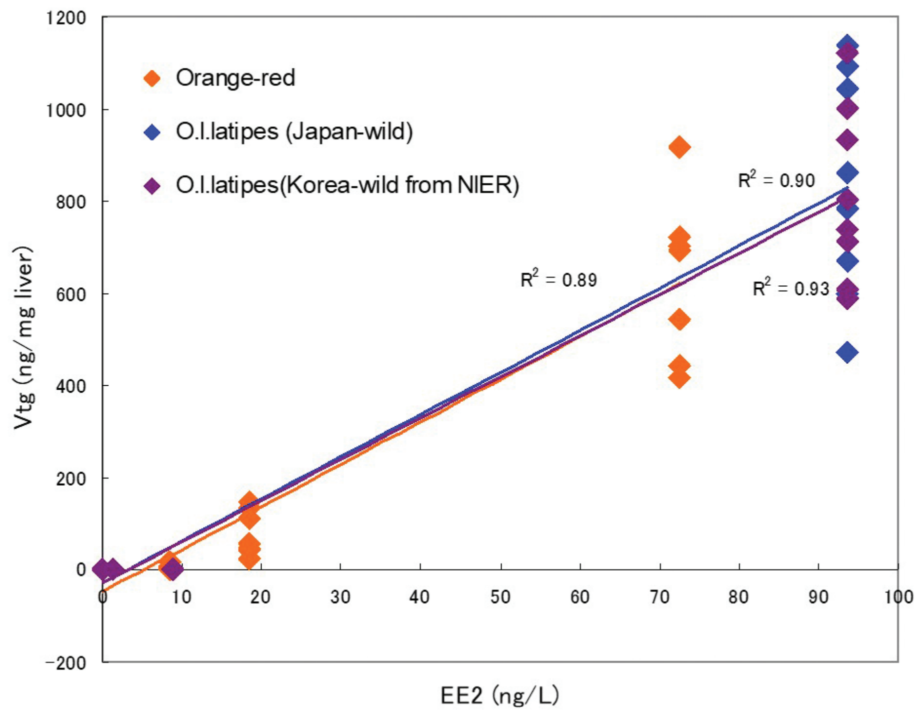
5) Experimental results showed no differences in morphological differences or secondary sexual characteristics between Japanese medaka, Japanese wild medaka and Chinese medaka. In addition, exposure to ethinylestradiol (EE_2) caused an increase in vitellogenin to almost the same extent in all of them. Furthermore, genetic sex discrimination by DMY was possible in all species of medaka, Japanese wild medaka and Chinese medaka. Therefore, it was shown that it is possible to treat medaka collected in each region equally and to compare data, and to compare field and laboratory data, when conducting environmental surveys using medaka as an indicator in Japan and South Korea.

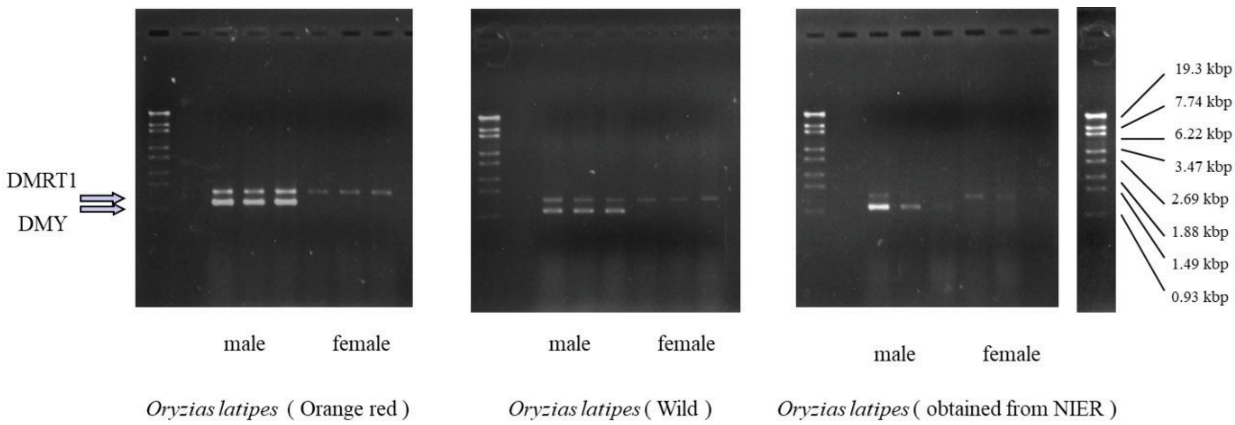
6) In sites Geomdan, Yeoju, Cheongwon and Goenju in western Korea, the species of wild medaka was *Oryzias sinensis*. In addition, wild medaka species in eastern Korea, including sites Yangyang and Ulsan, were *Oryzias latipes*. Vitellogenin levels in wild male medaka were very low, ranging from 0.5 μg/ml to 1.0 μg/ml. Female vitellogenin levels varied with season (breeding season).


Wild Medaka in Korea
Two Species of Medaka are Living in Korean Freshwater
north
west
east
south
O. sinensis
O. latipes
Oryzias latipes
called as (Japanese) Medaka
* Same type as Medaka in Japan
Oryzias sinensis
called as Chinese medaka
* Same type as Medaka in China
Inhabit East Area in Korea
Inhabit West Area In Korea
Chromosome 2n=48
Chromosome 2n=46

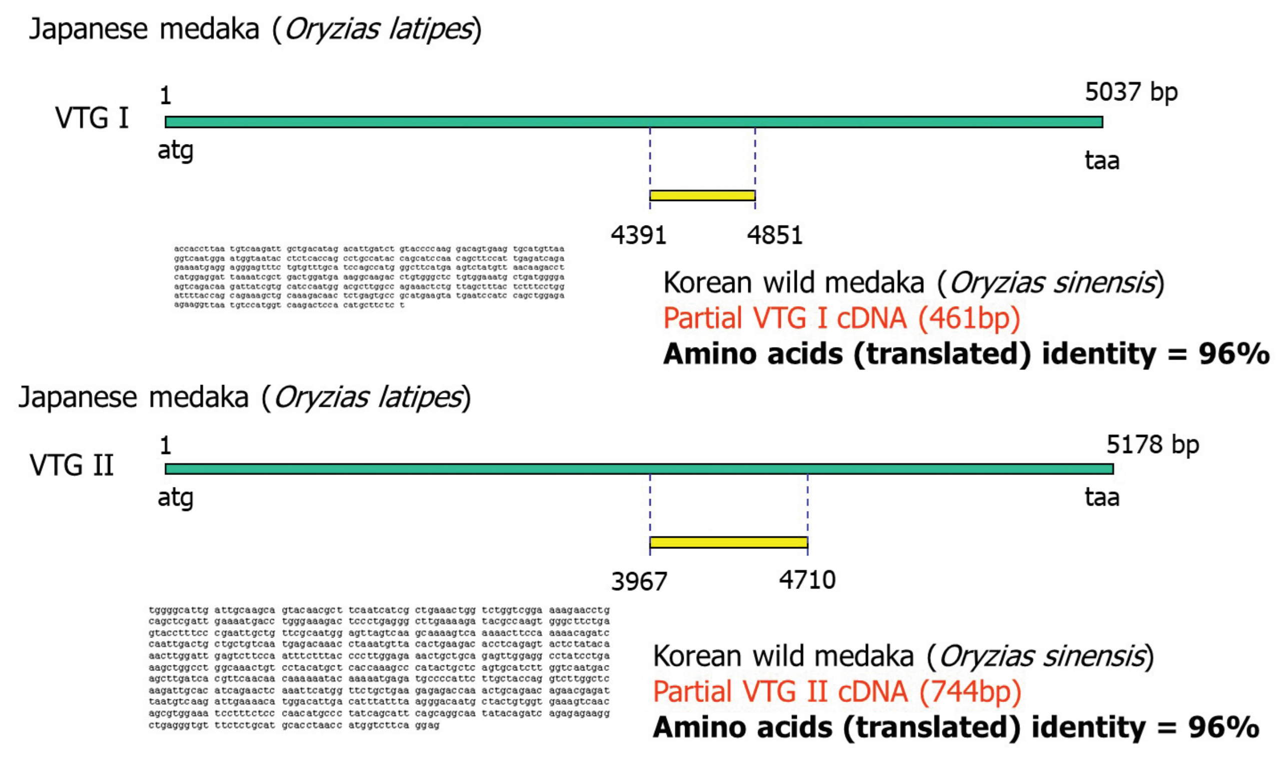

EE2 93.6ppt
Female
control
EE2 1.3ppt
EE2 8.9ppt
Oryzias latipes (Wild)
Oryzias latipes (obtained from NIER)
Oryzias latipes (Orange red)
Comparison of vitellogenin induction by EE2

Comparison of sensitivity for producing VTG with three strains of *Oryzias latipes latipes*

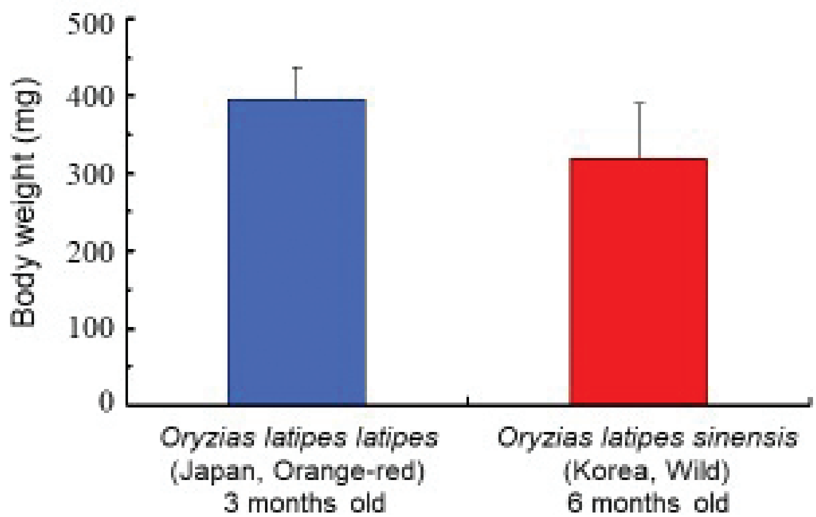




DMY and DMRT1 of individual type of Medaka



Difference in growth between *O. latipes latipes* and *O. latipes sinensis*

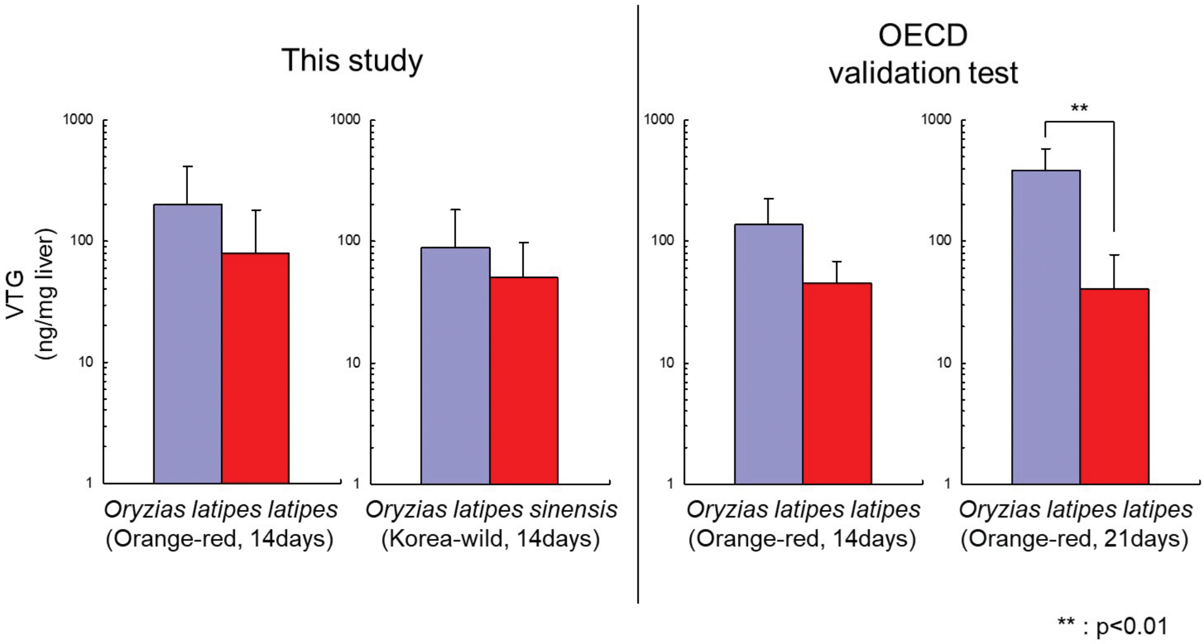


Growth is slower in Chinese medaka (Korea-wild) than Japanese medaka (Orange-red).
→ Difference of sensitivity in metabolic activities can be expected.

↓

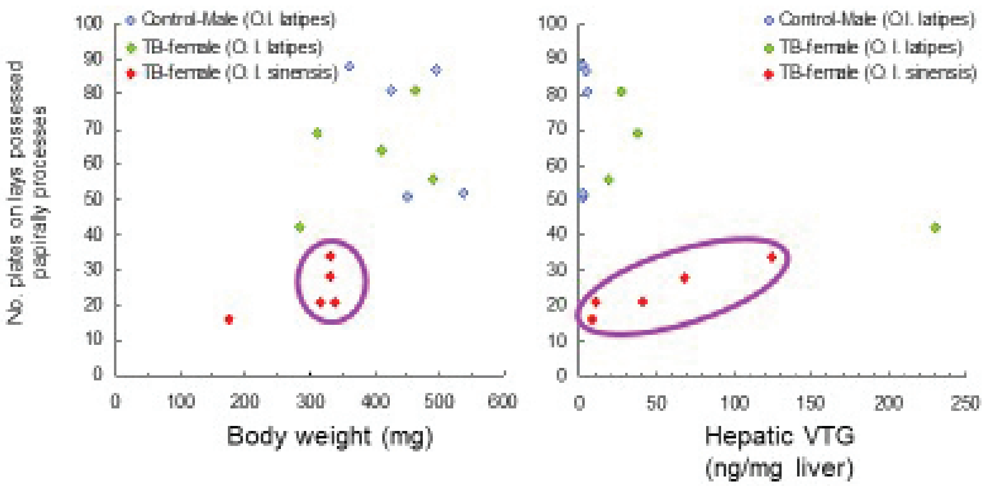
Validation for sensitivity on vitellogenesis under the exposure to endocrine active substances should be examined.

Result-1
Comparison of hepatic vitellogenin (VTG) between two different subspecies of *Oryzias latipes* spp. during the exposure to trenbolone (500 ng/L)



Result-2
Different sensitivity on the induction of secondary sex character between two different subspecies of *Oryzias latipes* spp.

Number of the plates on lays possessed papirally processes during the exposure to trenbolone (500 ng/L) for 14 days



O. latipes sinensis is less sensitive in the induction of secondary sex character during the exposure to trenbolone.

I-6 <2001~2005>

Research on effects of organotin pollution to shellfish populations in Korea and Japan (current status and a mode of action of organotins)

Japan - Toshihiro HORIGUCHI
Korea - Hyeonseo CHO

1. Background

Organotin compounds, such as tributyltin (TBT) and triphenyltin (TPT), have been worldwide used in antifouling paints for the hulls of ships/vessels and fishing nets since the mid-1960s. Legislation for producing and using those organotin compounds as antifoulants have been enforced in European countries, the United States, Australia, New Zealand and Japan since 1980s or 1990s, due to their very strong toxicities to organisms, especially to marine organisms. International Maritime Organization (IMO) adopted a new treaty on the worldwide ban of organotins, such as TBT (International Convention on the Control of Harmful Anti-fouling Systems on Ships; abbreviated as AFS Convention) in October 2001. Unfortunately, however, the AFS Convention has not come into effect yet (as of January 2006). In Korea, total ban of organotin compounds has started since November 2003. Therefore, it is still necessary to monitor the temporal trends of organotin concentrations in the marine environment.

Meanwhile, gastropod imposex (i.e., a superimposition of male type sexual organs (penis and vas deferens) on female prosobranch gastropods) is accepted to be typically induced and promoted at very low concentrations of certain organotin compounds, such as TBT and TPT, resulting in populations decline or mass extinction due to reproductive failure (i.e., oviduct blockage by vas deferens formation and spermatogenesis in ovary etc.) accompanied with severely affected stages of imposex. Gastropod imposex is also known as endocrine disruption in wildlife, which is clearly linked with TBT and/or TPT, one of man-made chemicals. Up to now, we cooperatively have studied the marine pollution by organotin compounds and its adverse effects on gastropod populations in Korea and Japan.

2. Research Plan

The research cooperation between Japan and Korea will include the following subjects:

1) In Korea, a country-wide survey to reveal the current status of contamination by organotin compounds, and imposex in the rock shell (*Thais clavigera*, currently recognized as *Reishia clavigera*; Gastropoda, Neogastropoda, Muricidae) to know its geographical distribution and to compare with that in Japan.

2) In Japan, a basic study on the mode of action(s) of organotin compounds to analyze mechanism of the development of imposex in prosobranch gastropods, focusing on one of the nuclear receptors, the retinoid X receptor (RXR).

3. Major Outcomes

<KOREA>

1) Inshore areas of Korea and Japan have been still widely contaminated by organotin compounds, such as TBT, from antifouling paints.

2) Imposex-exhibiting females also have been still extensively observed in the rock shell populations in Korea and Japan.

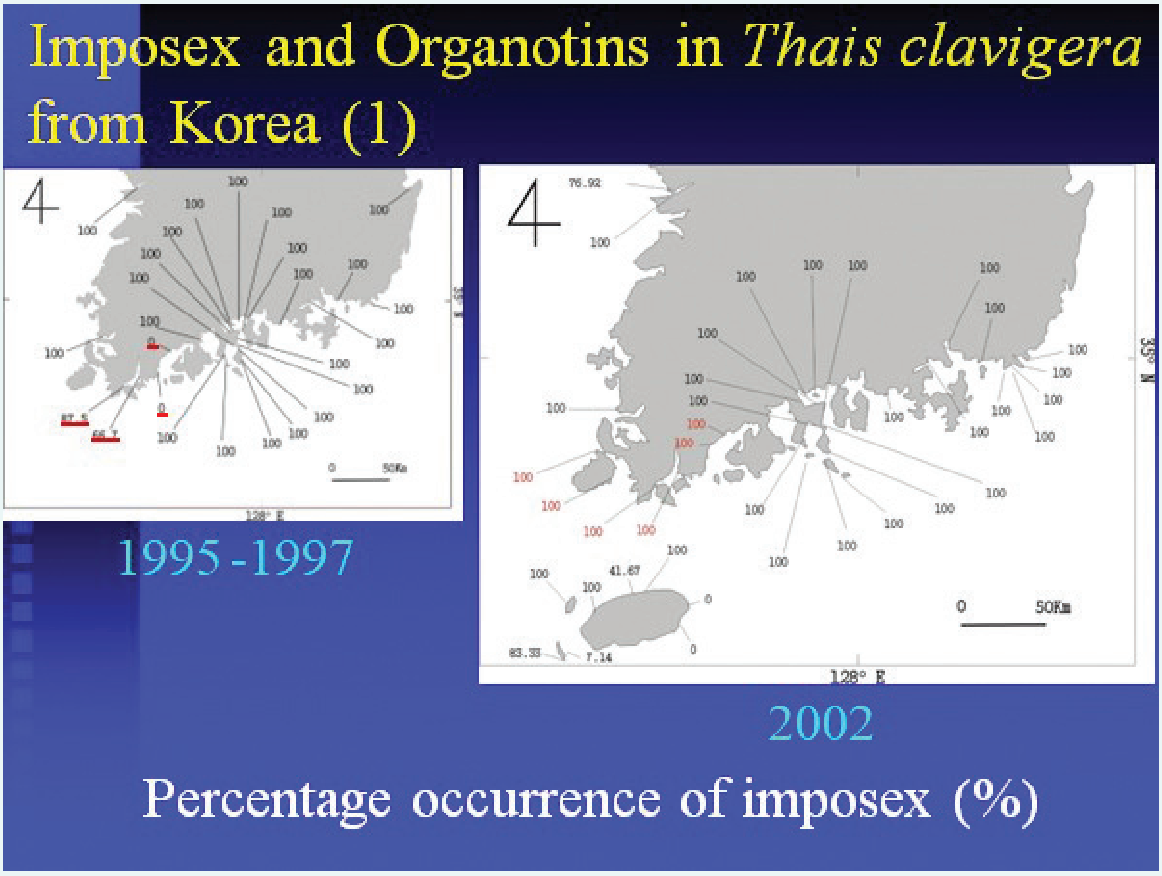
<JAPAN>

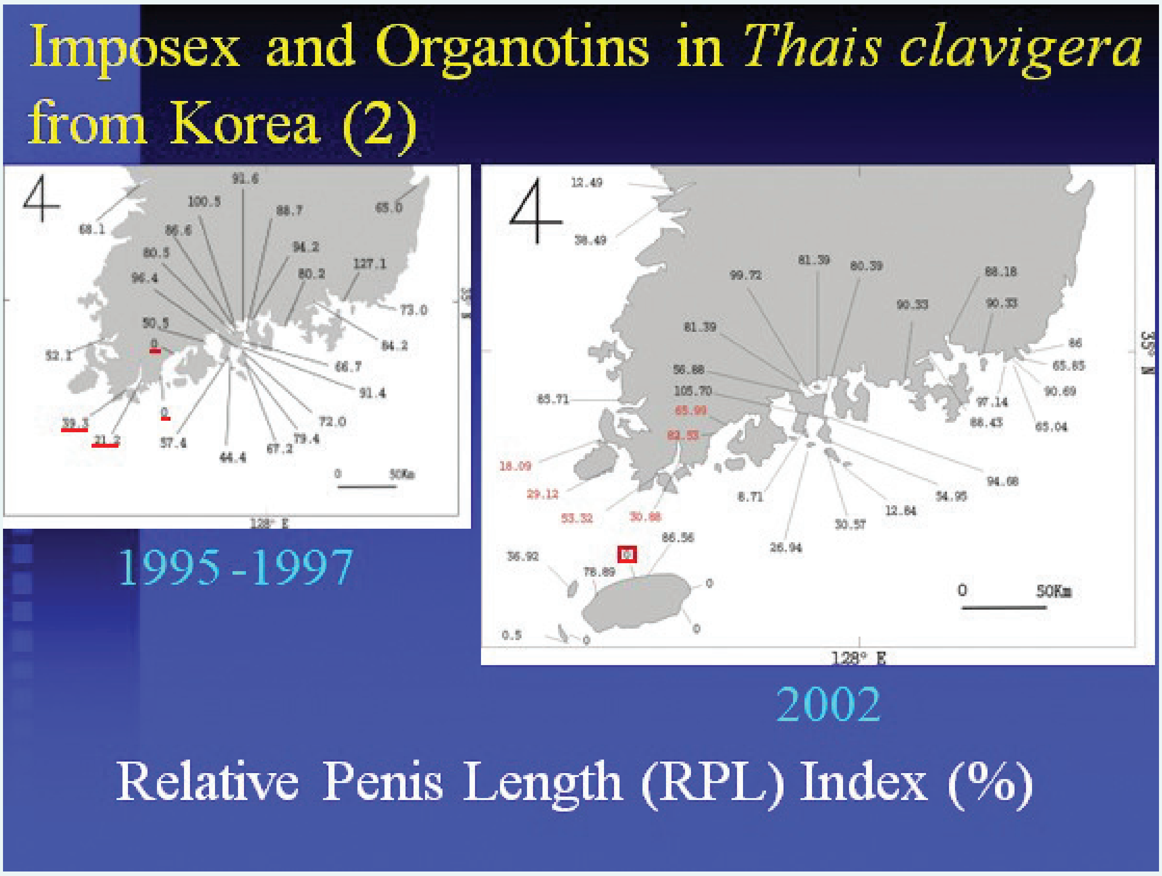
1) RXR has an important role in the development of imposex caused by organotin compounds in prosobranch gastropods.

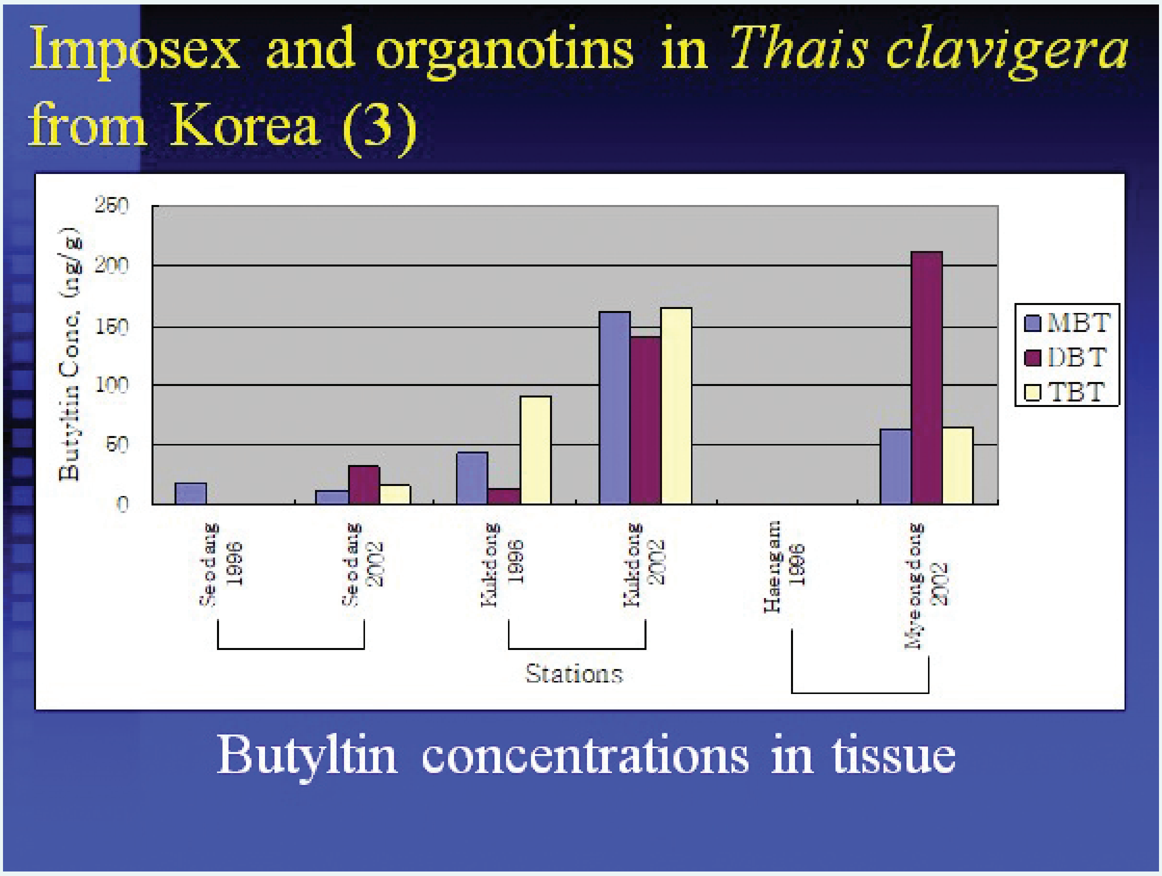
2) TBT and TPT seem to be agonists for RXR, and therefore both TBT and TPT could be recognized as environmental hormones.

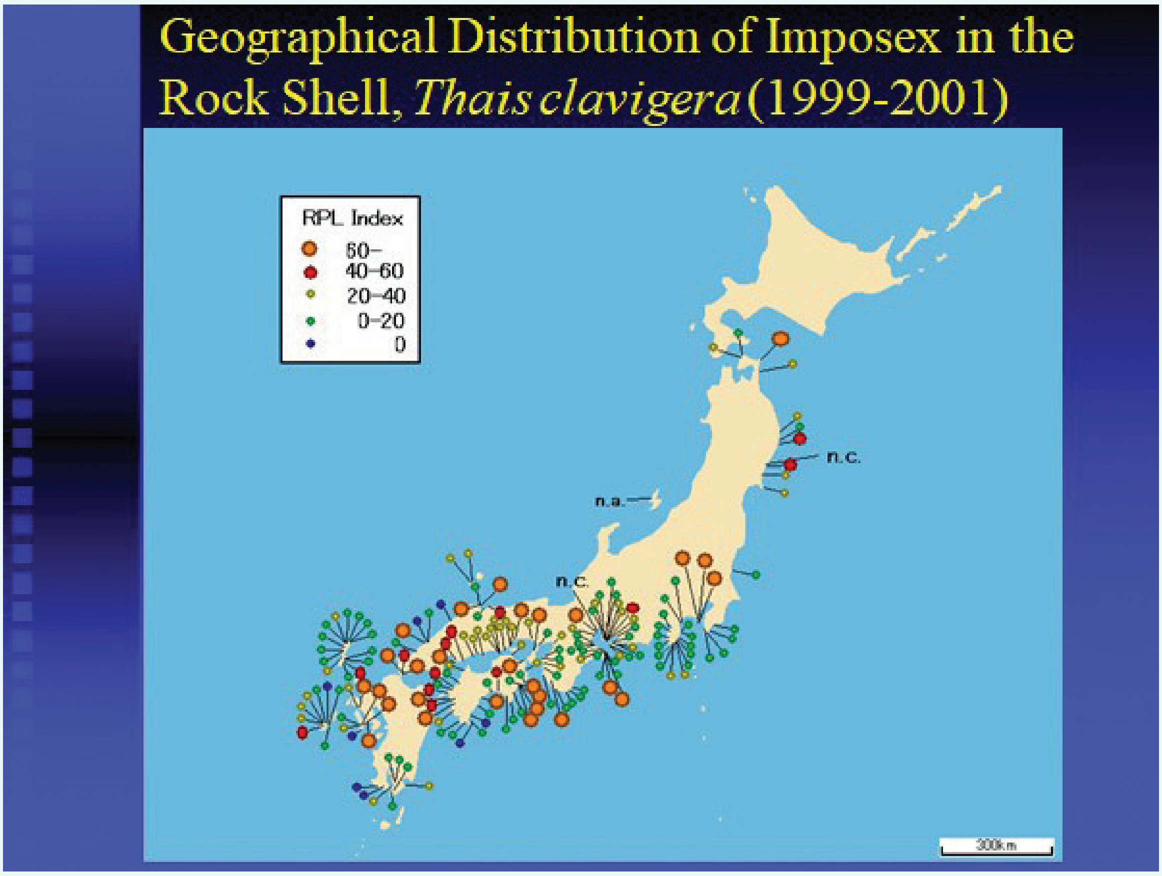
3) Further studies are necessary to clarify the entire mode of action(s) of TBT and TPT on the development of imposex in prosobranch gastropods.

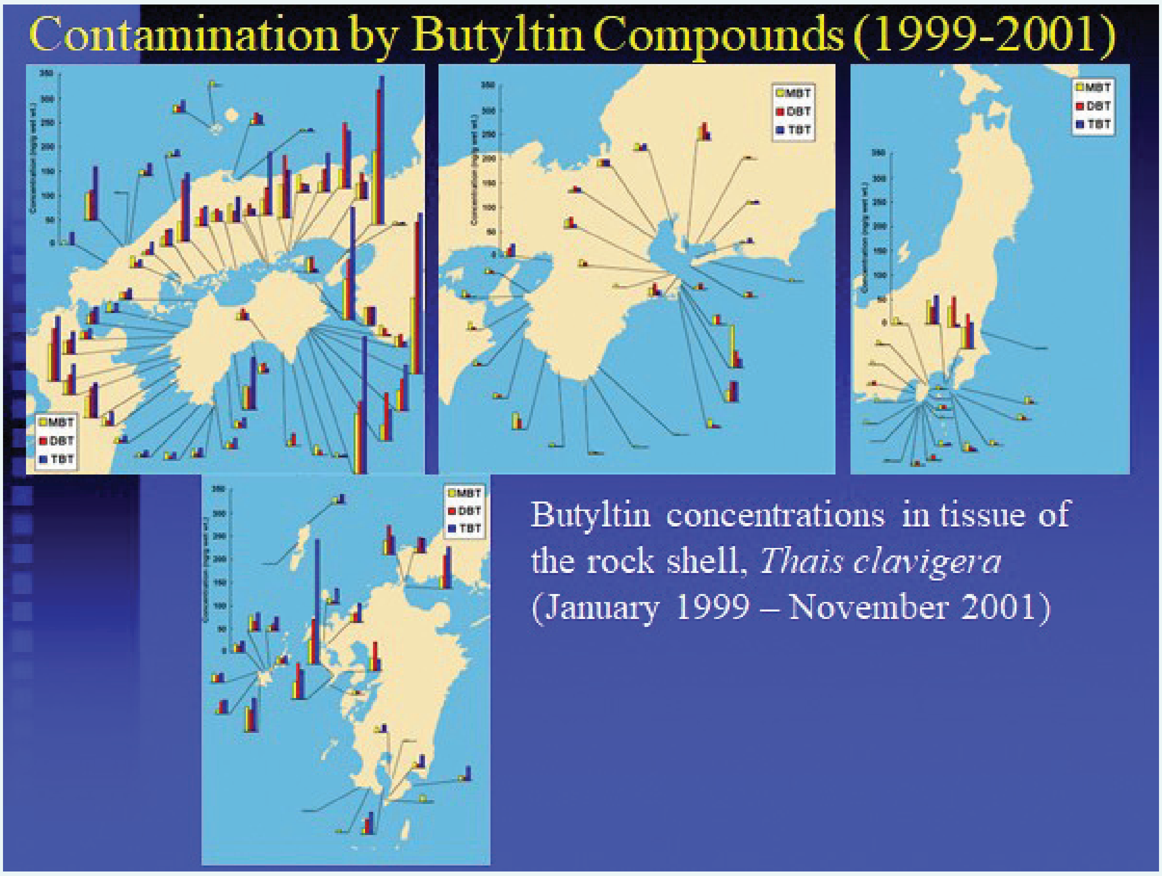

The Rock Shell, *Thais clavigera*
(Muricidae: Neogastropoda)
All over Japan (except for Okinawa) & Korea
On rocks intertidally
Carnivorous
Imposex induced by TBT and TPT
Population decline following reproductive failure (oviduct blockage by vas deferens formation and spermatogenesis in ovary)

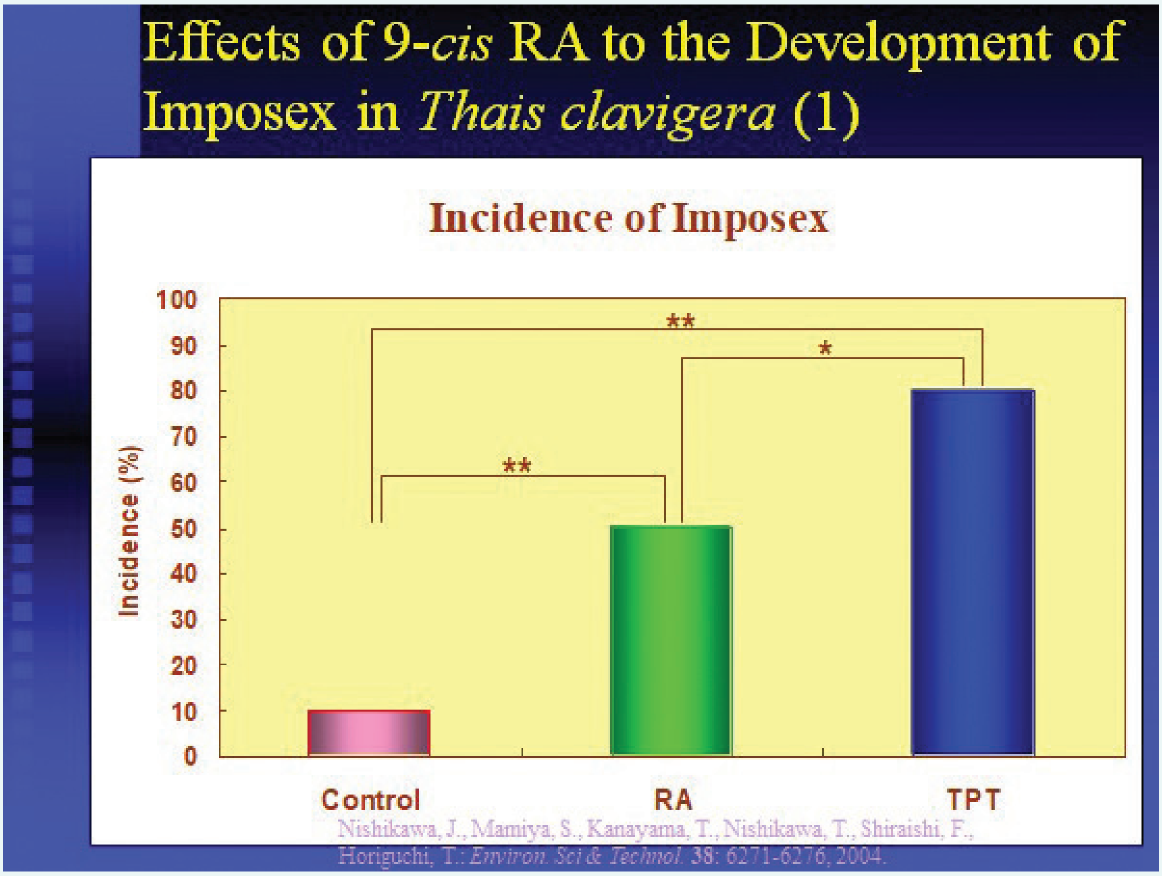

Imposex and Organotins in *Thais clavigera* from Korea (1)
1995-1997
2002
128° E
50Km
Percentage occurrence of imposex (%)

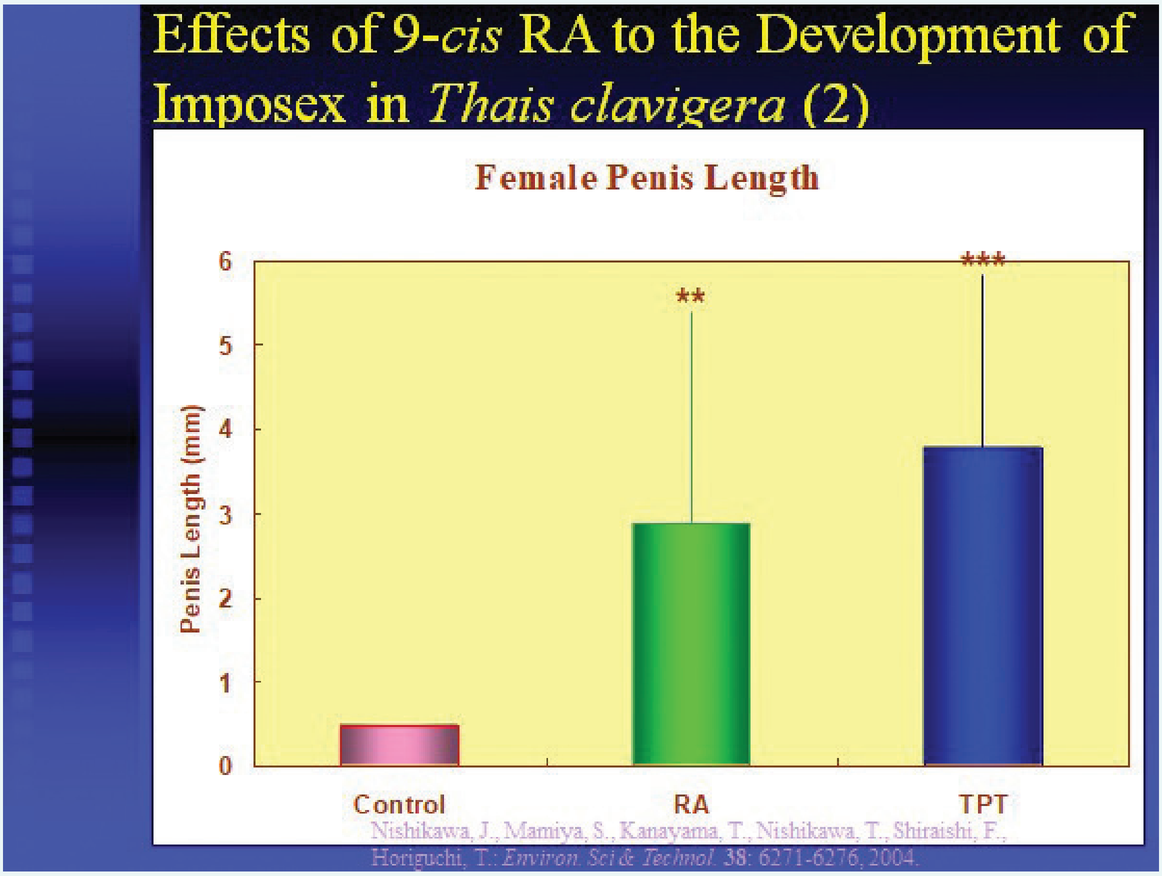

Imposex and Organotins in *Thais clavigera* from Korea (2)
1995-1997
2002
128° E
50Km
Relative Penis Length (RPL) Index (%)


Imposex and organotins in *Thais clavigera* from Korea (3)
Butyltin Conc. (ng/g)
250
200
150
100
50
0
Seodang 1996
Seodang 2002
Kukdong 1996
Kukdong 2002
Haengam 1996
Myeongdong 2002
Stations
MBT
DBT
TBT
Butyltin concentrations in tissue


Geographical Distribution of Imposex in the Rock Shell, *Thais clavigera* (1999-2001)
RPL Index
60-
40-60
20-40
0-20
0
n.c.
n.a.
n.c.
300km


Contamination by Butyltin Compounds (1999-2001)
MBT
DBT
TBT
Butyltin concentrations in tissue of the rock shell, *Thais clavigera* (January 1999 – November 2001)


Effects of 9-cis RA to the Development of Imposex in Thais clavigera (1)
Incidence of Imposex
Incidence (%)
100
90
80
70
60
50
40
30
20
10
0
**
*
**
Control
RA
TPT
Nishikawa, J., Mamiya, S., Kanayama, T., Nishikawa, T., Shiraishi, F., Horiguchi, T.: Environ. Sci & Technol. 38: 6271-6276, 2004.


Effects of 9-cis RA to the Development of Imposex in Thais clavigera (2)
Female Penis Length
Penis Length (mm)
6
5
4
3
2
1
0
**
***
Control
RA
TPT
Nishikawa, J., Mamiya, S., Kanayama, T., Nishikawa, T., Shiraishi, F., Horiguchi, T.: Environ. Sci & Technol. 38: 6271-6276, 2004.

I-7 <2004~2005>

Harmonization of analytical methods for Dioxins and other POPs between Korea and Japan

Japan - Yasuyuki SHIBATA
Korea -Samcwan KIM

1. Background

The Article 16 of the Stockholm Convention asked the Parties to conduct environmental monitoring and submit monitoring data periodically to the Convention for evaluating its effectiveness to reduce global contamination by POPs. According to the Convention text as well as the workshop report (2003) and the guidance on GMP (2004), there are several key factors in this monitoring scheme: 1) conduct the monitoring at regional basis when appropriate, 2) submit the comparable data on internationally-approved environmental media, including air, bivalves, fishes and human breast milk, and 3) collect the samples at background areas in order to reveal long-term trends of POPs levels with their regional/global transport. The Convention also asked each Party to conduct activities to eliminate/reduce POPs, including national POPs monitoring in order to find major sources, to measure environmental levels and to assess the effectiveness of national activity.

"Harmonization for POPs Monitoring Methods", including sampling scheme and QA/QC procedures, is a key to assure reliability and comparability of the monitoring data in regional/global scale to support the effectiveness evaluation of the Convention. In addition, highly sensitive and accurate methods are needed to monitor low levels of POPs and reveal their trends over time in background areas, while methods by inexpensive instruments are important to expand monitoring activities among developing countries.

Japan and Korea have been conducting cooperative activities on the monitoring and the information sharing of endocrine disruptive chemicals (EDCs), including the use of "SPEED 98 Methods". In this new program on the harmonization of POPs monitoring, the experiences on EDCs will be expanded to cover POPs under the Stockholm Convention. In addition, Japan and Korea play key roles together for leading regional POPs monitoring in East Asia to support the effectiveness evaluation of the Convention, and the outcome of this program will be reflected the regional activity.

2. Research Plan

The research cooperation between Japan and Korea on the "Harmonization of POPs Monitoring-Method" includes the followings:

1) Harmonization of POPs sampling methods at stationary sources and in atmospheric ambient.

2) Harmonization of POPs pre-treatment methods by matrix, including environmental and living-body samples.

3) Harmonization of POPs instrumental analysis methods.

3. Major Outcomes

1) Harmonization of air POPs monitoring was selected as a first step toward the goal based on information exchange and discussion in Korea (June 2004) and in Japan (January 2005).

2) Comparison and assessment of High Volume (HV) air sampling between Japan (Japanese method) and Korea (US EPA method) were conducted by sampling at Goisan, Korea, and analysis together at NIES, Japan.

3) Both HV methods were based on particulate matters and dioxins sampling methods, with the modification to adsorb rather volatile POPs, such as α-HCH and HCB, by adding active carbon fiber felt (ACF) or styrene-divinyl benzene (XAD) resin in Japan or US, respectively. Their results were generally consistent each other, while the sensitivity of the Japanese method was higher due to larger sampling volume. Significant role of ACF to trap volatile POPs was shown in the sampling at sub-tropical region.

4) Extraction and purification method of atmospheric samples was developed. By a one-step florisil column chromatography after acetone or toluene extraction, PCB, HCB, DDTs, mirex, heptachlors, toxaphene, chlordanes, and aldrin were obtained in the first fraction, and dieldrin and endrin in the second fraction. The first fraction was separated further by the second stage silicagel column chromatography to the first fraction including PCB, HCB, aldrin, mirex, and the second fraction including toxaphene and others. Each fraction is quantified using HRGC/HRMS and HRGC/NCI-LRMS.

5) Entire analytical method, including pre-cleaning of the adsorbents, use of isotope-labeled surrogates, extraction and clean-up procedures, and instrumental analytical conditions, as well as QA/QC procedures to assess reliability of the data, was thus established together, and was proposed as a basis of the POPs monitoring in East Asian countries (POPsEA project).

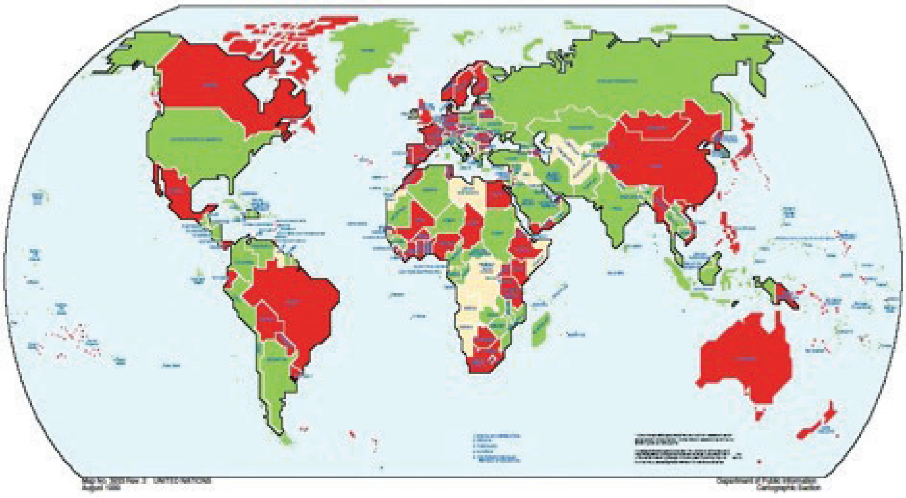
6) Very low recovery of aldrin during sampling in both Japanese and US methods were noted, and identified as target of further cooperative research.

7) Japan started monthly air sampling at a background site, Hateruma Island, and Korea also conducted preliminary background sampling. Japan analyzed POPs by HRGC/NCI-LRMS in order to assess applicability of inexpensive small analytical instrument in developing countries for background air monitoring under the GMP. Several organochlorine pesticides, including HCHs, chlordanes and DDTs, were quantified with good surrogate recoveries.

8) During the sampling period at Hateruma, Japan, the highest DDTs were detected in Sept, 2004. In this occasion, o,p′-DDT was higher than p,p′-DDT and also higher than o,p′-DDE, while p,p′-DDE was higher than p,p′-DDT. The data suggested occurrence of recent (or current) input of minor isomer, o,p′-DDT, without the major isomer in commercial DDTs, i.e., p,p′-DDT. The phenomenon was identified as further research target, too.

Japan-Korea Bilateral program meeting (28 Jan 2005)

Stockholm Convention on POPs



Adopted on 22 May, 2001; Entry into force on 17 May, 2004

Signatories 151; Parties 90 (21 Jan 2005)

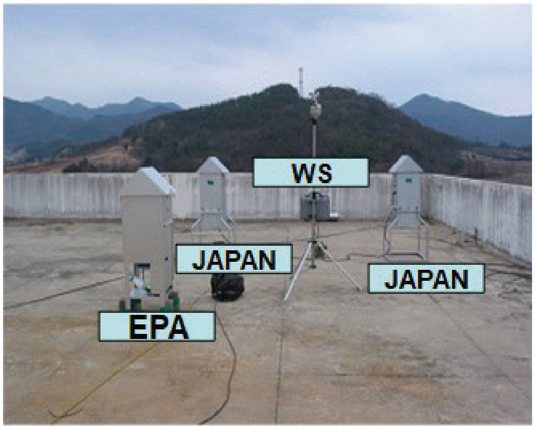
❑ Ambient Air Sampling

❖ High Volume Air Sampler

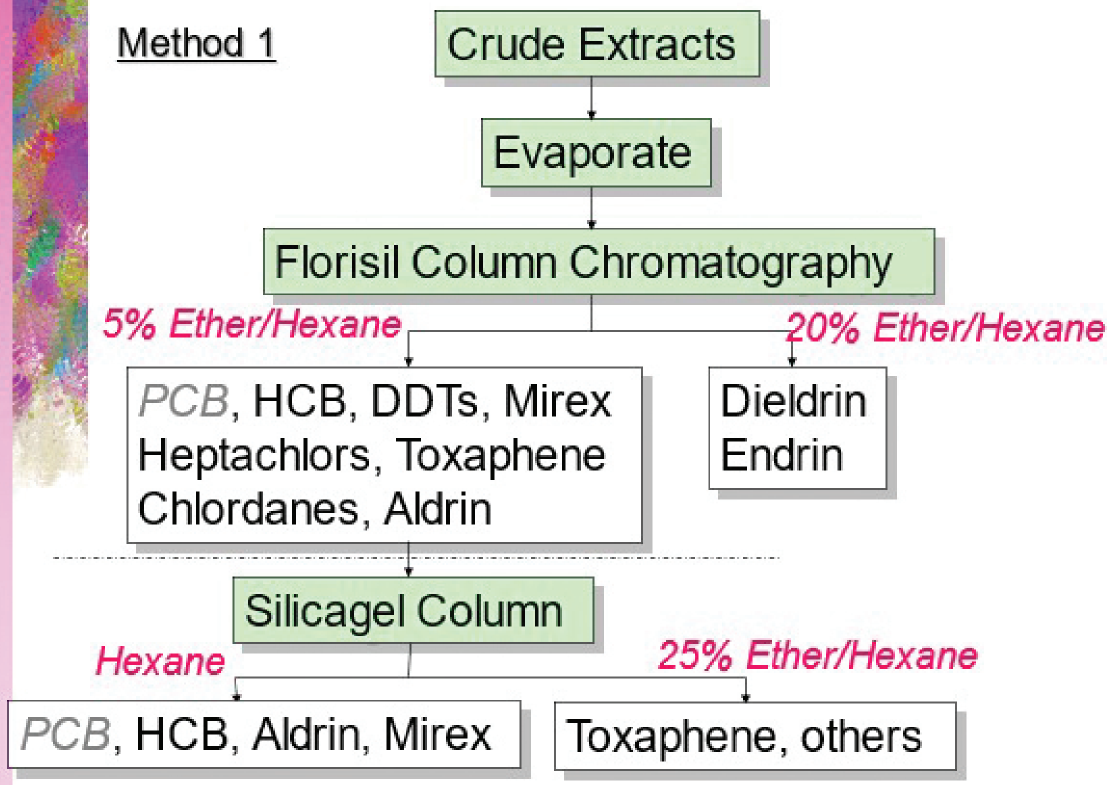
- **US EPA : EPA (TO-04A, TO-10A)**
  - Volume : 225 L/min (300 m^3/day)
  - Sampling Time : 24 hr
  - QFF (Φ 10.2 cm), PUF, XAD
- **Japan : NIES (National Institute for Environmental Study)**
  - Volume : 700 L/min(1,000 m^3/day)
  - Sampling Time : 24 hr
  - QFF(20 × 25 cm), PUF, ACF

❖ Sampling Site

- ✓ Name: Goisan Background Air Monitoring Station
- ✓ Address: Duckpyung-ri Chungchun-myun Goisan-Gun Choongchung-bukdo, Korea
- ✓ Latitude : 36.4, Longitude : 127.5
- ✓ T.M : 272.066, 359.165



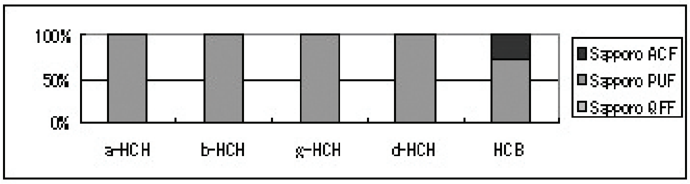
Japan-Korea Bilateral program meeting (28 Jan 2005)



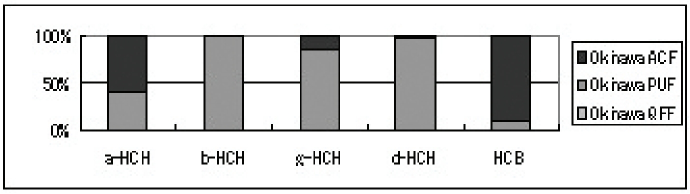
Significant Role of ACF to Trap Volatile POPs

Active Carbon Fiber (ACF) felt (Toyobo Co.)

- 2~3 mm thickness felt made from cellulose
  :~0.045 g/cm^3; 180~200g/m^2
  :adsorption efficiency for Benzene
  45~50 wt %
- Used to recover solvent etc in chemical industry



Sapporo
Temp 5.5 ℃~



Okinawa
Temp 27 ℃~

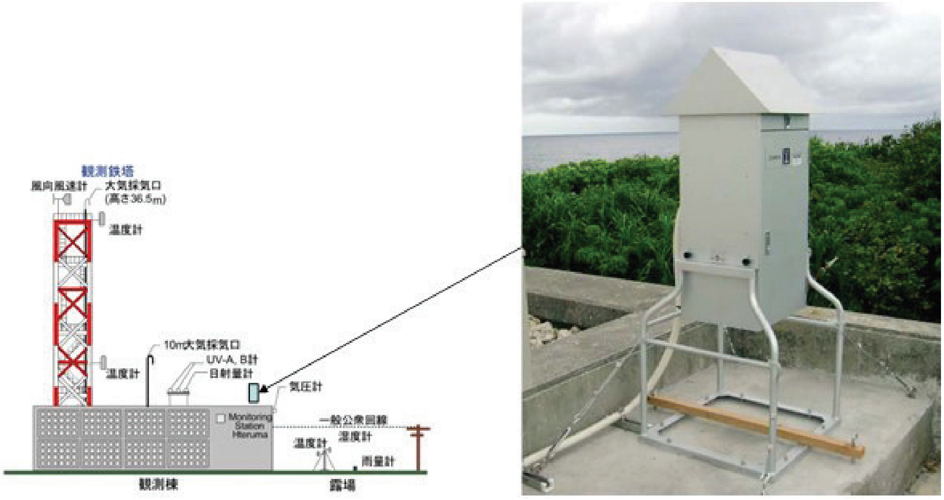
❑ Recovery (%)

Chemicals	EPA (2ng)		Japan (4ng)	
	Travel	Clean-up	Travel	Clean-up
HCB	27	71	46	66
Heptachlor	70	72	106	75
Aldrin	0	90	0	95
Dieldrin	82	110	112	113
Endrin	77	86	123	104
DDT	79	136	133	180
Chlordane	74	120	97	126
Mirex	68	135	89	141

- **Measured data on Feb. 22~25 in 2005**
- **Aldrin and HCB showed low recovery rate.**

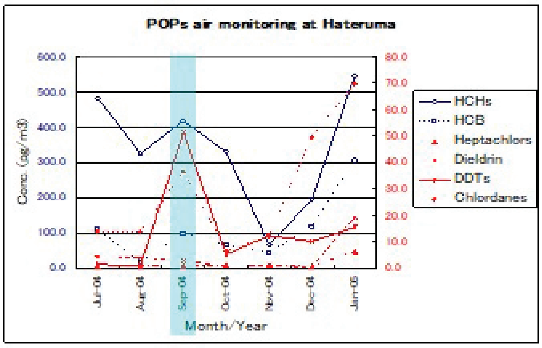
❖ CGER: Hateruma Monitoring Station

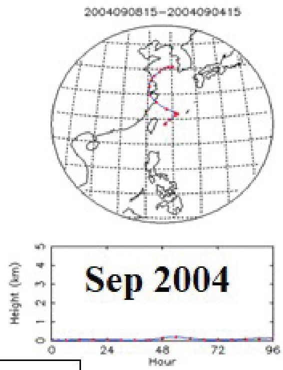
: Continuous Monitoring of CO_2, CH_4, N_2O, O_3, Rn
NOx, SOx, VOCs, Aerosols, Meteorological Data, etc.

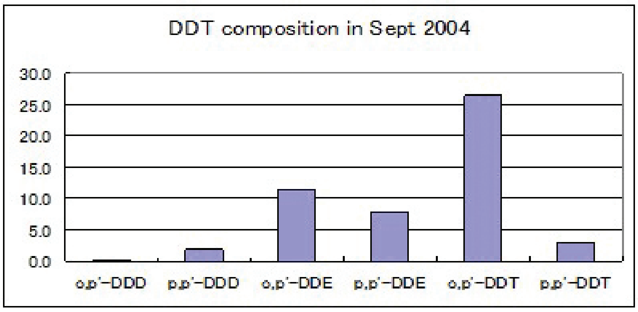


HV sampler on top of Hateruma Monitoring Station

❖ DDT composition in Sep. 2004







3-2. Setting Period of CJR(2007~2012)

II-1 <2006~2008>

Harmonization of Analytical Methods for Dioxins and Original/new POPs between Japan and Korea

Japan - Yasuyuki SHIBATA, Yoshikatsu TAKAZAWA
Korea - Samcwan KIM, Jongwoo CHOI

1. Background

According to Article 16 of the Stockholm Convention, the Parties should conduct environmental monitoring on priority media, including air, and submit "comparable" monitoring data to the Convention as an effort to reduce global contamination by POPs, such as dioxins, PCB and organochlorine pesticides. As a joint research theme in this Korea-Japan bilateral program, a harmonized POPs air monitoring method has been developed and used in both countries to obtain POPs data in remote areas, which were described in the first Regional Report of the Effectiveness Evaluation of the Stockholm Convention in the Asia-Pacific region.

Meanwhile, additional 11 candidate chemicals for the Convention have been submitted, among which 9 chemicals, i.e., pentabromodiphenylether, octabromodiphenyl ether, hexabromobiphenyl, chlordecone, PFOS, α-HCH, β- HCH, γ-HCH, and pentachlorobenzene, were concluded to be added to the Convention by the POPs Review Committee.

It is necessary for the Parties, therefore, to establish monitoring methods for the additional candidates and other related chemicals together with the original 12 POPs in order to conduct environmental monitoring and report data for the next effectiveness evaluation. To deal with the necessities mentioned above and devote efforts to preventing a global-scale contamination of POPs and related chemicals, both Japan and Korea will continue to develop more precise and accurate monitoring methods, including both sampling systems and analytical instrumentations as well as QA/QC protocols, in order to conduct monitoring in both countries as well as to play a key role together for research and development of other Asian countries in the field of regional/global POPs monitoring.

2. Research Plan

1) Harmonize POPs sampling methods at stationary sources and in ambient air.

2) Harmonize POPs pre-treatment methods by matrix, including environmental and biota samples.

3) Harmonize POPs instrumental analysis methods.

4) Develop air monitoring methods of new POPs together with the original POPs, particularly in background areas.

5) Develop and apply new techniques, such as GC/MSMS, for monitoring.

6) Harmonize with the detailed QA/QC procedures on POPs sampling and analysis methods.

3. Major Outcomes

<KOREA>

1) As a result of comparative evaluation between the US-EPA method and the Japan proposal method in sampling OCPs in the ambient air, the Japanese method (88.9%) showed a slightly higher recovery rate than the US-EPA method but the precision of the US-EPA method was better (22.0) than the Japanese method (32.7). Also, the correlation coefficient (0.76) between these two methods was confirmed except for aldrin.

2) OCPs monitoring results in background sites (coastal and rural areas) showed that the concentrations of HCB were 85 to 109 pg/m3 with the EPA method and 70 to 103 pg/m3 with the Japanese method. Chlodanes were detected in rural areas, and the concentrations of DDTs were slightly higher in coastal areas where the main wind direction was westerly. The detection concentrations of chlordane showed seasonal characteristics of winter (N.D.), summer (1.4 to 2.3 pg/m3), and spring (0.5 to 1.6 pg/m3).

3) Based on the existing dioxin official test methods and the newly developed OCPs measurement and analysis methods, POPs official test methods (initial 12 items, media: air, water, soil/sediment, waste, biota (human blood, breast milk, fish, eggs)) were enacted (27 January 2007).

4) Among the measurement and analysis methods for dioxins and OCPs in Korea and Japan, harmonization was confirmed in detailed QA/QC procedures (MDL, accuracy, precision, etc.).

<JAPAN>

1) Among the POPs pesticides, HCB has the highest concentration level, but HCB alone generally remains at a level of 250 pg/m3. The next highest concentration level is α-HCH, which has a relatively low boiling point and long-distance transport has been a problem.

2) When we look at the data collected at Cape Hedo, it is striking that the range of fluctuation is greater than that at Hateruma. Compared to Hateruma, HCB levels are relatively higher in Hedo from early spring to summer, and the concentration levels of chlordanes are particularly high in June and July after the second half of the rainy season.

3) Trajectory programs are useful tools for understanding the background of POPs concentration on the basis of "direction of air mass flow".

Highlight Slides, KOREA

Comparison of U.S. EPA method and Japanese method proposed during winter season on 22-24 Feb. 2005

Surrogate Chemicals	Recovery Rates of Whole Process (%)		Recovery Rates of Clean-up Process (%)		Ratio of Recovery Rate of EPA Method to Japan Method	
	EPA Method	Japan Method	EPA Method	Japan Method	Whole Process	Clean-up Process
HCB	27	46	71	66	0.59	1.1
Aldrin	0	0	90	95		0.95
Dieldrin	82	112	110	113	0.73	0.97
Endrin	77	123	86	104	0.63	0.83
p,p'-DDE	62	85	109	111	0.73	0.98
o,p'-DDT	79	133	136	180	0.59	0.76
o,p'-DDE	62	83	102	105	0.75	0.97
trans-Chlordane	74	97	120	126	0.76	0.95
trans-Nonachlor	71	95	116	118	0.75	0.98
cis-Nonachlor	65	89	105	110	0.73	0.95
Oxychlordane	76	89	120	126	0.85	0.95
Heptachlor	70	106	72	75	0.66	0.96
Heptachlor-epoxide	74	98	103	104	0.76	0.99
Mirex	68	89	135	141	0.76	0.96
Average	64	89	106	112	0.76	0.95
S.D.	22.0	32.7	19.5	26.5	0.08	0.07

Concentrations of POPs in Ambient Air in the Republic of Korea (Units : pg/m³)

Chemicals	2005 (Winter)		2006 (Summer)				2007 (spring)			
	Goisan (rural area)		Goisan (rural area)		Taean (coastal area)		Goisan (rural area)		Taean (coastal area)	
	EPA	Japan	EPA	Japan	EPA	Japan	EPA	Japan	EPA	Japan
HCB	-	-	109*	70*	94*	75*	87.4	81.5	98.3	103.2
Aldrin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dieldrin	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1	<0.2.	<0.1.	<0.2.	<0.1.
Endrin	<0.3	<0.1	<0.3	<0.1	<0.3	<0.1	<0.3.	<0.1	<0.3.	<0.1
o,p'-DDD	<0.1	<0.05	<0.1	<0.05	2.0*	<0.05	<0.1	<0.05	<0.1	<0.05
p,p'-DDD	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1
o,p'-DDE	<0.1	0.4	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	1.2	1.3
p,p'-DDE	2.6	2.0	<0.06	<0.02	<0.06	<0.02	<0.06	1.8	3.9	4.8
o,p'-DDT	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	1.1	1.6
p,p'-DDT	<0.3	<0.1	<0.3	<0.1	<0.3	<0.1	<0.3	<0.1	1.4	1.5
trans-Chlordane	<0.06	<0.02	<0.06	1.4*	<0.06	2.3*	1.6	1.4	0.6	1.0
cis-Chlordane							1.5	1.3	0.5	1.1
trans-Nonachlor	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	1.4	1.2
cis-Nonachlor							<0.2.	<0.1	<0.2.	1.4
Oxychlordane	<0.2	<0.1	<0.2	<0.1	<0.2	<0.1	<0.2.	<0.1	<0.2.	<0.1
Heptachlor	<0.1	<0.05	<0.1	<0.05	1.9	<0.05	0.3	0.4	0.9	0.5
Heptachlor-epoxide	<0.1	<0.05	<0.1	<0.05	<0.1	1.1	<0.1	<0.05	<0.1	<0.05
Mirex	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05	<0.1	<0.05
Toxaphene (Parlar-26)	<3	<1	<3	<1	<3	<1	<3	<1	<3	<1
Toxaphene (Parlar-50)	<3	<1	<3	<1	<3	<1	<3	<1	<3	<1
Toxaphene (Parlar-62)	<20	<10	<20	<10	<20	<10	<20	<10	<20	<10

* : reference value because surrogate recovery was out of 40 to 120 percent.
n.a.: not available because surrogate recovery was out of 25 to 150 percent.

Harmonization of QA/QC in Dioxin/POPs Monitoring

Korea	Japan	Remarks
☐ Sampling o Duration: 24 hrs o Repeat : 3 times o Aspiration Speed : 225 ~ 750 LPM o Adsorption Media : QFF, PUF, XAD or ACF o Instrument : HVAS o Surrogates: ^{13}C Dioxin o Spiking Position : QFF ☐ Calibration Curve o Standard Soln. : CS1 ~ CS5 o r^2 : 0.99 o RRF : RSD ±15% o Verification : CS3 ±20%	☐ Sampling o Duration: 24 hrs / 3 times or 7 days / 1 time o Aspiration Speed : 700 LPM or 100 LPM o Adsorption Media : QFF, PUF, (ACF for POPs) o Instrument : HVAS o Surrogates: ^{13}C Dioxin/POPs o Spiking Position : QFF/PUF ☐ Calibration Curve o Standard Soln. : CS1 ~ CS5 o r^2 : 0.99 o RRF : RSD ±15% o Verification : CS3 ±20%	

-continued-

Korea	Japan	Remarks
☐ Recovery Rate : 50~120% ☐ MDL Confirmation o EDL (Estimated Detection Limit) : S/N ratio x 2.5 ☐ HRGC/HRMS o Resolution : 10% valley above 10,000 o PFK : below 5 ppm o Isotope Ratio : ±20% o Lock Mass Stability : ±20% ☐ QA/QC in Laboratory o MDL, Accuracy, Precision : 1 time/year - MDL : 7 times, SD x 3.14 - Accuracy : Recovery Rate - Precision : RSD ☐ Units : 0 ℃, 1 atm	☐ Recovery Rate : 50~120% ☐ MDL / MQL Confirmation IDL/IQL (Instrument Detecion / Quantification Limit) ☐ HRGC/HRMS o Resolution : 10% valley above 10,000 o PFK : below 5 ppm o Isotope Ratio : ±20% o Lock Mass Stability : to check ☐ QA/QC procedure o MDL/MQL, Accuracy, Precision - duplicate analysis - blank check (including travel blank) ☐ Units : 0 ℃, 1 atm	

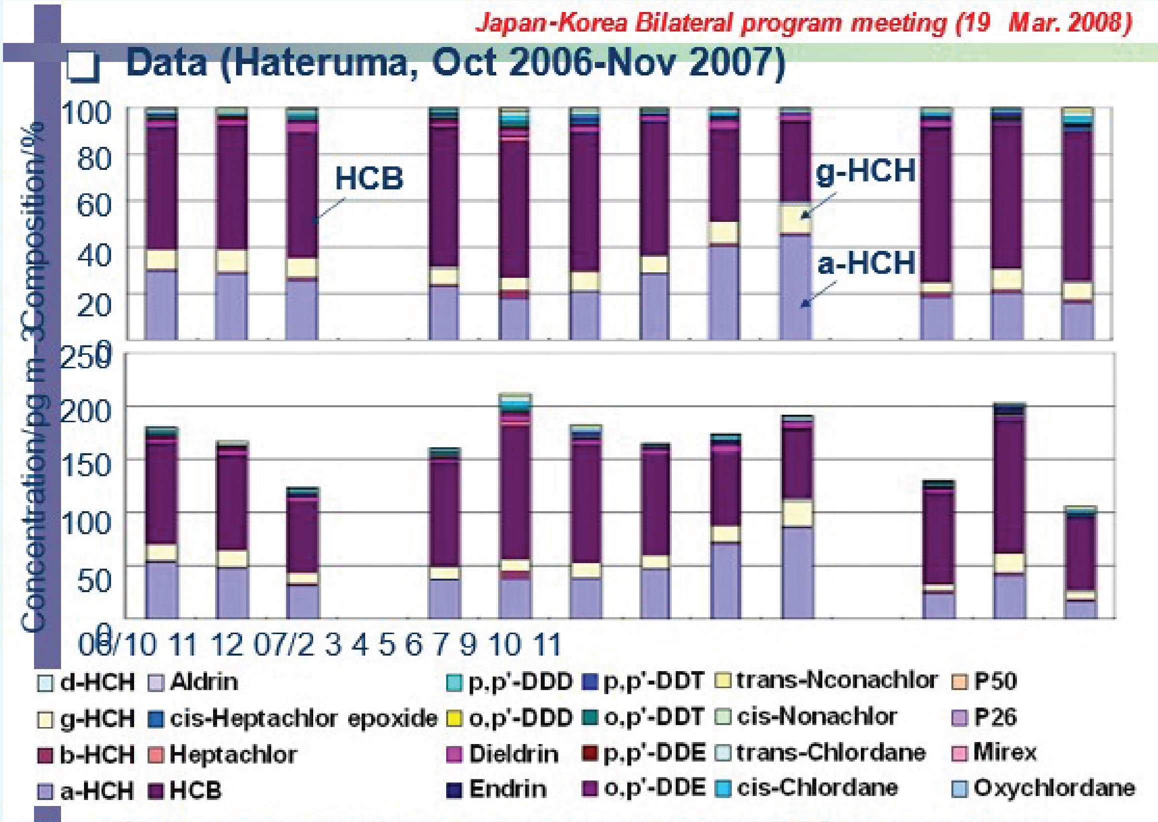


Fig. 5 Relative composition and concentration of POPs from Hateruma.

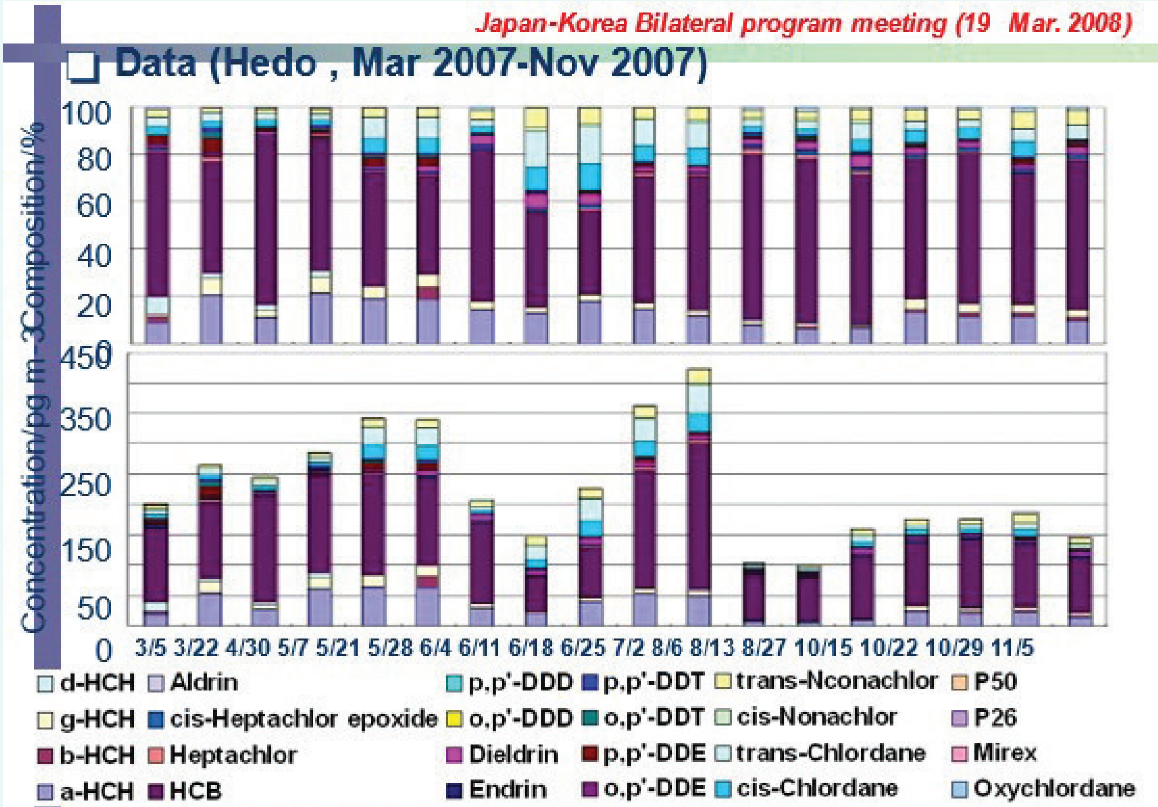


Fig. 6 Relative composition and concentration of POPs from Hedo.

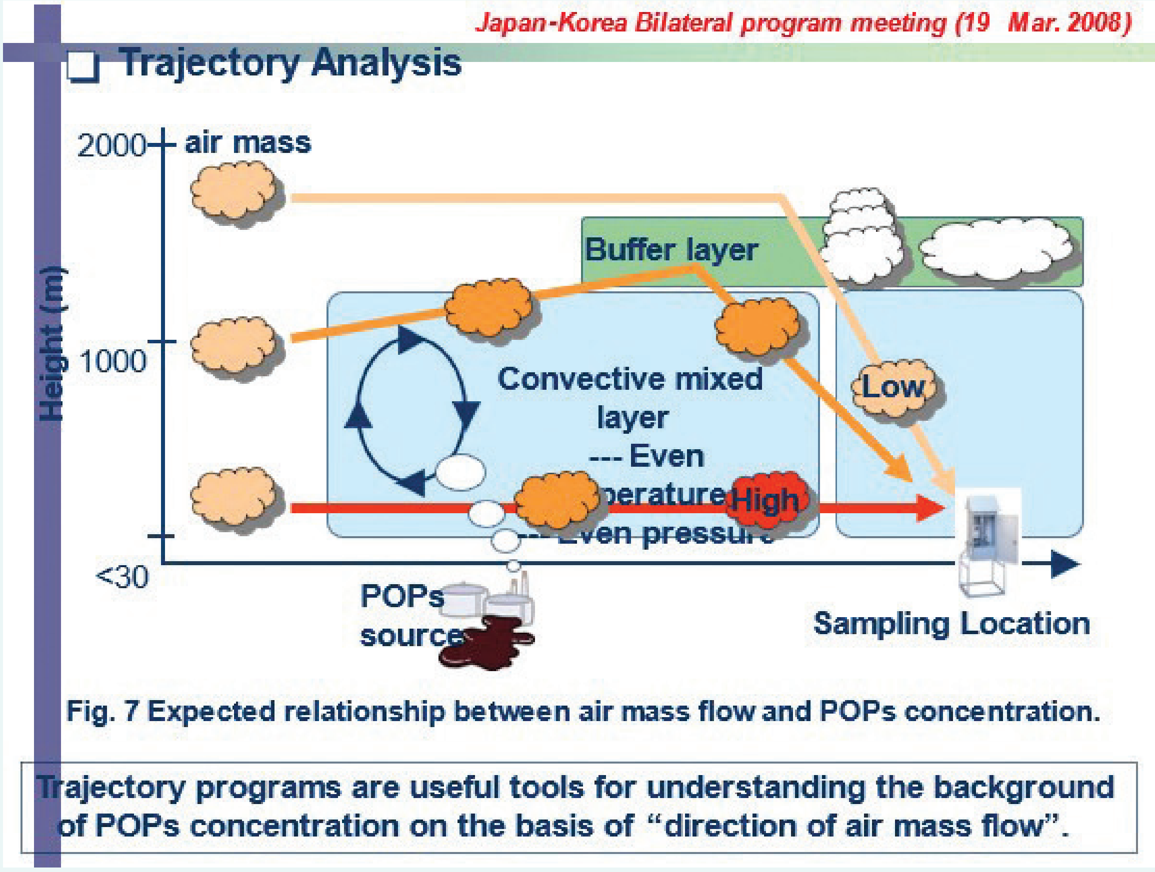
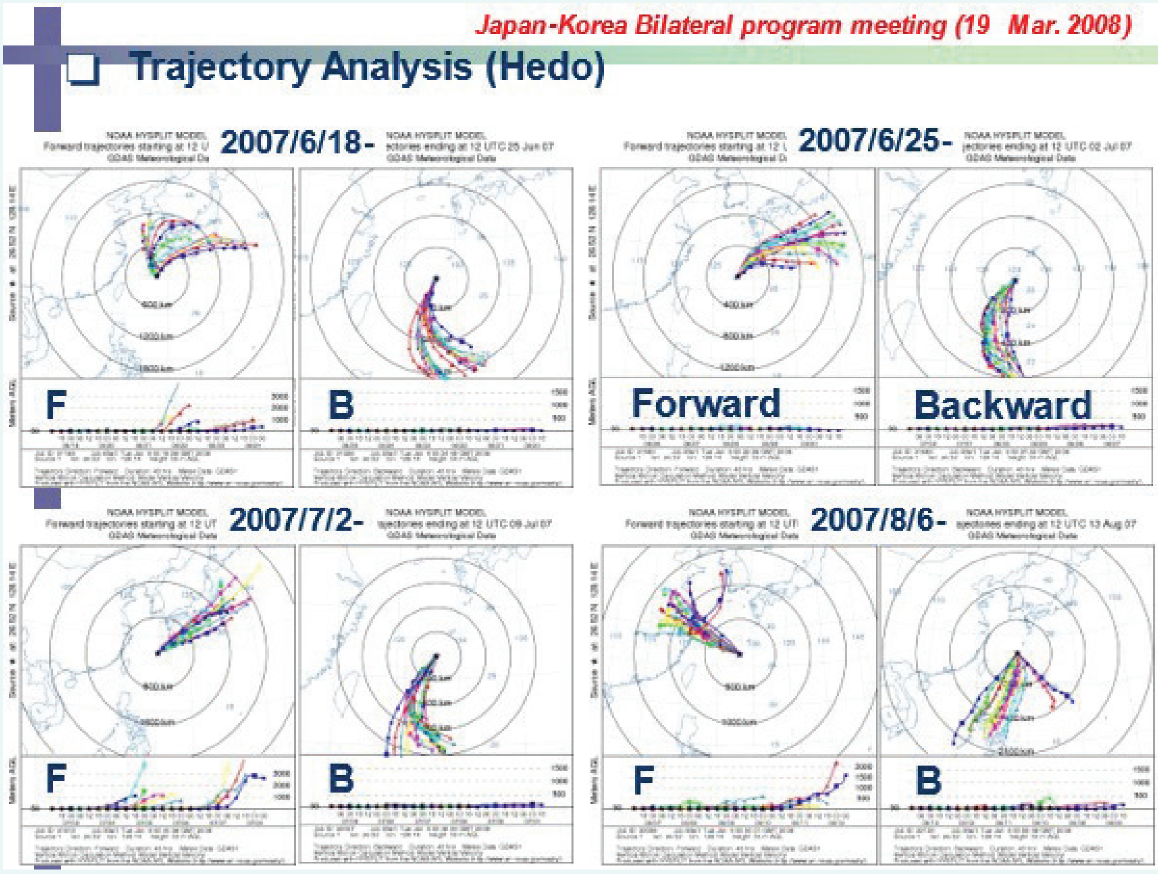


Fig. 7 Expected relationship between air mass flow and POPs concentration.



II-2 <2006~2008>

Cooperative research on fate models on POPs

Japan - Noriyuki SUZUKI
Korea - Junheon YOON

1. Background

There are several existing international project and/or framework on the co-operative scientific/governmental research project on fate modeling and long-range transport issue on POPs and other chemicals, including the efforts by OECD, UNECE and SETAC. However, there is less corresponding activities in East Asian region, especially concerning the modeling experience on trace organic contaminants like POPs. This project proposal intends to develop framework for sharing scientific experience on fate and transport analysis on POPs and other chemicals between both countries, and to help developing sharable scientific basis for the fate and transport assessment of the related trace chemicals by both countries.

As the current status of the related issues within the Japan-Korea EDC framework, the project "Comparison study of Dioxin inventory" has been performed during the past several years and the output of this project provides effective basic information to start the proposing new project especially for dioxins. There are also existing scientific achievements in both countries on the related issues, which would also be a basis to start this proposal.

2. Research Plan

1) Sharing information of fate and transport analysis of POPs and other chemicals between both countries.

2) Sharing experience on the integration of modeling and monitoring approaches for the fate and transport assessment of POPs and other chemicals.

3) Heading for more detailed collaboration of modeling efforts in both countries.

3. Major Outcomes

<KOREA>

1) Based on EDCseoul, an abnormal urban box model that began to be developed in 2002, Korea aimed to improve regional behavior such as Alkylphenols, PAHS, PCBs, OCs, and Phthalates for seven major cities. In the first year, the behavior of TBBPA in the atmosphere and water system was predicted under conditions such as suspension of future use, reduction of 5% use, and continuous use in the Ulsan area where TBBPA was being used.

2) Based on the results of the first year, EDCSeoul was improved and developed into a regional model named Korfate. It could reflect the regional climate and considered the characteristics of urbanization. It is also made in the form of a VBA Mac so that it can be run on Excel for user convenience.

3) In the third year, we tried to step up the research direction from model research to

cooperation on bioaccumulation of POPs. Bio-concentration can be effectively interpreted only when a combination of laboratory research, field investigation, and modeling is performed. Korea tried to analyze the characteristics of perfluorinated compounds in the water system, which were mentioned as POPs candidates, targeting common carp.

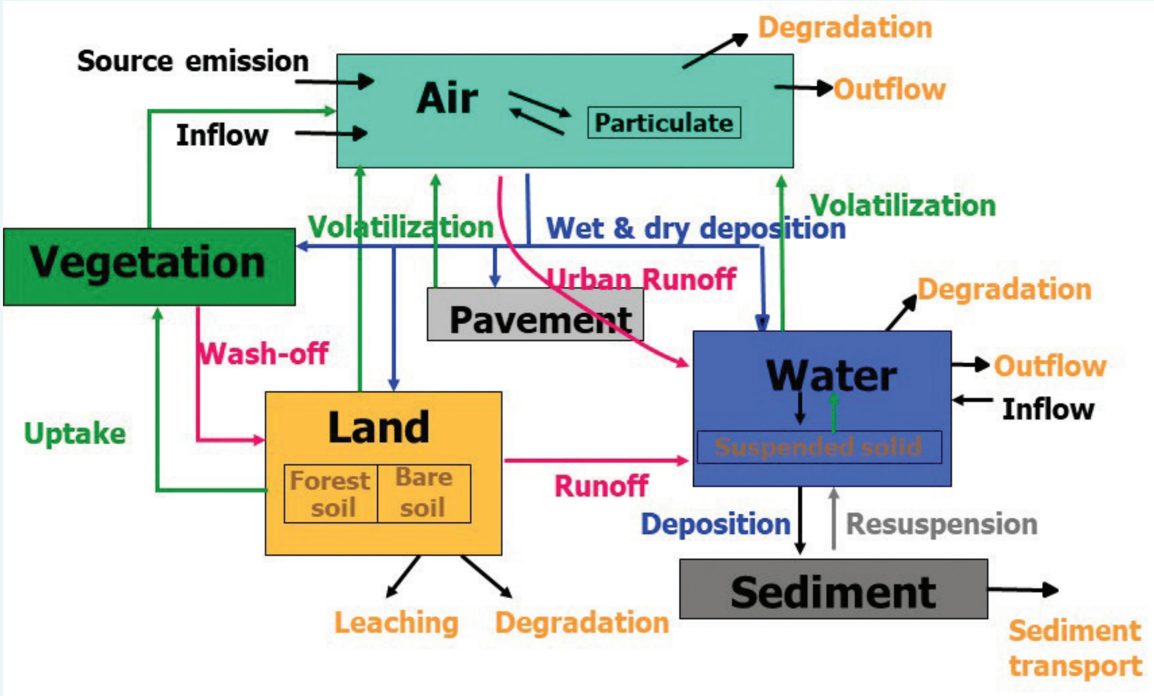
<JAPAN>

1) Based on the existing GIS-based multimedia fate model: G-CIEMS (Grid-Catchment Integrated Modeling System) on regional scale, multi-scale application of our G-CIEMS model to regional to global model domains are studied. Result of preliminary case study of global multimedia fate model simulation of PCB#153 is studied in the first year.

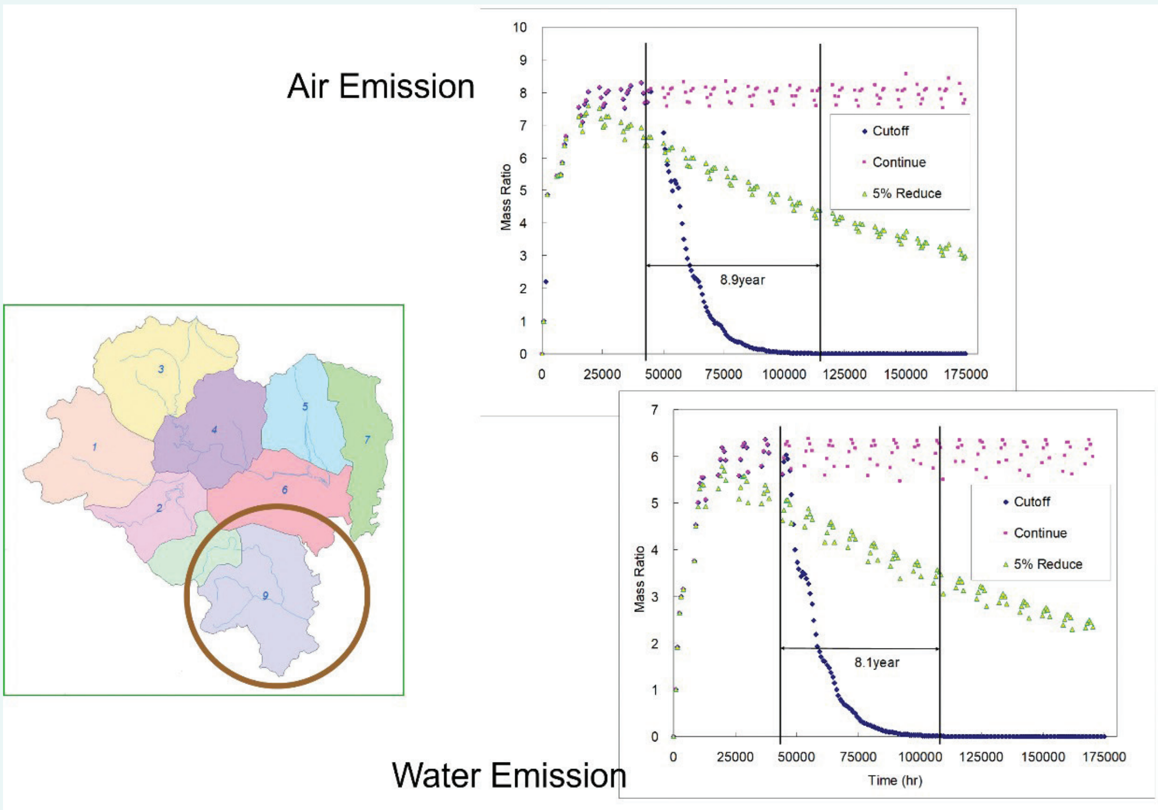
2) Global G-CIEMS model, based on the model domain of: 2.5 x 2.5 degrees (in general), single Arctic and Antarctic region, soil compartment with essentially same resolution of air, and single generic sea compartment were studied.

3) Source contribution from rectangular regions with 50 degrees of latitudes and 60 degrees of longitudes was estimated using the extracted global emission estimates on the region. Relative contribution reflects both transport nature and contribution of regional emission to the global total.

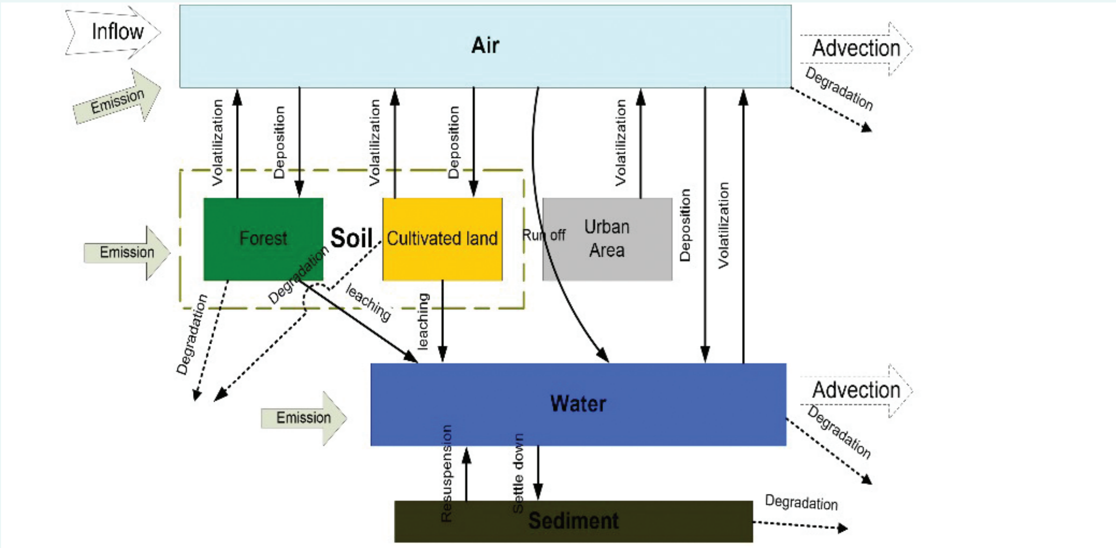
Concept diagram of the EDCSeoul model



Estimated TBBPA mass ratio trends in Ulsan Area sediment according to change in air and water emissions

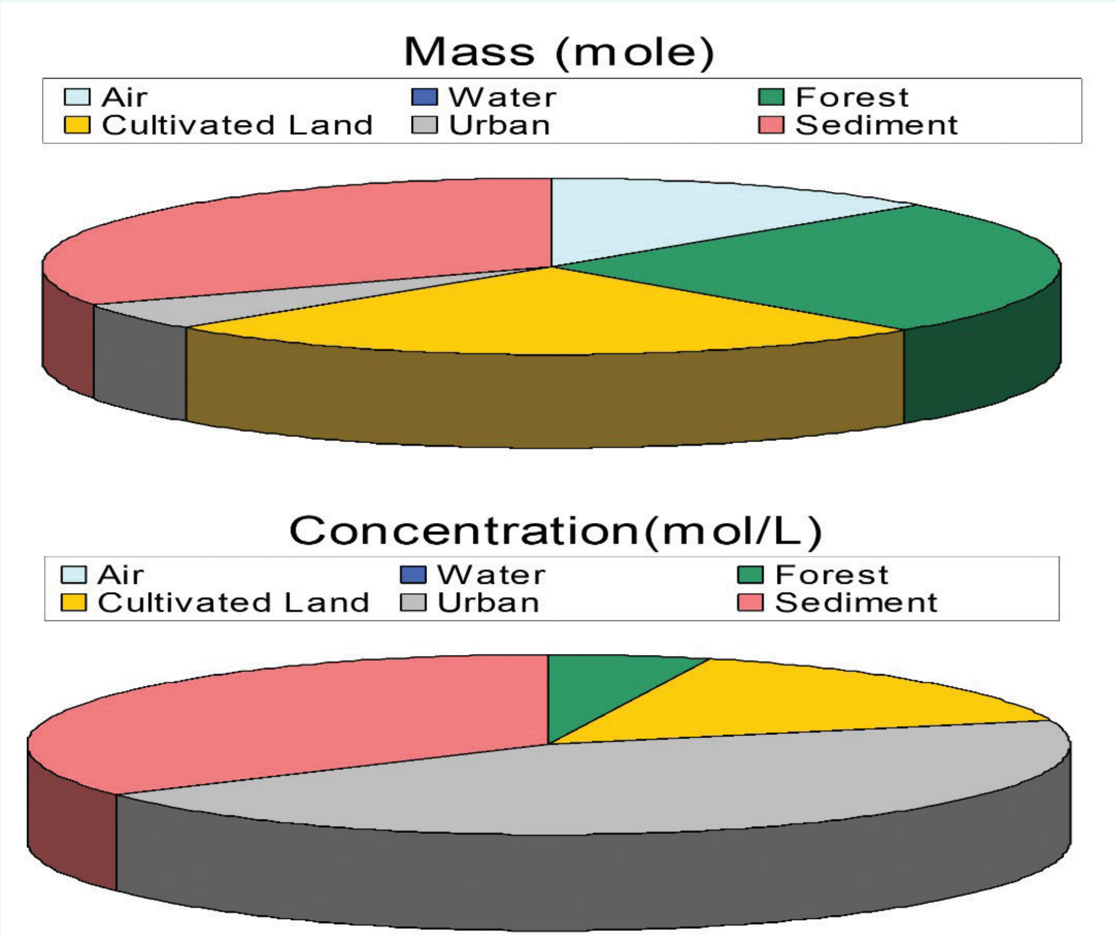


Concept diagram of the Korfate model

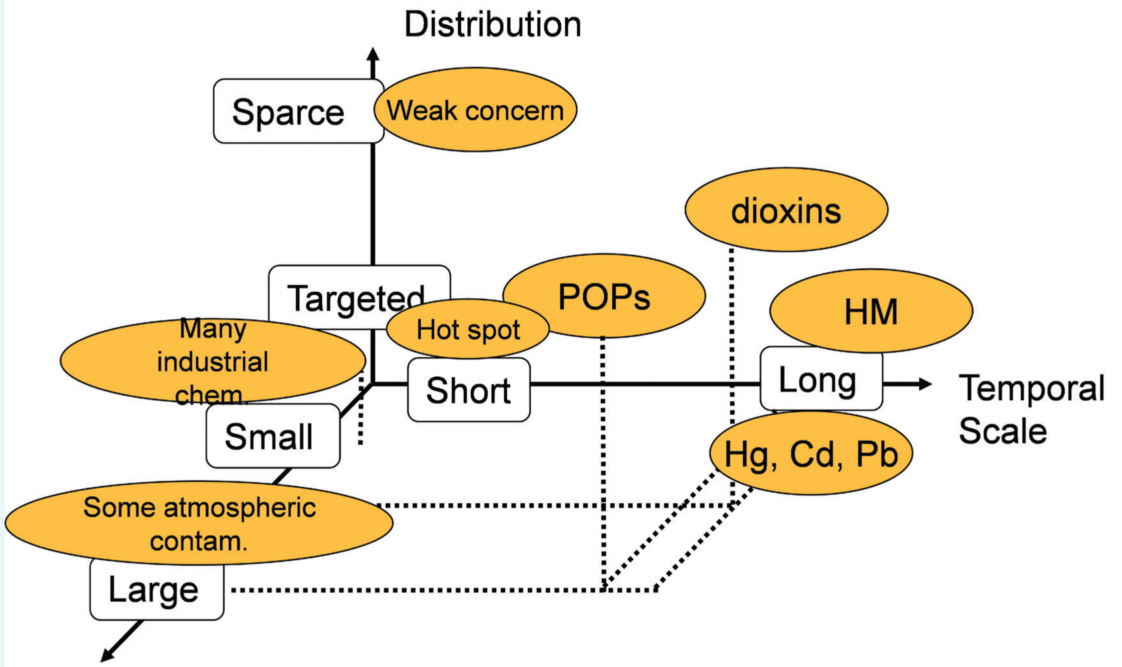


$$\frac{dMi}{dT} = input - output = E_i + \sum (T_{ji} - T_{ij}) + \sum (F_{input} - F_{outflow}) - DE_i$$

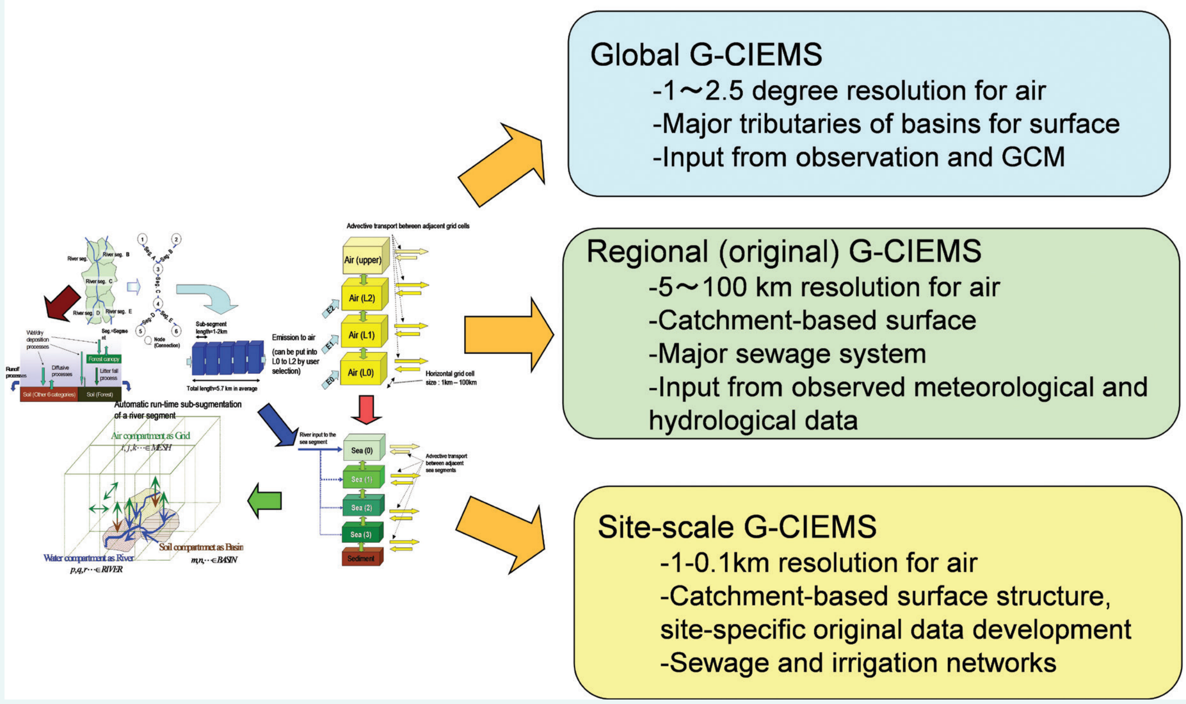
Estimation of PCB-180 distribution patterns
of each environmental medium using the Korfate model



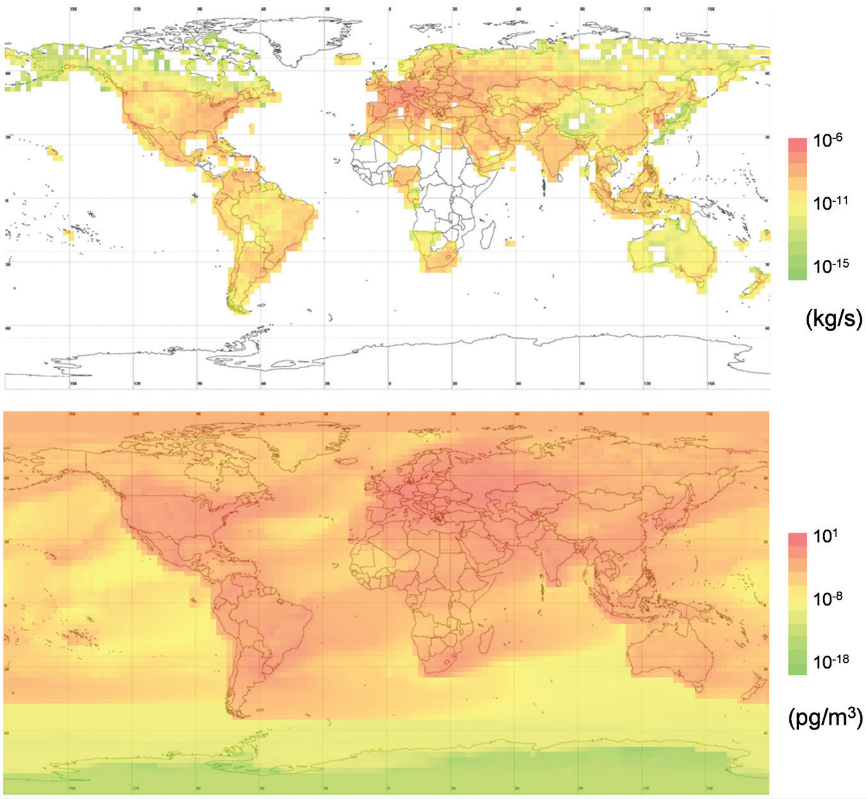
Geographical/time scales and distribution of exposure



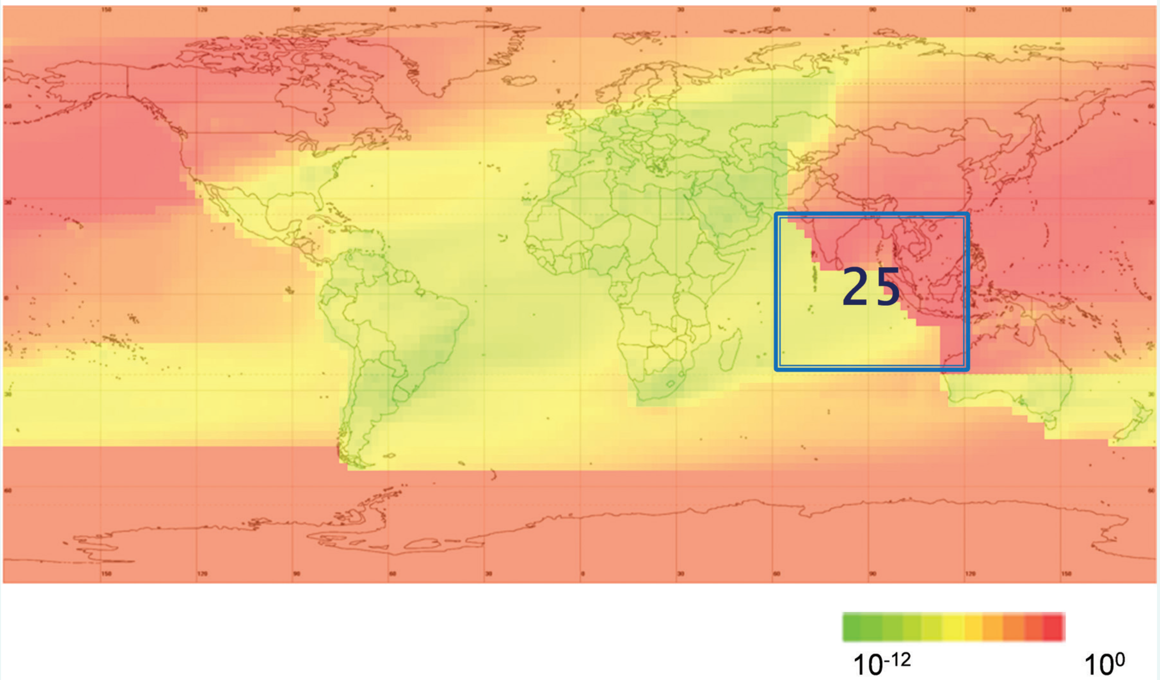
Multi-scale development of G-CIEMS MM



Emission pattern and air concentration of PCB#153 simulated by G-CIEMS model



Relative contribution from area 25



II-3 <2006~2008>

Comparison of dioxin/POPs levels in in-land/freshwater fish (Crucian carp) between Korea and Japan

Korea - Giho JEONG
Japan - Kiwao KADOKAMI, Tomomi IWAMURA

1. Background

Some chemicals are difficult to decompose in the environment, easily accumulate in living organisms, travel long distances on the earth, and have harmful effects on our bodies and organisms. Chemicals with these characteristics are commonly referred to as Persistent Organic Pollutants (POPs). In 2001, to prevent the spread of global environmental pollution by POPs, the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) was adopted to reduce or eliminate 12 substances, including PCBs, which are highly persistent in the environment.

We have been studying the accumulation of dioxins in freshwater fish in Japan and Korea, and decided to also investigate the accumulation of organochlorine pesticides (OCPs) such as DDT (dichlorodiphenyl trichloroethane), which were used in large quantities in the past, as well as dioxins. OCPs are designated as POPs and accumulate in high concentrations in the environment in organisms high up the food chain, where they may have harmful effects.

We measured concentrations of DDT, chlordane, drins, heptachlor, hexachlorobenzene (HCB), mirex, and hexachlorocyclohexane (HCH) in crucian carp, the same species used in the dioxins study. The objective of this study was to compare the concentrations and accumulation profiles of OCPs in freshwater fish and to identify the causes of significant differences between the two countries.

2. Research Plan

1) To compare the current concentrations and accumulation profiles of POPs and its candidates in freshwater fish (Crucian carp) in both countries.

2) To elucidate the causes of differences between sampling sites and both countries.

3) To obtain biota-sediment accumulation factors (BSAFs) of crucian carp.

4) To grasp maternal transfer and consequent sex difference in POPs concentration during the spawning season.

3. Major Outcomes

<KOREA>

1) In Korea, PCDFs concentration was much higher than PCDDs concentration, and in Japan, PCDDs concentration was higher. There was a gender difference in dioxin

concentrations. In Korea, it was higher in female carp, and in Japan, it was higher in male carp. Dioxin accumulated in the body of crucian carp collected in Korea appears to be mainly due to the combustion process, with a small portion due to the herbicides CNP and PCP. The major isomers for PCDDs, PCDFs, and co-PCBs in both countries were T4CDD, P5CDF, and PCB-118.

2) The ratio of DDTs and chlordane among the total residual persistent organic pesticides accumulated in the carp's body was more than 80%. Mirex has never been used, but has been detected in low concentrations in Japan. HCH and drins were not detected in both countries, and Myrex was not detected in Korea. Concentrations of DDTs and chlordane were significantly higher in Japan, while heptachlor and HCB were found at similar levels in both countries.

3) In Japan, persistent organic pesticides were detected in all sites, but in Korea, they were not detected in half of the sites. The main pesticides (DDTs and Chlordanes) and predominant compounds (p,p′-DDE and trans-Nonachlor) were the same in both Korea and Japan. There was no systematic distribution pattern or increase in concentration at the same location (Korea). Concentrations in three remote areas were lower than in other locations, possibly because the concentration of persistent organic pesticides is affected by previous use (Japan).

<JAPAN>

1) In addition to the 12 dioxin survey sites, two new sites were added for a total of 14 sites. Samples consisted of frozen preserved crucian carp samples from 12 sites, crucian carp samples from 2 additional sites prepared in the same manner as the 12 sites, and bottom sediment samples from 14 newly collected sites.

2) Dioxins concentration in Japan was higher than in Korea because of high concentration of PCDD in Japan. The reason why PCDD concentration in Japan was high seemed to be the cause of herbicides used in the past. From compositions of congeners and homologues of PCDDs/DFs, the 14 survey areas were able to be divided into 4 types; combustion, CNP, CNP & PCP, and PCP.

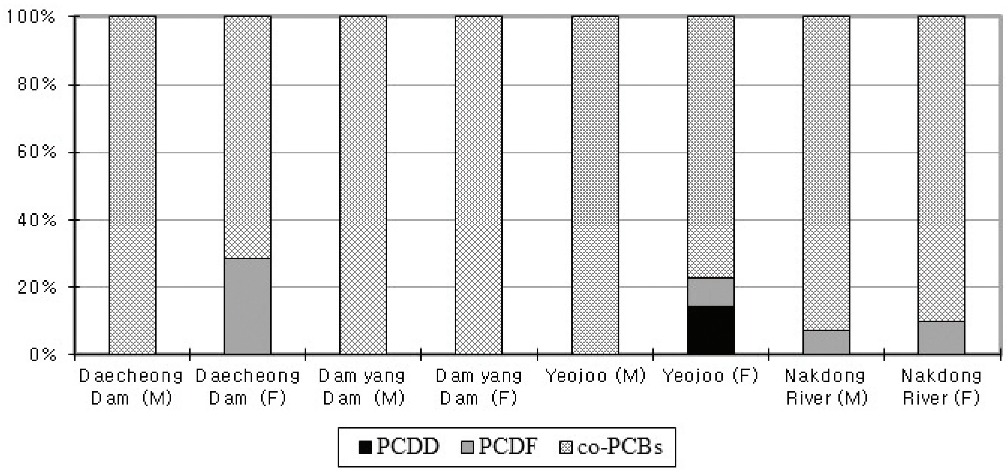
3) DDTs and chlordanes were dominant in POPs pesticides in both countries, but their concentrations in Japan were one order of magnitude higher than in Korea. The difference in volume used in both countries seemed to be the cause of difference in concentrations. In the both countries, DDE was dominant in DDTs and trans-nonachlor was dominant in chlordane.

4) Biota-Sediment Accumulation Factors (BSAFs) of POPs excluding PCDD/DF were above 10, indicating these POPs pesticides are easily accumulated by aquatic animals.

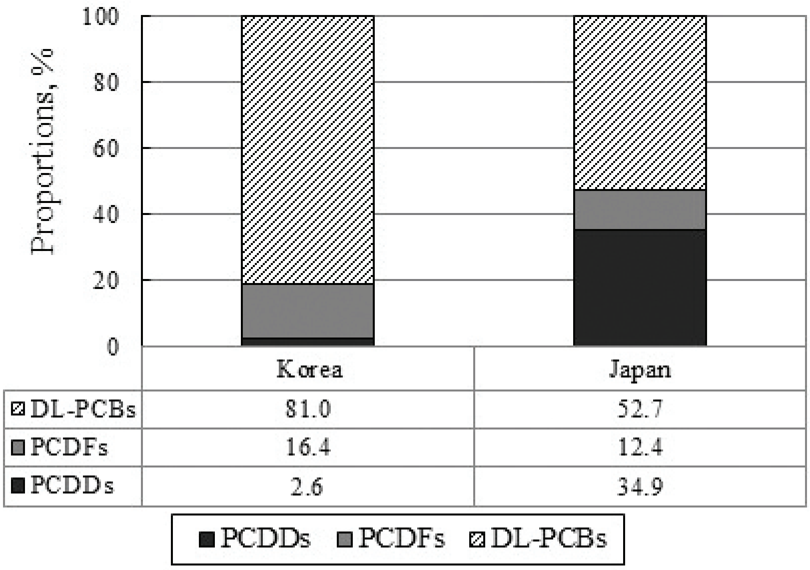
5) Sex difference in POPs concentrations was found during the spawning season because of maternal transfer. One-fifth of POPs in female transfer to their eggs.

Highlight Slides, KOREA

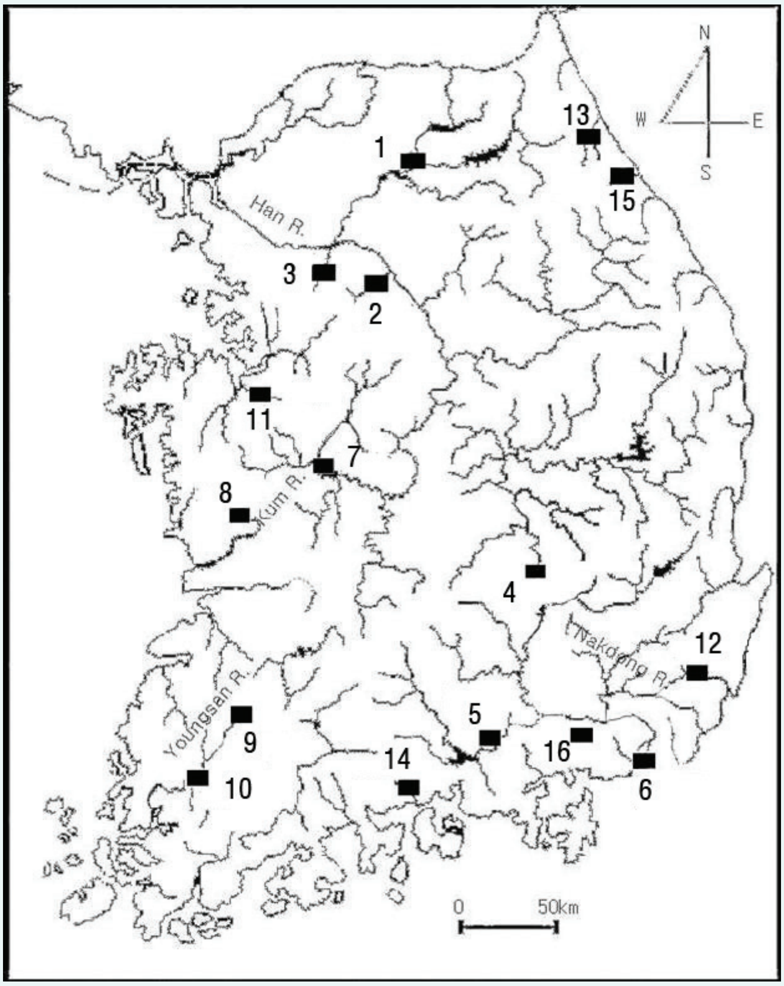
Proportions of PCDDs, PCDFs and co-PCBs in crucian carp



Relative distribution of PCDDs, PCDFs and co-PCBs accumulated in crucian carp from Korea and Japan



Locations of sampling sites
(124.6° E ~ 129.6° E, 34.0° N ~ 38.5° N)



1: Uiam-Dam	2: Bokha-stream	3: Kyungan-stream	4: Koomi
5: Nam-River	6: Nakdong-estuary	7: Daecheong-Dam	8: Booyeo
9: Damyang-Dam	10: Najoo	11: Oncheon-stream	12: Myungchon
13: Yangyang	14: Hadong	15: Kangnung	16: Junam

Production amounts of POPs in Japan

Compound	Production and/or import volume, ton	Use	Period of service	Log Kow
Dioxins	PCB: 57,300	Unintentional product PCB: Insulating oil, etc	PCB: 54-71	
DDTs	156,265	Insecticide	47-81	6.02-6.91
Chlordanes	16,900	Termite killer	50-86	4.76-6.16
Aldrin	3,313	Insecticide	54-75	6.5
Endrin	1,360	Insecticide	54-76	5.2
Dieldrin	1,041	Insecticide	54-80	5.4
Heptachlors	1,500	Insecticide	57-86	5.4-6.1
HCB	? (4,000/Y)	Unintentional product	-72	5.73
Mirex	0	Insecticide	Not used	5.28
HCHs	389,000	Insecticide	48-71	3.72-4.14
PBDEs	Deca-BDE: 18,720 from 1997 to 2001	Fire retardant	- present	4.28-9.9

DDT; p,p'- & o,p'-DDT, p,p'- & o,p'-DDE, p,p'- & o,p'-DDD; Chlordanes: trans- & cis-chlordane, trans- & cis-nonachlor, oxychlordane; Heptachlor: heptachlor, trans & cis-heptachlor epoxide; HCHs: α-, β-, γ- & δ-HCH

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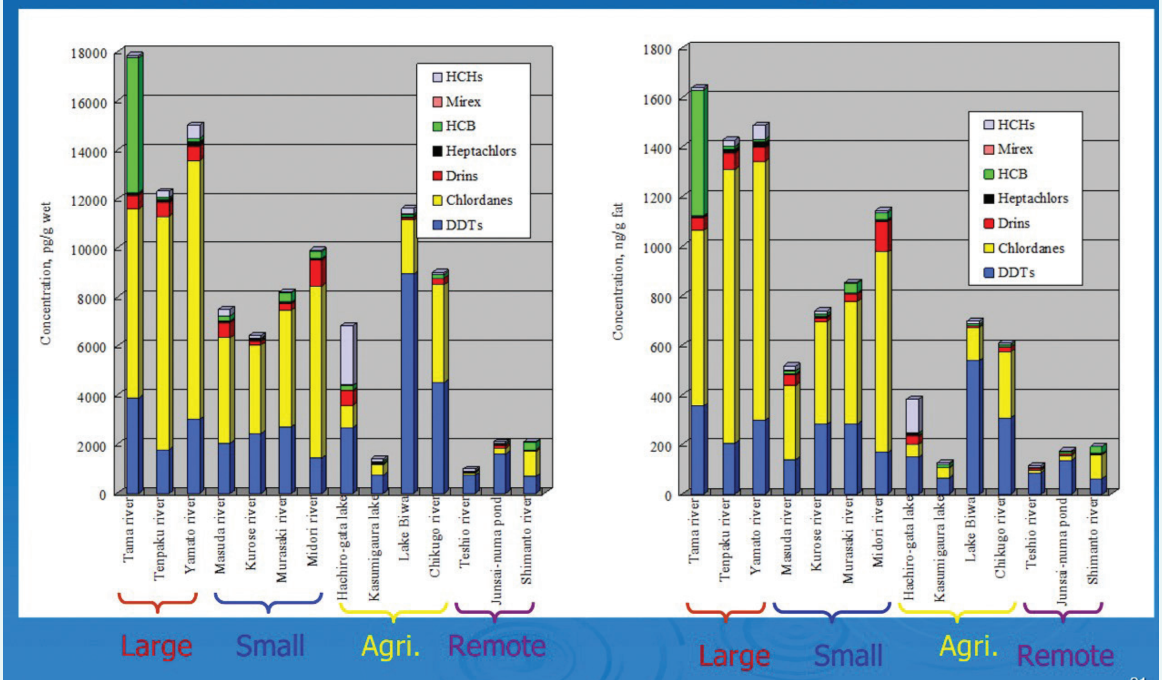
Pesticides Concentrations in Japan

pg/g wet basis ng/g fat basis



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