



EMECS NEWSLETTER

No. 3

A Letter from Hyogo

Hyogo Prefectural Government, Japan



The Second International Conference on Environmental Management of Enclosed Coastal Seas 1993 (EMECS'93)

November 10-13, 1993

Invitation from Maryland - Call for Papers & Registration



Among the busiest ports in the United States, Baltimore lies on the Western Shore of the Chesapeake Bay, on the Patapsco River. EMECS'93 will take place in Baltimore's attractive Inner Harbor area. (Credit: Roger Miller)

EMECS '93 was originally scheduled for July 1993, but the dates have been changed to November 10 through 13. There has been no change in the site or conference hall. The dates were changed because it was felt that prospective partici-

pants would also want to attend Coastal Zone '93, a conference sponsored by the American Society of Civil Engineers (ASCE). As both conferences are supported by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA), it would cause difficulties for these organizations if the dates overlapped.

The dates for submission of papers and posters, participant registration and application for travel assistance for speak-

ers from developing countries are as follows:

- Abstracts due: April 15, 1993
- Advance registration: September 15, 1993
- Applications for participant travel subsidies: July 1, 1993

For details, see the second announcement issued by the EMECS '93 Secretariat. This announcement will be mailed to readers of EMECS Newsletter. For further information regarding the conference, please contact the secretariat of EMECS'93.

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Seto Inland Sea Research Forum in Hiroshima

The Seto Inland Sea Research Forum in Hiroshima, sponsored by the Research Institute for the Seto Inland Sea, was held in Hiroshima on August 27 and 28, 1992. The theme of the conference was "Sustainable Development and Environmental Management of the Seto Inland Sea," and was attended by around 400 researchers and officials from administrative bodies.

"At the opening ceremony, Dr. Takeshi Goda, professor emeritus of Kyoto University and chairman of the Research Institute for the Seto Inland Sea, spoke on the history and purpose of the Research Institute, and words of welcome were heard from Takashi Hiraoka, mayor of Hiroshima, and Sakae Akagi, director general of the Water Quality Bureau, Environment Agency of Japan. Toranosuke Takeshita, governor of Hiroshima Prefecture pointed out that development in the Inland Sea is shifting from a focus on industry toward urban development and resorts that utilize the abundant natural beauty of the area. He said it is important to ensure a balance with the regional environment while pursuing development, and that he had high hopes for the accomplishments of the forum.

The forum was divided into six sessions entitled: "Water Quality and its Ups and Downs," "The Relationship Between the Ecosystem and the Environment," "Waterfront Development and Environmental Management," "The Interrelationship Between the Management of Estuaries and Scientific Progress," "The

Environment and Human Activities" and "The History of the Coastal Areas of Hiroshima." These sessions used the area around Hiroshima as a motif and were designed to correspond to the three main themes of the Second International Conference on Environmental Management of Enclosed Coastal Seas 1993(EMECS'93), to be held this November in Baltimore, U.S.A. Each session featured four presentations by researchers and others involved in the study of the Inland Sea. Presentations at the sessions included (1) an analysis of the cause and effect relationship between pollution and tidal currents, with particular emphasis on the special features of enclosed coastal seas; (2) the effect of eutrophication on the food chain and the status of plankton; (3) the most desirable form for artificial beaches considering the environment; and (4) the possibility of applying statistical analysis to environmental problems in coastal seas. Other problems were also discussed from a variety of perspectives, using the Seto Inland Sea as an example; one presentation focused on the relationship between eutrophication and development in Hiroshima Bay, while another discussed the status of nitrogen and phosphorous in the estuary of the Ota River in Hiroshima.

After the sessions, there was a panel discussion coordinated by Professor Toru Sawaragi of Osaka University and chairman of

the forum's steering committee. There was spirited debate between panelists and participants on the topic of "Sustainable Development and Environmental Management of the Seto Inland Sea." One participant, speaking about the necessity for increased freedom of information, said that more in depth research would be possible if the data held by administrative bodies could be obtained. Regarding the organization of future forums, another participant stated that the forums should provide an opportunity for young researchers to be stimulated through exposure to the findings of researchers in different fields.

The next forum is scheduled to be held this year in Takamatu, Kagawa Prefecture.

CONTENTS

- Enclosed Coastal Seas in the world -No.2-
The Chesapeake Bay Page 2-3
- Organizations in the field of Enclosed Coastal Seas -No.2-
Center for Environmental and Estuarine Studies/Coastal and Environmental Policy Program Page 4-5
- From Readers Page 8-9
- The Decimation of
the Horseshoe Crab Page 10-11

The Chesapeake Bay A Model for Coastal Seas Management? Enclosed Coastal in the World -No.2-

The Chesapeake Bay lies at the end of one of the longest rivers in the United States Susquehanna, which flows south from near the Great Lakes through the states of New York, Pennsylvania and Maryland. Thousands of years ago the Susquehanna River--now some 720 kilometers long--drained directly into the Atlantic Ocean, but with the ending of the last ice age, the sea flooded the mouth of the river and created a great estuary. By 10,000 years ago ocean waters had flooded the continental shelf and reached the present Bay mouth; by about 3,000 years ago, the salt water had reached as far as the northern Bay, and the Chesapeake had essentially taken its current shape. More than a dozen sizable rivers--including the Potomac, Rappahannock and James--as well as a multitude of smaller tributaries, had also begun to empty into this estuary, creating the bay we now call the Chesapeake.

A Productive Ecosystem

For thousands of years the Chesapeake Bay has provided a habitat for plants and animals that thrive at the coastal margin, Where fresh water from the rivers mixes with salt water from the sea. The Chesapeake ' s first human inhabitants, who migrated across a land bridge which once linked Alaska to Asia, harvested fish and shellfish from the Bay but did not deplete the stocks. Today the Chesapeake watershed is home to some 14 million people, who have come to this part of North America from all over the world, and their presence has had a much more profound effect on the health of the estuary.

The Chesapeake is not only the largest estuary of its kind in North America, but also is arguably the subject of more scientific research--and more political wrangling--than any other body of coastal water in the world.

The status of the Chesapeake Bay as a heavily studied, intensely political entity results directly from its historical, social and economic importance.

The Chesapeake, well protected by the land which surrounds it, has served from the beginning of North American history as a sheltered and remarkably fertile fishing ground. With the coming of Europeans to the region, the Bay provided secure and navigable waterways to rich forests and farm land. The Bay became at once both food source and liquid highway, and provided the setting for the first English settlements, most notably Jamestown and Williamsburg, Virginia.

The economic importance of the Chesapeake Bay has long been appreciated by those who live in the region. The seafood industry, a rich tradition in the Bay region, is worth millions of dollars annually, and the Chesapeake Bay has, over time, often led the nation in commercial landings of oysters and blue crabs. The shipping industry, with major ports at Baltimore and Norfolk and a major shipyard at Newport News, is worth billions of dollars. The Chesapeake Bay also serves as a valuable site for homes, commerce and industry, as well as a

thriving recreational boating and tourism business.

At the same time, the Bay has become the scene of conflicts between varying groups. Disputes have pitted fisherman (known in this region as " watermen ") against resource managers, environmental groups against developers, and different levels of government against each other. But the largest threat to the Bay has come from an upsurge in human population over the past several decades, combined with wasteful patterns of land use and with the overharvesting of Bay fisheries.

Within the last century, use of the estuary has become so intense that its resilience as an ecosystem has been tested. This perceivable decline in the estuary ' s ecological health has led to a growing realization that the Bay has a value beyond its economic and social importance, as a rich and abundant natural system. Just as the Bay ' s ecological richness led to its productivity, so a decline in its productivity has led to a greater appreciation of the Bay itself.



Farm fields still line the shore in many parts of the Chesapeake Bay. (Credit: Maryland Sea Grant)

Pinpointing the Bay's Problems

It has only recently become clear that the health of the Chesapeake Bay is tied to the health of its entire watershed, an area of some 104,000 square kilometers. The state of the Bay ' s health became apparent after a six-year, 26-million dollar study supported by the U.S. Environmental Protection Agency (EPA), which culminated in a comprehensive report in 1983. The EPA discovered that many parts of the Bay ' s ecosystem were changing. Not only had fishers declined, but some areas showed high levels of toxic compounds, and the underwater grasses which once covered much of the Bay's shallow area had largely disappeared. Overfishing could perhaps

explain the decline in fisheries abundance, but the die-off of many species of underwater grass pointed to a more systemic problem.

Researches at the University of Maryland and other Bay laboratories concluded that the underwater plants had succumbed to a widespread increase of nutrients, especially phosphorus and nitrogen. These nutrients caused increased turbidity, which blocked sunlight from the plants, and stimulated the growth of fouling organisms on the plants themselves, further retarding photosynthesis. The increase in nutrients also resulted in an overabundance of algae and, as a consequence, decreasing levels of oxygen in bottom waters, where the algae decay.

Nitrogen and phosphorus find their way into the Bay through waste treatment plants and industries, but also come from farm fields, and from runoff from cities and sprawling suburbs. Increasingly, attention is being focused on these nonspecific or "nonpoint" sources. Recent studies have shown that pollution from the air is also an important source of both oxides and nutrients, including nitrous oxides from trucks and automobiles.

A series of agreements signed by the U.S. government and the states in the Bay region--Virginia, Maryland, Pennsylvania, as well as the District of Columbia--began large, coordinated effort not only to halt the degradation of the Bay but also to restore its former health and productivity. The effort is overseen by an Executive Council, comprised of the governors of the participating states, the Mayor of Washington, D.C., the Administrator of the U.S. EPA, and the head of the Chesapeake Bay Commission(a joint committee of legislators from Maryland, Virginia and Pennsylvania).

Major programs have helped to improve the treatment of sewage in the Bay area, have helped to bring back important species such as the striped bass (or rockfish)--and have focused greater attention on halting the runoff of sediment and contaminants. Key in the development of such programs has been citizen action and involvement. Citizen groups, such as the Chesapeake Bay Foundation or the Alliance for the Chesapeake Bay, have helped to draw attention to pressing problems in the region, often serving as a catalyst for action.

At the same time, the region's universities, often working with the support and cooperation of state and federal agencies, have helped to determine more precisely the nature of the Bay's problems. Colleges, universities and public schools--again, often with support from state or federal agencies of private foundations--have focused greater attention on environmental education, and on the Chesapeake Bay in particular.

The future of the Chesapeake

In many ways, the Chesapeake Bay has had the advantage of both the technical expertise and the political will to bring about effective environmental management. Resource managers and decisionmakers now have at their disposal considerable scientific data and sophisticated computer models which can help guide their strategies. Numerous laws and regulations help to control the cutting of trees and the development of land in ecologically sensitive or "critical" areas.



Traditional wooden sailboats, called skipjacks, still harvest oysters from the Chesapeake, though the natural oyster stocks have suffered from disease and are near depletion in many areas. (Credit: Michael W. Fincham)

But the Bay region still faces serious difficulties. Some problems, such as air pollution, many originate outside of the jurisdictions of the Bay states (the Ohio River valley, for example) and do not fall under the mandates or efforts of the Bay Program. Expanding population, much of it caused by the arrival of people from other regions, continues to stress the programs designed to reduce the impact of human activity on the watershed.

And finally, certain lifestyle patterns cause impacts which can slow environmental progress. In particular, like Americans of other regions, those in the Chesapeake Bay area rely heavily on the automobile for transportation. This use is tied to social patterns, including the rapid expansion of far-flung suburbs and the decline of the inner city (in this case Baltimore, Washington and Richmond). The automobile has become a major air polluter, requires an extensive network of roads and highways and is a great consumer of energy. Studies show that Americans generally are heavy users of resources, and this is reflected not only in gasoline consumption, but also in the use of electricity (which requires the burning of fossil fuels or the use of nuclear fission), and in the heavy consumption of water.



In remote parts of Bay, small fishing areas have changed little over the years--but change is approaching quickly. (Credit: Maryland Sea Grant)

Waste water finds its way into the Chesapeake through waste treatment plants or through other nonspecific means, including septic fields and groundwater, usually with nutrients added--a major problem for the Bay.

The Final Analysis

The Chesapeake Bay is, in many ways, a world-class model for sound environmental management. The multi-state, multi agency program now in place to guide the restoration of the Bay is impressive and well directed. Because of citizen concern and energetic political leadership, the Bay Program has helped to coordinate the efforts of federal agencies with those of state and local governments.

On the other hand, the future remains uncertain. Programs, no matter how well intended, may find it difficult or even impossible to bring about necessary environmental stewardship in the face of expanding population growth in the region and a continued high rate of energy consumption and sprawling land use.

Perhaps the most decisive factor will prove to be the will of the citizenry in the Bay region. Their affection and concern for the Chesapeake Bay not only as a resource but also as a special place, with its own rich history and ecological integrity, offers the best hope for the region ' s long-term environmental health.

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Table 1. The watershed ' s population at a glance (only those portions of each state within the watershed are included).

State or District	1940	1986	2020 (projected)
District of Columbia	636,235	626,100	626,100
Delaware	84,559	214,900	215,000
Maryland	1,706,959	4,436,800	5,496,600
New York	495,710	672,400	700,000
Pennsylvania	3,006,638	3,514,300	3,854,500
Virginia	1,530,935	4,510,900	6,229,800
West Virginia	118,617	66,900	166,900
Total watershed	7,579,653	14,142,300	17,288,900

Source: Bureau of the Census, 1592,1988, Maryland Office of Planning

UNIVERSITY OF MARYLAND SYSTEM CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES (CEES) COASTAL AND ENVIRONMENTAL POLICY PROGRAM (CEPP)

Organizations in the Field of Enclosed Coastal Seas -NO.2-

CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES (CEES)

CEES is an institution of the University of Maryland System with a special mission in environmental research, education, and public service. The Center consists of three laboratories located in the State of Maryland, U.S.A., on the watershed of Chesapeake Bay:

- Appalachian Environmental Laboratory
- Chesapeake Biological Laboratory
- Horn Point Environmental Laboratory.

The strategic location of these facilities (Figure 1) has enabled CEES to develop a comprehensive program of coastal seas' research. More than 150 active projects are being conducted on environments ranging from terrestrial uplands and freshwater tributaries to tidal wetlands, brackish estuaries, and the continental ocean.

The Maryland State Legislature established CEES in 1973"....to conduct a comprehensive program to develop and apply predictive ecology for Maryland to the improvement and preservation of the physical environment. ..."State funds support nearly half of the Center's annual budget. The remainder is derives from outside grants awarded to the nearly 90 Ph.D.-level faculty members. Over 120

students from University of Maryland institutions pursue M.S. and Ph.D.degrees under the guidance of CEES faculty members through collaborative programs such as the System's graduate program in Marine-Estuarine-Environmental Sciences (MMES), Toxicology, Seafood Science, and Fisheries/Wildlife Management. In addition, each of the Center's laboratories operates environmental education programs, CEES constitutes a statewide network that serves more than 15,000 young people, their teaches, and concerned citizens each year.

Over three-fourths of CEES' research focuses on the Chesapeake Bay. These studies broadly involve the Bay's water quality, nutrient cycles, food chains, and living resources. Research strengths include the following:

- physical oceanography, including circulation and sediment transport professes;
- biological oceanography, specializing in phytoplankton ecology, eutrophic dynamics, and microbial mediation of food chains
- seagrass and wetland ecology, covering both non-tidal and tidal wetlands
- fisheries sciences, including physiology

and behavior, population biology, and management of finfish and shellfish resources;

- environmental chemistry, focusing on nutrient cycles, biogeochemical processes, and toxicology
- aquaculture of commercial finfish and shellfish, including the famous Chesapeake Bay striped bass, oyster, and blue crab;
- ecology of disturbed ecosystems, covering both aquatic and terrestrial habitats on coastal watersheds.

Chesapeake Bay studies are complemented by projects undertaken on the Great Lakes, Puget Sound, and other North American coastal seas, on coastal systems bordering both developed and industrialized nations (Figure 2), and on the world's major oceans through such programs as the Joint Global Ocean Flux Study (JGOFS). Together, they provide a wealth of comparative information on man's ecological place in coastal systems and the influence of global environmental processes on these most important of human environments.

CEES has pioneered in bridging gaps between the natural sciences, socio-economics, and policy under the aegis of

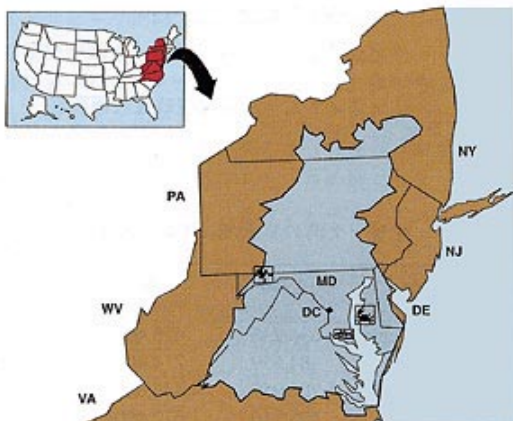


Figure 1. Location of the three CEES laboratories on the Chesapeake bay watershed:
 [Icon] Appalachian Environmental laboratory
 [Icon] Chesapeake Biological Laboratory
 [Icon] Horn Point Environmental laboratory and CEES Administrative Offices

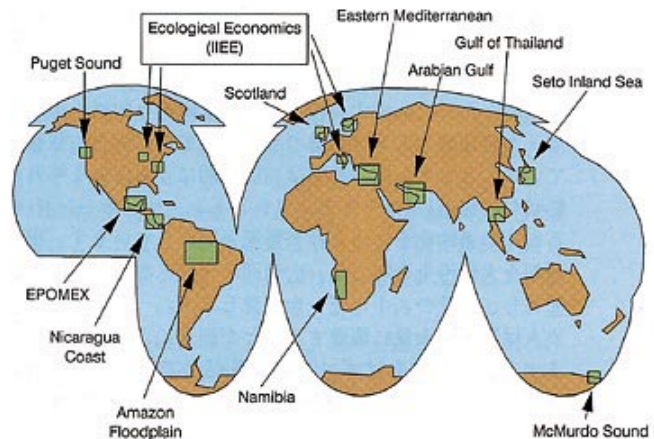


Figure 2. Locations of CEES research and policy programs on coastal seas and their watersheds around the world.

more effective coastal seas governance. The Coastal and Environmental Policy Program (CEPP), described below, is one example of the Center's leadership. CEES also houses the Maryland International Institute for Ecological Economics (MDIIEE), one of for such institutes worldwide that is part of a global network under a rapidly growing and increasingly important field to those who must make hard decisions for the sustained use management of our irreplaceable coastal resources.

The administrative organization of CEES lacks discrete departments defined by traditional academic disciplines. This administration enables and actually fosters the undertaking of truly multidisciplinary studies. It is not unusual for physical oceanographers, marine biologists, and geochemists to collaborate on a single research project. Indeed, CEES has been a leader in such research through projects funded by the National Science Foundation, including MECCAS (Microbial Exchanges and Couplings in Coastal Aquatic Systems) and LMER (Land-Margin Ecosystem Research, for which Chesapeake Bay was the first site in the U.S.A.). The U.S. Environmental Protection Agency has designated CEES as one of four national Exploratory Ecosystem Research Centers. This award will provide significant funding for up to 10 years of research into the functioning of coastal ecological systems. The CEES project employs toxic compounds to unravel the effects of increasing scale (size and complexity) on ecosystem behavior. Understanding the problem of scale is extremely important to policy makers who are expected to extrapolate predictions based on laboratory and computer models to the behavior of systems as complex as even the smallest coastal seas.

Studies undertaken by CEES scientists have made significant contributions to the state-federal Chesapeake Bay restoration and protection effort (the Chesapeake Bay Program). These studies have clarified the importance of nitrogen as a pollutant in estuaries and shown how point- and non-point nutrient pollution is linked to the disappearance of sea grasses and the spread of oxygen-free waters during periods of summer stratification. Recent revisions to the 1987 Chesapeake Bay Agreement reflect these contributions, among which are the following:

- shift in emphasis from pollution control on the estuary proper to reduction of nutrient loadings from the land via the tributaries;
- increased emphasis on control of nitrogen pollution;
- use of submerged aquatic vegetation (SAV) recovery as an indicator of improved water quality;
- linkage between water quality and habitat restoration as key to restoration and sustained use management of living resources.

These revisions not only respond to advances in science, but also to an increased understanding of how man's activities on land influence and are in turn influenced by the ecology of our coastal seas.

COASTAL AND ENVIRONMENTAL POLICY PROGRAM (CEPP)

In the context of the Chesapeake Bay Program, research at CEES and other University of Maryland institutions is both independent and relevant—it is not managed according to the priorities of the Program alone. This places a premium on the effective translation of scientific data for use by the environmental management community and by a citizenry increasingly informed on environmental issues. Unfortunately, the roles of the various parties in coastal seas governance programs around the world have often been more confrontational than participatory.

In 1987, components of the University of Maryland established the Coastal and Environmental Policy Program. CEPP is a cooperative effort involving CEES, the School of Law, School of Public Affairs, Maryland Institute for Agriculture and Natural Resources, and the Maryland Sea Grant College (where the directorate is located). It is truly multi-disciplinary program that transcends the traditional natural sciences to consider environmental issues in the broadest possible context of social studies, economics, law, philosophy, and public policy.

The principal mission of CEPP is to serve as a forum to stimulate dialogue among scientists, lawyers, resource

managers, philosophers, and citizens interested in the search for solutions to environmental problems, particularly those of the world's coastal seas. Recent projects include the following:

- Solomons Forum, a mediated policy dialogue on environmental issues bringing together scientists, policymakers, managers, and citizens with diverse points of view (topics have included sediment and erosion control, and the aquaculture industry);
- Watershed, a periodical magazine on Chesapeake Bay environmental and socioeconomic issues targeted for a non-technical audience;
- Conference on the Ecological Economics of Sustainability, an international meeting to examine relationships between long-term and short-term environmental goals, convened in cooperation with the World Bank and the U.S. Agency for International Development.

In addition, CEPP provides opportunities for internships, training, and technical assistance for students, resource managers, and policy makers interested in broadening their familiarity with present and future environmental issues in the Chesapeake Bay region and beyond.

CEPP and the international forum represented by the EMECS conferences are both responses to a growing need for more effective dialogue between research, management, and citizen involvement in coastal seas governance. These two forums are elements of a continuing dialogue between the State of Maryland and Japan's Hyogo Prefecture on regional and global environmental problems. It is fitting that the first EMECS Conference took place on the Seto Inland Sea in Kobe. It is equally fitting that EMECS'93 will be hosted by Maryland on the shores of Chesapeake Bay, and that the conference is being organized for the State by CEPP and its participating programs and institutions.

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The Japan Forum on the Environmental Management of Enclosed Coastal Seas '92(JEMECS '92)

On October 1 and 2, 1992, the Japan Forum on the Environmental Management of Enclosed Coastal Seas '92 (JEMECS '92) was held under the sponsorship of the city of Omura in Nagasaki Prefecture, in Kyushu, the westernmost of the four main islands of the Japanese archipelago. The theme for the conference was 'The Sea! Revive our mother seas!', and its objective was to search for ways to protect the environment of enclosed coastal seas, by devising measures to prevent pollution and clean up Omura Bay, one of the major enclosed coastal sea areas in Kyushu. Another objective was to exchange information and discuss common problems with local community organizations and related groups and individuals in areas surrounding enclosed coastal seas in Kyushu. In a sense, this was a local version of the international EMECS conference.

Following the opening ceremony, Professor Toshihiko Ariyoshi of Nagasaki University gave the keynote address entitled 'An Enclosed Coastal Sea: The Environment of Omura Bay.' The 12 forum panelists included government officials from the Environment Agency of Japan and other administrative bodies, as well as scholars and representatives from the residents living around Omura Bay. The panelists discussed what should be done and agreed that the government, research institutions and residents must reach a common perspective to regenerate the oceans. Concrete suggestions were also made as to how to revive enclosed coastal seas, such as promoting the installation of treatment-purification tanks designed for households and implementing measures to reduce pollution from residential waste water. They also pointed out the need for companies with advanced technologies to work together to develop innovative new technologies and bold measures, such as replacing the seawater of Omura Bay. In this manner, they affirmed that efforts to clean up the bay would continue.

At the closing ceremony, an Omura Bay Declaration was adopted, calling for appropriate efforts to clean up Omura Bay on the part of the government, research institutions and individual families.

1992 Minamata International Conference

Aiming at redevelopment of the local community based on the lessons of the Minamata disease, a series of events entitled "Environment Creation Minamata '92" was held in Minamata, Kumamoto Prefecture, from November 7 through 14, with 10,200 persons attending, including 150 participants from 23 foreign countries. The events—which included "the International Bamboo Congress" and "the International Environment Forum"—were sponsored by Kumamoto Prefecture and Minamata City, starting in 1992, to mark the completion of the Minamata Bay Pollution Prevention Project a year earlier. Their objective is to restore the economy and industry in the city blighted by the outbreak of Minamata disease in 1956, and to restore communication within the local community, in an effort to eliminate the image of Minamata as a "city of pollution," and to inform those at home and abroad about the current situation in Minamata.

On the last day, November 14, Kumamoto Prefecture, the city of Minamata and the United Nations University joined together to sponsor the 1992 Minamata International Conference under the of "Community Responses to Industrial Hazards." This conference followed up on the one held in 1991 on "Industry, the Environment and Human Health." At that conference, scholars from nine nations presented medical studies of Minamata disease and the worldwide situation regarding heavy metal pollution as well as related medical research. Presentations and discussion at this year's conference focused on how local communities in various places around the globe are being affected by the destruction of the environment caused by large-scale industrial activity, and the regenerative measures that these local communities have taken in response.

The keynote speech was given by Dr. James Mitchell, professor of Rutgers University, U.S.A., and was entitled "Improving Community Responses to Industrial Disasters." He pointed out that industrial hazards are caused in complex ways linking technology, man and the environment, such as equipment breakdowns, side effects of technology and other factors.

In the International Session that followed, three guest speakers gave presentations showing examples of community responses to industrial hazards in other countries. Dr. Stephen Couch, associate professor of Pennsylvania State University, U.S.A.,

pointed out the similarities between the Minamata disaster and an underground coal mine fire in Centralia, Pennsylvania. Both, he said, occurred in an industrial "castle town" during times of economic slowdown and both were complicated by labor problems. Dr. Paul Shrivastava, professor of Bucknell University, U.S.A., commented on the disaster in Bhopal, India, in which methyl isocyanate gas leaking from the Union Carbide pesticide plant caused numerous casualties. He pointed out that the disaster was the result of inadequate equipment maintenance caused by reduced operating expenses attributable to structural instability in the pesticide manufacturing industry.

Finally, Dr. Hooshang Amirahmadi, associate professor of Rutgers University, U.S.A., used the example of the Iran-Iraq war to postulate that war itself can be ranked as a deliberate industrial disaster. He pointed out the resulting damage, such as oceanic and atmospheric pollution and the destruction of the manufacturing base, and that the people who suffer most from the effects of war are those at the lowest levels of society.

During the Minamata Session held in the latter half of the conference, Dr. Sadami Maruyama, professor of Kumamoto University gave a presentation entitled "Minamata Disease and the Local Community." He said that the social structure of Minamata City was that of an industrial "castle town" created by the Chisso Corp. famous for carbide production, and this created pressures, discrimination and so on in the local community, depriving the local residents of their will to resolve problems.

Dr. Motoo Fujiki, professor of Tsukuba University presented the results of his research into the medical mechanism by which Minamata disease was created. He also revealed that the mercury content in the bottom sediment of Minamata Bay has stabilized at 25ppm or lower, while that found in fish has stabilized at around 0.4 ppm. However, he cautioned that another decade or so would be required before the bay could be declared safe.

Finally, a panel discussion was held between government officials, scholars and representatives from groups made up of Minamata disease sufferers. Participants called for the restoration of interpersonal contacts in the local community that have been lost, the elimination of prejudice toward Minamata disease sufferers, and the restoration of safe fishing grounds. Proposals were also made regarding the future direction that Minamata should take. One suggestion was that Minamata should become the world's most progressive city in terms of medical treatment and social welfare.



Northeast Asian Conference on Environmental Cooperation



The Northeast Asian Conference on Environmental Cooperation (NEAC) was held in the city of Niigata October 13-16, 1992 under the sponsorship of the Environment Agency of Japan and Niigata Prefecture. This conference grew out of the Japan-Korea Environmental Symposium that has been held since 1988. As one phase in the effort to promote regional cooperation, which was also emphasized at the Earth Summit (UNCED) held in 1992, countries in Northeast Asia joined together to exchange information on environmental problems in the region and discuss official measures towards overcoming these problems, and to promote policy dialogue on effective cooperation regarding environmental affairs.

Participants included the environmental ministries and departments of the central and local governments of China, Korea, Japan, Mongolia and Russia. Also participating were the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP) and the Economic and Social Commission for Asia and the Pacific (ESCAP). The friendly atmosphere was the setting for spirited and frank discussions. There were also many participants from various parts of Niigata Prefecture, showing the deep interest felt in this issue (there were approximately 400 participants including members of the general public who came to listen to the proceedings).

On the first day of the conference, an open symposium was held, entitled "The Environment and Regional Cooperation in Northeast Asia." On the second and third days, four sessions (devoted to the fields of air quality, water quality, waste management and protection of the natural environment) were held, in addition to a general session. The fourth day featured on-site observation of environmental preservation measures.

At the conference, there were reports from each country on the present state of the environment and the status of measures to protect it. Based on these reports, an exchange of views was held on the future direction of environmental cooperation in Northeast Asia. The main points of the conference as summed up by the conference chairman were as follows:

(1) There should be strengthened environmental cooperation in the region among all parties concerned, including

active involvement of both public and private sectors as well as non-governmental and grassroots organizations.

(2) There should be exchanges of information, experience of information, experience and expertise on a regular basis, through which a process of policy dialogue could be built up on environmental problems of

common concern to the region as a whole.

(3) In order to facilitate regional cooperation in the field of the environment, it was generally agreed that the Northeast Asian Conference on Environmental Cooperation should be held regularly, in principle on an annual basis, preferably hosted each time by different countries of the region. Concerning the next conference, there is a kind offer by the Government of the Republic of Korea to host it.

(4) Taking into account the unique role of local authorities who are situated close to people's needs and concerns, it is important to ensure active participation of local governments in the process of planning for and implementation of a cooperative programme.

(5) Regional cooperation might initially be focused on selected priority areas in which certain activities have already been initiated, or those which require urgent actions.

(6) Among those which were suggested as possible modalities of regional cooperation were: to immediately set up an information sharing and exchange network, to conduct joint surveys and monitoring activities including acid rain, coastal and inland water pollution and biodiversity, and to carry out collaborative research and training programmes in some of the specific subject areas.

(7) A particularly keen interest was shown among the participants in undertaking case studies on the use of economic instruments for environmental management.

(8) Specific mechanisms for promoting these activities, financial, institutional and otherwise, should be further worked out in the near future, hopefully at the next Northeast Asian Conference on Environmental Cooperation.

(9) The United Nations agencies should play an active role in coordinating the efforts and activities of the participating countries as well as of the United Nations system as a whole.

This year's conference was held not only due to increased interest in environmental issues as a result of the Earth Summit (UNCED), but as an ideal opportunity to make progress on easing tensions in Northeast Asia. Niigata Prefecture Government hosted this conference.

In 1993, the Government of Korea will host the next conference.

Asian Wetland Symposium

Promoted by the Environment Agency of Japan, Shiga Prefecture, Hokkaido, and other organizations, the Asian Wetland Symposium was held in October 1992 at two venues: the city of Otsu in Shiga Prefecture and the city of Kushiro on the island of Hokkaido. The theme for the conference was "The Wise Use of Wetlands."

The conference in Otsu was held from October 15-17 at the Lake Biwa Research Institute. This session was attended by 260 participants from 25 countries. Discussion and reports focused on the conservation and wise use of the wetlands which are a crucial habitat for aquatic birds. Shiga Prefecture, one of the organizers of the symposium, anticipates great interest in the preservation of Lake Biwa as a result of the ordinance that came into effect last year concerning the protection of the reed beds in the lake.

Starting on October 19, the venue of the symposium switched to Kushiro in Hokkaido, and the content focused on international cooperation in the effort to protect the wetlands. During this symposium, it was recognized that Japan must play a leading role in strengthening environmental assessment in order to achieve a balance between environmental preservation and economic growth in Asia. At the Kushiro symposium, an open forum was held on the theme of "ecotourism," representing tourism consistent with the protection of the environment. Following the open discussion, a recommendation was adopted calling for active measures to protect the wetlands, such as increasing the number of Ramsar listed sites in Japan and other parts of Asia.

The standing Committee meeting of the Ramsar Convention was held from October 21. The participants included administrators of environmental agencies and non-governmental organizations (NGOs) from 36 countries.

The ordinary meeting of the conference of the Ramsar contracting parties is scheduled to be held in Kushiro in June 1993, and will be the first one held in Asia.



INTERNATIONAL SYMPOSIUM '92 IN OKAYAMA

"The Future of the Global Environment and the Seto Inland Sea"

The program "International Symposium '92: What will become of the earth? What should we do about the Inland Sea" sponsored by the Okayama Broadcasting Company was held on March 14, 1992 at Convex Okayama (international convention center).

This symposium was organized as a summation of the regular program "We are all citizens of the earth," which encourages children to study, consider and directly experience environmental issues. During the program, a four-person panel used pictures to introduce issues related to enclosed coastal seas and examples of successful regeneration of the environment, pointing out problems and offering concrete advice.

One of the panelists was Mr. Kiam Seng Goh, former director and regional representative for the regional office for Asia and the Pacific of the United Nations Environment Programme. He emphasized that, due to the current situation in developing countries, protecting the environment will require considerable expense as well as increased awareness at the individual level, and he called for increased economic and technical assistance on the part of the developed countries.

Another panelist was Ms. Lily E. Venizelos, chairperson of the Mediterranean Association to Save the Sea Turtle (MEDASSET). She pointed out that, compared to the Mediterranean, which stretches across many different national borders, the Seto Inland Sea is the responsibility of a single country and it should therefore be easy to implement cleanup measures. She called for related organizations to work together to make the Mediterranean, the "cradle of civilization," a specially protected region.

Dr. Tomotoshi Okaichi, president of Kagawa University and one of the foremost authorities on "red tides" in Japan, warned that the PCB, DDT and other organic chemical substances that have been dumped into the oceans up to now may seriously affect not only the physical health of human beings but our ways of thinking and our social environment as well. He also pointed out the need to find ways to halt the decimation of living organisms in the Seto Inland Sea caused by development.

Dr. Tomio Itow, associate professor of Shizuoka University, cited the examples of the horseshoe crab and short-neck clam in the Seto Inland Sea to warn that the decimation of species and deformation would eventually come back to affect mankind.

In the final presentation, the coordinator of the forum, Dr. Kyozo Chiba, professor of environmental preservation studies at Okayama University, described how Humboldt Bay in the United States was restored through the efforts of a citizen's movement and a purification plant designed to utilize the regenerative powers of nature to clean up the bay. He proposed a "Declaration of Okayama" to appeal for adequate cooperative efforts to protect the world's environment, which was adopted by all the participants.



(Credit: The Chugoku Shimbun)

Training in Techniques of Environmental Management of Enclosed Coastal Seas

The third group Training Course in Systems of Environmental Management of Enclosed Coastal Seas was held from September 21, 1992 through December 3, 1992 at the Hyogo International Center in Kobe. Participants in the training course were officials and researchers from nine developing countries: China, Brazil, Columbia, Indonesia, Madagascar, Malaysia, the Philippines,

Kuwait and Senegal.

This training course was established by JICA in response to a request by Hyogo Prefecture. Its purpose was to implement some of the objectives included in the Seto Inland Sea Declaration adopted at EMECS '90. Starting from 1990, it has been implemented under the sponsorship of JICA and the support of the Association for Environmental Conservation of the Seto Inland Sea, one of the organizers of EMECS '90.

This training course is one phase in an effort to provide technical assistance to developing countries. It is also designed to provide leading officials and technicians in administrative bodies engaged in environmental management of enclosed coastal seas and coastal waters with the technical guidance they need to accomplish these tasks. The 1992 training course was led by Dr. Takeshi Goda, professor emeritus of Kyoto University with the assistance of scholars and researchers and government institutions related to enclosed seas.

To apply for the next training course, please inquire at the nearest Japanese Embassy, consulate, or the JICA office in your respective country.

Training Course for Environmental Management Following Industrialization

The first program for Environmental Control in Industries (PECI) was held from September 7 through September 18, 1992 at the Kansai training center of the Association for Overseas Technical Scholarship (AOTS) in Suita, Osaka Prefecture. The theme of the course was "Environmental Control problems Caused by Industries." The course was attended by 22 persons from six countries: Brazil, India, Malaysia, Mexico, Sri Lanka and Thailand.

The course was sponsored by AOTS, a non-profit association run with Japanese government subsidies from the Ministry of International Trade and Industry (MITI). The objective of the course was to illuminate measures that Japan as a major industrialized country has taken in the field of environmental management, in order to contribute to environmental management efforts on the part of developing countries. Assistance was provided by the prefectures of Hyogo and Osaka, the city of Osaka, the Department of Ecology of the State of Washington U.S.A., and by private companies.

The course focused on environmental management to prevent water contamination, air pollution and industrial waste treatment. It consisted of lectures on the history and current status of environmental management in Japan, as well as related technologies and legal considerations. The participants were technicians involved in environment-related work in developing countries, many of them plant managers. They had many questions regarding practical measures for environmental management being implemented in Japan.

AOTS plans to increase the number of target countries for which this training will be offered and also to hold training courses at locations other than the Kansai Kanshu Center. For further information, please contact AOTS.

AOTS Kansai Kanshu Center

3, Tsukumodai 3-chome, Suita, Osaka 565, Japan

Tel: +81 6-871-1681

Fax: +81 6-831-9119

FROM READERS

We welcome contributions from our readers, such as reports of on-going research and relevant information available, recent publications, recent conferences our readers participated in, notification of international conferences, and requests to the EMECS international network.

We set up this "From Readers" column to introduce such information we have received to facilitate information exchange

among our readers. The network roster published in 1991 is also available to assist your information exchanges. We will publish a revised issue after EMECS '93.

We look forward to your continued contributions.

Japan

Shinichi Aoki: Conducted research on fluid force applied on floating structures including silt curtain such as oil boom & pollution preventing films & movements of floating structures/Yuhei Inamori: Researched into purification of contaminated water in Tokyo Bay, especially in the coastal area, using bio-film process replenished with ceramics, charcoal, etc. /Nobuyoshi Imada: Found the number of cells of diatoms, especially *Skeletonema Costatum*, was rapidly reduced by autoinhibitor detected in sea water from Hakata Bay, not by allelopathy/Jyun Iwasaki: Presented "effects of water temperature, salinity & pH on the growth of *Alexandrium Catenella*, paralytic shellfish poison producing dinoflagellate" in Bull. Ibaraki Pref. Fish. Exp. Stn.; Researched into damage prevention measures against the growth of phormidium tenue in large quantity since 1990 which yields & transfers moldy odor onto natural fish as well as cultured fish at Ibaraki Pref. Fish. Exp. Stn./Masao Ukita: Arranged pollutant-loading factors of COD, N, P in Japan and estimating the pollutant load flowing into the Seto Inland Sea from 1957 to 1987; Developed water quality model simulating the seasonal change of the water quality & the interrelationships between overlying water & bottom sediments in eutrophicated enclosed sea areas/Masayoshi Kudo: Presented "Basic research on countermeasures against oil spills No.1 regarding a equipment on board for preventing spilt oil diffusion" /Naomasa Kobayashi: Presented "Marine pollution bioassay by sea urchin eggs, an attempt to enhance sensitivity" /Toshimitsu Komatsu: Developing a high-precision calculus for diffusion simulation/Keizo Nagasaki: Researched on the function of bacteria which attacks alga causing red tide, solid-phase culture of microalga, detection of virus inhabiting on microalga & screening of cryo-olerant microalga/Takeshi Nanashima: Researched into oil recovery from sunken vessels & its method/Yoshiaki Harada: Engaged in the development of the high-level treatment technology of highly concentrated COD, NH₃ in waste water & sludge by catalytic wet oxidation process/Hiroki Yagi: Researched into the impact of the changing marine environment on the ecosystem/Shouichi Yokoyama: Presented "The geographical approach toward the environmental problems in the Seto Inland Sea area" based on his presentation at EMECS'90.

From Overseas

(Canada) Colin D. Levings: Organized a Forum on Science & Management in Estuaries in San Francisco 1991; Gave a talk on environmental impact of fish farming at the Northeast Fish & Wildlife Meeting in Portland 1991; Published scientific papers related to coastal habitats/ (China) Sun shuncai: Research of the sea level rising & impact on the depression of North Jiangsu Province; Study of the flood disaster in Yangtze Delta Area; Research of climatic and sea level changes in China/Xiaoping Zhang: World-wide academic organization concerning enclosed coastal seas should be set up/(Egypt) El-Mohamady El-sayed Eid: Prepared reports on sea-level rise, sustainable development, health effects of toxic substances & sound management of coastal areas/(Greece) Agni Vlavianos-Awanitis: Published "Biopolitics-the Bio-Environment: Vol.3," "Proceedings of the 4th B.I.O.Int. Conf. On the Int. Univ. for the Bio-Environment" / (Jamaica) Beverly A. Miller: The Action Plan for the UNEP Caribbean Environment Programme concentrates Overall coordination Specially protected areas & wildlife Assesment & control of marine pollution Integrated planning & Institutional development Information systems Education, training & awareness/(Korea) Hee-Do AHN: Academic exchanges among countries are important/(Rumania) Pia Elena Mihnea: The working of all countries round the Black Sea 1st. program is developing at Constanta Rumanian Marine Research Inst.; At Geneva Oct. 1992 was organized the first workshop on the Black Sea Declaration, supervised by GEF, FAO etc./ (Spain) Concepcion

Marcos-Diego: Presented at the Int. Cong. On Ecology (Yokohama, Japan, 1990) & the 2nd. Int. Cong. On Regional Planning (Valencia, Spain, 1991)/Francisco Montoya: Participated in Coastal Society Annual Meeting in Washington D.C. & Int. Workshop on Sea Level Rise (Working Groups) organized by IPCC held in Margarita island, Venezuela. All information I got endorses the importance of the coastal zone/(Thailand) Surin Setamanit: The eastern seaboard of the Gulf of Thailand is undergoing rapid industrial development & urbanization; With a regional plan drawing up, monitorings of coastal & the Gulf water quality are undertaken by various organization/(U.K.) Dominic Reeve: Presented "A PC-Based Water Quality Prediction Toll for Tunis North lake," "Numeical Prediction of Tidal Flow in Shallow Water"/ (U.S) Edward R. Holly: Primary area of interest is pollutant transport; Recent work has related to surface gas transfer in shallow bays, dispersion measurements, eddy simulation modeling, modeling the transport of floating debris/ Mostafa A. Foda: Research work on the interaction of marine sediment with water waves, sediment fluidization, sediment transport, soil liquefaction, landslides.

Provision of information

(China) He Qiang: A program of waste water marine disposal of Beihai city located in the west coast of Gngsi province/Xu Quiwang: Red tides, deformation fish or shellfish, decimation of species in the sea off China/(Egypt) Mohamed M. El-Komi: The rate of growth of fouling organisms developed on submerged panels in S.W. decreased; Algae and diatoms are true indicator for water quality/(France) Guy Barroin: Phosphorus-Oxygen relationship close to deep sediments; Restoration modelling of enclosed waters ecosystems degraded by phosphorus pollution/(Greece) Lily Venizelos: Survey of nesting beaches on North Aegean Coast of Greece, Sardinia island for turtle nesting & exploitation, coast of Syria for green & loggerhead; Assesment of incidental catches of turtles in Greek Ionian waters/Nicolas Vernicos: Study of influence of social changes towards Greek ethnic communities in islands/(India) Malneedy Babu Rao: Study of fishes of the Hooghly estuary in the Bay of Bengal/Balasaheb Govind Kulkarni: Result on monitoring of coastal area concentrated higher copper, zinc, iron than cadmium, mercury; Physiological parameters of intertidal animals like clams, crabs affected with copper, zinc/(Israel) Abraham Golik: Studies on coastal changes in the past 50 years with aerial photo; Studies on coastal pollution by garbage/(Italy) Cuomo Vincenjo: eutrophication, monitoring, biosensor, bioassay, nutrient removal by natural system, heavy metal bioaccumulation, waste water treatment and reuse/(The Netherland) Pieter Hoogweg: Coastal zone management; Effects of micropollutants & nutrients, human activities including fisheries on the North Sea ecosystem/(Poland) Stanislaw Radwan: Chemism of saline coal mine waters including heavy metals in abiotic & biotic components in water bodies; Invertebrate fauna inhabiting coal mine waters; Possibilities of utilization of coal mine waters for the production of some fresh water fish species; Protection of water ecosystems/(Kuwait) Saleh Al-Muzaini: Study on the movements of land, air, water pollutants due to fire in Kuwait oil fields/ (Russia) Khablatian M artin Gaikovich: Liquid movement in various media; ground water seepage; interaction of fresh & saline waters in estuaries; aquatic ecological problems; water protection & quality/(Saudi Arabia) Wasef S.M. Alhaj Mostafa: Works of Meteorology & Environmental Protection Administration are To collect information of Red Sea & Arabian Gulf in cooperation with IUCN To issue reports on the assesment of biotopes & coastal zone management requirements for research sea areas/(Sweden) Gunnar Norèn: Environmental & nature conservation problems in the Baltic Sea area; Pollution load of nutrients & hazardous substances/(Thailand) Suneek Suvapepun: Papers "Trichodesmium blooms in the Gulf of Thailand" (Marine Pelagic Cyanobacteria).

Crisis in the Seto Inland Sea: The Decimation of the Horseshoe Crab

Dr. Tomio Itow, Associate Professor
Department of Biology, Faculty of Education, Shizuoka University

It Began in the Tethys Sea...

Two hundred million years ago or more, before all of the continents of the world had drifted apart, there was an enormous inland sea, open on its eastern side, called the Tethys Sea. The Tethys Sea had large coral reefs, said to be the source of present-day oil deposits, and was inhabited by creatures such as the trilobite, ammonite, coelacanth and horseshoe crab. The center and western end of this Tethys Sea ultimately became the present-day east coast of the United States, while the exit, the eastern end, became Japan and the other parts of East Asia.

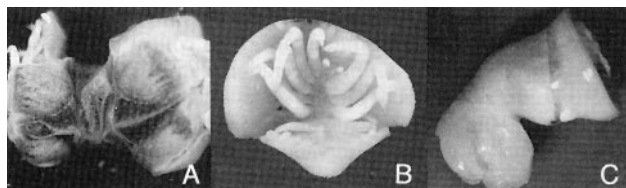
The horseshoe crab has been called a living fossil. It is said to be far older than the dinosaurs. After branching off from the trilobite at the beginning of the fossil or Paleozoic era 500 million years ago, it reached its present form in the Triassic period of the Mesozoic era 200 million years ago and has changed hardly at all since that time. With the breaking apart and movement of the continents that occurred 200 million years ago, the horseshoe crab was split between the American and Eurasian continents, and it survives today in the east coast of North America and in East Asia. Within East Asia, in fact, the Seto Inland Sea horseshoe crab is found at the meeting point of the northern and eastern regions, and other than in the Seto Inland itself, within the Japan region as a whole, it is only found in the northern part of Kyushu, the westernmost of the four main islands of the Japanese archipelago.

Will It Disappear from the Seto Inland Sea?

It is said that the horseshoe crab once thrived throughout the entire Seto Inland Sea and was even found in Osaka Bay. However, it began to disappear from the eastern regions, and its breeding grounds off the island of Shikoku were decimated by reclamation of coastal areas and other factors (Shinohara, 1989). Even so, many horseshoe crab eggs and larvae could be found in the Chugoku region as recently as the 1970's, in the ocean off Kasaoka, Okayama Pref. Since the beginning of the 1980's, however, they have decreased year by year until by 1990 almost none were left. In a study in 1992, I found horseshoe crab eggs at the Ouki Coast of Shimonoseki near the tip of Yamaguchi Pref. However, in the entire Chugoku region, eggs could be located only here and there were no larvae to be found at Aio and Habu in Yamaguchi Pref., areas previously known as breeding grounds for the horseshoe crab. Meanwhile, in Hakata Bay, Karatsu Bay and Imari Bay in the northern part of Kyushu—known breeding grounds for the horseshoe crab outside the Seto Inland Sea—horseshoe crabs are said to be disappearing, but breeding is continuing in these areas (Wakamiya 1989, Sekiguchi 1989, Yoshinaga 1989).

In light of this situation, an experiment in artificial fertilization was performed using horseshoe crabs in the Seto Inland Sea, and the appearance of many deformities was discovered (Itow et al, 1983) (see photo. 1). In the local coastal regions, too, horseshoe crab embryos and larvae have been disappearing from the ocean, and deformed horseshoe crab embryos and larvae were discovered here as well. In some cases, the ratio of deformities was as high as 20% (Tsuchiya 1989; Tsuchiya & Asano 1989; Itow et al 1991).

Adult horseshoe crabs have a hard skeletal structure which is sturdy and can withstand considerable changes in the environment, so although their numbers continue to decrease each year they still exist in the Seto Inland Sea. However, with no larvae to breed the



(Photo.1) Deformities of horseshoe crabs
A: Double monster, in which there are multiple bodies
B: Segment defective embryos, in which legs or segment are missing or damaged
C: Embryos having separate embryonic areas, in which front back sections have been torn off

next generation, they will undoubtedly disappear completely in the near future.

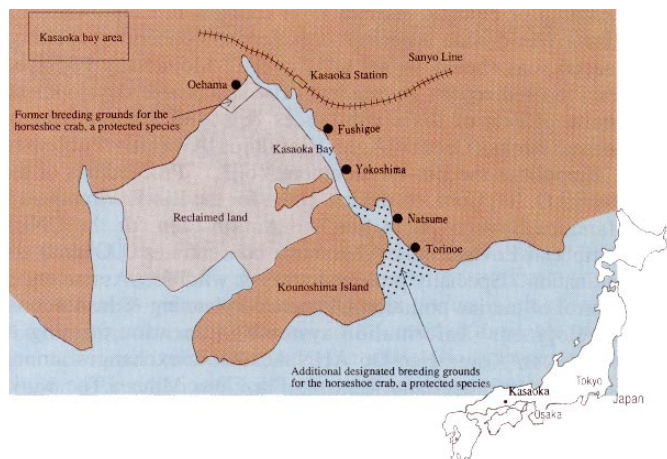
Horseshoe crab embryos and larvae, on the other hand, are extremely fragile and can only survive in very pure ocean water. Moreover, they are also affected by minute quantities of chemical substances that would not cause abnormalities in other animals (Itow 1979, 1980). Newly born larvae must breed in a special type of breeding ground called tidal flats, consisting of mud in clean ocean water. Moreover, their movements are awkward at this stage, and they are easy prey for fish and other creatures.

In a comparison of human beings and horseshoe crabs, it can be argued that human beings are more important. However, if the ocean is polluted, the horseshoe crab, whose eggs and larvae cannot breed in anything but especially pure ocean water, will be the first to die, and then the fish and shellfish will be affected, and ultimately the effects will be felt by human beings as well. The decimation of the horseshoe crab can thus be seen as a warning to man, alerting us to the worsening situation of the ocean environment.

The Cause of the Decimation

There are many different overlapping causes for the disappearance of the horseshoe crab embryos. However, the direct cause is the diminishing number of beaches at which the horseshoe crab can lay its eggs. The Status of the beaches in the Seto Inland Sea coastal areas has changed dramatically due to reclamation and revetment operations, and in many cases the beaches have been greatly diminished or have been destroyed altogether. In Kasaoka Bay, Okayama Pref., most of the bay area of 1,800 hectares has been filled in, and Oehara, an area of sea once designated as a national monument for the breeding of the horseshoe crab, and other horseshoe crab habitats and areas suitable for breeding have almost all been destroyed. In Kasaoka Bay, which has been the site of large-scale reclamation, only a few coastal areas suitable for horseshoe crabs to lay eggs have been left, and this is not an exceptional case. In addition to the changes in littoral currents along with alteration of the topography, the size and speed of oceangoing vessels has increased in recent years. The resulting abnormally large waves repeatedly surging onto the beaches has changed their nature, and this is also thought to have made these beaches unsuitable for laying eggs. Also, the passing of ships and the like is thought to have interfered with the act of laying eggs itself, as the horseshoe crab is very sensitive to its surrounding environment. When one considers the diminishing numbers of horseshoe crabs throughout the entire Seto Inland Sea, it would seem that the increasing pollution of coastal areas is also a likely cause. As stated above, the number one cause is the physical destruction of the environment needed for the horseshoe crab to breed.

Until approximately 15 year ago, horseshoe crab larvae could be readily found in the tidal flats on the seacoast, but now there are almost none. This is because of the diminishing number of eggs being laid in the nearby sandy areas, but even more it is because the environment that could serve as a habitat for the larvae has disappeared. Landfills and revetment operations have caused a loss of silt and mud in the tidal flats, turning them into pebble beaches. There is little doubt that this change has made it impossible for larvae to survive in these areas. There is no way for the organisms living in the silt that serve as food for the larvae to propagate in such places, and there is no silt for the larvae to bury themselves in. There is also no way for the tidepools and channels, where the



larvae must live, to be created in these areas. These changes in the tidal flats have occurred before the changes in the seacoast, so destruction of the living environment of the larvae has occurred before that of the breeding environment.

As the horseshoe crab eggs and larvae have disappeared from the coastal regions of the Seto Inland Sea, an extremely high incidence of deformities has become noticeable. I have included a table (Table 1) showing important data related to this problem, taken from a paper by Tsuchiya and Asano (1989). This table comes from a 1978 study of the eggs laid in the Fushigoe area bordering the harbor of Kasaoka where the ocean waters were subjected to severe pollution, and the eggs in the Natsume region in which there was comparatively little pollution in the ocean water and bottom sediment. It is important to note that there is a clear difference between these two in terms of the incidence of insufficient propagation and deformities. As stated above, at present there are no eggs or larvae to be found in either of these areas. In the case of deformities, there are many deformities in the area with severe pollution, and few in the area with little pollution. From this, the effects of environmental pollution cannot be denied. The level of pollution has become especially bad since landfill operations were begun (see Table 2).

Even eggs from horseshoe crabs sampled from the Seto Inland Sea that were raised in clean ocean water through artificial fertilization showed a low rate of propagation, and the crabs were often deformed. Based on this fact, it is thought that, in addition to development of the eggs after they were laid, the abnormalities resulted from the process of egg formation in the mothers' body. There are many possible causes for abnormalities that occur during egg formation in the mother's body, but the most likely possibility is that breeding is inhibited by changes in the breeding area, and therefore the formation of the egg in the mother's body is abnormal due to excessive maturation or the like. Furthermore, as indicated by the decreasing number of fish caught in these areas, the number of living organisms is decreasing due to pollution of the sea and changes in the shoreline conditions. Therefore, the organisms on which the horseshoe crab must feed are decreasing, and so it can be presumed that egg formation is also inhibited by the lack of sufficient nourishment. In addition, landfill operations result in the death of embryos and larvae, causing an aging of the overall horseshoe crab population this can be assumed to

cause an increase in the number of abnormal eggs formed in the aged mother's body. Abnormalities in the eggs formed in the mother's body may also be directly caused by poisonous substances in the ocean that result from environmental pollution. Horseshoe crab feeding habits may play a role as well. The horseshoe crab ingests silt from the bottom sediment, together with the living organisms on which it feeds, directly into its body. Accordingly, the possibility cannot be denied that pollutant substances accumulated in its body might have an adverse effect on egg formation.

Therefore abnormal egg formation is thought to result from many different causes. The outer layer of these abnormally formed eggs is imperfect; even if it is formed, the cell structure on the outer layer is not even as in the case of normal eggs. This uneven cell structure causes imperfect contacting between the cells, and even if development continues the embryo region may separate or other abnormal development may occur. See papers by Itow (1998) and Itow et al (1991) for more detailed information on the types and causes of deformities.

To Save the Horseshoe Crab and Protect the Health of the Seto Inland Sea

In order to preserve a habitat for the horseshoe crab, the following five factors will be necessary:

- (1) The beaches needed for laying eggs must be near the high tide mark
- (2) There must be tidal flats rich in silt layers nearby so the larvae that have hatched on these beaches can mature
- (3) There must be a shallow ocean of several meters in depth in which the horseshoe crabs that have matured to some degree can get large quantities of food so they can grow to adulthood.
- (4) There must be an ocean of a dozen or more meters in depth in which the adults can hibernate
- (5) The surrounding sea water that ensures this maturation must remain free from pollution.

It goes without saying that the destruction of the environment is the major cause of the horseshoe crab's decimation. The horseshoe crab is extremely well suited to its environment. It has survived for nearly 500 million years, since the Paleozoic era, and it exists today in much the same form as it existed 200 million years ago. Therefore, as long as its habitat continues to exist, the horseshoe crab may continue to exist for many more millions of years. While present circumstances do not bode well, the horseshoe crab has not yet

disappeared completely from the Seto Inland Sea. All hope is not lost, as in the case of the Japanese crested ibis.

In Beppu Bay, Oita Pref., which borders the Seto Inland Sea to the west, the horseshoe crab was once said to be rapidly diminishing (Soji, 1989; Kawahara, 1989), but there have been reports that it is being restored (Soji). According to the Oita prefectural and municipal offices, this may be due to a decrease in the inflow of agricultural chemicals following the reduction in the acreage of mandarin orange growers. The seacoast in the Ouki area, the only confirmed breeding ground in the Chugoku region, is located behind a Self-Defense Forces military base, and therefore it is possible for the natural environment to be preserved with some success.

It would not be that difficult to restore the environment needed for the horseshoe crab to live. Nature, including the ocean, has a purifying effect. The organisms that inhabit the environment play a crucial role in this process. We need only help the process along. We can do this in three ways:

- (1) Protect the natural seacoast in which these organisms live
- (2) Remove the polluting substances
- (3) Prevent any further pollution

When it was the habitat of numerous horseshoe crabs, Kasaoka Bay had a natural seacoast and tidal flats as well as clean ocean water. Now it has been reduced to concrete shore embankments, polluted tidal flats and dirty water. The beautiful natural environment of the sea was what originally made mankind's development possible. For its own future, and for the sake of the horseshoe crab as well, mankind must restore this environment. First and foremost, all of us should refrain as much as possible from actions that will contribute to the polluting of the ocean. The unrestrained actions of modern man will not result in the preservation of the natural environment. In order to bring back the natural ocean environment in which the horseshoe crab can survive, we will need not only restrictions on waste water from homes and factories but also restrictions on the entry and speed of high-speed vessels. These restrictions will necessarily require some self-restraint on the part of local residents. Therefore, it will be up to these local residents to choose between preservation of the environment or further development. It is not an overstatement to say that practical actions to preserve the natural environment will depend on the determination of the local residents. Above all, the cooperation of government agencies will naturally be required in order to ensure that the actions of residents progress smoothly.

Table 1 A comparison of the development of eggs sampled from the Natsume and Fushigoe regions. (Tsuchiya & Asano 1989)

Detail of eggs / Region	Natsume	Fushigoe
Total number off eggs	542	520
Normal	527 (97.2%)	236 (45.4%)
Abnormal (Deformation)	0 (0.0%)	45 (8.7%)
Insufficient propagation	15 (2.8%)	239 (46.0%)

Table 2 Study of the bottom sediment in the sea off Kasaoka Municipal Hospital (taken from materials provided by Kasaoka Municipal Office)

Item \ Date	March 6, 1975	September 4, 1989
Arsenic (mg/kg)	Not detectable	6.4
Chromium (mg/kg)	Not detectable	25.5
Cadmium (mg/kg)	Not detectable	0.31
Lead (mg/kg)	0.06	31.9
Total Mercury (mg/kg)	Not detectable	0.02
Alkyl Mercury (mg/kg)	Not detectable	Not detectable
Cyanide (mg/kg)	Not detectable	Not detectable

Forthcoming Conferences

(1993)

April 13-16
3rd Scientific Meeting of the Oceanography Society
Seattle, U.S.A.
Contact: The Oceanography Society
Address: 1124 Wivenhoe Way, Virginia Beach, VA 23454, U.S.A.
Tel: +1 804-4968958

May 3-7
25th Int. Liège Colloquium on Ocean Hydrodynamics
Liège, Belgium
Contact: J.C.J. Nihoul, Modelenvironment, Univ. of Liège
Address: B5, Sart Tilman, B-4000 Liège, Belgium
Tel: +32 41-563350, Fax: +32 41-562355

May 17-21
5th Int. Conf. on Conservation & Management of Lakes (LECS Stresa '93)
Stresa, Italy
Contact: R.M. Società di Congressi s.r.l.
Address: Via Ciro Menotti 11, 20129 Milano, Italy
Tel: +39 2-70126308, Fax: +39 2-7382610

May 18-21
6th World Filtration Cong.
Nagoya, Japan
Contact: T. Murase
Address: Nagoya Univ., Furo-cho, Chikusa-ku, Nagoya, Japan
Fax: +81 52-7818356

Jun. 8-11
4th IAWQ Sympo. on Forest Industry Wastewaters
Tampere, Finland
Contact: Sirpa Sand, Tampere Univ. of Technology
Address: P.O. Box 692, SF-33101 Tampere, Finland

Jun. 8-16
5th Meeting of the Conf. of the Contracting Parties
Kushiro, Hokkaido, Japan
Contact: Wildlife Protection Div., Nature Conservation Bureau, Environment Agency of Japan
Address: 2-2, Kasumigaseki 1-chome, Chiyoda-ku, Tokyo 100, Japan
Tel: +81 3-35802161, Fax: +81 3-35817090

Jun. 28-30
2nd Int. Specialized Conf. on Design & Operation of Small Wastewater Treatment Plants
Trondheim, Norway
Contact: Foundation of Norwegian Institute of Technology
Fax: +47 7-517226

Jul. 7-14
5th Int. Cong. on the History of Oceanography La Jolla, California, U.S.A.
Contact: P.F. Rehbock, History Dept., Univ. of Hawaii
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Tel: +1 707-9870114, Fax: +1 707-9879351

Jul. 19-23
8th Sympo. On Coastal & Ocean Management (Coastal Zone'93)
New Orleans, Louisiana, U.S.A.
Contact: Gail Oakley, Coastal Zone Foundation Headquarters
Address: P.O. Box 279, 21000 Butts Canyon Rd., Middletown, CA 95461, U.S.A.
Tel: +1 707-9870144, Fax: +1 707-9879351

Aug. 11-13
Stockholm Water Sympo. '93
Stockholm, Sweden
Contact: Stockholm Water Front
Address: P.O. Box 6407, S-113 82, Stockholm, Sweden
Tel: +46 8-308810, Fax: +46 8-348000

Aug. 24-27
Environment Northern Seas Int. Conf. & Exbn.
Stavanger, Norway
Contact: ENS Secretariat
Address: P.O. Box 410, N-4001, Stavanger, Norway

Aug. 30-Sep. 3
25th Cong. of Int. Ass'n of Hydraulic Research (IAHR)
Tokyo, Japan
Contact: Secretariat
Fax: +81 75-7610646

Sep. 27-28
1st Int. Specialized Conf. on Microorganisms in Activated Sludge & Biofilm Processes
Paris, France
Contact: Secretariat, AGHTM
Address: 9 rue de Phalsbourg, 75854 Paris Cedex 17, France
Tel: +33 1-44151550, Fax: +33 1-43806590

Sep. 27-30
Regional Meeting on Environmental Toxicology
Roma, Italy
Contact: Istituto Superiore di Sanità
Address: Segreteria per le Attività Culturali Viale Regina Elena 299, 00161 Roma, Italy
Tel: +39 6-4990, Fax: +39 6-4440235

Oct. 4-8
2nd Int. Ocean Pollution Sympo.
Beijing, China
Contact: Iver W. Duedall, Dept. of Oceanography
Ocean Engineering & Environmental Science, Florida Institute of Technology
Address: Melbourne, FL 32901, U.S.A.
Fax: +1 407-9848461

Oct. 5-9
4th IAWPRC Asian Regional Conf. on Water Conservation & Pollution Control (Asian Waterqual'93)
Jakarta, Indonesia
Contact: Ir. Andria
Address: Japan Dempo No. 6, Matraman, Jakarta, Indonesia
Tel: +62 21-3904211, Fax: +62 21-7205793

Oct. 12-14
World Cong. on Engineering & Environment
Beijing, China

Contact: Li Ying, Secretary of Organizing Committee
Address: Tsinghua Univ., Dept. of Environmental Engineering, Beijing 100084, China
Tel: +86 1-2561227, Fax: +86 1-2562768

Oct. 13-15
Pretreatment of Industrial Wastewaters Specialised Conf.
Athens, Greece
Contact: Andreas Andreadakis
Address: c/o Office Services Int.
163 Michalakopoulou St. 115 27 Athens, Greece
Tel: +30 1-7716420, Fax: +30 1-7753428

Oct. 18-22
6th Int. Conf. on Toxic Marine Phytoplankton
Nantes, France
Contact: Patrick LASSUS, Institute Francais de Recherche Pour L'Exploitation de La Mer
Address: pour L'Exploitation de la Mer BP 1049 44037 Nantes cedex 01, France
Tel: +33 40374130, Fax 33 40374073

Oct. 20-23
3rd Int. conf. on Waste Management in the Chemical & Petrochemical Industries
Salvador, Brazil
Contact: Secretariat, IAWPRC Int. Conf. CETREL SA, Caixa
Address: Postal 011 CEP 42.800, Camacari, Bahia, Brazil
Tel: +55 71-8321186, Fax: +55 71-8322562

Nov. 10-13
2nd Int. Conf. on Environmental Management of Enclosed Coastal Seas '93 (EMECS'93)
Baltimore, U.S.A.
Contact: H. Tenner, Executive Director, EMECS'93 Secretariat
Address: c/o CEPP P.O. Box 775, Cambridge, Maryland 21613, U.S.A.
Tel: +1410-9745047, Fax: +1 410-9743158

Nov. 14-18
12th Biennial Int. Estuarine Research Conf. (ERF'93)
Hilton Head, South Carolina, U.S.A.
Contact: Rick DeVoe, South Carolina Sea Grant
Address: S.C. Sea Grant Consortium, 287 Meeting St., Charleston, SC 29401, U.S.A.
Tel: +1 803-7272078, Fax: +1 803-7272080

Dec. 5-8
6th Int. Sympo. on the Interactions Between Sediments & Water
Santa Barbara, CA, U.S.A.
Contact: E.D. Ongley, River Research Branch, NWRI, Canada Center for Inland Waters
Address: 867 Lakeshore Rd., P.O. Box 5050 Burlington, Ontario, L7R 4A6, Canada
Tel: +1 416-3366439

Dec. 5-8
Int. Cong. on Metropolitan Areas & Rivers
Roma, Italy
Contact: Secretariat
Address: c/o Studio EGA s.r.l., Viale Tiziano, 1900196 Rome, Italy
Tel: +39 6-3221806, Fax: 39 6-3240143

Call for articles

EMECS Newsletter is targeted at researchers and individuals affiliated with organizations related to study of enclosed coastal seas. Its purpose is to provide a forum for the exchange of information on enclosed coastal seas and to disseminate this information to as wide a readership as possible, linking concerned persons and organizations throughout the world. Your contributions would be greatly appreciated.

All submissions to:

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