The changing Japan Sea:
Toward the conservation of a healthy marine environment

Jing Zhang
Professor, Graduate School of Science and Engineering for Research
University of Toyama

As the effects of global climate change become more and more apparent, marine research has a major role to play in determining the current situation and resolving the problem. Large-scale circulation in the world's oceans, which takes 2,000 years to complete one circuit, functions as a sort of global air conditioning system. Conversely, the ocean water in the deep layers of the Japan Sea takes only around 100 years to circulate. Ocean water in the shallow and middle layers is replaced in a short period of time and is characterized by its tendency to change to reflect subtle variations in the surrounding environment. In this way, it is a microcosm of the large-scale global ocean circulation. In the 20 or so years between 1977 and 2001, the dissolved oxygen in the deep layers of the Japan Sea decreased by roughly 10%. Moreover, the temperature of the ocean water in the deep layers has been increasing each year, while simultaneously the thickness of the deep layers has been decreasing. These developments are closely related to global climate change, and they are thought to indicate a slowing of the submergence of surface layer water off the coast of Russia and so on in winter. Moreover, the IPCC has stated that the increase in the temperature of the surface water in the Japan Sea during the past 100 years is 0.79 to 1.19°C higher than the average for the northern hemisphere, and that the Japan Sea is one of the ocean regions in which the effects of global climate change can be seen most clearly. The Japan Sea is also greatly affected not only by warming from neighboring countries such as Russia, South Korea and China (which is adjacent to the East China Sea, which constitutes the upper regions of the Tsushima Current) but also by human factors.

Research that spans various academic domains is currently underway with the aim of gaining an accurate overall picture of the environmental trends in the Japan Sea, including ocean physics, chemistry, biology, fisheries, ecosystem models and so on. In order to help to achieve sustainable development in the changing Japan Sea to preserve its healthy ocean environment, debate is urgently needed to discover and raise wide-ranging scientific and environmental issues and find solutions to these issues.

This presentation will focus on the construction of a framework for joint international research on ocean biogeochemistry in marginal seas and the progress of the Far East and Asia GEOTRACES Project that involves primarily observations. The presentation will also cover Topic 3 of the Ministry of the Environment's Environment Research and Technology Development Fund S-13 "Development of Coastal Management Method to Realize the Sustainable Coastal Sea." The goal of this project is to study management techniques for the Japan Sea (an international enclosed coastal sea), based on the effect that a potential rise in seawater temperature in the Japan Sea, together with changes in the load from the East China Sea, would have on material cycles and low-order and high-order ecosystems in the Japan Sea.

Recognition to the new direction of the management of the Seto Inland Sea

Osamu Matsuda
Professor Emeritus, Hiroshima University

The system for environmental management of the Seto Inland Sea has a long history. It is now at a profoundly important turning point. At the end of February 2015, the Cabinet approved the plan to have the national government undertake a major revision of the “Basic Plan for Conservation of the Environment of the Seto Inland Sea.” To back up this effort, the Diet passed a revised “Act on Special Measures Concerning Conservation of the Environment of the Seto Inland Sea” at the end of September of the same year. Thus, major revisions of both the law and the Basic Plan were conducted for the first time. In response to the major systemic changes, in the fall of 2016, a new Prefectural Plan (Prefectural Plan for the Environmental Conservation of the Seto Inland Sea) was formulated by the 13 relevant prefectures that will put these changes into actual practice. Since the start of FY 2017, the new management policy has been gradually transitioning to actual on-site implementation.

As a result of the recent changes, there has been a major change in the direction of Seto Inland Sea policy, from working to achieve “a clean sea” to striving for “an abundant sea.” Following the original enactment of the Seto Inland Sea Act in the age of pollution and eutrophication, intensive efforts over many years to clean up the sea by means of total pollution load control policies and the like were able to achieve a “clean sea” to a significant degree in terms of water quality. In recent years, the rate of achievement of environmental standards for total nitrogen (TN) and total phosphorus (TP) concentrations has been close to 100% for the areas of the Seto Inland Sea with the exception of Osaka Bay. At the same time, however, the natural coastlines, seaweed beds and tidal flats have been reduced, and the fishing catch has also declined. The result of the loss of the original abundance of the Seto Inland Sea has been the creation of new problems due to so-called “oligotrophication” — reduction of the concentration level of nutrients in the sea. The recent systemic revision represents a major shift in direction away from the previous regulatory water quality conservation and toward a more proactive effort to conserve marine resources and achieve environmental conservation and restoration and so on. The basic principles of the revised law clearly state the goal of making the Seto Inland Sea “an abundant sea with multifunctional value, one that fulfills its capabilities to the maximum degree possible.” To a substantial degree, the revised version incorporates the *Satoumi* approach that emphasizes ecosystems and material circulation.

The major revisions to the Basic Plan by the national government can be summed up as a shift from a two-pronged approach to a four-pronged approach. Prior to revision, the two main goals of the plan were (1) conservation of water quality and (2) conservation of natural landscapes. In contrast, the revised plan has four main goals: (1) conservation and appropriate management of water quality (2) conservation of natural landscapes and cultural landscapes (3) conservation, restoration and creation of coastal zone environments and (4) ensuring sustainable use of marine living resources. Under the new system, the “area of the field to be managed” in the Seto Inland Sea has been greatly expanded, with a dramatically increased recognition of the importance of cross-sectoral efforts across different fields and government agencies. Moreover, overall the revised system emphasizes policies that are tailored to the circumstances of specific bays and sea areas and specific seasons, and it introduces new policies that include the mechanism of a Bay and Sea Council, efforts to create “an abundant *Satoumi*” in regional areas, the accumulation of scientific data, adaptive management and so on.

What we must recognize anew is that, as a result of this change in direction, efforts in the Seto Inland Sea have moved ahead of Tokyo Bay, Ise Bay and other areas in the world in beginning to adopt a “post-total pollution load control policy” for the “age of oligotrophication.” Yet although this new approach has been established, its aims are very high. The new objective of “an abundant *Satoumi*” is not a simple return to the past. The goal will be to achieve diverse participation and thereby maximize in the aggregate the multifaceted “bounties of the sea” (ecosystem services) to a level never before achieved.

Integrating Monitoring Data into Environmental Health Report Cards in the US and Brazil

David A. Nemazie
Chief of Staff, University of Maryland Center for Environmental Science

Introduction

Based upon monitoring data, environmental report cards are an emerging technique used to assess and report on the ecosystem health of a region. Providing rigorous, quantitative assessments provides an accountability that supports environmental protection and restoration efforts by engaging funders, government and non-government organizations, and the public. They also provide a level of transparency for the public through the use of color-coded metrics, maps, graphs and diagrams.

Chesapeake Bay is the largest estuary in North America with an extensive watershed that includes a population of 16 million people who live in a portion of five States. The Chesapeake Bay report card has been done annually for the last 10 years and scores were calculated back to when the Chesapeake Bay Program monitoring system was established in the mid1980's. Guanabara Bay has a watershed population of six million people, all within the State of Rio de Janerio.

Methods

The following multi-step process for developing report cards was used to meet objectives:

Conceptualization: Some early crucial decisions need to be made at the outset of a report card program, including the geographic size and scope of the reporting regions, the reporting time intervals and integration periods for reporting and the types of indicators. Conceptual diagrams can be used to communicate this framework. The Chesapeake Bay report card uses 15 reporting regions including several tributaries while the Guanabara Bay has six watershed sand five Bay reporting regions. The geographic data density is a consideration in creating reporting regions.

Choosing indicators: Selecting indicators that convey meaningful information and be measured reliably typically involves an iterative process. Streamlining the data collection and analyses to make them timely and useful requires a concerted effort. The Chesapeake Bay report card uses data from 180 monitoring stations and has 11 indicators. The initial Guanabara Bay report card has 8 indicators.

Defining thresholds: After selecting indicators, several decisions are required for developing a report card. Pass/fail thresholds require large data sets and multiple thresholds appear to work better where using limited data sets. There are ecological thresholds that can be determined through scientific studies, but also there are various management thresholds that can be used based on goals and objectives created by the regulatory agencies or by conservation targets.

Calculating scores: Indicator scores can be calculated by comparing the indicator metrics to the various thresholds established. The percent attainment of indicators provides a common reporting framework that allows various water quality, living resources or habitat indicators to be compared with one another. These individual scores then need to be rolled up into an overall index. The method of aggregating data needs to be clearly defined, and often in developing report cards, back-calculating scores using historical data helps test and refine the indices.

Communicating results: Communication of report card results provides a regular opportunity to engage with a wide public audience on the status of a region. This communication can be effective using mass media outlets and events, elected officials and designated science communicators.

Results and Conclusions

Chesapeake Bay, USA: This report cards has tracked 15 reporting regions since 2006, with interactive trend graphics for indicators and reporting regions - previous years have been back calculated. It takes several months after the monitoring year is completed to calculate scores and finalize the report card.

Guanabara Bay, Rio de Janeiro, Brazil: This inaugural report card is currently in development with eight indicators and 11 reporting regions. A series of workshops were conducted with key stakeholders including resource managers, scientists, and NGOs.

Report card credibility relies on independent rigorous assessments by environmental scientists. UMCES has been collaborating with a wide variety of partners on developing various report cards. Environmental report cards can be an important tool for effective management of natural resources. Report cards utilize environmental monitoring data and can guide the prioritization of ongoing monitoring efforts. The goal of environmental reporting is to provide effective feedback as to the efficacy of management actions so that the often considerable resources devoted to environmental protection and restoration are used efficiently. The annual release of the Chesapeake Bay report card has been an important tool that helps resources managers and the public calibrate their restoration planning and communication efforts.

The Gulf of Thailand and the Environmental Issues

Piamsak Menasveta

Professor Emeritus, Fellow of the Royal Society of Thailand

The Gulf of Thailand is one of the 21 enclosed coastal seas as identified by the International EMECS Center. The gulf locates in Southeast Asia, immediately to the west of South China Sea. Its bordering nations, Thailand, Cambodia, Malaysia, and Vietnam. The gulf is roughly triangular and may be divided into two sections,

i.e. the “inner gulf” and the “Gulf”. The inner gulf is a small apex of the Gulf of Thailand. The average depth of the inner gulf and the Gulf is 20 m and 45 m, respectively. The water circulation of the Gulf is influenced by the flux from South China Sea and the monsoon winds. The Gulf of Thailand is one of the most productive areas of the world.

During the past four decades, there have been a number of environmental issues mostly occurred in the inner gulf. These issues are, for instance eutrophication, mangrove conversion and destruction, coastal erosion, contamination of toxic wastes, overfishing and marine litter. Eutrophication used to be a problem during 1978 – 1983. At present the problem was alleviated. Mangrove forest area decreased sharply during 1961 – 1986. Since then the rate start to slow down. The reversal started after 1996 due to a big restoration campaign. At present, the percent increase from 1996 is 47%. The problem of coastal erosion is still growing. One important factor to this problem is the rising sea level, the global issue. Contamination of toxic wastes especially lead (Pb) and mercury (Hg) used to be a problem; but now it is under controlled. Overfishing is still an issue in the Gulf. We are preparing several control measures, with a hope to reverse the situation. Marine litter has received a lot of attention recently, especially the plastic debris. Several campaigns have been exercised for the clean-up.