# 6th International Symposium on Food and Environment

## “Sustainable Use and Conservation of Marine Resources in Southeast Asia and Japan”

13:00 - 16:30

: C206

Date: 2 Nov (Sat) 13:00 – 16:30
Venue: Room C206, Faculty of Applied Biological Science, Hiroshima University.

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### Greetings from the Dean

Marine organisms comprise one of the major components of our food resources. Reproduction and maintenance of the marine organisms’ supply pool are affected by natural environmental factors. The preservation of marine ecosystems and the development of fishery systems that present lesser risk for environmental changes are expected to enhance the marine resources and their sustainable use. It is therefore important to share ideas for the maintenance of marine ecosystems side by side with productive systems for the future of sustainable use of marine resources. We will discuss about the sustainable use and conservation of marine resources in Southeast Asia and Japan in this symposium.

We are also happy to have the installation ceremony for Professors Hidemi Kumai and Akira Sakata who are invited as visiting professors of our Graduate School.

Prof. Kohzo Taniguchi, Dean

## Program

General Chairman : Yukinori Yoshimura

**13:00-13:40 Installation ceremony of visiting professors**

Welcome message from the Dean

Kohzo Taniguchi, Dean

Speech of Prof Hidemi Kumai
Speech of Prof Akira Sakata

## = Symposium =

**13:45** Opening message

Masahiro Yamao, Vice Dean

**13:50** Marine Fish-borne Helminthic Zoonoses: Public Health Risk?

Dr. Sri Subekti Bendryman, Airlangga University (Indonesia)
Chair : Koichiro Kawai ---Page 3

**14:30** Marine Protected Areas Management in Thailand: Challenges and Solutions

Dr. Suchai Worachananant, Kasetsart University (Thailand)
Chair : Kazuhiko Koike ---Page 5

**15:10 Coffee break**

Reports of studies supported by the 2012 Grant-in-Aid for Research from the Graduate School of Biosphere Science

2012

**15:30** Stock Enhancement for Sustainable Fishery: Experiences and Lessons from Black Sea Bream, *Acanthopagrus schlegelii* (Bleeker) in Hiroshima Bay

Dr. Tetsuya Umino, Hiroshima University (Japan)
Chair : Koichiro Kawai ---Page 9

**16:10 General discussion** Chair : Lawrence M. Liao

**16:30 Closing Remarks** Yukinori Yoshimura

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# Marine Fish-borne Helminthic Zoonoses: Public Health Risk?

**Sri Subekti Bendryman**

**Department of Marine Science**
**Faculty of Fisheries and Marine, Airlangga University, Surabaya, Indonesia**

Food-borne diseases caused by helminth parasites transmitted by fish and shellfish product pose major public health problems. The number of people at risk worldwide, including those in developed countries, is more than half billion. Some of these parasites are highly pathogenic, and human infection is a result of the consumption of raw or undercooked fish infected by parasites. Food-borne parasites are widespread and more common than generally recognized. Humans suffer from numerous parasitic as well as marine fish-borne helminthic zoonoses. Marine-fish food is

Several species of salmonid parasites, such as *Anisakis* spp, *Diphyllobothrium* spp and *Nanophyetus salmincola* , pose a high risk to public health problem. Interventions involving modifications of human behavior to reduce disease prevalence are neglected in many disease control programs.

Key words: marine fish-borne helminthic, seafood, zoonosis.

# Marine Protected Areas Management in Thailand: Challenges and Solutions

**Suchai Worachananant**[1]

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Thailand is located between 5 and 20° north of the equator on the Indo-Chinese Peninsula and extending south to the Malay Peninsula. The country covers 514,000 $km^2$ with a coastline of over 3,000 km. Thailand has a predominantly tropical monsoonal climate with a pronounced wet and dry season. In southern areas the slender Thai peninsula is subject to strong maritime influences from the Andaman Sea to the west and the Gulf of Thailand to the east of the country. Thailand borders four countries: Myanmar, Lao PDR, Cambodia and Malaysia. Administratively, Thailand is divided into 77 provinces with twenty-three of these located along the coastlines.

Thailand’s biogeographical location results in a rich assemblage of flora and fauna. The country has over 1,700 globally threatened species including several Critically Endangered mammals, birds, reptiles, fish and plants. Nine per cent of all species are reported to be found only within the country. Thailand’s marine life is equally rich and substantially different species assemblages occur in the waters on either side of the narrow Thai Peninsula. About 35 species of mangroves and 12 species of seagrass have been reported with 5 species of turtles, as well as dugongs also found in the area.

Thailand’s efforts to create protected area complexes and enhance connectivity are increasing over time, however, the gains made through these initiatives are being eroded by other threats to natural systems. While Marine Protected Areas are a principal means used around the world to conserve marine environments, the health of the environment within Thai

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marine national parks has decreased in recent years due to coral bleaching, illegal fishing and poor tourism management.

Thailand’s protected area system was established more than five decades ago. The country has a remarkable record in creating and expanding parks which now cover more than 20% of the country’s land surface. More than 12% of marine and coastal areas are also reported as protected under the jurisdiction of a number of government agencies and Thailand has aspirations to increase marine and coastal protection to 30%. Nonetheless, gaps remain in the protection of all ecosystems, habitats and threatened species. There is a need to classify more clearly what the overall vision is for Thailand’s protected areas and how they will contribute to national biodiversity conservation and sustainable development strategies.

The proliferation of ‘protected area’ terminology around the world created confusion for international and national conservation management agencies, making it difficult to develop an understanding of the status of protected area establishment around the world. The same terminology was applied to different types of reserve while similar areas were called different names. To address this confusion, the General Assembly of IUCN defined the term 'national park' in 1969 and preliminary categories were revised several times throughout time. When IUCN published the categories, different levels of management were ascribed to each category. With the recent categories, human activities and levels of participation are integrated with conservation areas.

Human uses of the natural environment are expanding and protected areas are being used to target the ambitious goals of integrating management across the landscape and seascape, while meeting the wide range of human needs. Similar to terrestrial protected areas, objectives of Marine Protected Areas need to expand to cover the changing circumstances. Such objectives range from rather straightforward goals of conserving the stock of a single species or helping to develop eco-tourism industries, to complex goals of conserving overall biodiversity and assisting in community development and poverty alleviation. Generally, objectives of Marine Protected Areas are to maintain biodiversity, control exploitative uses of resources and manage marine environments. These objectives divide Marine Protected Areas by the degree of restriction into strict preservation areas, limited-exploitation areas and multiple-use areas.

Thailand’s Marine Protected Areas include a diverse range of characteristics, from coastal areas to remote islands; areas with no local community inhabitants to areas with dense populations; and areas with a few thousand visitors per year to those with more than 300,000 visitors per year. The habitat composition in Marine Parks also ranges widely, from the domination of coral reefs to seagrass to mangrove forest.

Legislation and authorisation of management of Marine Protected Areas in Thailand are also highly diverse. Thailand has several types of protected areas, including Navy restriction areas, marine national parks, wildlife sanctuaries (or “wildlife conservation areas”), forest parks and non-hunting areas, Man and Biosphere Reserves (MAB), RAMSAR sites to protect wetlands, ASEAN Natural Heritages (ANH), Marine Fishery Reserved Areas (MFRA) and Environmental Protection Areas (EPA).

While there are numbers of conservation areas which are variously recognised as Marine Protected Areas in Thailand, some would not meet the current IUCN definition of a protected area. Four types of protected area are commonly recognised as being central to the Thai system, which are established under the Department of National Parks, Wildlife and Plant Conservation (DNP) legislation including: National Parks (including Marine), Forest Parks, Wildlife Sanctuaries and Non hunting Areas.

Although some other types of protected areas might not meet the exact meaning definition of IUCN categories system, there can be roughly attributed into several types within categories systems such as the Marine Fishery Reserved Areas (under the Fisheries Act) which aim to protect specifically from some type of destructive fisheries but provided substantial use for artisanal fisheries, then it can be categorised as IUCN Category VI. Another example is the Aquatic Preserved Areas which are also regulated under the Fisheries Act the aims to conserve purposely the recruitment of fish stock when it can be classified as IUCN category Ia. In total there are five types of IUCN categories in Thailand; category Ia, category II, category IV, category V and category VI.

Though Thailand Marine Protected Areas system seems to be expanding and evolving, there are some obstacles which limit the success of the system including obsolete legislation (some Acts need to be reviewed and reformed), the lack of Thailand Master plan for Protected Areas, the uncontrollable illegal fishing, the lack of collaboration between management agencies, escalating pressures of tourism and threatening natural phenomena such as the global warming or tsunami.

# Stock Enhancement for Sustainable Fishery: Experiences and Lessons from Black Sea Bream, *Acanthopagrus schlegelii* (Bleeker) in Hiroshima Bay

**Tetsuya Umino**

**Graduate School of Biosphere Science**
**Hiroshima University, Higashi-Hiroshima, Japan**

## Stock enhancement programs in Japan

Stock enhancement programs are conducted worldwide to increase the stock biomass and sustainable fishery. More than 180 species have been released into coastal and marine environments in 64 different countries over the period 1984-1997.

The history of the stock enhancement programs in Japan started with targeting several species including red seabream (*Pagrus major*) and kuruma prawn (*Marsupenaeus japonicus*) form the 1960s. The programs are now extensively conducted throughout the country in order to recover depleted stocks of commercially valuable species. The total number of marine fish fingerlings released in 1983 was 35 million, reaching 76 million in 2006.

Traditionally in Japan, red seabream has been the marine finfish species accounting for the largest number of juveniles released in stock enhancement programs. In 1983, more than 16 million hatchery-reared red seabream were released throughout the country. Recently, the number of Japanese flounder (*Paralichthys olivaceus*) juveniles released in stock enhancement programs has stabilized ~ 25 millions per year, while red sea bream accounts for ~20 million. On the other hand, releases of black seabream (*Acanthopagrus schlegelii*) has decreased to ~ 2 million after reaching the peak in 1996 (~10 million). In consequence, the relevance of the stock enhancement program for this species has been displaced to the sixth place in 2006 in favor of other species such as Japanese pufferfish (*Takifugu rubripes*) or Pacific herring (*Clupea pallasii*).

## Stock enhancement of the black sea bream in Hiroshima Bay

Hiroshima Bay is located in the western part of the Seto Inland Sea. After the intensive fishing pressure for the black seabream caused a drastic drop in catch in this Bay in the 1970s, a stock enhancement program was conducted in its northern part since 1982 to restore the depleted stock. Almost 1.4 million of these juveniles were released over the last three decades in Hiroshima Bay.

Black seabream juveniles have confirmed their fast and good acclimatization to the natural conditions within 2 weeks. Also, parts of the previously released fish maturing after 3-4 years may have contributed to the recovery of landings in the late 1980s and 1990s. Nowadays, the

Bay is well known as one of the biggest production areas for black sea bream in Japan, accounting for about 10% of the total catch of the species in this country.

## Abundance constraints in Hiroshima Bay

Drastic recovery of landings has led to several problems. The excessive supply was accompanied by a reduction in the market price. This fact was remarkable during the last years of the 1990s. From 1994 to 2000, the landings increased from 145 to 258 metric tons (mt), but at the same time the wholesale price of the species fell from 1,048 to 432 Japanese yen (JY) kg$^{-1}$

Socio-economic problem involving the Pacific oysters (*Crassostrea gigas*) is widely felt in Hiroshima Bay. Pacific oysters represent a high-value cultured shellfish, producing more than 200,000 mt with a value of 38.2 billion JY. One of the main predators for oyster spats under the rafts is the omnivorous black sea bream. The complaints from the oyster farmers about a possible reduction of their production due to the feeding of black sea bream led the fisheries organisations to reduce the annual number of fish juveniles released.

In addition to the above mentioned constraints our research provides some scientific evidences of genetic conservation concerns. The high survival and contribution of hatchery-reared fish for the natural stock has a potential to trigger some genetic effects. The use of a limited number of breeders (e.g. n = 51) to produce offsprings for release has resulted in a low effective population size and an important genetic drift. The high rate of inbreeding detected warrants the necessity to carefully preserve and not compromise the genetic diversity of the species in the Bay.

In this symposium, we discuss the main constraints associated with the increment on the stock biomass in Hiroshima Bay. In addition, some lessons learned and recommendations to be considered before and during the development of future stock enhancement programs are given.

## ■ 2012 Reports of studies supported by Grant-in-Aid for Research from the Graduate School of Biosphere Science, Hiroshima University

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| Grant-in-Aid for Project Research | Study on functional factors of *Aspergillus* and its application to development of foods<br>Restricted release of patent information | Norihisa Kato |
| Grant-in-Aid for International Cooperative Research | Survey of attitudes among Japanese students and Filipino hosts towards the Foreign Practice curriculum instituted by the Faculty of Applied Biological Science | Masahiro Yamao |
| Grant-in-Aid for Fundamental Research | Novel approach to monitor red tide status and its application for red tide prediction | Kazuhiko Koike |

# Survey of attitudes among Japanese students and Filipino hosts towards the Foreign Practice curriculum instituted by the Faculty of Applied Biological Science

**YAMAO Masahiro**
**Graduate School of Biosphere Science**

(UPV) JICA

UPV Prof. Evelyn T. Belleza UPV

UPV

# Novel approach to monitor red tide status and its application for red tide prediction

**Kazuhiko Koike, Tato Arimoto, Maung Saw Htoo Thaw**

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**Higashi-Hiroshima 739-8528, Japan**

Preface  Mass mortalities of caged fish caused by red tide remain a serious problem in Japanese waters. In 2009 and 2010, *Chattonella* red-tide caused severe yellow-tail kill, equivalent to a so far loss of 8.7 billion JPY in the Ariake and Yatsushiro Seas. The only possible countermeasures for red tide incidences are fish-cage evacuation, early-harvest, and stop fish feeding, all of which need early alerts for forthcoming red-tide growth or approach. Nevertheless, red tide prediction is still very unreliable because their growth depends on a combination of various environmental parameters. Recently, the pulse-amplitude-modulation (PAM) fluorometer has become a popular device which enables *in vivo* detection of photosynthetic activity in plants. PAM fluorometers detect maximum photo-energy (quantum) yield (*Fv/Fm*) in dark-adapted photosystem II, and at the same time, actual quantum yield ( $\Phi_{II}$ ) under illumination of various light regimes. $\Phi_{II}$ indicates how much energy flow from PSII to PSI and thus further gives “electron transportation rate (ETR)” by multiplying ETR with photon-flux density of the illuminated light. These parameters, *Fv/Fm* and ETR, are known to be good indicators for plant photosynthesis. In this study, PAM fluorometry was employed for phytoplankton surveys, and tested for its usefulness for red-tide prediction.

Methods  Two on-ship surveys were conducted at Tachibana Bay and south Ariake Sea on July 2012. At 23 sampling stations, water samples from 1.5 m depth were collected and subjected to *Fv/Fm* measurement and further determination of physico-chemical parameters (i.e. water temperature, salinity, dissolved inorganic nutrients) or phytoplankton assessment. From April 11th to August 19th, weekly samplings were conducted at Kure port, an embayment of Hiroshima Bay, and vertical profiles of *Fv/Fm* and ETR were measured.

Results  No *Chattonella* blooms were found on the sampling occasions at Tachibana Bay and Ariake Sea. *Fv/Fm* values given by phytoplankton communities showed significant negative correlation with water temperature (rs = -0.499, $p < 0.01$), and significant positive correlation with PO4-P and dissolved inorganic nitrogen ($NO_3$+$NO_2$+$NH_4$-N) with rs = 0.432 ($p < 0.01$) or rs = 0.305 ($p < 0.01$), respectively. This result suggests *Fv/Fm* would be a good indicator for water temperature and nutrient status, which largely affect phytoplankton growth. In the Kure-port survey, *Fv/Fm* values were high when diatom bloom from April to May and a flagellate (*Heterosigma akashiwo*) bloom on June 15thwere observed. However, the values were not indicative; these were not primarily increased to reflect the blooms. On the other hand, $ETR_{max}$, assumed from the relationship between the light regimes and each corresponding ETR, increased almost one week prior to the blooming of a dinoflagellate (*Alexandrium* spp.  on May 11th and *Heterosigma* on June 15th. Thus, $ETR_{max}$ would be usable for primary prediction for such phytoplankton blooms. $ETR_{max}$ seems to have another advantage: the value was high at the surface water when diatoms (high-light adapter) dominated, or high at the middle or deeper waters for flagellates (low-light adapter), suggesting that the vertical measurement can give a warning whether blooms of diatoms or flagellates would be forthcoming.