広島大学ホームカミングデー　生物生産学部・生物圏科学研究科企画

第６回 生物圏科学研究科 食料・環境問題国際シンポジウム
「東南アジアと日本における水産資源の持続的利用と保全」

6th International Symposium on Food and Environment
“Sustainable Use and Conservation of Marine Resources in Southeast Asia and Japan”

日　時：平成２５年１１月 ２日（土）　13:00 – 16:30
場　所：広島大学生物生産学部 C206 講義室

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

研究科長からのご挨拶

水産資源は私達の食料として大切な役割を担っています。水産生物は海洋生態系の一員であるとともに、その増殖は海洋の自然環境の影響を受けます。海洋に生息する水産資源を豊かにし、そして食料としての安定的な供給を可能にするためには、海洋生態系の保全とともに、自然環境の悪化によるリスクが少ない水産技術の開発が期待されています。アジア諸国では水産資源の利用技術が各国の工夫により着実に発展していますが、一方で水産資源を持続的に利用していくためには海洋資源の保全が大切です。東南アジアと日本における水産資源の持続的な利用と保全の現状と将来展望を活発に意見交換してくださるようにお願いいたします。

また、本年 10 月から熊井英水先生と坂田明先生に本研究科の客員教授に就任していただくことになりました。シンポジウムに合わせて両先生の就任式を挙行できることを嬉しく思います。

研究科長　谷口 幸三

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 プログラム

General Chairman 総合司会: Yukinori Yoshimura 吉村 幸則

13:00-13:40 Installation ceremony of visiting professors 客員教授就任式

Welcome message from the Dean 研究科長挨拶

Kohzo Taniguchi, Dean 研究科長 谷口 幸三

Speech of Prof Hidemi Kumai 熊井 英水 先生 ご挨拶
Speech of Prof Akira Sakata 坂田 明 先生 ご挨拶

= Symposium =

13:45 Opening message 開会のご挨拶

Masahiro Yamao, Vice Dean 副研究科長 山尾 政博

13:50 Marine Fish-borne Helminthic Zoonoses: Public Health Risk?
（海産魚媒介性蠕虫人畜共通感染症：公衆衛生リスクか？）
Dr. Sri Subekti Bendryman, Airlangga University (Indonesia)
Chair 司会: Koichiro Kawai 河合 幸一郎 ---Page 3

14:30 Marine Protected Areas Management in Thailand: Challenges and Solutions
（タイにおける海洋保護管理区域：その挑戦と問題解決）
Dr. Suchai Worachananant, Kasetsart University (Thailand)
Chair 司会: Kazuhiko Koike 小池 一彦 ---Page 5

15:10 Coffee break 休憩

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

2012 年度研究科長裁量経費助成研究成果報告

15:30 Stock Enhancement for Sustainable Fishery: Experiences and Lessons from Black Sea Bream, *Acanthopagrus schlegelii* (Bleeker) in Hiroshima Bay
（持続的漁業生産に向けた放流：広島湾のクロダイから学ぶ）
Dr. Tetsuya Umino, Hiroshima University (Japan)
Chair 司会: Koichiro Kawai 河合 幸一郎 ---Page 9

16:10 General discussion 総合討論 Chair 司会: Lawrence M. Liao

16:30 Closing Remarks 閉会の辞 Yukinori Yoshimura 吉村 幸則

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

平成 24 年度研究科長裁量経費による助成研究報告 ---------------------Page 11

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 well-known as seafood and is a nutrient-rich part of healthful diet. Seafood consumption is associated with potential health benefits, including neurologic development during gestation and infancy and reduced risk of heart disease. Seafood consumption has increased in recent decades almost worldwide, reaching a high during the past decade. However, along with the nutrients and benefits derived from seafood consumption come the potential risks of eating contaminated seafood. Therefore, seafood is responsible for an important proportion of food-borne illness and outbreak worldwide.

The tradition of eating raw fish is becoming increasingly fashionable in many countries, principally with foods such as sushi, sashimi, koi-pia, lomi-lomi salmon, tako poki, palu, green herring, gravlax and ceviche. This has led to a dramatic rise in the incidence of a large number of fish-borne zoonotic helminthic infections in previously uninfected ethnic groups. The zoonotic reservoir hosts, which are primarily domestic animals and other fish-eating mammals, are also heavily parasitized, leading to a high prevalence in various hosts. Some zoonotic helminthic infectious agents have been transmitted to humans from stranded animals including fishes and shellfish.

Marine fish-borne helminthic zoonoses could be caused by nematodes, cestodes, and trematodes. The most important of the nematode diseases of humans acquired from marine fish is Anisakiasis. This disease is caused by *Anisakis simplex*, the species most frequently associated with human disease, followed by *Pseudoterranova decipiens. Contracaecum asculatum* has rarely been reported to cause disease. Diphyllobothriasis is an intestinal infection that is the most important marine fish-borne cestode zoonoses, caused by the fish tapeworm *Diphyllobothrium,* and is responsible for most reported cestode infections in humans. *Nanophyetus salmincola* causes Nanophyetiasis, may be the most common trematode endemic to the United States. In particular, the parasite is a food-borne intestinal trematode prevalent in the coasts of the Pacific Northwest.

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]

Department of Marine Science
Faculty of Fisheries, Kasetsart University, Thailand

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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* Assistant Professor of Marine Science, Deputy Head of Department of Marine Science, Faculty of Fisheries, Kasetsart University , Thailand: suchai.yo@gmail.com

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.

平成２４年度

研究科長裁量経費による研究助成

成果報告書

平成２５年１１月２日

広島大学大学院生物圏科学研究科

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

平成 24 年度研究科長裁量経費による助成研究報告

助成区分	研究課題名	研究代表者
プロジェクト研究 Grant-in-Aid for Project Research	麹菌の機能性成分の解析とその食品開発への応用 Study on functional factors of *Aspergillus* and its application to development of foods （特許出願予定につき要旨は非公開） （Restricted release of patent information）	加藤　範久 Norihisa Kato
国際共同研究 Grant-in-Aid for International Cooperative Research	生物生産学部の海外実習における学生と地域住民の交流意識に関する調査 －フィリピン大学ビサヤ校との交流協定締結をめざして－ Survey of attitudes among Japanese students and Filipino hosts towards the Foreign Practice curriculum instituted by the Faculty of Applied Biological Science	山尾　政博 Masahiro Yamao
基盤研究サポート Grant-in-Aid for Fundamental Research	高精度モニタリングを利用した赤潮分布予測手法の開発 Novel approach to monitor red tide status and its application for red tide prediction	小池　一彦 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

生物生産学部の海外実習における学生と地域住民の交流意識に関する調査

－フィリピン大学ビサヤ校との交流協定締結をめざして－

山尾政博
生物圏科学研究科

【研究の目的】本研究は、本学部が実施しているフィリピン・パナイ島での学生の海外実習を通して、地域の受入機関の関係者、ホスト・ファミリーがどのように学生と交流したか、今後の交流事業の拡大に対して、何を期待しているかを分析することであった。また、実習に参加した学生が現地での生産・生活体験を通して、どのような教育成果を得たかを、フィリピン大学ビサヤ校の協力を得て明らかにすることを目的にしていた。

【学部学生のための海外実習の意義と成果】海外の農林水産業の実態を見聞し、住民参加型の地域振興や資源・環境保全プロジェクトの実施状況を視察し、地域住民、ＮＧＯ、援助関係者との交流を図りながら、食料生産の実態、持続的開発、持続的資源利用、生物多様性の保全をどのように実施しているかを考える。学生の今後の学習に対するインセンティブを高めるとともに、グローバルな動きに対応できる人材として英語力を強化し、異文化への対応力を養うという意義を確認しつつ、海外実習の成果を具体的に検証した。

【学生を受け入れた側からの評価】受け入れ機関であるフィリピン大学ビサヤ校(UPV)、JICA、体験学習やホームステイに協力してくれた地域行政機関から聞き取りを実施した。また、学生を滞在させていただいたホスト・ファミリーの代表者には詳細な聞き取りを実施し、学生が滞在した時の様子、今後の宿泊体験の持ち方等について意見を聞いた。どの家庭も、ホームステイ活動に参加するのは始めてだったが、「活動に参加して満足しているか」、という問いに対しては、ほぼ全員がとても満足していた。改善点として、ホームステイ先での学生の滞在時間を長くすること、学生のコミュニケーション能力の向上が指摘された。ホームステイには様々なリスクがあるが、学生の満足度が高いことから、学部としては他の協力支援機関と連携しながら、今後も続けていく価値があると考える。

UPV で受け入れ代表をしていただいた Prof. Evelyn T. Belleza （UPV 副学長，経営学部所属）は、生物生産学部との交流を積極的にとらえ、今後の本学との交流を拡大させるきっかけにしたいとの意向を持っておられた。同教授は、学生との交流を通じ，また、バナテ町での活動等を視察して、学生の英語能力を向上させることの必要性を強調された。UPV の学生や地域住民との間で、コミュニケーションを十分にとれない学生が少なからずいた。生物生産学部での講義において、専門用語を必ず英語で表記するなどして、能力向上をはかってはどうかという助言をいただいた。

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

Kazuhiko Koike, Tato Arimoto, Maung Saw Htoo Thaw

Graduate School of Biosphere Science, Hiroshima University,
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 (Φ_{II}) under illumination of various light regimes. Φ_{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.