Kuroshio Science **3**-1, 7-14, 2009

Summary Report on the 2nd Joint Kuroshio Symposium* -Biodiversity in Kuroshio Waters-

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Introduction

Great changes are now occurring in the Kuroshio Current and its coastal areas. These changes include rising seawater temperatures, ocean pollution, erosion of coastlines and changes in ocean ecosystems. Such changes have often been widely reported in the media. How are global warming, world-wide climate changes, rapid economic growth, rising population pressures, changing lifestyles and other types of natural and artificial effects affecting the degradation of the environment and ecosystems? What is the real state of these phenomena? How can we use ocean resources in a sustainable way? What is the outlook for biodiversity in the years ahead?

To examine and compare the problems of the ocean mentioned above that have arised beyond national borders, Kochi University took the initiative and began joint studies of the waters extending from Taiwan to the Philippines. Signing an agreement on joint studies and interchange of students with National Sun Yat-sen University in Taiwan and with the University of the Philippines, Bicol University and the Second Regional Branch of the Bureau of Fisheries and Aquatic Resources in the Philippines, the university started joint study projects in 2005. The first workshop was held at Kochi University from November 21 to 23, 2007 to report on and examine the outcome of the joint studies conducted by the participating institutions, including the preparatory activities. The results of the first workshop were compiled and published under the title of "Recent Changes in the Seaweed Ecosystem along the Kuroshio Current," in Kuroshio Science, Vol. 2, No.1, in March 2008.

After the first workshop, the second joint workshop (hereafter symposium) took place under the auspices of National Sun Yat-sen University in Taiwan at the university's campus in Kaohsiung from December 1 to 3, 2008 (Fig. 1). The unifying theme was "Biodiversity in Kuroshio Waters," and the results of a total of 20 studies were reported: four of them were concerned with the management of coastal resources, six with fish resources, six with biodiversity and four with the diversity of ocean life. Behind the theme "Biodiversity in Kuroshio Waters" lay the fact that special emphasis was placed on the animals and plants that had not received much attention in the past, including jellyfish and seaweeds. There were twelve reports from Taiwan, five from Japan and three from the Philippines.

Fig. 1 National Sun Yat-sen University, Kaohsiung, Taiwan.

The following sections outline the reports made at each of the workshop sessions. For details of the workshop programs, please see Appendix tables and, where applicable, the abstracts.

1. Management of Coastal Resources

In this session, the following four reports were delivered:

1-1) Lee *et al*.: Adaptation to climate change in integrated coastal management

*Edited by chairpersons of the symposium.

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1-2) Syashank *et al*.: Importance of coral reef health in the Kuroshio region
1-3) Nieves *et al*.: Socio-economic conditions, status of fisheries and agriculture
1-4) Kanda: Environmental education rooted in the local area of Kashiwajima

In the report by Lee *et al*. (1-1), four survey sites in Taiwan and the Philippines were presented as examples for the comparative study of seashore protection, resources management and conservation of the coastal environment. While in Taiwan, seashore protection work and the conservation of coastal areas have been carried out using both physical and social measures, there have been major moves in the Philippines to lay stress on social measures mainly with regard to Marine Protected Areas (MPAs). In addition, in the MPA, it seems that the activities of local people have been effective in rebuilding work after climate changes, especially after damage are caused by typhoons. The course of typhoons has become different from that in the past due to climate changes, and damage from typhoons to coastal areas and their ecosystems has been increasing markedly in both Taiwan and the Philippines. The reconstruction steps taken after disasters and the state of seashore protection work in coastal zones for rebuilding purposes are noteworthy subjects in connection with recent climate changes.

The report by Shashank *et al*. (1-2) gave an outline of the present condition of coral reefs and colonies. Developing well in the western parts of the Pacific, coral reefs account for only 0.1% of the total area of oceans in the world. But over one-third of marine fish species live around coral reefs and fish catches in coral reef waters amount to 10% of the total global catches. The report drew attention to and described the importance of coral not only as fishing grounds but also from biological and oceanographic standpoints and outlined the meaning of joint studies on coral reefs and colonies extending along Kuroshio waters.

Nieves *et al*. (1-3) reported the results of their socio-economic study on the MPA in Lagonoy Gulf in the Philippines. Using the analysis of the 1,035 households randomly sampled in the five villages on San Miguel Island, the site of the joint studies, they provided such basic data as the island's population, household data, fishing methods and the scale of fishing activities. Their report detailed, for the first time, the socio-economic structure of fishing communities, which had not been known in detail previously because of limited economic statistics.

The report by Kanda *et al*. (1-4) was at the invitation of the workshop. The activities of the Kuroshio Zikkan Center on Kashiwajima at the western tip of Kochi Prefecture, Japan, have helped to inform many people about the steady efforts of non-profit organizations (NPOs) to protect the costal environment and restore it into "Sato Umi (the sea for the area and its inhabitants)." Because priority was given to the development of tourist resources in the "Sato Umi Creation" activities carried out by people in the island acting together, dissension arose between local inhabitants and outside divers and travel agents. Dealing with such issues has also become an important subject in Ludao in Taiwan as well as in Lagonoy Gulf in the Philippines. The case of Kashiwajima reported by Kanda provided helpful insights into the problems these districts are facing.

2. Fish Resources

This session consisted of the following six reports:
2-1) Chang *et al*.: Flyingfish around Taiwan
2-2) Ame *et al*.: Preliminary assessment on the seagrass resources in northern Philippines
2-3) Nakamura: Seagrass decline and challenges for future conservation
2-4) Soliman *et al*.: Overfishing of Siganidae in Lagonoy Gulf
2-5) Yagi *et al*.: Fish larval communities in Ariake Bay
2-6) Haraguchi *et al*.: The decline of *Ecklonia cava* in Kochi

The report by Chang *et al*. (2-1) examined the characteristics of flyingfish, which have a wide home range mainly in the East China Sea (Fig.2). This species was

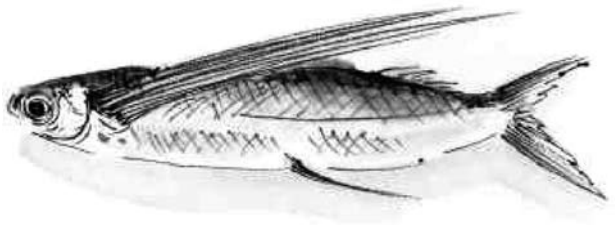

Fig. 2 Flying fish
Souce: http://www.maruha-shinko.co.jp/uodas/syun/27-tobiuo.html

reported on at the first workshop in 2007, too, when it was proposed to conduct a joint study of this fish as an indicator species for Kuroshio waters because of the existence of different types and sizes of fish according to the waters where they live and because cooking methods for this fish display regional characteristics. The present report was more specific than the proposal in 2007; it

showed that five genera and 11 species of this fish are confirmed at present and described the characteristics of different sizes of flyingfish, including the seasonality of their appearance and the time and place of their spawning. At National Sun Yat-sen University, investigations stressing the importance of this fish have continued progressively. In the years ahead, there will be an urgent need to examine implementation methods for joint studies on flyingfish.

The report by Ame *et al*. (2-2) deals with the ecology of seagrass in the waters along the coast of the Babuyan Channel in northern Luzon, the Philippines. The study was conducted at four survey sites in the Cagayan Valley Region and was intended to collect and identify naturally growing seagrass and specify cultivable seagrass species from an economic standpoint as a means to prevent excessive collection as a result of the uncontrolled and illegal fishing methods used in the area. While this is not limited to the Philippines, fishing communities, especially those in developing countries, remain economically disadvantaged in most cases. In these communities, it is an important issue in rural development to cultivate and raise seagrass that can be processed for marketing purposes. The report by Ame *et al*. is based on a realistic awareness of the issues facing fishing communities in that it suggested the use of marine products as a way to improve the economic condition of fishing areas in remote districts.

In his report (2-3), Nakamura reconfirmed the importance of seaweed beds, composed mainly of seagrass, and paid attention to the deterioration of ecosystems of fish living near seaweed beds. From 1978 to 1991 about 2,000ha of seaweed beds were lost, thus decreasing the activity of their role in the nursery of young fish, and creating a dangerous situation for the growth of fish. To cope with this problem, there is an urgent need to take steps to conserve seaweed beds and to study the relationship between land and sea areas, and also the correlations among organisms living in coastal waters. In addition, the report mentioned the effective role of environmental education for the conservation of seaweed beds and the measures to control human activities, including how to establish the MPAs.

The report by Soliman *et al*. (2-4) details the results of their study of *Siganus canaliculatus*. In the Lagonoy Gulf in southern Luzon, the Philippines, both Bicol and Kochi Universities have continued a follow-up survey on the yearly change in the ecosystem of fish, mainly rabbitfish (especially white spot rabbitfish: *Siganus canaliculatus*). The report presented the results of the numerical analysis that estimated, by model estimation of the population, the quantity of stock of the fish from such data as the early growth of the fish and the age in days of fry. It is considered that overfishing was the result of reckless fishing of both fry and adult fish, and the decrease in adult fish was caused by the decrease in fry, which were over-fished in the past four years. In the waters of Lagonoy Gulf, the peak fishing season is from April to May when fry and adult fish are caught customarily. The report warns that if present fishing practices are continued in the future, sooner or later, it will become impossible to maintain any rabbitfish population in the waters.

The report by Yagi *et al*. (2-5) is concerned with a study of young fish that persist in the Ariake Sea, Kyushu, Japan. To assess the importance of the estuaries in the bay in the Ariake Sea as a place for the growth of fish, they compared fish fauna both at the planktonic period and after settlement in the five waters with different types of environment. The environment of the estuaries in the bay was characterized by low salinity content, high turbidity and heavy interchanges and greatly differed from that of other waters. The report showed that the quantity of larvae and juveniles was greater in the estuaries than in Isahaya Bay and in the waters off the coast and that in particular, the larvae and juveniles indigenous to the Ariake Sea collected in the estuaries in the bay and used those areas as places for growth (Fig. 3).

Fig. 3 Symposium at NSYSU

The subject of the report by Haraguchi *et al*. (2-6) was the decline of *Ecklonia cava* and the efforts to establish beds for this plant in the coastal areas in Kochi Prefecture. *Ecklonia cava* beds along the coasts of the prefecture existed widely until the 1980s but have rapidly declined in the 1990s and after. The main causes are rises in seawater temperature and damage resulting from feeding by sea urchins and algophagous fishes. Because *Ecklonia cava* beds are important for the conservation of marine resources and the ocean environment, a variety

of projects for developing these beds have been undertaken. The main development methods are the direct replanting of *Ecklonia cava*, the use of its spore bags and the establishment of cages for protecting *Ecklonia cava* from feeding damage. While each of these methods has advantages and disadvantages, the result of their application confirmed that what was the most important in developing *Ecklonia cava* beds was to select an appropriate sea area.

3. Diversity of Ocean Life

The following four reports were delivered in this session.

3-1) Dawson *et al*.: Aggregations, blooms, and swarms of jellyfish

3-2) Lo *et al*.: A preliminary ecological study on the box jellyfish

3-3) Shieh *et al*.: Using structural equation modeling for Lutao seagrass ecosystem

3-4) Mok *et al*.: Triplefin as an indicator species for monitoring a seagrass ecosystem

In their report (3-1), Dawson *et al*. examined the rapid breeding of jellyfish from an evolutionary standpoint (Fig. 4). The breeding of this species consists of phases known as aggregation, blooming and swarming and is a notable phenomenon produced by some jellyfish species. Therefore, it is considered that such breeding is not only beneficial for the evolution of jellyfish, but also promotes its appearance in groups and produces the phenotypes that are advantageous to the species. Paying attention to the jellyfish that appear in groups, Dawson's team studied the evolution of its morphological, ecological and life history characteristics. It is supposed that the biological characteristics of jellyfish mostly interact with the physical environment, and the team examined how these characteristics and a changing environment were of benefit to jellyfish.

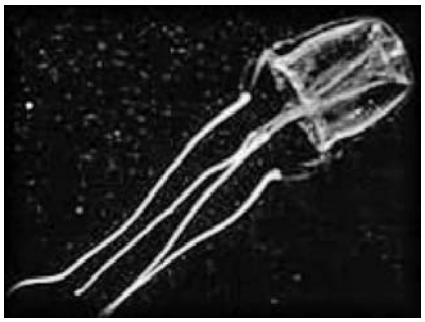

Fig. 4 Box jellyfisf
Souce: nagisastyle.hp.infoseek.co.jp/surf10.htm

The report of Lo *et al*. (3-2) is concerned with an ecological study of poisonous jellyfish. Cubozoans (box jellyfish; *Charybdea rastonii*), a very poisonous species that is the subject of the report, is widely distributed in the Pacific Ocean and is problematic for sea bathers and fishers when it breeds rapidly. In the sea off Taiwan, box jellyfish regularly grow rapidly in shallow bay waters on the east coast close to the Kuroshio from summer to fall. Measurement of the weekly sampled box jellyfish individuals showed that there were at least two peaks, close to strobilation, from July to September 2008. The fact that the respiration rate of the box jellyfish was higher than that of other jellyfish species in these months suggested that box jellyfish maintained enormous energy as predators in these sea areas.

Due to the importance of seagrass beds and their deterioration, interest in research in seagrass is growing recently. But there have been only a few cases where researchers in the different fields of ecology studied the correlation among aquatic life at the same location from various viewpoints. The report of Shieh *et al*. (3-3) integrated the knowledge of different fields and analyzed a seagrass ecosystem using a mathematical model. The method they used was a structural equation model (SEM) based on the Path theory, and the data from a survey conducted on Green Island in May 2008 was employed. They applied the SEM to the biota data collected from the 20 quadrats and finally analyzed the correlation between species, i.e., snails, hermit crabs and sea anemones, and seagrass. They showed, for example, that the population of hermit crabs was related to the propagation of snails and that water temperatures and salinity concentration did not, in fact, have a very strong effect. They considered that the results of their study, including those referred to above, might be affected by an insufficient survey period, the adoption of a relatively longer period of observation and data collection is planned, to reinforce the analysis of the model in the future.

The study conducted by Mok *et al*. (3-4) was based on the idea that triplefin might be used as an indicator species for monitoring a seagrass ecosystem (Fig. 5).

Fig. 5 Triplefin species (*Enneapterygius philippinus* [Peters,1869]) (Photo by H. Endo)

At a previous workshop, it had already been suggested that to observe changes in the ecosystem in Kuroshio waters, it would be important to pay attention to a spe-

cific organism and to compare the data regarding the organism from Japan, Taiwan and the Philippines. The reporters emphasized that seagrass meadows appearing at ebb tide would serve as valuable indicators for observing the impact of global warming. Seagrass meadows exist widely in the sea around Taiwan, and at ebb tide, a limited number of fish species appear in the seagrass meadows. Triplefin is among these fish species and its population is large. Paying attention to the fact that the triplefin population is closely related to seagrass beds, the researchers have studied the population, distribution by body length, age, seasonal reproduction activities and other data from triplefin since April 2007. Based on the analysis of the data, they reported, among other things on the period of and activities for reproduction, sex ratios and life span of triplefin. Although this species has a low economic value from the standpoint of fisheries, it would be recorded as a candidate for common biological indicator for long-term environmental changes.

The study of Liu *et al*. (3-5) examined the ecology of coral-inhabiting snails (purple coral snails) from a viewpoint similar to that of the report mentioned above. This snail is parasitic on Porites spp. and can be observed widely in the coastal waters of Taiwan, Vietnam and the Philippines. Using histograms and other means, the researchers reported that they found from the observation of the age composition of the snails in particular that the species' population was greatest at the age of five and six years and that the age composition greatly differed according to the sampling site.

The report of Lee *et al*. (3-6) focused attention on the growth characteristics of seagrass (*Thalassia hemprichii*) in Taiwan (Fig. 6). On an island known as Hsiao-hu-Chiao in the waters off the southwestern coast of Taiwan (known as the only one island composed of coral reefs in Taiwan; the area is about half, and the population (12,508), about four times, that of Green Island), this seagrass grows in the shallows where the sea bed appears at ebb tide. By contrast, on Green Island in the sea southeast of mainland Taiwan, it grows in relatively deep tidal pools. Comparison of the biomass of the areal shoot, rhizome and root of *Thalassia hemprichii* on the two islands showed that while the biomass of the areal shoot and rhizome was greater on Green Island, that of the root was greater on Hsiao-hu-Chiao. It was found that the photosynthetic activity of the areal shoot of *Thalassia hemprichii* was smaller on Hsiao-hu-Chiao where the seagrass grew in shallow waters and that when the seagrass was given high intensity light in excess, it was unable to convert all of the light energy into chemical energy and emitted part of it as thermal energy. As noted, *Thalassia hemprichii* has a mechanism for adjusting its growth according to the condition of its habitat, thickening its root in shallow waters where it is exposed to strong light and developing its leaves in locations where it is always soaked in seawater.

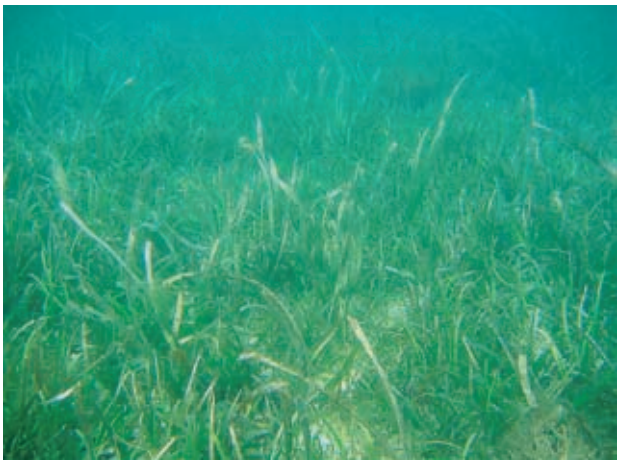

Fig. 6 Seagrass (*Thalassia hemprichii*) (Photo by K. Okuda)

4. Ocean Life

This session was comprised of four reports.

4-1) Chen *et al*.: Resistance and resilience of coral communities

4-2) Hung *et al*.: Control of transparent exopolymer particles

4-3) Lee *et al*.: Atmospheric transport of polycyclic aromatic hydrocarbons

4-4) Soong *et al*.: Is Green Island turning black?

Chen *et al*. (4-1) paid attention to the coral reefs and coral communities in Kuroshio waters, especially in the sea areas from Taiwan to Kochi Prefecture, Japan, where subtropical and tropical waters mingle together. They consider that changes in the ocean environment observed in Kuroshio waters are affected by rises in water temperature and ocean acidification. It is supposed that coral not only adapts itself to the two factors referred to above but also resists, opposes and acclimatizes to them. The questions they addressed were: "How will the growing environment of coral reefs in the tropics expand into the temperate zones as a result of rises in seawater temperature?", and "How will the new coral moving northward get acclimatized to the endemic species?" and finally "What kind of symbiodinium will be newly formed there?" Taiwan is geographically situated between Japan and the Philippines, serving as a bridge between them. Thus studies on coral reefs will provide barometers for

comparative research on the changing ocean environment in the three countries. For more details, please see their paper included here as a keynote report.

The report by Hung *et al*. (4-2) is concerned with the control of transparent exopolymer particles (TEPs). TEPs are the substances derived from large algae and phytoplankton and are difficult to observe with an optical microscope. Recently it has become possible to observe the characteristics of polysaccharides using dyeing technology, which has allowed rapid progress in research. Recent studies have shown that TEPs serve, for example, as the propagation base of bacteria and as the food supply for ciliates and copepods, and thus TEPs have attracted attention in that they affect the community structure and food chain of the ocean ecosystem. The reporters collected TEP samples in the north of the East China Sea and in the Bashi Channel and closely examined its correlations with phytoplankton, the concentration of seawater by depth, the distribution of TEPs, etc., taking geographical characteristics into account. They found that TEPs played an important role as a carbon source for bacteria.

The report by Lee *et al*. (4-3) is the result of their study on the effects of polycyclic aromatic hydrocarbons (PAHs) on the ocean environment, which differs from the other reports at the workshop with were related to marine life as outlined above. Oceans are the global-scale reservoirs of hydrophobic organic pollutants (HOPs), and HOPs are accumulated on the seabed because they are not water-soluble. Bearing food chains in mind, it is very important to consider the problems of HOPs because they will have effects on our bodies, too. In Taiwan, the economy has been developed rapidly, and the pollutants produced by the industrial sector spread through the air before reaching the ocean. This study presented the results of the comparison of the concentration of pollutants in the air measured in 2007 at four locations, i.e., the urban and coastal areas of Kaohsiung, Keng-Ting Island and Lan-yu Island. The concentration in the urban area of Kaohsiung was higher than that on Lan-yu Island far away from the city by about as much as 100 times, and the concentration of pollutants was higher in the dry season than in the rainy season. The study also analyzed the seawater sampled in Lan-yu Island and gave the measured values of PAHs, etc. at the four study sites.

The last report (4-4) in the workshop by Soong *et al*. attracted much attention with its unique title, "Is Green Island turning black?" The researchers reported the results of their observations of the ecology of black sponge in the coastal waters. Sponge is widely distributed around coral reefs and their environs; the distribution, colony scale, density, coverage and colony expanding rates of sponge were surveyed in 2008 at the 32 coral reefs on Green Island and Lan-yu Island. The results showed the ecological characteristics of the sponge. The rate of which the sponge expanded its colonies was estimated using randomly sampled cases, and it was found that the area covered by sponge increased roughly fourfold annually, although the pace differed from habitat to habitat, which indicated that the sponge expanded its colonies very quickly. According to the researchers, if sponge continues to expand its colonies at this rate, the coasts of Green Island will be totally covered with black sponge in five years. But the estimate does not fully take account of the factors that would inhibit the sponge's growth, including new recruitment of different sponge species, differences in the height of the sea bottom and possible damage from typhoons. Therefore it is hoped that more basic data will be collected in the future.

At this symposium, the participants asked many fruitful questions about each of the 20 reports outlined above. However, because no systematic record of these questions is available, they are not included here.

5. Action Plan

Following a proposal by National Sun Yat-sen University, the participants were organized into three groups: (1) Management of coastal resources, (2) Fish resources and (3) Biodiversity and sustainable utilization. Each of the groups exchanged opinions about action plans for the future, and the discussions are summarized at the end of this report.

Conclusion

1) Summary of the 2nd workshop

As stated above, a variety of topics were reported at the 2nd workshop on the common theme "Biodiversity in Kuroshio Waters." Three points about the workshop are stated below:

The first point concerns the trend of studies in Taiwan in recent years. Study efforts in Taiwan placed emphasis on the Taiwan Strait in the past but have shifted their focus to the Pacific Ocean lately. Studies now cover a wide variety of fields, including the current of the Kuroshio, the impact of climatic changes and physiological and ecological research into specific ocean life. Importantly, in terms of studies on the Kuroshio,

Taiwan is located between the Philippines and Japan. As research concerning the Kuroshio is expected to increase further in the years ahead, we have to start the work proposed in the first workshop as soon as possible, that is, the selection of some fish or algae as common indicators of environmental changes and the long-term analysis of their ecology and stock, such as the scope of their migration, growth processes and reproduction mechanisms.

The second point concerns the activities carried out by Bicol University and the Ministry of Agriculture in the Philippines. In that country, researchers have concentrated their efforts on the investigation of the Marine Protected Areas (MPAs), which has been established to protect the sea from excessive and illegal fishing. The activities for conserving the ocean based on the participation of residents in the area provide many insights for Japan and Taiwan, too, in that they involve efforts to organize the community and to have it take part in activities for the protection of the coastal environment. But because priority is given to a view which regards ocean resources only as fishery resources, the reports from the Philippines give us the impression that marine life with low economic value has been neglected. In our joint studies in the future, it will be important to consider how to give this kind of study a proper position in the broad framework of research into biodiversity and ecosystems. The ecological study of Siganidae, an herbivorous fish species, attracted our attention because Japan has been faced with the same problem: this species is considered to be a cause of the encroachment of seaweed beds in the waters off Kochi Prefecture, where the sea has been warmed and has grown as tropical sea.

The third point relates to the cooperative studies by researchers in the humanities (or socio-economics) and scientific fields continued at Kochi University. Studies by a team composed of researchers from these two areas have not been seen much at the Taiwanese and Philippine member universities. As stated above, almost all of the 20 reports presented at the workshop were those focusing on a particular specialty. The beginning of studies featuring the cooperation of both researchers in the humanities and also of scientists has basically coincided with that of environmental problems. With our positive attitude toward these collaborative studies and their achievements, we should show what it means for specialists in the humanities and scientists to work together to explore problems of the coastal and ocean environment which is continuously deteriorating and declining without being noticed by anyone due to both artificial and natural effects. We will have to present problems from Kochi, which is situated at the downstream end of the Kuroshio, to our fellow researchers in the Philippines and Taiwan, which lie in its upper and middle reaches. We should engrave this in our hearts in preparing for the coming workshop.

2) Future plans: toward the 3rd Symposium

The tri-national scientific research network has just been created, and the subjects for joint study have not been defined precisely yet. We would like to strive to enhance our exchange of scientific information by having each of us bring topics of research to the study meetings to be held in Japan, Taiwan and the Philippines in turn. The third workshop of the three countries will be convened from December 1 to 4, 2009 at Legazpi City, Albay, the Philippines, under the sponsorship of Bicol University. Preparations for the workshop are now steadily underway.

Note:

We would like to dedicate this bulletin to Dato S. Jegatheesan, Former Director of Muda Agricultural Development Authority (MADA) in Malaysia, an illustrious agricultural economist, and one of our chief advisors who supported our joint studies from the initial stages. We were greatly saddened when Dato S. Jegatheesan passed away this spring after the completion of the editorial work of this summary report. We are grateful for his stewardship of our projects, and the valuable advice that he provided as an outside observer of the Kuroshio Triangle countries.

Action Plan for Joint Studies

1. Purposes of joint studies

1) To collect and analyze scientific data concerning Kuroshio waters and to increase mutual understanding through the exchange of information, thereby contributing to the international community.

2) To plan scientific research projects and to carry out the projects jointly.

3) To plan professional exchanges for the promotion of study activities and to strive to understand Kuroshio-related research in the member countries.

4) To hold seminars and symposiums regularly and to strive to spread the study results widely.

2. Main subjects for joint study

1) Fish resources: To select and jointly investigate specific fish species for the purpose of examining the correlations between environmental changes in Kuroshio waters and marine resources. At present, flyingfish and Siganidae are among the species proposed for selection.

2) Algae and seagrass resources: To make a comprehensive study of ocean vegetation and ecosystems, mainly those of seaweed beds. Also to promote the comparative study of coral reefs and coral communities in the tropics, subtropics and temperate zones.

3) Conservation of the coastal environment: To study the ideal way to conserve and protect the coastal environment in cooperation with local residents, putting emphasis on the marine protected areas established at various places along the Kuroshio so as to realize the sustainable use of ocean resources.

4) For the time being, joint studies will share the following study sites:

* Kochi Prefecture, Japan: Tatsukushi coast and Kashiwajima.
* Taiwan: Green Island.
* Philippines: Whole areas of Lagonoy Bay in southern Luzon and Aparri and its environs in northern Luzon.

3. Exchange of students

1) To have students, mainly graduate students, take part in the research into the coastal areas of the Kuroshio in order to enhance their capability for the future.

2) To provide students with the opportunity to learn making the most of student exchange programs, etc.

4. Conclusion of agreements

To conclude agreements with related universities and government agencies so as to carry out scientific studies and human exchange programs.

5. Holding of study meetings

To hold seminars and other similar events whenever needed and conduct symposiums regularly in order to share the achievements of scientific studies on the Kuroshio.

6. Others

The expenditure needed to carry out the activities mentioned above will basically be covered by the budget of the university and any related organization. In addition, efforts will be exerted to acquire funding from outside sources.