Introduction of IOC/WESTPAC - from Japanese perspective

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Followed by the high level objectives of Intergovernmental Oceanographic Commission (IOC) of UNESCO, IOC Sub-commission for the Western Pacific (WESTPAC) promotes international cooperation and coordinates programs in three areas; marine research and application, ocean observation service, and capacity building in the western Pacific and its adjacent seas.
At present WESTPAC consists of 22 member states mainly from East Asia, Southeast Asia, and south Pacific. In the area of marine research and application, twelve projects are endorsed by member states, and four projects are supported by the Japanese government (Harmful Algae Bloom, Toxic Marine Organism, Ocean Remote Sensing, and Biodiversity in coral reefs). WESTPAC also endorsed the working group activities to foster scientific and societal discussions on the regional marine science. The working group (WG) on Asian dust was the first WG in WESTPAC, led by Japanese experts, and compiled the collection of scientific papers to foster the inter-disciplinary study in WESTPAC. There are two regional Global Ocean Observing System (GOOS) projects in the area of ocean observation service. North-East Asian Regional GOOS (NEAR-GOOS) is conducted by Japan Meteorological Agency and Japan Oceanographic Data Center in cooperation with China, Korea, and Russia, to share in-situ ocean data from each country. The other one is the South East Asian Regional GOOS (SEA-GOOS), led by Thai and conducting several pilot studies from observation to forecasting experiments. Capacity development (CD) is one of key activities in WESTPAC to foster and develop capability of marine science in the region. In the case of Japan in conjunction with the marine research projects, CD has been conducted through the workshops of laboratory experiments and field surveys. In parallel to these activities, a new type of CD activities was proposed in 2008, aimed to establish the Regional Training and Research Center (RTRC) with specific research subject respectively and to develop networks among centers in sustainable manner. The first RTRC was established in China, and the efforts have been continuously made in Japan. In recent years, based on these activities, inter- and trans-disciplinary contributions are welcomed to WESTPAC. Detailed information will be introduced in the presentation.

Keywords: IOC, WESTPAC, Asia, marine science, ocean observation, capacity development

Development of information infrastructure on global warming and ocean acidification

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The oceans, which cover 70 per cent of the earth’s surface, have in recent years been experiencing various changes. The small island countries dotting the oceans are of course significantly affected by such changes and are now struggling to deal with them.

We, OPRI-SPF, held international seminars with relevant organizations and discussed our new international joint policy proposal, ‘For the Better Conservation and Management of Islands and their Surrounding Ocean Areas’ to further materialize policy for the sustainable development of islands and their surrounding ocean areas. We participated in the International Conference on Small Island Developing States (SIDS 2014), at which we presented the above policy proposal as a contributing document, and organized a side event to launch the international collaboration network, “Islands and Oceans Net (IO Net)”.

The 2nd General Meeting of IO Net was held in December 2016 with great success and significance, with 120 participants coming from 11 countries and 12 international/intergovernmental organizations. At this meeting, the Partners not only discussed the development strategy for 8 projects, based on the results of the 1st General Meeting held in May 2015 and the interactions thereafter, but also reinforced cooperation and information sharing for the implementation phases.

We proposed a project titled “Start-up of Regional Monitoring Network Platform on Ocean Acidification” as one of the 8 projects. Although it is certain that an increase in CO2 concentration causes ocean acidification, there is still much to learn about the actual processes. Furthermore, because acidification occurs over multiple spatiotemporal scales, it is vital that both onsite and satellite observations of the oceans are used to elucidate the overall picture and establish an information infrastructure for integrating data from models of marine physics, chemistry, and biology and generating projections. In order to address the issues of ocean warming and acidification, we are developing the “Marine Crisis Watch & Action” platform based on the west Pacific region and planning to provide it to neighboring countries.

キーワード：小島嶼開発途上国、島と海のネット、海洋危機ウォッチ、海洋酸性化
Keywords: SIDS, IO-net, Marine Crisis Watch, Ocean Acidification

High-resolution hydrographic observation with local communities in the Sanriku coastal seas, Japan

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In the Sanriku coastal seas, facing the North Pacific in the northeastern part of Japan and exchanging a large amount of seawater with the open ocean, a variety of seaweeds and shellfish are farmed without artificial feeding. After the 2011 Great East Japan Earthquake and the subsequent giant tsunami, we have built an ocean observation system to elucidate circulation patterns in the Sanriku coastal seas, not only aiming at producing globally recognized scientific results, but also putting a high priority on integrating our activities with local communities in the area. That is, practical ways were developed to carry out scientific study together with local communities.
In the study we have built a WEB site that distributes real-time-monitored marine environmental data, such as water temperature, wave height, salinity, concentration of nitrate, and meteorological conditions. The marine environmental information distributed by this system has been widely viewed and been practically utilized by the local communities including fishermen, because growth of the seaweeds and the shellfish depends greatly on the seawater circulation, which conveys nutrients into the “non-feeding” sea farming areas.
Moreover, we have held local meetings in rural fishing villages. Direct exchanges of marine information between the researchers and fishermen are very useful not only for the fishery, but also for the progress of the oceanography, because the fishermen know the sea very well. In addition, the hydrographic observation over the inshore fishery areas cannot be made safely without support from fishermen. In other words, in situ observation with local communities is essential for performing state-of-the-art coastal physical oceanography.

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Human-Environmental Security in Asia-Pacific Ring of Fire: Water-Energy-Food Nexus

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The objectives of this research are to understand the complexity of the water-energy-food (WEF) nexus system and to create scenarios and policy options to reduce trade-offs among resources and to alleviate conflicts of resource users using scientific evidence and under assumptions of uncertainty to maximize human-environmental security. Five different interdisciplinary approaches, scales and clusters will be used in this investigation: 1) the science in/for society; 2) the water-energy nexus; 3) the water-food (e.g., fisheries resources) nexus; 4) the stakeholder analysis; and 5) the interdisciplinary study.
A primary challenge of this nexus study is to analyse the interlinkages between groundwater and fisheries production, regarding the hypothesis that the flow of nutrients from land to ocean affects the coastal ecosystem. This suggests that water use for producing and/or consuming food and/or energy on land might affect fisheries production in coastal areas. To examine this theory, we address two primary objectives; 1) to understand the complexity of the water-energy-food (WEF) nexus system since the relationships of all three resources are interrelated and interdependent; and 2) under scientific evidence and scientific uncertainty to create scenarios and policy options to solve the identified nexus problems, that is, to reduce the number of tradeoffs among three resources and to mitigate potential conflicts among these resource users through transdisciplinary approaches.
(To understand the complexity of WEF nexus system)
At the local level of WEF in Beppu, hot spring resort area, a finding of the WEF nexus shows that changes in the heat environment caused by hot spring drainage water from resorts and power generation affect river ecosystems, including non-native Tilapia habitat. As for the interlinkages between groundwater and fishery production, changes in submarine ground water (SGD) rates cause change in nutrients flux, which results to change in primary production, and finally leads to change in fishery resources. We found that there was a positive correlation between phytoplankton primary production and radon concentration, as a groundwater tracer of SGD in Obama Bay. Regarding the relationship between SDG and nutrient flux, we found nutrients supplied from the SGD have a high contribution to primary production. As a result of addressing SDG and fisheries production, we discovered that more fishes were found near SGD. We demonstrated the interlinkages between groundwater and fishery production.
(Developing methods for interdisciplinary and transdisciplinary studies)
We designed WEF nexus system integrating methods such as computer science, ontology engineering and economic tools to understand and visualize the nexus system in Beppu to contribute to scenario planning and define the academic concept of nexus. Regarding stakeholder analysis, we identified governance issues for the coexistence between hot spring energy development and hot spring resource conservation. They also visualized the social network of hot spring stakeholders, who shared same interests in Beppu. Regarding scenario planning, we identified stakeholder interests, held stakeholder meetings and expert meetings. We will provide scenarios and develop action plans by collaborating with stakeholders, and experts next year.

Keywords: water-energy-food nexus, interdisciplinary, transdisciplinary, coastal ecosystem

太平洋亜熱帯海域における魚類生産への窒素固定の寄与
Biological nitrogen fixation sustains fishery production in the subtropical Pacific Ocean

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Nitrate below the euphotic layer has been generally considered as a primary nitrogen source to sustain new production which leads to fishery production in the sea. Recently nitrogen fixed by diazotrophs is gaining attention as another nitrogen input to fuel new production in the subtropical ecosystem. While a number of studies indicate that the nitrogen fixation contributes to secondary production, its role in the fishery production is still unknown. Here we present two attempts to prove the contribution of diazotrophic nitrogen to fishery production by means of the analysis of food-chain structure with carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotopic ratios. Firstly in the central Pacific, we determined the isotopic signatures in suspended particulate organic matter (POM), net-plankton and micronektonic fish from the epipelagic zone. $\delta^{15}N$ of surface POM and all biotic components was low, reflecting *in situ* N_2 fixation activity in the subtropical regions where the N_2 fixation activity was high , with a clear contrast with high $\delta^{15}N$ in the areas where the activity was low. Thus, a distinct food-chain to micronektonic fish sustained by diazotrophs existed in the subtropical Pacific. Secondly, we examined contribution of nitrogen fixation to predatory fish as indexed by the isotopic signatures in benthopelagic fish, *Beryx splendens* and their prey in the Kuroshio Current in which the diazotrophy was active. The signature of nitrogen fixation was evident in POM, net-plankton, micronektonic prey fish and *B. splendens*. Thus, diazotrophy is an important nitrogen source for fishery production in the subtropical ocean. The response of diazotrophy to the on-going climate change and the subsequent impact on higher trophic levels is the critical issue to be tackled to predict sustainability of subtropical fishery production.

キーワード：安定同位体、窒素固定、キンメダイ
Keywords: stable isotope, diazotroph, Beryx splendens

