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Phuket, Thailand, 12-15 May 2015

SUMMARY REPORT ON

THE WESTPAC 9TH INTERNATIONAL SCIENTIFIC SYMPOSIUM "A HEALTHY OCEAN FOR PROSPERITY IN THE WESTERN PACIFIC: SCIENTIFIC CHALLENGES AND POSSIBLE SOLUTIONS", 22-25 APRIL 2014, NHA TRANG VIETNAM

25 WESTPAC
Years of Dedication to Marine Science 1989-2014

WESTPAC 9th International Scientific Symposium

"A Healthy Ocean for Prosperity in the Western Pacific: Scientific Challenges and Possible Solutions"

22-25 April 2014, Nha Trang, Vietnam

Summary Report

In collaboration with
Institute of Oceanography, Vietnam Academy of Science and Technology

Prepared by
UNESCO/IOC Regional Office for WESTPAC

Bangkok, Thailand, June 2014

22-25 April 2014
Sheraton Hotel, Nha Trang, Vietnam

THEME:
A Healthy Ocean for Prosperity in the Western Pacific:
Scientific Challenges and Possible Solutions

Hosted by
Vietnam Academy of Science and Technology, Vietnam

Organized by
Institute of Oceanography, VAST, Vietnam
National IOC Committee for Vietnam
IOC Sub-Commission for the Western Pacific

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1. BACKGROUND

1. The ocean, our common heritage, is key to sustaining all humankind on the planet. It shapes Earth's climate and influences the distribution of ecosystems, biodiversity, and thus food availability. The Western Pacific region is of vast social and economic importance with over 70% of its population living in and relying economically on coastal areas, approximately 54% of the world's GDP generated and more than half of the world's annual merchant tonnage traversing this area. Meanwhile, the ocean in the region is among the richest and most productive marine areas in the world as a home to some 70% of the world's coral species, and is universally recognized as one major influence on the global climate system.

2. Humans, however, have put the ocean at risk of irreversible damage by unregulated exploration and development, increasing pollution, climate change and ocean acidification. The ocean is becoming more acidic at a rate not seen for the last 20 million years, with significant impacts on the marine food chain, biodiversity, food security and livelihoods of coastal community. As such, it is imperative to strengthen sound scientific research and systematic observations to underpin the sustainable governance of the ocean.

3. It is within this context that the IOC[1] Sub-Commission for the Western Pacific (WESTPAC) has been committed to its mission to promote international cooperation in marine research, observation, services, and capacity development in the Western Pacific and its adjacent regions, in order to learn more about the nature and resources of the ocean and coastal areas and to apply that knowledge for the improvement of management, sustainable development and the protection of the marine environment.

4. Since its establishment in 1989, WESTPAC has organized a series of WESTPAC international scientific symposia as a unique regional platform to advance marine scientific knowledge, and catalyze multi- and cross-disciplinary collaborations among its Member States with a view to addressing challenges this particular region is facing.

5. Upon the kind offer of the Government of Vietnam, the WESTPAC 9th International Scientific Symposium entitled "A Healthy Ocean for Prosperity in the Western Pacific: Scientific Challenges and Possible Solutions" took place in Nha Trang, Vietnam, 22-25 April 2014 in commemoration of the 25th Anniversary of WESTPAC. This Symposium was hosted by the Vietnam Academy of Science and Technology (VAST), and jointly organized by the Institute of Oceanography, VAST; National IOC Committee for Vietnam and IOC Sub-Commission for the Western Pacific (WESTPAC).

2. OBJECTIVES AND STRUCTURE

6. The objectives of the WESTPAC 9th International Scientific Symposium were to bring together marine scientists, particularly young scientists, with a view to examining the achievements of WESTPAC in marine sciences over the last 25 years, advancing marine scientific knowledge, and catalyzing multi- and cross-disciplinary collaborations towards the

[1] Intergovernmental Oceanographic Commission (IOC) of UNESCO, the competent agency within UN system for marine research, observations, services and capacity building.

improvement in management practices and decision-making processes for sharing the wealth of the ocean to benefit all.

7. The Symposium featured 6 keynote speeches, 14 sessions structured around four themes: (1) Understanding ocean processes in the Indo-Pacific region; (2) Ensuring marine biodiversity, food safety and security; (3) Maintenance of ocean health; and (4) Cross-cutting and emerging issues.

8. Meanwhile, for the first time, a Research Directors Forum was organized on 22 April 2014. Serving as an open-ended platform for directors from marine scientific institutes, academic faculties and/or operational agencies in the Indo-Pacific, the Forum aimed to build and enhance networks; exchange strategic directions of their institutions; identify scientific and technical challenges; and spark regional actions in the framework of IOC for future collaborations by exploring any opportunity of synergizing existing and planned observations, and furthering operational oceanography through the emerging Indo-Pacific Ocean Observations and Services Network (IPON). To this end, directors were expected to consider the feasibility of establishing an appropriate scientific mechanism, i.e. Scientific Steering Committee (Group of Experts), to further propel the development of the Network in question.

9. Nine side workshops were also organized in parallel by respective WESTPAC Projects and relevant partners with focus to review the current progress and come up with roadmaps for the next intersessional period. These workshops were as follows: Coastal & Marine Biodiversity and Conservation (WESTPAC-CMBC), Harmful Algal Bloom (WESTPAC-HAB), Ocean Remote Sensing for Coastal Habitat Mapping (WESTPAC-ORSP), Coral Reef under Climate and Anthropogenic Perturbation (WESTPAC-CorReCAP), Toxic Marine Organisms (WESTPAC-TMO), Recruitment Monitoring of Coral Reef Organisms (WESTPAC-DRMREEF), Ocean Acidification, Asian CORE project, and EWIN 2013 Expedition.

10. Response to the symposium announcement was overwhelming. A total of 607 people from 24 countries registered prior to the Symposium with 250 oral and 251 poster presentations finally selected, and 550 scientists, governmental officials from 21 countries actually participating in the Symposium.

11. The Program at a Glance is attached to the report as Annex II

3. PLENEARY SESSIONS

3.1 Opening

12. Prior to the opening, all participants stood in silence for one minute in mourning for people who lost their lives in the recent Korea Sewol Ferry Tragedy, and praying for all passengers and crew members on board the missing Malaysia Airlines Flight MH 370. We sincerely wish their families and countries immense strength.

13. Dr Vo Si Tuan, Chair of the National Organizing Committee (NOC), Vietnam opened this Symposium by welcoming all participants to this event. He recalled the need for the establishment of WESTPAC in 1989 to forge international cooperation on marine science, observations and services in the Western Pacific and adjacent regions, and highlighted the importance of running WESTPAC Symposia once every three years to achieve its mission. On the occasion of 25th Anniversary of WESTPAC, it is timely to

organize this symposium to review its past achievements, and shape its future directions. He briefed the plenary that this symposium received overwhelming interests from within and outside the region with more than six hundred scientists and governmental officials from 24 countries having registered prior to the event. He extended his sincere thanks to all organizers, sponsors for their great efforts made in the preparation of this event.

14. Prof Chau Van Minh, President of the Vietnam Academy of Science and Technology (VAST), delivered his welcome remarks on behalf of the Government of Vietnam. He congratulated on the tremendous achievements of WESTPAC over the past years, and emphasized the essential role of WESTPAC in the promotion, development and coordination of regional scientific programs and observations. He considered it as a great honour for Vietnam to host this Symposium, and thanked WESTPAC and its Member States for selecting Vietnam as the venue for this Symposium. He finally expressed his appreciation to all organizers, International Scientific Steering Committee, National Organizing Committee, WESTPAC Office for all their support provided and hard work done, and wished the Symposium a great success.

15. Dr Wendy Watson-Wright, Executive Secretary of the Intergovernmental Oceanographic Commission and Assistant Director General of UNESCO, extended her heartfelt thanks to the Government of Vietnam for hosting; the Institute of Oceanography, Vietnam National Committee for IOC, and WESTPAC for organizing the important event. IOC attaches great importance to the Western Pacific and its adjacent regions, given the tight links of ocean and coasts to human well being, safety and prosperity in the most densely populated region. While emphasizing the importance of marine scientific research, observations and services in the management of our links to ocean, she further congratulated on the remarkable achievements WESTPAC has made in the establishment of strong partnership with its member states, the development of national and regional capacity for the study and monitoring of the ocean and coasts, and serving the needs of countries for sustainably managing their ocean and coastal biodiversity and resources. Recalling the Outcome Document of Rio+20 “the Future We Want”, she expected that WESTPAC, serving as the regional arm of IOC, would continuously keep its momentum and further strengthen the leadership of IOC in the region in contributing to sound scientific research, systematic observations, reliable services, and capacity development.

16. On behalf of Khanh Hoa Province, Dr Tran Son Hai, Permanent Vice Chair of the Provincial People’s Committee welcomed all participants to Nha Trang, capital of Khanh Hoa Province. He introduced that Nha Trang is not only reputed as the most popular tourism destination in Vietnam, but home to several leading scientific institutes of Vietnam. The Institute of Oceanography with a history of ninety years, has been contributing to the economic development of the Province. He extended his thanks to IOC and VAST for

organizing this event in Nha Trang, and affirmed his commitment to supporting marine scientific research nationally and internationally in order to keep the healthy ocean for present and future generations.

17. The Opening concluded with token of appreciation presented by Dr Minh to Dr Watson-Wright for the support IOC and WESTPAC provided to the social and economic development in Vietnam. Tokens of appreciation were also presented by Dr Wendy Watson-Wright, to Dr Chau Van Minh and Dr Vo Si Tuan in recognizing their contributions to the hosting and organization of this Symposium.

18. Full statements made at the opening ceremony are given in Annex I

3.2 Keynote Addresses

19. In order to commemorate the 25th Anniversary of WESTPAC, present the latest research development on the global/regional hotspot issues, one special presentation and five keynote addresses were invited on the morning of 22 and 23 April 2014. The keynote addresses were thought-provoking and substantial in their contents.

Achievements and Perspectives of WESTPAC towards Peace and Sustainability in the Region

20. Dr Somkiat Khokiattiwong, Chairman of WESTPAC, reviewed the development of WESTAPC over the past twenty-five years. He briefed on the first program of IOC in the region initiated in 1965-Cooperative Study of Kuroshio (CSK), which provided an impetus for marine science cooperation in the region, and led to the establishment of the IOC Program Group for the Western Pacific in 1979 that was replaced afterwards by the IOC Regional Committee for the Western Pacific in the mid of 1980's. The IOC Sub-Commission for the Western Pacific (WESTPAC) was established in 1989 as a successive organization of the Regional Committee with its regional office located in Bangkok, Thailand.

21. He described key features of WESTPAC development over its three different stages: the pre-establishment period, the period of 1989-2008, and the period of 2008 till present. He particularly highlighted the tremendous achievements made since the revitalization strategy and a series of effective measures had been put into place in 2008. WESTPAC has been taking a significant step in the establishment of partnership with marine scientific institutes, operational agencies in the region; and the development of regional ocean observing systems, marine scientific programs and associated capacity building, related to ocean and climate, marine biodiversity and ecosystems. These achievements could be demonstrated by the strong willingness of Member States to support WESTPAC either in cash or in-kind, increased participation of marine scientific communities in WESTPAC various activities etc. He commended that regional marine scientific communities are more united than ever, keep working together to address challenges the particular region is facing.

22. Dr Somkiat concluded that, despite substantial achievements, great challenges still remained ahead for WESTPAC Member States to further develop long term observing and monitoring capacity in order to generate more ocean knowledge to assist its Member States in underpinning sustainable development and governance for a healthy ocean, and management of risks and opportunities from the ocean.

Impacts of the 2011 Mega-Earthquake and Tsunami on Marine Coastal Ecosystems on Pacific Coast of Northeast Japan

23. Prof Tomohiko Kawamura, Atmosphere and Ocean Research Institute, University of Tokyo presented the latest research result on the destructive impact of the 2011 Tohoku Earthquake and tsunami on marine ecosystems in the wide area of the Pacific coast of northeast Japan. He informed that Japan had launched a research project "Tohoku Ecosystem-Associated Marine Sciences" in 2012, aiming to understand the effects of the earthquake and tsunami on marine ecosystems, and the following changing processes of the damaged ecosystems. Despite the fact that further intensive long-time studies are needed, the present result has shown that the effects of the tsunami are likely to vary largely on location, seafloor morphological feature, and shape of coastline.

24. He illustrated that the effects on sandy or muddy bottom ecosystems appear to be much heavier than those on rocky reefs. Seagrass communities on sandy bottoms in many areas had serious impacts and largely decreased in density, while macro-algal communities on rocky reefs had relatively limited impacts. On rocky reefs, organisms with weaker adhesive strength had more serious impacts than strongly attached sessile organisms. Although the damaged ecosystems and inhabiting organisms have started recovering and/or adapting to the new environment, the changing speed and process are different among ecosystems and organisms. The changes in community structure and balance of organisms may affect ecosystems and populations of many organisms for a long time. The continuous sedimentations caused by the land subsidence triggered by the earthquake may have negative effects on larval/zoospore settlement and juvenile survival of benthic animals and macro-algae.

25. Prof Kawamura underscored the importance of continuous long-term monitoring to understand such indirect and gradually revealed effects on coastal ecosystems as well as to know the secondary succession of the damaged ecosystems. He conclude that any human activities including restarted fisheries should be carefully conducted based on scientific guidelines, to minimize further negative effects on the damaged ecosystems, for the conservation of coastal ecosystems and subsequent sustainable fisheries in the future.

Anthropogenic Impacts to and Resilience of Regional Ecosystems

26. Dr Christopher L. Sabine, Oceanographer and Director of the NOAA's Pacific Marine Environmental Laboratory, started his talk by illustrating that warming of the climate system is unequivocal, and since the 1950s many of the observed changes are unprecedented over decades to millennia. He pointed out that changes in climate had caused impacts on natural and human systems on all continents and across the oceans. WESTPAC countries are extremely vulnerable to a changing climate in the coming decades, including sea level rise, changes in annual rainfalls.

27. He explained that the ocean plays a major role in the global carbon cycle through the uptake and redistribution of atmospheric carbon dioxide (CO^2). Since industrialization, the ocean has reversed its role from a small global source of CO^2 to the atmosphere to a major atmospheric CO^2 sink. This role reversal has resulted in measurable ocean chemical changes, including a decline in seawater pH, termed ocean acidification. Increasing acidity and related changes in seawater chemistry can affect reproduction, behavior, and general physiological functions of many marine organisms and lead to significant shifts in marine

ecosystems. These changes in ocean chemistry together with shifts in precipitation patterns, ocean and atmospheric temperature increases, and rising sea levels are already impacting the Western Pacific and its adjacent regions. In some cases the impacts can be exacerbated by interactions between multiple climate change effects. The combined effects of the multiple stressors reduce the resilience of regional ecosystems beyond estimates based on changes in a single parameter.

28. Dr Sabine further explained that although changes are occurring globally and ecosystems respond to local stresses, ocean acidification, temperature and other anthropogenic changes will undoubtedly impact marine ecosystems. It is still not clear how these changes will interact and be manifested at the local level. He finally encouraged more detailed and coordinated studies at regional and local levels to be conducted to document and predict the ecosystem responses and the vulnerability of the WESTPAC nations.

29.

Sustaining Marine Biodiversity and Food Security in the southern Western Pacific (Coral Triangle region): From Marine Process to Management Challenges.

30. Prof Jamaluddin Jompa from Hasanuddin University, Indonesia, highlighted the social and economic importance of the southern Western Pacific in view that it is home to the highest concentration of coastal marine biodiversity and endemism in the world, sustaining the livelihoods of majority populations in the region. In particular, the Coral Triangle is the epicenter of marine life abundance and diversity on the planet hosting more than 600 coral species and 3000 fish species. However, with the rapid economic development, coral reefs and other coastal resources in this area were severely degraded due to various factors, such as overfishing, destructive fishing, mining, sedimentation, pollution, coupled with stresses caused from climate change and ocean acidification.

31. To cope with those challenges, he illustrated the Coral Triangle Initiative for Coral Reef, Fisheries, and Food Security (CTI-CFF) and its five 5 ultimate goals, respectively on the designation and effective management of priority seascapes, the application of ecosystem-based approach to fisheries management and other marine resources, the establishment and effective management of marine protected areas (MPAs), strengthened adaptation and resilience to climate change, and the improvement of threatened species status.

32. Prof Jompa further underlined, through the Indonesian COREMAP program, the importance of science for better understanding on the marine process for sustaining the biodiversity and directing strategic actions. He called upon scientific communities to further integrate “pure” science and “applied” science, management groups to shift balance between “pure” and “wet” management, and both scientific communities and management group to jointly design safe “Viral” interventions to trigger changes that can be self-replicated to reach all affected areas and peoples.

Understanding the Abrupt Monsoon Onset and its Impacts on Climate Disasters

33. Dr Weidong Yu, First Institute of Oceanography, State Oceanic Administration of China, briefed on Asian Monsoon and its social-economic impacts in South, Southeast, and East Asian countries. He explained that, largely due to the unique geographical location and land-ocean configuration, the giant monsoon climate

prevails over vast areas of the Indo-Pacific region. He pointed out that many climate associated and even ecosystem disasters, such as the floods, droughts, hot waves, super cyclones, dramatic coastal erosion, large-scale coral reef bleaching, are closely linked to the anomalous behaviour of the monsoon system rising from its internal and local land-ocean-atmosphere interactions and /or from the remote forcing, likely from ENSO or even from high-latitude processes. Thus understanding key mechanisms underlying the complex spatial-temporal variations associated with the Asian monsoon system is critical to improve climate and weather predictions in this densely populated region.

34. Dr Yu underscored the importance of regional cooperation in the monitoring of abrupt monsoon onset, given that it marks the transition of dry-wet condition in the region and hence has important social consequence. He further introduced the SEAGOOS pilot project Monsoon Onset Monitoring and its Social and Ecosystem Impacts (MOMSEI), which was established and has been coordinated by WESTPAC since 2009 with six cruises conducted in the Andaman Sea, Bay of Bengal and Equatorial Eastern Indian Ocean, and one time-series deep ocean buoy deployed in the Andaman Sea, considering that the Bay of Bengal and Andaman Sea (BoB-AS) witness the earliest onset over the whole Asian monsoon region. The collected data reveals the key ocean-atmosphere coupled process leading to the earliest monsoon onset over the BoB-AS region.

Climate Variability, Climate Change and Related Disasters in Viet Nam

35. Prof Tran Thuc, Vietnam Institute of Hydro-Meteorology and Environment, presented the current status and projected changes in climate extremes, climate change, and related natural disasters in Vietnam. He expressed his concerns that Vietnam is likely to be one of the several countries most adversely affected by climate change and associated sea level rise, given its long coastlines. He introduced the analysis conducted on the changes on climate extremes, including mean, maximum and minimum daily temperature; hot day and cold night, cold front, heat wave; annual rainfall, rainfall in dry and wet season, extreme rainfall; typhoon; flood, flash flood and drought among others.

36. He also provided the projected changes of climate extremes by the end of 21st century compared against 1980-1999. The results showed a decrease in rainfall intensity and length of the summer monsoon season; a decrease in frequency and an unclear trend in intensity for tropical cyclones; a decrease in extreme rainfall along the east coast while an increase is seen in central highlands; more frequent droughts and long-term droughts with higher severity; and more frequent and longer heat waves over Vietnam with higher severity in the south. Sea level rise was also projected based on three scenarios[2] with up to 1 m sea level rise projected in the High Emission Scenario[3] by the end of the century, which will lead to inundation in huge low lying areas, such as Mekong Delta, Red River Delta, and Ho Chi Minh city with a large number of population affected living in those areas.

37. Finally, Prof Thuc suggested that, to assist policy makers to formulate adaptation strategy to climate change, climate change scenarios should be selected with due consideration of characteristics of sectors and provinces, effectiveness of socio-economic, environmental sustainability, and feasibility of integration with other strategies, policies and

2. Low emission scenario (B1), Medium emission scenario (B2), and High emission scenario (A2). Please refer to the Special Report of the Intergovernmental Panel on Climate Change (IPCC) on Emissions Scenarios (SRES). http://www.ipcc.ch/pdf/special-reports/spm/sres-en.pdf

3. High emission scenario (A2) represents a very heterogeneous world where economic development is regionally-oriented and economic growth and technological change are relatively slow.

development plans. It is necessary to identify priorities based on practical needs and resources at each stage to select the appropriate scenario.

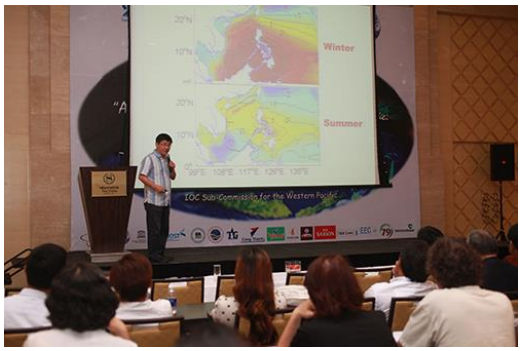
4. PARALLEL SESSIONS

38. A total of 251 oral presentations and 250 posters have been selected for 14 parallel sessions structured around four themes: (1) Understanding ocean processes in the Indo-Pacific region; (2) Ensuring marine biodiversity, food safety and security; (3) Maintenance of ocean health; and (4) Cross-cutting and emerging issues.

Theme I: Understanding Ocean Processes in the Indo-Pacific Region

4.1 Session 1: Role of the Indo-Pacific Ocean in Regional Climate Change and Variability

Conveners:
[1]Dr Weidong Yu, First Institute of Oceanography, SOA, China; Email: wdyu@fio.org.cn;
[2] Dr Kentaro Ando, Japan Agency for Marine-Earth Science and Technology, Japan; Email: andouk@jamstec.go.jp;
[3] Prof Dr Bo Qiu, University of Hawaii at Manoa, United States of America; Email: bo@soest. Hawaii.edu



39. The session aimed to review the latest research on ocean and climate processes in the Indo-Pacific as well as their impacts upon the marginal seas, identify frontier research topics, catalyze regional and international cooperation, and entrain next-generation scientists from WESTPAC countries in ocean climate observation and research.

40. The session attracted around 50 participants with 21 oral presentations and 17 posters, covering various topics from ocean circulation; ocean planetary waves; air-sea interactions associated with Indian Ocean Dipole (IOD), El Niño–Southern Oscillation (ENSO), Monsoon and Madden-Julian Oscillation (MJO); coral-derived paleo-oceanographic and paleo-climate records; long-term in-situ measurement analyses; combined analyses of satellite measurements; dynamical model simulations; and simple process-oriented models. All talks were of high qualities.

41. The frontier topics were identified and discussed in depth, which include high-resolution paleo-climate proxy time series data from coral, decadal variability over the Indo-Pacific Ocean, MJO process and local impacts, upwelling process in coastal regions and ITF, and Indo-Pacific ocean linkage and interactions.

42. Recognizing that field campaigns should be one of critical drivers for ocean science advancement, particularly for WESTPAC region, the session suggested that collaborations under the leadership of WESTPAC could play a vital role in promoting good science in the region, and that young scientists get intensive and long-term trainings at advanced institutions in the region and beyond.

4.2 Session 2: Status, Trends and Effects of Climate, Natural Disturbance and Anthropogenic Stressors on Ocean Ecosystems

Conveners:
[1]Prof Dr Uematsu Mitsuo, University of Tokyo, Japan; Email: uematsu@aori.u-tokyo.ac.jp;
[2]Dr Thamasak Yeemin, Ramkhamhaeng University, Thailand; Email: thamasakyeemin@yahoo.com;
[3]Prof Dr Huiwang Gao, Ocean University of China, China; Email: hwgao@ouc.edu.cn

43. This session was designed with objectives to exchange knowledge on status, trends and effects of climate, natural disturbances and anthropogenic stressors on ocean ecosystems in the Western Pacific, build/enhance capacity for multi-disciplinary research in marine science, and support research networks in the Western Pacific.

44. Roughly 60 participants took part in this session, including 17 oral and 18 poster presenters. Various research aspects concerning status, trends and effects of climate, natural disturbances and anthropogenic stressors on ocean ecosystems were presented, covering the diversity of habitats such as coral reef, rocky shore, mud flat, etc., and a wide range of geographic locations, such as Yellow Sea, South China Sea, Gulf of Thailand, Bay of Bengal, Andaman Sea, etc. It is worth noting that several graduate students and young scientists demonstrated their high potential for future advanced research on marine science in the Western Pacific region. Informal networks among presenters and participants were developed in this session.

4.3 Session 3: Risk/Vulnerability Assessment on Coastal Sea-Level Related Hazards with Focus on Sea Level Rise, Storm Surges and Coastal Erosion

Conveners:
[1]Dr Bui Hong Long, Institute of Oceanography, Vietnam; Email: buihonglongion@gmail.com;
[2]Prof Dr Ahmad Khairi Abd Wahab, Universiti Teknologi Malaysia, Malaysia; Email: drakaw@gmail.com

45. The session aimed to share experience on the development of various risk and vulnerability assessment tools with respect to physical marine hazards such as rising sea level, tsunami, storm surge and coastal erosion; improve the understanding on the processes of some physical environmental and hydrodynamic factors such as wave, sea level and storm surge through computational modelling and field observations; and provide a platform to exchange ideas amongst participants.

46. There were a total of 13 oral presentations and 4 poster presentations with lively discussions throughout the whole session, especially on the vulnerability assessments and coastal erosion topics. It should be noted that one winner of the “WESTPAC Best Young Scientist Awards” was from this session.

47. It was recognized that vulnerability assessments against marine hazards are useful tools to guide coastal managers, planners and governments in planning for coastal developments, safeguarding the public and ensuring safety of coastal properties. Many WESTPAC countries have initiated national and/or local studies to develop these tools. With various methodologies adopted to fulfill these needs, It is timely for WESTPAC countries to review currently adopted methods and possibly devise a common or standard methodology that may be adopted by all in this region.

48. The session further highlighted the importance of collaborative efforts between countries sharing the same coastal boundary to mitigate marine hazards and cross-boundary flux movements. Therefore, such collaborations between scientists from neighboring countries shall be continuously strengthened.

4.4 Session 4: Sediment Sources-to-Sink Process

Convener:
[1]Prof Che Abd Rahim Mohamed, Universiti Kebangsaan Malaysia; Email: carmohd@ukm.my; carmohd@gmail.com

49. The session was proposed to present recent results related to sediment sources and deposition process in the nearshore and offshore of WESTPAC countries. The session was attended by 25 audiences with 9 oral presentations made.

50. Topics presented at the session covered various aspects of the sediment sources-to-sink process, ranging from the method for monitoring suspended sediment, to natural and anthropogenic influences on sedimentation. Geographic areas of those studies include coastal landform over the past 3000 years in Mekong River Delta, natural Uranium-Thorium decay series in seaport sediments off East Malaysia, distribution of petroleum hydrocarbon and Mercury in the Gulf of Thailand, and gas hydrate study around the margin of the Pacific Ocean. The Session concluded with a suggestion, which could be further pursued, on the trans-boundary study on Asian dust and Tropical haze in relation to marine productivity in the southern South China Sea among WESTPAC countries.

Theme II: Ensuring Marine Biodiversity, Food Safety and Security

4.5 Session 5: Status, Trends of Marine Biodiversity and Productivity (including marine endangered species, invasive species, etc.)

Conveners:
[1]Dr Shuhei Nishida, University of Tokyo, Japan; Email: nishida@aori.u-tokyo.ac.jp;
[2]Dr Youn Ho Lee, Korea Institute of Ocean Science and Technology Development, Korea; Email: ylee@kiost.ac;
[3]Dr Suchana Chavanich, Chulalongkorn University, Thailand; Email: suchana.c@chula.ac.th

51. This session attracted a large number of papers which reflected widespread interest in biologically and ecologically oriented research in the Western Pacific region. Totally 89 abstracts, including 35 oral presentations and 54 poster presentations, were finally selected.

52. A number of new discoveries were presented, and suggestions were made including those on the functional role of biodiversity in coral reefs and seagrass beds; roles of coral-mucus associated bacteria; methodological improvements and challenges in coral restoration; indicators and proxies for the health of coastal habitats; monitoring of endangered and non-indigenous species; application of genetic, phylogeographic, and metagenomic approaches in combination with morphology to better understand current status of coastal habitats; and mechanisms for the generation and maintenance of the high biodiversity in the Western Pacific.

53. While noting the importance of scientific motivation, special emphasis was made on the pressing need of linking purely scientific research with social issues, such as those related to fisheries resources, life of local communities, endangered and non- indigenous species, and climate change. The session emphasized the importance of marine biodiversity related study in the Western Pacific region, and strongly recommended the session on marine biodiversity be included in the program of the next WESTPAC Symposium in 2017.

4.6 Session 6: Sustainable Fisheries and Aquaculture

Conveners:
[1]Prof Dr Saleem Mustafa, Universiti Malaysia Sabah, Malaysia; Email: saleem@ums.edu.my
[2]Prof Dr Choi Kwang-Sik, Jeju National University, Republic of Korea; Email: skchoi@cheju.ac.kr, skchoi@jejunu.ac.kr

54. The session was intended to review challenges, and identify possible solutions to the sustainable development of aquaculture and fisheries. Around 50 participants took part in the session with 12 oral presentations made. Specific problems facing aquaculture of finfish and shellfish, and capture fisheries were highlighted, and how these problems can be addressed through potential solutions were discussed. Certain papers covered topics of growing importance such as ecological aquaculture, ecological fisheries, marine ecosystem services, MPAs and biodiversity management. Participants were united in their support for the inclusion of sustainable development perspectives into fisheries and aquaculture management, and the development of climate change adaptation strategies.

55. To achieve environmentally sound and sustainable fisheries and aquaculture, the session called for the implementation of the ecosystem-based management with requirements to be met on: identification of undesirable outcomes, seeking efficient ways to avoid undesirable outcomes, initiation of corrective measures, conserving the productive capacity and sustainable resources, maintaining the biodiversity and habitat quality, maintaining social-economic benefits in fisheries and aquaculture, and establishing a legal and institutional management framework.

4.7 Session 7: Toxic Marine Organisms and Seafood Safety

Conveners:
[1]Dr Dao Viet Ha, Institute of Oceanography, Vietnam; Email: daovietha69@gmail.com;
[2]Dr Po Teen Lim, National University of Malaysia, Malaysia; Email: poteenlim@gmail.com

56. The objectives of the session were to update information on natural toxins associated seafood poisonings, their occurrence, and mechanisms of toxin accumulation; and share the experiences of lessening poisoning problems in the Western Pacific.

57. A total of 50 participants joined this session with 14 oral presentations made and 13 posters displayed. The session noted that the regional research network on seafood safety among scientists has been well established, but still need strengthening further to cope with emerging issues of common interests, e.g. trans-boundary issue concerning the export of toxin contaminated seafood to neighboring countries

58. It was strongly suggested that regional efforts be enhanced to build research and monitoring capacity for toxic organisms, given the lack of expertise in toxin chemistry in dealing emerging toxic organisms and toxins. The session also underlined the need for the development of outreach and awareness program among member states to minimize the risk of seafood poisoning to the public health.

Theme III: Maintenance of Ocean Health

4.8 Session 8: Changing Ocean Biogeochemistry and its Ecosystem impact (particularly nutrient supply and cycle, hypoxia, POPs and heavy metals)

Conveners:
[1]*Dr Zainal Arifin, Indonesian Institute of Sciences, Indonesia; Email: arifinz2010@gmail.com;*
[2]*Dr Gil Jacinto, University of the Philippines Diliman, Philippines; Email: gjacinto@gmail.com; gsjacinto@msi.upd.edu.ph*

59. The session aimed to share recent developments among WESTPAC scientists in the field of ocean biogeochemistry and possible impacts on various marine ecosystems. The session received wide interest with participation of more than 50 scientists and students.

60. There were 17 oral presentations and 23 posters displayed with focus on nutrient supply and cycles, hypoxia, Persistent Organic Pollutants (POPs), heavy metals, organic contaminants, and model organisms to determine impact/effect of various pollutants.

61. While noting the need for periodic inter-comparison exercises for the determination of chemical parameters (e.g., nutrients, POPs, etc.), the session strongly suggested that WESTPAC develop and lead the inter-comparison exercises, and consider identifying 'reference laboratories' in the WESTPAC region for various chemical parameters and techniques.

4.9 Session 9: Ocean Acidification and its Effects on Marine Ecosystems

Conveners:
[1]*Dr Somkiat Khokiattiwong, Phuket Marine Biological Center, Department of Marine and Coastal Resources, Thailand; Email: skhokiattiwong@gmail.com;*
[2]*Dr Zulfigar Yasin, University Sains Malaysia, Malaysia; Email: zulfigarusm@gmail.com;*
[3]*Dr Aileen Tan Shau, University Sains Malaysia, Malaysia; Email: aileen@usm.my*

62. This session was organized as an attempt to address the challenge of ocean acidification in the Western Pacific. To this end, the session aimed to share the knowledge on OA and its effects on marine ecosystems; review the present efforts on OA research and monitoring at global, regional and national level; facilitate the establishment of regional OA research and monitoring network; and further explore the possibility of the development of a regional scale monitoring programme within the framework of WESTPAC on the impacts of OA on coral reefs and other marine habitats.

63. Overwhelming interests were received in this hotspot issue with full audience throughout the session. 15 selected oral presentations were made, covering laboratory experiments and studies on the impacts of OA on coral reef ecosystem, aquaculture and other marine organisms; impact of sea water acidity on microbial communities and bio-chemistry processes in marine ecosystems; and field observation on ocean acidification in the upwelling region and its potential impact on coral reef ecosystem. New approach to studying the effects of OA on coral reef ecosystem were also proposed through studies on the ecology of coral reef in the vicinity of an underwater thermal vent, and numerical experiments investigating the effects of coastal upwelling on the biogeochemical cycle. Moreover, the session concluded with two presentations provided, respectively on global efforts in the development of the Global Ocean Acidification Observing Network (GOA - ON), and regional efforts in monitoring ecological impacts of OA on Indo-Pacific coral reefs.

64. Shortly after the session, Workshop 8 on Ocean Acidification was held with a view to exploring the possibility of the development of a regional scale monitoring programme within the framework of WESPTAC on the impacts of OA on coral reefs and other marine habitats.

4.10 Session 10: Harmful Algal Bloom

Conveners:
[1]Dr Mitsunori Iwataki, University of Tokyo, Japan; Email: iwataki@anesc.u-tokyo.ac.jp;
[2]Dr Nguyen Ngoc Lam, Institute of Oceanography, Vietnam; Email: ngoclam-ion@planktonviet.org.vn

65. The session was convened to exchange information on the recent occurrence of local HAB in the WESTPAC region; and advance knowledge on micro algal studies including biology, autecology, and toxicity, the application of molecular techniques to species identification and the numerical modeling of HABs.

66. More than 50 participants took part in this session with 14 oral presentations made and 19 posters displayed. Papers presented covered various aspects of harmful algal study, such as red tide events, taxonomy, phylogeny, ecology, and new techniques.

67. The session exchanged information of recent occurrences of HAB species in China, Indonesia, Japan, Korea, Philippines, Thailand, and Vietnam, in particular red tide forming species (*Gymnodinium* and *Phaeocystis*) and potentially toxic microalgal species such as *Alexandrium*, *Dinophysis*, *Gambierdiscus*, *Pseudo-nitzschia*, etc. Several techniques for HAB studies, e.g., Loop-mediated isothermal amplification (LAMP) and quantitative Polymerase Chain Reaction (qPCR) for rapid and specific detection, culture of microalgae, and numerical modeling were provided.

4.11 Session 11: Restoration and Conservation of Marine Ecosystems

Conveners:
[1]Dr Chou Loke Ming, National University of Singapore, Singapore; Email: dbsclm@nus.edu.sg;
[2]Dr Edgardo D. Gomez, University of the Philippines, Philippines; Email: edgomezph@yahoo.com

68. The session was held to share experience and ideas on restoration and conservation efforts, understand the generous ecosystem services provided by marine ecosystems in view of their extensive degradation in the Western Pacific, identify challenges facing the restoration and conservation of marine ecosystem, and review responsive conservation measures.

69. The session was attended by 30 participants with 12 oral presentations made and 11 posters displayed. Presentations covered aspects of conservation from biology (molecular, organism), ecology (habitat, connectivity, restoration, rehabilitation), approaches (community-based management, MPAs, stakeholder participation, livelihood) and assessment indices for management success.

70. The session noted with great concerns over grand challenges in the restoration and conservation of marine ecosystems, which were posed by not only economic development, but also looming climate change impacts. These challenges must be addressed in our desire for a healthy ocean for prosperity in the Western Pacific. We need to identify the scientific challenges and possible solutions. Experiences from different localities were useful and can be considered for replication. Various management approaches were also beneficial to the audience because of the lessons emanating from the variety of case studies.

4.12 Session 12: Remote Sensing in Integrated Coastal and Marine Management

Conveners:
[1]Dr Teruhisa Komatsu, University of Tokyo, Japan; Email: komatsu@aori.u-tokyo.ac.jp;
[2]Dr Duong Hong Son, Institute of Meteorology, Hydrology and Environment; Email: dhson@cenre.ac.vn

71. The session was designed with objectives to review, share experience on remote sensing techniques and their applications to the monitoring of ocean health in the Western Pacific.

72. The topic received wide interests with roughly 80 participants taking part in this session. 14 selected oral presentations were made and 11 posters were displayed with focus on various issues in relation to remote sensing studies for ocean health. The session reviewed present information on mapping methods and results for ocean health such as corals and seagrasses, chlorophyll, ground water sources in coastal waters, and SAR for oil spills and ship tracking. All presentations reflected the great benefit of using remote sensing data for various marine applications.

73. The session appreciated WESTPAC for giving the opportunity to exchange scientific knowledge on remote sensing and its application in Integrated Coastal Area Management (ICAM), and recruit young scientists into this field, and further request WESTPAC to support the development of scientific community on remote sensing studies for ocean health.

74. Recognizing that processing of remote sensing data for marine/oceanography applications is not as easy or straight forward as its applications over land, the session stressed the need to strengthen the research and development of relevant algorithms or processing techniques through the conduct of regular training courses and /or workshops; in view of the different Algorithms and processing techniques for imaging data and non-imaging data, courses/workshops should be organized separately with different specific purpose; Moreover, it is suggested that one handbook on the best practices of marine remote sensing applications be developed for beginners in this field.

Theme IV: Cross-cutting and Emerging Issues

4.13 Session 13: Development and Demonstration of Ocean Forecasting System

Conveners:
[1]*Prof Dr Fangli QIAO, First Institute of Oceanography, State Oceanic Administration of China, China; Email: qiaofl@fio.org.cn;*
[2]*Prof Dr Fredolin TANGANG, National University of Malaysia, Malaysia; Email: ftangang@gmail.com;*

75. The session was organized with objectives to update knowledge on the latest ocean forecasting systems in the Western Pacific, share experience from existing initiatives on the development of ocean forecasting system, and promote cooperation on model development and associated ocean forecasting systems.

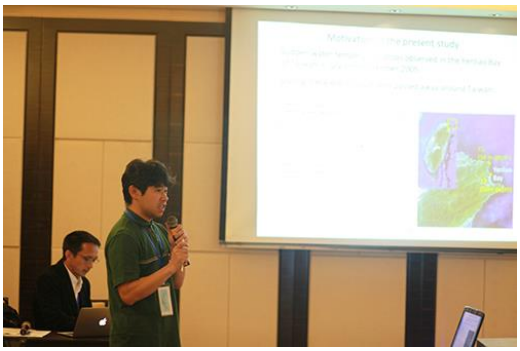
76. As one of emerging hotspot topics, this session prompted strong interests with more than 50 participants. 19 selected oral presentations were made and 15 posters were displayed. Participants were updated on the operational ocean forecasting systems operated in China, Korea and Japan which could provide valuable information to various stakeholders.

77. The session stressed the urgent need for WESTPAC to implement the second phase of SEAGOOS Ocean Forecasting System, built on its achievement made in the first phase and ever-increasing requirements of its participating countries. It was also suggested that competent government agencies be engaged in the development of ocean forecasting system.

4.14 Session 14: New Technology and Data Management

Conveners:
[1]*Dr Kentaro Ando, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan; Email: andouk@jamstec.go.jp;*
[2]*Prof Dr Nor Aieni Haji Mokhtar, Universiti Teknologi Malaysia International Campus, Malaysia; Email: noraieni-m@utm.my*

78. In view of the importance of technical & technological development and data sharing to advance ocean science in this region, this session aimed to share experience, either failure or successful stories, on the latest technological development such as profiling float and wave glider, and ocean data management and sharing at project-based, national and institutional levels.



79. The session was attended by around 20 participants with 10 oral presentations made. It was noted that data management and sharing in this region still remains in need for development in terms of technical, technological, financial and political constraints. In doing so, more collaborative programs should be developed with data exchange practice to be further explored. Meanwhile, it was encouraging that several researchers had been trying to

develop observation techniques at their own institutes, but it would be more beneficial if they could be better networked and jointly address technological challenges.

5. CONCURRENT WORKSHOPS

5.1 Workshop 1: Coral Reef under Climate and Anthropogenic Perturbation (WESTPAC-CorReCAP)

Convener:
Dr Jing Zhang, State Key Laboratory of Estuarine and Coastal Research, East China Normal University, China, Email: jzhang@sklec.ecnu.edu.cn

80. The workshop aimed to: identify hotspot and critical issues of coral reefs in the Western Pacific in order to provide a synthesis of knowledge in the region; brainstorm the topics and themes of the 4th training activities (i.e. Summer School) and its potential host in WESTPAC countries; and discuss about joint research activities of WESTPAC-CorReCAP Project for the next two years (i.e. 2014-1015).

81. The workshop was run with no oral presentations made but with open discussions on the following two questions: given that the IOC/WESTPAC-CorReCAP Project has published a special issue on coral reefs studies in DSR-II, what will be the future direction to move forward?; built on the lessons and experiences from previous summer schools of the IOC/WESTPAC-CorReCAP Project, shall we prepare another training activity and what type of topics that training will focus on?

82. With regard to the future direction of the IOC/WESTPAC-CorReCAP Project, salient points were raised and summarized as below:

- study on the impact of climate sensitive issue;
- how to distinguish between the impacts of climate change and anthropogenic activities;
- study and long term monitoring on possible impact of ocean acidification on coral reefs;
- development of a regional protocol for monitoring and data comparison;
- study on coral diseases and the structure of coral reefs;
- region-wide monitoring and comparisons network of coral reefs;
- development of manuscripts on data integration;
- study on the effects of Colored Dissolved Organic Matter (CDOM) and sedimentation on the coral reefs

83. In terms of a synthesis of knowledge on coral reef studies in the WESTPAC region, participants suggested that the synthesis in question could

- feature three key words, i.e. coral reefs, climate, and human activities;
- be structured around four components, e.g. water quality, ecology and biology, tools and proxies, and social and economic aspects, etc;
- contain site-specific studies and examples;
- contain management components (e.g. MPA).

84. The workshop also discussed about the next training activity with suggestions made as follows:

- focus on the impact of climate change, rather than human activities;

- invite more lectures on isotope applications in coral studies;
- input more knowledge on the carbon chemistry for coral reef systems (e.g. from larvae to habitat issues);

85. The workshop concluded that WESTPAC-CorReCAP Project will organize new training activities and start to synthesize the knowledge related to coral reefs based on its previous experiences and lessons learnt, as well as relevant research results and data from other studies in the world.

5.2 Workshop 2: Ocean Remote Sensing for Coastal Habitat Mapping (WESTPAC-ORSP)

Convener:
Dr Teruhisa Komatsu, Atmosphere and Ocean Research Institute, University of Tokyo, Japan; Email: komatsu@aori.u-tokyo.ac.jp

86. The workshop took place on 23 April 2014 with participation of 38 participants. The objectives of this workshop were to review past and current activities of the WESTPAC-ORSP and ORSP for ICAM, discuss about potential future activities and identify new project steering members.

87. Dr Teruhisa Komatsu, ORSP Project Leader, briefed all participants on WESTPAC-ORSP project, including its activities at earlier stage on New Generation Sea Surface Temperature and Ocean Color. National ORSP related activities were also presented by participants from Cambodia, Indonesia, Japan, Malaysia, Thailand and Vietnam.

88. The workshop identified and adopted the standardized analyzing methods: Depth Invariant Index (DII) and Bottom Reflectance Index (BRI). Studies on temporal changes in seagrass habitats using these methods would be conducted in participating member countries.

89. In view of the need to standardize and share ground truthing methods among participants, the workshop agreed that the next training workshop would focus on ground truthing methods in seagrass habitat with date and venue tentatively scheduled for early 2015, Thailand.

90. The workshop finally selected the following to form the ORSP Steering Group: Prof Mazlan Hashim and Dr Aidy Muslim (Malaysia), Ms Thidarat Noiraksar and Anchana (Thailand), Mr Luong Cao Van, Mr Phan Minh Thu and Dr Hoang Son Tong Phuc (Vietnam), Prof Kenichi Hayashizaki and Dr Tatsuyuki Sagawa (Japan), Prof Sam Wouthyzen and Nurjannah Nurdin (Indonesia), and Mr Sophany Phauk (Cambodia).

5.3 Workshop 3: Recruitment Monitoring of Coral Reef Organisms (WESTPAC-DRMREEF)

Convener:
Dr Sung-Dae Kim, Korea Institute of Ocean Science and Technology, Korea; Email: sdkim@kiost.ac

91. The workshop was held on 23 April 2014, aiming to provide technical information on the development of database on marine organisms in each participating country, and

discussed about the workplan of the establishment of WESTPAC portal system which consists of links to databases or inventories of marine organisms in each DRMREEF participating country.

92. The workshop was attended by totally 24 participants with reports presented on the development of an inventory of marine organisms living in the Coral Triangle and neighboring coral reef ecosystem, and the establishment of the WESTPAC portal system consisting of links to databases or inventories of the marine organisms in each WESTPAC country. Participants recognized the portal system will be of help to conserve and manage properly marine bio-resources in the region.

93. Extensive discussions were made with respect to the number of samples and taxonomic information for the database. Due to time constraints, no conclusion was reached at this workshop, and participants agreed to seek another opportunities to further address those issues.

5.4 Workshop 4: Harmful Algal Blooms (WESTPAC-HAB)

Convener*:*
Dr Mitsunori Iwataki, Asian Natural Environmental Science Center, The University of Tokyo, Japan; Email: iwataki@anesc.u-tokyo.ac.jp;

94. The objectives of the workshop were to: exchange information of recent occurrence of HAB and examine the distribution of selected HAB causative species e.g., *Cochlodinium* spp., *Pseudo-nitzschia* spp. and benthic HAB species in the region; develop local (national) training workshops; and discuss about future activities in the framework of WESTPAC-HAB project.

95. Recent HAB events including red tide and poisoning cases were reported from six countries. In the Philippines there was the change of microalgal composition from green *Noctiluca* to red *Noctiluca*. Singapore and Malaysia had massive red tides caused by *Karenia* related dinoflagellates and it involved massive mortalities of culture fishes. Russia reported characteristic diatoms blooming under ice and occurrences of three ribotypes of toxic dinoflagellates *Ostreopsis* spp. In Vietnam large-scale blooms of a haptophyte *Phaeocystis*, dinoflagellate *Noctiluca* and cyanobacterium *Trichodesmium* have been recorded.

96. The workshop identified the needs for local (national) training workshops, and explored the possibility of supporting 3 local training workshops which will be conducted in Malaysia (Dr Lim Po Teen), Singapore (Dr Sandric Leong Chee Yew), and Thailand (Dr Thaithaworn Lirdwitayaprasit) respectively.

97. In term of future activities, the workshop agreed to start preparing a draft project proposal for its future activities over 2014-2015 via e-mail.

5.5 Workshop 5: Asian CORE

Convener:
Dr Shuhei Nishida, Atmosphere and Ocean Research Institute, University of Tokyo; Email: nishida@aori.u-tokyo.ac.jp;

98. This workshop was organized with participants of 76 participants with focus on the development of implementation and synthesis plan over 2014 - 2015 for the Asian CORE-COMSEA Project entitled “Establishment of Research and Education Network on Coastal Marine Science in Southeast Asia (2011 - 2015)”. This project has been supported by the Japan Society for the Promotion of Science (JSPS) through the Asian CORE Program.

99. The workshop noted with pleasure that collaborative research on physical oceanography, harmful algae, plankton, fish, macrophytes, benthos, and pollution in the coastal waters and habitats in the member countries was well conducted in 2012-2013, with close collaborations and linkage with relevant WESTPAC projects. Notable activities include (1) training workshops, respectively on integrative molecular and genetic analysis of benthos (2012, 13, Malaysia), ecology/taxonomy of jellyfish and its rearing and exhibition techniques in aquaria (2013, Thailand), and zooplankton ecology and identification (2013, Philippines); (2) publication of field guides on marine phytoplankton and fishes; and (3) compilation of zooplankton database over Indo-Pacific region and predictive model of their biodiversity.

100. The workshop also exchanged views on synthesis of specific research groups for 2014–2015, national coordination, and grand synthesis and prospects after 2015. In terms of synthesis of specific research groups for 2014-2015, the workshop agreed on proposals for the publication of field guides and/or synthesis papers and compilation of database. Regarding national coordination, the workshop encouraged each member to approach funding agency in their country with well developed proposals, and recruit more young members.

101. With respect to the grand synthesis and prospects after 2015, the workshop decided to organize one workshop aiming to synthesize the results of the integrative research on sea-grass ecosystems, to enhance collaborative network, and to develop funding strategies. It was also agreed that National Coordinators will disseminate information on ABS (Access to genetic resources and Benefit Sharing) and research permission in each country through the network of the Asian CORE.

102. Special emphasis was made on the importance of linking purely scientific research with social issues. It was strongly recommended that ACORE-COMSEA should keep close collaborations with WESTPAC when implementing its activities in 2014 – 2015, and planning its activities beyond 2015.

5.6 Workshop 6: Coastal & Marine Biodiversity and Conservation (WESTPAC-CMBC)

Convener:
Dr Suchana Apple Chavanich, Department of Marine Science, Faculty of Science, Chulalongkorn University; Email: suchana.c@chula.ac.th, achavanich@hotmail.com

103. The workshop was attended by more than 30 participants including 14 project steering group members, 1 from NOWPAP, 6 invited experts from the region. It aimed to i) review past and current activities that have been carried out through WESTPAC Project on Coastal Marine Biodiversity and Conservation; ii) discuss about future activities; iii) review the list of the Project Steering Group; iv) provide steering group an opportunity to present their research work on marine biodiversity in order to enhance visibility of the project at international conferences.

104. Dr Suchana Chavanich summarized all activities that have been carried out since 2009 through the WESTPAC Project on Coastal Marine Biodiversity and Conservation, which includes: six workshops on marine non-indigenous species and management in the Western Pacific region, two workshops on coral reef restoration technique, and one workshop on taxonomy of certain taxonomic group (soft corals); current status report on marine non-indigenous species in the Western Pacific region, and coral restoration techniques in the Western Pacific region; one poster on pathways of introduction of marine non-indigenous species in the Western Pacific region.

105. Meanwhile, collaborations have been well established with other WESTPAC projects, such as WESTPAC-HAB, WESTPAC-DRMREEF, WESTPAC-TMO, WESTPAC- Remote Sensing; and other partners and international programmes, including PICES, ICES, UNEP/COBSEA, UNEP/NOWPAP, and JSPS ACORE-COMSEA.

106. In terms of future activities, the Project Steering Group decided to prepare scientific papers related to marine non-indigenous species and coral restoration, update the list of marine non-indigenous species in the Western Pacific region, and prepare the report/book of WESTPAC coral restoration and rehabilitation techniques.

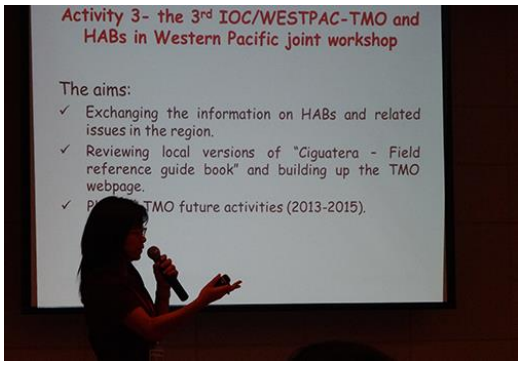
107. Several other activities have also been proposed. However, if possible, those activities could be carried out in collaboration with other WESTPAC Projects, for example, biodiversity and molecular technique with WESTPAC-DRMREEF, Taxonomy of planktons with WESTPAC-HAB and WESTPAC-TMO.

108. While expressing their interests in monitoring the impacts of ocean acidification on coral reef ecosystem in the region, the Group stressed the need for WESTPAC to lead the development of a regional ocean acidification monitoring protocol/program, and further expressed their willingness to join this effort.

5.7 Workshop 7: Toxic Marine Organisms (WESTPAC-TMO)

Convener:
Dr Dao Viet Ha, Institute of Oceanography, Vietnam; Email: daovietha69@gmail.com; dvhaio@yahoo.com

109. The workshop aimed to review the progress made on the translation of the bilingual (English/French) publication entitled “Ciguatera: Field Reference Guide” into local languages, discuss about future activities of TMO project in 2014-2015 on Ciguatera Fish Poisonings (CFP). Up to 40 participants including 11 project steering committee members joined the workshop.



110. “Ciguatera: Field Reference Guide” has been translated into five languages: Chinese, Thai, Tagalog, Malay and Vietnamese. Malay and Tagalog versions were submitted. Chinese, Thai and Vietnamese version would be submitted in June 2014. In addition, participants from Russia and Japan agreed to participate in the translation of the book in Russian and Japanese respectively, which will be submitted in 2015.

111. The workshop agreed that Ciguatera Fish Poisonings (CFP) would be one of main activities of the TMO project in 2014-2015. The status of ciguatera could be assessed through the study on reef fishes and causative dinoflagellate species. Participating countries

were encouraged to assess the status of CFP in their home countries. The workshop also proposed joint field survey on the ciguatera outbreak event in the region, and encouraged members to secure possible funding from their national sources.

112. However, considering the difficulties in CFP study, such as sample collection by chance, limited laboratory facilities and human resources, Dr Dao Viet Ha, TMO Project Leader suggested that TMO focus its activities in 2014 – 2015 on the development of one Guide Book on Toxins. She would take a lead to develop one proposal and send it to all members in June 2014 for further comments and revisions.

5.8 Workshop 8: Ocean Acidification

Convener:
Dr Somkiat Khokiattiwong, Phuket Marine Biological Center, Department of Marine and Coastal Resources, Thailand, Email: skhokiattiwong@gmail.com

113. Following the closure of Session 9: Ocean Acidification and its Effects on Marine Ecosystems, this workshop was convened, aiming to explore the possibility of the development of a regional program in relation to OA research and monitoring, and its effects on coral reef ecosystems.

114. While noting with appreciation the great opportunity provided by WESTPAC to network OA experts within and outside the region, the workshop highlighted the need for WESTPAC to lead the development of one regional program on OA research and monitoring. With strong willingness received from many scientists, the workshop decided to start preparing, with great assistance of experts from the U.S. National Oceanic and Atmospheric Administration (NOAA), a proposal for one regional training workshop towards the development of a monitoring program on OA's impact on Coral Reefs in the Indo-Pacific region.

5.9 Workshop 9: Expedition of Widya-Nusantara (EWIN)-2013

Convener:
Dr Zainal Arifin, Research Center for Oceanography, Indonesian Institute of Sciences, Indonesia, E-mail: arifinz2010@gmail.com;

115. The EWIN cruise 2013 is a regional activity supported by the Government of Indonesia in commemoration of the 25th Anniversary of WESTPAC. The cruise was conducted in May 2013 with participation of scientists from several countries in the region, aiming to explore vertical mixing processes, transport of pollutants, and pelagic and benthic biodiversity in the deep sea of the Makassar Strait,. The objectives of the workshop 2014 were two folds, firstly to share information among participants of the result of cruise and the status of the oceanographic data analysis; and secondly to receive feedbacks among participants if the EWIN cruise could be done on a regular basis.

116. The workshop was run through five presentations by team members from China, Republic of Korea and Indonesia and discussions followed. More than 20 participants attended this workshop with topics ranging from physical process in Makassar Strait (Indonesia), Carbon budget (China), Genetics of Plankton (Republic of Korea), to the ecology of eel (Indonesia). Mr Arief Rahman of Indonesia presented the draft plan for EWIN cruise 2014, and invited workshop participants to join the cruise in the western part of the Sulawesi Sea.

117. High level of enthusiasm for the EWIN 2014 was expressed by most participants, especially those from Korea and China. The workshop recommended that the EWIN could

be further developed as a regional “Training on Board” activity to nurture young scientists in the WESTPAC region. The workshop further suggested that appropriate funding mechanism be explored to make this cruise possible, including cost-sharing and/or donation.

6. RESEARCH DIRECTORS’ FORUM

Conveners:
[1]Dr Dosoo Jang, Korea Institute of Ocean Science and Technology, Korea; Email: dsjang@kiost.ac;
[2]Dr Yutaka Michida, University of Tokyo, Japan; Email: ymichida@aori.u-tokyo.ac.jp;
[3]Mr Wenxi Zhu, IOC Regional Office for WESTPAC, Thailand; Email: w.zhu@unesco.org

118. The Research Directors’ Forum, as an integral part of the 9th WESTPAC International Scientific Symposium, was held in Nha Trang, 22 April 2014. Serving as an open-ended platform for directors from marine scientific institutes, academic faculties and/or operational agencies in the Indo-Pacific, the Forum aims to build and enhance networks; exchange strategic directions of their institutions; identify scientific and technical challenges; and spark regional actions in the framework of IOC for future collaboration by exploring any opportunity of synergizing existing and planned observations, and furthering operational oceanography through the emerging Indo-Pacific Ocean Observations and Services Network (IPON). To this end, directors are also expected to consider the feasibility of establishing an appropriate scientific mechanism, i.e. Scientific Steering Committee (Group of Experts), to further propel the development of the Network in question.

119. More than fifty research directors, representatives and regional experts in the Indo-Pacific met at the Forum. The Forum culminated in the adoption and signing of one Joint Statement of Research Directors towards the attainment of the future we want: “A Healthy and Safe Ocean for Prosperity in the Indo-Pacific Region”, calling for the following:

- urgent action to establish the Indo-Pacific Ocean Observations and Services Network (IPON);
- creation of the Scientific Steering Committee for Indo-Pacific Ocean Observations and Services Network (SC-IPON) as an arm to guide the development of IPON;
- heightened recognition from IOC/UNESCO Member States, regional leadership and policy decision makers on the need to establish IPON;

- marine scientific communities to undertake further research on, and sustained observations of, the ocean processes and climate, earth dynamics, and the impacts of climate change and anthropogenic activities on vulnerable marine biodiversity and ecosystems;
- continued support for GOOS and other IOC Subsidiary Bodies, and active engagement in, the development of sustained, integrated and multi-purpose observation and information system on ocean processes, earth dynamics and marine ecosystems for improved services to the Indo-Pacific societies through the development of IPON;
- increased assistance to developing nations in the Indo-Pacific region, including Small Island Developing States (SIDS);
- enhanced efforts in capacity building in developing nations in the Indo-Pacific region, in particular through the development of technical assistance programs and materialization of the “IOC Regional Network of Training and Research Centers on Marine Science”.

120. The Joint Statement of Research Directors is attached to this report as Annex V, and the draft Concept Paper on Conceptualizing an Initiation towards the Establishment of a Scientific Steering Committee for the Indo-Pacific Ocean Observations and Services Network (SC-IPON) is attached as Annex V for further suggestions.

7. WESTPAC OUTSTANDING SCIENTIST AWARD 2014

121. On the occasion of the 25th Anniversary of WESTPAC, the WESTPAC Outstanding Scientist Award is established for the first time in recognition and appreciation of marine scientists for their long term dedication to regional marine science development and cooperation. The selection process has been conducted since December 2013 with broad engagement of WESTPAC Offices, Officers and WESTPAC Advisory Group.

122. Dr Fangli Qiao (China), Dr Suchana Chavanich (Thailand), Dr Yutaka Michida (Japan), Dr Nguyen Tac An (Vietnam), and Dr Yasuwo Fukuyo (Japan) were finally selected and awarded WESTPAC Outstanding Scientist 2014 on 22 April 2014 at the WESTPAC Ninth International Scientific Symposium, Nha Trang, Vietnam.

123. For more information on their achievements, please link to http://iocwestpac.org/news/395.html

Left to right: Dr Yasuwo Fukuyo (Japan), Dr Yutaka Michida (Japan), Dr Suchana Chavanich (Thailand), Dr Nguyen Tac An (Vietnam), and Dr Fangli Qiao (China)

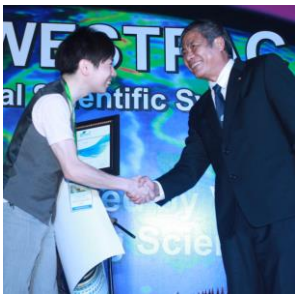
8. WESTPAC BEST YOUNG SCIENTISTS AWARD 2014

124. IOC Sub-Commission for the Western Pacific (WESTPAC) awarded its Best Young Scientist Award 2014 on 24 April 2014 to five outstanding young scientists from the region, three for the best oral presentation and two for the best poster. The WESTPAC Best Young Marine Scientist Award was first established in 2011 at its 8th Symposium (Busan, Republic of Korea, 28-31 March 2011) in order to assist young scientists to further dedicate themselves to marine science, sustained observations and services underpinning the sustainability of ocean and coastal resources to benefit all.

125. After three days' evaluation and selection, Mr Ryota Nakajima (Japan), Ms Intan Suci Nurhati (Indonesia) and Ms Ngoc Tuyen Nguyen (Vietnam) won the Best Young Scientist Oral Presentation Award with their presentations, respectively on "*Enrichment of microbial abundance in the sea-surface microlayer over a coral reef: implications for biogeochemical cycles in the reef ecosystems*", "*Coral record of surface seawater density in the Western Indonesian Seas: Implication to 20th Century Indonesian Throughflow Variations"* and "*Assessing coastal vulnerability for Phu Quoc Island in conditions of sea level rise"*..

126. While Mr Toh Hii Tan (Malaysia) and Mr Kazuya Takahashi (Japan) obtained the Best Young Scientist Poster Award with their posters on *" Habitat preference of potentially harmful benthic dinoflagellates in the fringing reefs of Talang Besar Island, Malaysia*" and " *Morphology and phylogeny of two Suessiaceae related species (Dinophyceae) from Vietnamese coast"* respectively.

Best Young Scientist Oral Presentation Award



Mr Ryota Nakajima (Japan)

Ms Intan Suci Nurhati (Indonesia)

Ms Ngoc Tuyen Nguyen (Vietnam)

Best Young Scientist Poster Presentation Award

Mr Toh Hii Tan (Malaysia)

Mr Kazuya Takahashi (Japan)

127. The five winners will be awarded the full financial support for their participation to the next IOC/WESTPAC International Scientific Symposium in 2017 once their abstracts are accepted, including the most economic roundtrip air ticket, food and local accommodations.

128. With the financial support of the Government of Vietnam, Korea Institute of Ocean Science and Technology (KIOST), and State Oceanic Administration of China (SOA), 50 young scientists of no more than 35 years have been provided with partial and full travel support to facilitate their participation in the 9th International Scientific Symposium, 22-25 April 2014, Nha Trang.

129. Let's cheer these young winners and wish them a brighter career development in marine science.

9. CONCLUSIONS AND RECOMMENDATIONS

130. The WESTPAC 9th International Scientific Symposium entitled ""A Healthy Ocean for Prosperity in the Western Pacific: Scientific Challenges and Possible Solutions" concluded with a great success in Nha Trang, Vietnam.

131. Built on the achievements from the last symposium (Busan, Republic of Korea, 28-31 March 2011), the WESTPAC 9th International Scientific Symposium sets a new record in its history with up to 14 sessions and 9 workshops conducted concurrently and an overwhelming number of participants registering either online or on site. A total of 607 participants from 24 countries had registered online prior to the event with 550 scientists and governmental officials from 21 countries, within and outside WESTPAC region, finally taking part in the Symposium. All statistics demonstrated the ever-increasing interests of scientists and countries in WESTPAC, and the ever-growing leadership of WESTPAC in the promotion of marine science development and cooperation in the region.

132. WESTPAC organized its first-ever Research Directors' Forum to provide one open-ended platform for directors from marine scientific institutes, academic faculties and/or operational agencies in the region, to build and enhance networks; exchange strategic directions of their institutions; identify scientific and technical challenges; and spark regional actions for future collaboration. This Forum culminated in the signing of the Joint Statement of Research Directors. The number of participating institutes from this region reflected the willingness of the directors and their institutes to engage in regional collaborations, and contribute to the common undertakings towards the attainment of the Future We Want.

133. It was also the first time that WESTPAC established the "WESTPAC Outstanding Scientist Award" at this Symposium in recognition and appreciation of those marine scientists for their long term dedication to regional marine science development and cooperation. This award shall continue to be presented at future symposia to those selected recipients with selection criteria and process to be further improved.

134. To nurture young science leaders and facilitate international exposures of young scientists under thirty-five, the WESTPAC Young Scientist Travel Grant was continuously established with financial support of the Government of Vietnam, Korea Institute of Ocean Science and Technology, and State Oceanic Administration of China. Fifty young scientists have been provided with partial or full financial support for their participation in this Symposium.

135. More importantly, this Symposium continued to tap world leading scientists/agencies in global hotspot issues to regional context, with a view to providing a clearer global picture, such as climate change and ocean acidification, for our regional scientists and enabling them to better tune up their research in the global context.

136. A number of recommendations were put forward from the Symposium, which are listed below.

137. **Participants recognized** the critical role and socio-economic importance of the Western Pacific and its adjacent regions which constitutes one major influence on regional & global climate system, the epicenter of the world marine biodiversity, spawning and nursery grounds for diverse marine species, a potential reservoir of non-living resources, and a treasure sustaining over one–third of the world's population.

138. **Participants expressed concerns** over the pressures and threats to the health of marine ecosystems and prosperity in the region, such as depletion of resources, escalating pollution, degradation of coastal habitats, climate change and ocean acidification, as well as climate disasters regarding monsoons, droughts, typhoons/extreme weather events.

139. Given that our knowledge on ocean remains too limited for us to be able to understand and predict global and regional ocean conditions and their interactions with the atmosphere, biosphere and land, **participants therefore called for** a renewed commitment to marine scientific research, sustained ocean observations, development and transfer of technology, and related education and training.

140. As such, **participants emphasized the importance** of the WESTPAC International Scientific Symposium as an essential regional platform for marine scientific communities, competent government agencies within and outside the region to advance ocean knowledge, catalyze inter and multi-disciplinary collaborations with a view to addressing those challenges towards the attainment of "A Healthy Ocean for Prosperity", and further **underlined the need** for WESTPAC to continuously organize the event on a regular basis by bringing together scientists from within and outside the region.

141. **Participants expressed their appreciation** to WESTPAC for its tremendous efforts made in the past, **and further underscored** the essential role of WESTPAC in the coordination, development and implementation of marine scientific programs, sustained observations and services in the Western Pacific and its adjacent region (or Indo-Pacific region) through its well established intergovernmental mechanism and operational framework.

142. **Participants recommended** WESTPAC to develop closer links among scientists, institutes and countries in the region, and intensify its efforts to continue cultivating marine science talent, developing sustained observations and relevant infrastructure, and sharing the knowledge and data through capacity development activities in the region, in particular through the development of technical assistance programs and materialization of the "IOC Regional Network of Training and Research Centers on Marine Science".

143. Bearing in mind the spirit of south-south, and south-north cooperation, **participants strongly encouraged** the transfer of technology between scientifically advanced institutes and developing institutes, and **appealed to** their national competent authority for increased investment on marine science, observations and capacity building to underpin the sustainability of their marine and coastal biodiversity and resources for sharing the wealth to benefit all.

144. Concurring on three WESTPAC themes[4], **participants further suggested** the following inexhaustive subjects concerning the future research and development in the Western Pacific and its adjacent regions:

- Sustained Ocean Observations and Services, particularly the emerging Indo-Pacific Ocean Observations and Services Network (IPON);
- Ocean forecasting system, particularly the second phase of SEAGOOS Ocean Forecasting Demonstration System;
- Ocean Acidification and its impact on marine ecosystems;
- Atmosphere and ocean circulation, and sea-air interaction;
- Coastal erosion and coastal hazards, such as storm surge;
- Ecosystem restoration techniques/methods;
- Vulnerability assessment methodology and tools…

145. Massive campaigns should be launched to prepare the general public, particularly policy makers to understand critical issues such as ocean acidification and its consequences, and the role of ocean in climate change and variability and humans' lives. This requires combined efforts of the government and non-governmental organizations, and especially the media of mass communication.

146. **Participants highly appreciated** the establishment of "WESTPAC Outstanding Scientist Award" as an effective motivation for scientists in the region to dedicate themselves to regional marine science development and cooperation, and **further called upon** more capable scientists to demonstrate their leadership in addressing scientific challenges the region is particularly facing.

147. Meanwhile, the "WESTPAC Best Young Scientist Award" has proven to be a valuable means to encourage young scientists to engage in international scientific

[4] (1) Understanding ocean processes in the Indo-Pacific region; (2) Ensuring marine biodiversity, food safety and security; (3) Maintenance of ocean health

collaborations. **Participants therefore strongly recommended WESTPAC to** continuously selecting the best young scientists for this award in the future symposia.

148. In terms of organization, with some lessons learnt from the 8th Symposium (Busan, Republic of Korea, 28-31 March 2011), some measures were taken, prior to the 9th Symposium, to improve the "no notification and no show" situation of selected oral presenters though they confirmed their attendance to their session conveners. It proved that this situation was greatly improved this time. However, there were still some selected oral and poster presenters who did not show up without informing the organizers and conveners. More appropriate measures shall be sought for the future symposia. Furthermore, suggestions were made by several session conveners on the possibility to allocate more time for discussions at the last part of their sessions.

10. ACKNOWLEDGEMENT

149. The success of this WESTPAC International Scientific Symposium could not have been possible without the support, hard work and continuous efforts of a large number of individuals and institutions.

150. The IOC Sub-Commission for the Western Pacific is particularly grateful to the Government of Vietnam, through its Vietnam Academy of Science and Technology (VAST) for hosting this Symposium, the Institute of Oceanography, VAST; National IOC Committee for Vietnam for co-organizing this Symposium.

151. Special thanks to all invited keynote speakers for preparing and delivering thought-provoking presentations out of their extremely busy schedule. Our sincere appreciation shall be extended to Session and Workshop Conveners for their valuable time spent in chairing and screening the best candidate from their respective sessions and workshops for the "WESTPAC Young Scientist Award 2014", and all members of the International Scientific Symposium for their guidance on the symposium programs and final selection of the "WESTPAC Best Young Scientist Award 2014".

152. Last but not the least, the IOC Sub-Commission for the Western Pacific would like to express its sincere gratitude to the Local Organizing Committee, particularly Dr Vo Si Tuan, Ms Do Minh Thu, and Ms Dao Viet Ha of the Institute of Oceanography, Vietnam for their long-term hard work and efficient coordination with relevant individuals and institutions.

Annex I

Opening and Congratulatory Remarks

Opening Remark of Dr Vo Si Tuan
Chair of the National Organizing Committee

H.E. Prof. Chau Van Minh, President, VAST
Dr. Wendy Wright Watson, Executive Secretary, Intergovernmental Oceanographic Commission, Interim Assistant Director General, Natural Sciences of UNESCO
Dr. Tran Son Hai, Permanent Vice Chairman of the People' Committee of Khanh Hoa Province
Participants of the 9th IOC/WESTPAC Scientific Symposium
Guests, Colleagues and Friends

As you may be aware, 25 years ago in 1984, the Sub-Commission for the Western Pacific of Inter-Governmental Oceanographic Commission (IOC/WESTPAC) was established with the mandates to forging cooperation among scientists, institutes and countries in the Western Pacific and adjacent regions in the study of ocean, in order to assist countries in sustainably managing ocean and coastal biodiversity and resources, protecting coastal populations, and maintaining ecosystem services in line with their own priorities and needs. The Scientific Symposium is considered as a tool for implementing these WESTPAC mandates, and in its history 8 symposia had been convened periodically in the member states, including: Australia, Malaysia, Indonesia, Japan, Korea and China.

Upon the kind offer of the Government of Vietnam, the WESTPAC 9th International Scientific Symposium entitled "A Healthy Ocean for Prosperity in the Western Pacific: Scientific Challenges and Possible Solutions" is hosted by the Vietnam Academy of Science and Technology (VAST), and organized by the Institute of Oceanography, VAST; National IOC Committee for Vietnam and IOC Sub-Commission for the Western Pacific (WESTPAC).

The objectives of the Symposium are to bring together marine scientists, particularly young scientists, with a view to examining the achievements in marine sciences over the last 25 years, advancing marine scientific knowledge, and catalyzing multi- and cross-disciplinary collaboration towards the improvement in management practices and decision-making processes for sharing the wealth of the ocean to benefit all.

According to pre-symposium statistics, more than 550 scientists from 24 countries and territories registered and accepted to participate in the symposium, including 16 from the Western Pacific; and countries from outside region such as England, France, India, Bangladesh, Iran, Yemen, Germany and USA. Five hundred and one abstracts were accepted and confirmed for presentations in the symposium with 250 for oral presentations and 251 for poster session. The symposium is conducted under 14 sessions under 3 themes namely: Understanding Ocean Processes in the Indo-Pacific Region; Ensuring Marine Biodiversity, Food Safety and Security; Maintenance of Ocean Health; and Cross-cutting and Emerging Issues. Specially, a Director Forum is convened in order to serve as one open-ended platform for Directors from marine scientific institutes, academic faculties and operational agencies in the Indo-Pacific region to build and enhance networks among participants; exchange strategic directions of their institutions; identify scientific and technical challenges; and spark regional actions in the framework of IOC. Nine parallel workshops and 4 pre- & post-symposium side events are also convened. It is considered that this is a big event to celebrate the 25th Anniversary of IOC/WESPAC.

Having said that the preparation of this symposium required great efforts of many organizations and individuals, including inter alia: the International Scientific Steering Committee, National Organizing Committee, WESTPAC Secretariat, and local secretariat with main financial support by VAST, and contributions of international and in-country sponsors. Thanks very much for everything and having the honor of opening the 9th IOC/WETSPAC Scientific Symposium.

Thank you for your attention.

Opening Remark of Prof Chau Van Minh
President of Vietnam Academy of Science and Technology, Vietnam

On behalf of the Government of Vietnam, I welcome you all to the IOC/WESTPAC 9th International Scientific Symposium and congratulate all member states on the occasion of the 25th anniversary of IOC Sub-commission for the Western Pacific (WESTPAC). After 25 years since its establishment, WESTPAC has developed a systematic framework and strategic process for member states in the region to develop and coordinate regional marine scientific research programmes and activity of the IOC in the regional context.

The IOC/WESTPAC has organized and co-sponsored a series of statutory WESTPAC international scientific symposia as a unique regional platform to advance marine scientific knowledge, and catalyze multi- and cross-disciplinary collaboration with a view to addressing regional challenges which have occurred in the changing world. Since its first symposium held in Townsville, Australia 1989, the WESTPAC symposia had been successfully held in Penang-Malaysia, Bali-Indonesia, Okinawa-Japan, Seoul-Korea, Hangzhou-China, Kota Kinabalu-Malaysia and Busan-Korea. This time, the Government of Vietnam through Vietnam Academy of Science and Technology is very much honor to be the host of the 9th event. Thanks all WESTPAC state members for this selection which indicated your high appreciation to Vietnam's role in the region.

With the theme "*A Healthy Ocean for Prosperity in the Western Pacific: Scientific Challenges and Possible Solutions*", the IOC/WESTPAC 9th international scientific symposium with the participation of more than 500 scientists from 24 states and international organizations will provide opportunities for scientists, specially young ones, to share achievements' and advances in marine science over the last 25 years, and develop further collaboration to address challenges toward a healthy ocean for long-term sustainability and to benefit all.

I would take this opportunity to thank UNESCO, IOC and WESTPAC for the long term supports to Vietnam during recent many years. I would express the high appreciation to the International Scientific Steering Committee, National Organizing Committee, WESTPAC Secretariat, Institute of Oceanography, international and in-country sponsors, the distinguished speakers and delegates for contributions in preparation and organization of this important event. I wish successful deliberations and hope you will enjoy the interactive and intensive discussion in the symposium. Also, I hope all of you will enjoy Nha Trang city - a well-known tourist destination of Vietnam.

Opening Remark of Dr Wendy Watson-Wright
Executive Secretary of IOC and Assistant Director General of UNESCO

Dear H.E. Prof. Chau Van Minh, President of Vietnam Academy of Science and Technology,
Dear Dr Tran Son Hai, Permanent Vice Chairman of the People' Committee of Khanh Hoa Province

Dear Dr Vo Si Tuan, Chair of the National Organizing Committee,
Participants of the 9th IOC/WESTPAC International Scientific Symposium

It is a great pleasure for me to welcome you all to the ninth WESTPAC International Scientific Symposium entitled "A Healthy Ocean for Prosperity in the Western Pacific". On behalf of the Intergovernmental Oceanographic Commission (IOC) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), I would extend my heartfelt thanks to the Government of Vietnam, through its Vietnam Academy of Science and Technology (VAST) for hosting; the Institute of Oceanography, Vietnam National Committee for IOC, and IOC Sub-Commission for the Western Pacific (WESTPAC) for organizing the important event.

IOC has been attaching great importance to the Western Pacific and its adjacent regions, given the tight links of ocean and coasts to human well being, safety and prosperity in the most densely populated region. In the case of Vietnam, marine economy has amounted to 30% of its GDP with 10 million job opportunities provided for people in coastal provinces. We have been benefiting from the ocean on one hand, and impacting on ocean, even negatively, on the other hand. The need for management of our links to ocean requires ocean-related research, observations and monitoring including data management, ocean and earth system forecasting, and the development of information for societal benefit.

IOC started with a regional project - Collaborative Study of Kuroshio (CSK) in the Western Pacific in 1965 with 12 countries participating in, which provided the impetus for setting-up the IOC Program Group for WESTPAC in 1977, and eventually leading to the formal establishment of the IOC Sub-Commission for the Western Pacific (WESTPAC) in 1989 with its regional office having been hosted by the Government of Thailand since 1994. Since then, IOC, through its WESTPAC, has been sparing no effort to foster international cooperation among scientists, institutes and countries in the Western Pacific and adjacent regions.

I would extend my warmest congratulation on remarkable achievements WESTPAC has been made over the past years in the establishment of strong partnership with its member states in the region, and the development of national and regional capacity for the study and monitoring of the ocean and coasts, serving the needs of countries in sustainably managing their ocean and coastal biodiversity and resources, protecting coastal populations, and maintaining ecosystem services. Among others, the regular WESTPAC International Scientific Symposia have fully demonstrated the Sub-Commission's role as the regional platform for advancing marine scientific knowledge, catalyzing multi- and cross-disciplinary collaboration towards the improvement in management practices and decision-making processes for sharing the wealth of the ocean to benefit all.

On the occasion of its 25th anniversary, I believe the 9th Symposium is organized in an ideal time, providing an optimum opportunity for marine scientific communities to examine the past achievement, identify scientific and technical challenges, and spark concrete actions for future collaborations.

I would recall, the Outcome Document of Rio+20 “the Future We Want” sets out main challenges facing our oceans, highlights the need for networks of ocean observation and knowledge underpinning sustainable development, and calls for a wide range of actions by UN, governments, and civil society . As the United Nations Secretary-General said, Rio+20 is not “an end but a beginning.” I saw it as a call to action to the Intergovernmental Oceanographic Commission (IOC), a call to strengthen its role within UN system in contributing to sound scientific research, systematic observations, and reliable services for sustainable management of marine and coastal resources. As such, I do expect that

WESTPAC, serving as the regional arm of IOC, will continuously keep its momentum and further strengthen the leadership of IOC in the region.

In closing, I would like to express my sincere appreciation AGAIN to the Vietnam Academy of Science and Technology (VAST), the Institute of Oceanography, VAST; National IOC Committee of Vietnam for hosting and co-organizing this symposium, particularly the members of the National Organizing Committee and its Local Secretariat, the International Scientific Steering Committee, and the WESTPAC Office for their hard work in the preparation of the Symposium.

I wish the Symposium a great success!

Opening Remark of Dr. Tran Son Hai
Vice president of People Committee of Khanh Hoa Province

Dear Prof. Chau Van Minh, the President of Vietnam Academy of Science and Technology,
Dear Dr. Wendy Watson-Wright, Executive Secretary of IOC & Assistant Director General of UNESCO
Distinguish Guests, Ladies and Gentlemen

On behalf of Khanh Hoa Province Leaders, I would like to deliver my sincerely welcome to all of international scientists attending the 9th IOC/WESTPAC International Scientific symposium, 22-25 April, 2014 in Nha Trang city, Khanh Hoa Province. It is our honor to have all of you here.

Ladies and Gentlemen,

Nha Trang city, Khanh Hoa province is well-known as the most famous tourist destination in Vietnam, with more than 350 km coastal line, which is face to the sea with beautiful white beach and several surrounding islands, back to imposing and holy mountains and forests.

Not only that, our province is very much proud of the presence of several leading Institutes, which have contributed a lot for social and economic development of the province. Among of these, Institute of Oceanography has been well-known with more than 90 years of developmental history. Nowadays, Institute of Oceanography is the leading organization on Oceanographic sciences in Vietnam, and has affirmed scientific achievement in the Western Pacific region as well as in the world.

We are very happy to know that Institute of Oceanography, VAST is organizing this International Scientific event in our lovely city. This is great honor for Vietnam, especially for Khanh Hoa Province. I would like to deliver a deeply thank to all international friends as well as VAST to commit us in this important task.

By taking this chance, I wish to send to all of you the message that Khanh Hoa Province, Vietnam is always ready to support scientific activities nationally and internationally, in order to keep our healthy ocean for our future prospect, as the slogan of this symposium.

Further, I hope during staying in Nha Trang, all of you will have a chance to discover and experience about the natural, people and culture of our beautiful and smiling City.

One again, I wish to send the best wish to all of delegations, distinguish guests and participants. Thank you very much!

Annex II

Program at a glance

21/4 (Monday)	22/4 (Tuesday)	23/4 (Wednesday)	24/4 (Thursday)	25/4 (Friday)
	Registration 08:00-12:00	Registration 08:00-12:00		-
	Opening & A Commemoration of 25th Anniversary of IOC/WESTPAC (incl. Keynote 1) 09:00-10:00 Keynote 2 10:00-10:30	Keynote 3 Keynote 4 09:00-10:00	Sessions & Workshops 09:00-10:40	Excursion 10:00-18:00
	PHOTO & COFFEE BREAK 10:30-11:10	COFFEE BREAK 10:00-10:30	COFFEE BREAK 10:40-10:50	
	Sessions & Workshops 11:10-12:20	Keynote 5 & 6 10:30-11:30	Sessions & Workshops 10:50-12:30	
	LUNCH 12:20-13:30	POSTER / LUNCH 11:30-13:30	LUNCH 12:30-13:30	
Early Registration 14:00-19:30	Sessions & Research Directors' Forum 13:30-15:30	Sessions & Workshops 13:30-15:30	Sessions & Workshops 13:30-15:30	
	COFFEE BREAK 15:30-15:50	COFFEE BREAK 15:30-15:50	COFFEE BREAK 15:30-15:50	
Preparatory Meeting 16:30-18:00	Sessions & Research Directors' Forum 15:50-18:00	Sessions & Workshops 15:50-18:00	Sessions & Workshops 15:50-18:00	
	Welcome Reception & WESTPAC Outstanding Scientist Award 18:30-21:00		Farewell Party & WESTPAC Best Young Scientist Award 18:30- 20:30	

DAY 1: Tuesday 22 April 2014

Grand Ballroom AB	Altitude
Registration 08:00-12:00	Research Directors' Forum 13:30-15:30
Opening & Commemoration of 25th Anniversary of IOC/WESTPAC 09:00-10:00 Keynote 2 10:00-10:30	COFFEE BREAK 15:30-15:50
PHOTO SESSION & COFFEE BREAK 10:30-11:10	Research Directors' Forum 15:50-18:00

Grand Ballroom A	Grand Ballroom B	Hon Tre	Yersin A	Hon Chong
Session 1: Role of the Indo-Pacific Ocean in regional climate change and variability 11:10-12:20	**Session 5:** Status, trends of marine biodiversity and productivity 11:10-12:20	**Session 8:** Changing ocean biogeochemistry and its ecosystem impact 11:10-12:20	CorReCAP Side Event 11:10-12:20	**Session 9:** Ocean acidification and its effects on marine ecosystems 11:10-12:20
LUNCH 12:20-13:30				
Session 2: Status, trends and effects of climate, natural disturbances and anthropogenic stressors on ocean ecosystems 13:30-15:30	**Session 5:** Status, trends of marine biodiversity and productivity 13:30-15:30	**Session 8:** Changing ocean biogeochemistry and its ecosystem impact 13:30-15:30	**Session 10:** Harmful algal blooms 13:30-15:30	**Session 6:** Sustainable fisheries & aquaculture 13:30-15:30
COFFEE BREAK 15:30-15:50				
Session 2: Status, trends and effects of climate, natural disturbances and anthropogenic stressors on ocean ecosystems 15:50-18:00	**Session 5:** Status, trends of marine biodiversity and productivity 15:50-18:00	**Session 8:** Changing ocean biogeochemistry and its ecosystem impact 15:50-18:00	**Session 10:** Harmful algal blooms 15:50-18:00	**Session 6:** Sustainable fisheries & aquaculture 15:50-18:00
Welcome Reception hosted by WESTPAC & WESTPAC Outstanding Scientist Award (18:30-21:00)				

DAY 2: Wednesday 23 April 2014

Grand Ballroom AB
Registration 08:00-12:00
Keynote 3 & Keynote 4 09:00-10:00
COFFEE BREAK 10:00-10:30
Keynote 5 & Keynote 6 10:30-11:30
POSTER SESSION (Presenters' presence required at the poster display) 11:30-12:30

Grand Ballroom A	**Grand Ballroom B**	**Hon Tre**	**Yersin A**	**Hon Chong**
LUNCH 12:30-13:30				
Session 12: Remote sensing in integrated coastal and marine management 13:30-15:30	**Session 5:** Status, trends of marine biodiversity and productivity 13:30-15:30	**Session 14:** New technology & data management 13:30-15:30	CorReCAP Side Event 13:30-15:30	**Session 13:** Development and demonstration of ocean forecasting system 13:30-15:30
COFFEE BREAK 15:30-15:50				
WESTPAC Workshop on Remote Sensing for Coastal Habitat Mapping Project 15:50-18:00	WESTPAC Workshop on DRMREEF Project 15:50-18:00	**Session 14:** New technology & data management 15:50-18:00	**Session 4:** Sediment source to sink process in the Western Pacific 15:50-18:00	**Session 13:** Development and demonstration of ocean forecasting system 15:50-18:00

DAY 3: Thursday 24 April 2014

Grand Ballroom A	Grand Ballroom B	Hon Tre	Yersin A	Hon Chong
Session 12: Remote sensing in integrated coastal and marine management 09:00-10:40	**Session 5:** Status, trends of marine biodiversity and productivity 09:00-10:40	**Session 3:** Risk/vulnerability assessment on coastal sea-level related hazards 09:00-10:40	WESTPAC Workshop on Harmful Algal Blooms Project 09:00-10:40	**Session 13:** Development and demonstration of ocean forecasting system 09:00-10:40
COFFEE BREAK 10:40-10:50				
Session 2: Status, trends and effects of climate, natural disturbances and anthropogenic stressors on ocean ecosystems 10:50-12:30	Workshop on Asian CORE Project 10:50-12:30	**Session 11:** Restoration and conservation of marine ecosystems 10:50-12:30	**Session 7:** Toxic marine organisms and seafood safety 10:50-12:30	**Session 9:** Ocean acidification and its effects to marine ecosystems 10:50-12:30
LUNCH 12:30-13:30				
Session 1: Role of the Indo-Pacific Ocean in regional climate change and variability 13:30-15:30	Asian CORE Project Workshop 13:30-15:30	**Session 11:** Restoration and conservation of marine ecosystems 13:30-15:30	**Session 7:** Toxic marine organisms and seafood safety 13:30-15:30	**Session 9:** Ocean acidification and its effects to marine ecosystems & a related workshop 13:30-15:30
COFFEE BREAK 15:30-15:50				
Session 1: Role of the Indo-Pacific Ocean in regional climate change and variability 15:50-18:00	WESTPAC Workshop on Coastal Marine Biodiversity and Conservation Project 15:50-18:00	**Session 3:** Risk/vulnerability assessment on coastal sea-level related hazards 15:50-18:00	WESTPAC Workshop on Toxic Marine Organisms Project 15:50-18:00	Workshop on Ewin 2013 Expedition 15:50-18:00
Farewell Party hosted by VAST & WESTPAC Best Young Scientist Award 18:30-20:30				

Annex III

List of the International Scientific Steering Committee & National Organizing Committee

INTERNATIONAL SCIENTIFIC STEERING COMMITTEE

- **Chairperson:** Dr Vo Si Tuan (Vietnam)
- **Co-Chairperson:** Dr Do Soo Jang (Republic of Korea)
- **Members:**

Dr Peter Dexter (Australia)

Dr Weidong Yu (China)

Dr Zainal Arifin (Indonesia)

Dr Ken Ando (Japan)

Dr Shuhei Nishida (Japan)

Dr Youn-Ho Lee (Republic of Korea)

Dr Nor Aieni Haji Mokhtar (Malaysia)

Dr Gil Suico Jacinto (Philippines)

Dr Vyacheslav Lobanov (Russia)

Dr Somkiat Khokiattiwong (Thailand)

Mr Wenxi Zhu (WESTPAC Office)

NATIONAL ORGANIZING COMMITTEE

- **Chairperson:** Dr Vo Si Tuan, Institute of Oceanography (VNIO), VAST
- **Co-Chairperson:** Dr Bui Hong Long, Vietnam National IOC
- **Vice-Chairperson:** Dr Le Dinh Mau, VNIO, VAST
- **Members:**

Prof Dr Ninh Khac Ban, Department of International Co-operation, Vietnam Academy of Science & Technology, VAST

Dr Nguyen Manh Thang, Vietnam National UNESCO

Dr Le Quang Thanh, Ministry of Science & Technology

Representative from Ministry of Security

Dr Phan Ngoc Minh, Department of Planning and Finance, VAST

Prof Dr Tran Duc Thanh, Institute of Marine Environment & Resources, VAST

Prof. Dr. Bui Minh Ly, Nha Trang Institute of Technology Research and Application, VAST

Dr Phung Van Phach, Institute of Marine Geology & Geophysics, VAST

Dr Nguyen Xuan Anh, Institute of Geophysics, VAST

Dr Huynh Ky Hanh, Department of Science & Technology, Khanh Hoa Province

Mrs Vu Thi Thuan, Department of International Co-operation, VAST

Mrs. Do Minh Thu, VNIO, Secretary

Annex IV

List of Session and Workshop Conveners

Theme and Session		Conveners
Understanding Ocean Processes in the Indo-Pacific Region		
Session 1	Role of the Indo-Pacific Ocean in regional climate change and variability	Dr. Weidong Yu - First Institute of Oceanography, SOA, China; email: wdyu@fio.org.cn Dr. Ken Ando - Japan Agency for Marine-Earth Science and Technology (*JAMSTEC*), Japan; email: andouk@jamstec.go.jp Prof. Dr. Bo Qiu - University of Hawaii at Manoa, United States; email: bo@soest.hawaii.edu
Session 2	Status, trends and effects of climate, natural disturbances and anthropogenic stressors on ocean ecosystems	Prof. Dr. Uematsu Mitsuo - the University of Tokyo, Japan; email: uematsu@aori.u-tokyo.ac.jp Dr. Thamasak Yeemin - Ramkhamhaeng University, Thailand; email: thamasakyeemin@yahoo.com Prof. Dr. Huiwang Gao - Ocean University of China, China; email: hwgao@ouc.edu.cn
Session 3	Risk/vulnerability assessment on coastal sea-level related hazards focusing on sea level rise, storm surges and coastal erosion	Prof. Dr. Bui Hong Long - Chairman of Vietnam National IOC Committee, Vietnam; email: buihonglongion@gmail.com Prof. Dr. Ahmad Khairi Abd Wahab - University Technology Malaysia, Malaysia; email: drakaw@gmail.com; akhairi@utm.my
Session 4	Sediment source-to-sink process in the Western Pacific	Dr. Zhifei Liu - Tongji University, China; email: lzhifei@tongji.edu.cn Dr. Fernando P. Siringa - University of the Phillipines, Philippines; email: ando.msi@gmail.com, fpsiringan@upmsi.ph Prof. Dr. Che Abd Rahim Mohamed - National University of Malaysia, Malaysia; email: carmohd@ukm.my
Ensuring Marine Biodiversity, Food Safety and Security		
Session 5	Status, trends of marine biodiversity and productivity (including marine endangered species, invasive species, etc.)	Prof. Dr. Suchana Chavanich - Chulalongkorn University, Thailand; email: suchana.c@chula.ac.th Dr. Youn-Ho Lee - Korea Institute of Ocean Science and Technology, Korea; email: ylee@kiost.ac Prof. Dr. Shuhei Nishida - University of Tokyo, Japan; email: nishida@aori.u-tokyo.ac.jp
Session 6	Sustainable fisheries and aquaculture	Prof. Dr. Choi Kwang-Sik - Jeju National University, Korea; email: skchoi@cheju.ac.kr, skchoi@jejunu.ac.kr Prof. Dr. Saleem Mustafa - University Malaysia Sabah,

		Malaysia; email: saleem@ums.edu.my
Session 7	Toxic marine organisms and seafood safety	Dr. Dao Viet Ha - Institute of Oceanography, VAST, Vietnam; email: daovietha69@gmail.com Dr. Lim Po Teen - National University of Malaysia, Malaysia; email: poteenlim@gmail.com
Maintenance of Ocean Health		
Session 8	Changing ocean biogeochemistry and its ecosystem impact (particularly nutrient supply and cycles, hypoxia , POPs and heavy metals)	Dr. Zainal Arifin - Indonesian Institute of Sciences, Indonesia; email: arifinz2010@gmail.com Dr. Gil Suico Jacinto - University of the Philippines Diliman, Philippines; email: gilj@upmsi.ph
Session 9	Ocean acidification and its effects on marine ecosystems	Dr. Somkiat Khokiattiwong - Phuket Marine Biological Center, Thailand; email: skhokiattiwong@gmail.com Prof. Dr. Zulfigar Yasin - University Sains Malaysia, Malaysia; email: zulfigarusm@gmail.com
Session 10	Harmful algal blooms	Dr. Mitsunori Iwataki, the University of Tokyo, Japan; email: iwataki@anesc.u-tokyo.ac.jp Prof. Dr. Nguyen Ngoc Lam - Institute of Oceanography, VAST, Vietnam; email: habviet.nnl@gmail.com
Session 11	Restoration and conservation of marine ecosystems	Dr. Chou Loke Ming - National University of Singapore, Singapore; email: dbsclm@nus.edu.sg Dr. Edgardo D. Gomez - University of the Philippines Diliman, Philippines; email: edgomezph@yahoo.com
Session 12	Remote sensing in integrated coastal and marine management	Dr. Teruhisa Komatsu - the University of Tokyo; email: komatsu@aori.u-tokyo.ac.jp Dr. Duong Hong Son - Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam; email:dhson.monre@gmail.com; dhson@cenre.ac.vn
Cross-cutting and Emerging Issues		
Session 13	Development and demonstration of ocean forecasting system	Dr. Fangli Qiao - First Institute of Oceanography, SOA, Qingdao, China; email: qiaofl@fio.org.cn Prof. Dr. Fredolin Tangang - National University of Malaysia, Malaysia; email: ftangang@gmail.com
Session 14	New technology and data management	Dr. Ken Ando - Japan Agency for Marine-Earth Science and Technology (*JAMSTEC*), Japan; email: andouk@jamstec.go.jp Prof. Dr. Nor Aieni Haji Mokhtar - Ministry of Science, Technology and Innovation, Malaysia; email: noraieni@mosti.gov.my

Parallel Workshops

No.	Workshop	Time	Location	Organizer
1.	Research Directors' Forum	13:30 - 18:00 (22 April)	Altitude Hall, Sheraton Hotel	Dosoo Jang Yutaka Michida Wenxi Zhu
2.	CorReCAP Side Event	11:10 - 12:20 (22 April) 13:30 - 15:30 (23 April)	Yersin A, Sheraton Hotel	Jing Zhang
3.	WESTPAC Workshop on Remote Sensing for Coastal Habitat Mapping Project	15:50 – 18:00 (23 April)	Grand Ballroom A, Sheraton Hotel	Teruhisa Komatsu
4.	WESTPAC Workshop on DRMREEF Project	15:50 - 18:00 (23 April)	Grand Ballroom B, Sheraton Hotel	Youn Ho Lee
5.	WESTPAC Workshop on Harmful Algal Blooms Project	09:00 – 10:40 (24 April)	Yersin A, Sheraton Hotel	Mitsunori Iwataki
6.	Workshop on Asian CORE Project	10:50 - 15:30 (24 April)	Grand Ballroom B, Sheraton Hotel	Shuhei Nishida
7.	WESTPAC Workshop on Coastal Marine Biodiversity and Conservation Project	15:50 - 18:00 (24 April)	Grand Ballroom B, Sheraton Hotel	Suchana Chavanich
8.	WESTPAC Workshop on Toxic Marine Organisms Project	15:50 - 18:00 (24 April)	Yersin A, Sheraton Hotel	Dao Viet Ha
9.	Workshop on Ocean Acidification	13:30 - 15:30 (24 April)	Hon Chong, Sheraton Hotel	Somkiat Khokiattiwong
10.	Workshop on Ewin 2013 Expedition	15:50 - 18:00 (24 April)	Hon, Chong, Sheraton Hotel	Zainal Arifin & Youn Ho Lee

Pre – and Post - Symposium

No.	Workshop	Time	Location	Organizer
1	WESTPAC-CorReCAP Project – Third Summer School on "Resilience of Coral Reefs to the Climate Change and Anthropogenic Disturbances"	18 - 21 April	Institute of Oceanography	Jing Zhang
2	WESTPAC DRMREEF Training Course on Recruitment Monitoring of Coral Reef Organisms	20 - 21 April	Institute of Oceanography	Youn-Ho Lee
3	LOICZ Training Workshop	20 - 21 April	Institute of Oceanography	Vikkii Cheung
4	WESTPAC Training Course on Remote Sensing for Coastal Habitat Mapping	25 - 27 April	Institute of Oceanography	Teruhisa Komatsu

Annex V

JOINT STATEMENT
of the Research Directors

Research Directors' Forum
at the 9th WESTPAC International Scientific Symposium

22 April 2014
Nha Trang, Vietnam

The goal of the Research Directors' Forum is to serve as one open-ended platform for Directors from marine scientific institutes, academic faculties and operational agencies in the Indo-Pacific region to build and enhance networks; exchange strategic directions of their institutions; identify scientific and technical challenges; and spark regional actions in the framework of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) for future collaboration by exploring any opportunity of synergizing existing and planned observations and services, and furthering operational oceanography through a coordinated scientific network in the Indo-Pacific region. This goal can only be met if effective action for furthering sustained observations is implemented in a timely manner to improve services for the Indo-Pacific societies.

We, Directors of marine scientific institutes and marine experts in the Indo-Pacific region (see the participants' list in appendix), met on 22 April 2014 in Nha Trang, Socialist Republic of Vietnam during the 9th WESTPAC International Scientific Symposium under the theme of "**A Healthy Ocean towards the Prosperity in the Western Pacific: Scientific Challenges and Possible Solutions**";

Recognizing the critical role and importance of the ocean, seas and coastal areas of the Indo-Pacific region which constitutes one major influence on regional & global climate system, the epicenter of the world marine biodiversity, spawning and nursery grounds for diverse marine species, a potential reservoir of non-living resources, and major maritime shipping routes;

Recognizing further the IOC's High-Level Objectives for 2014-2021, namely healthy ocean ecosystems, early warning for ocean hazards, resiliency to climate change and variability, and enhanced knowledge of emerging ocean science issues;

Considering that the Indo-Pacific region contains close to half the world's population, possessing vast social and economic importance with over 70% of its total population living in coastal areas and relying economically on these ocean, seas and coastal areas;

Mindful of concerns over the pressures and threats to the health of marine ecosystems in the Indo-Pacific region, such as depletion of resources, marine pollutions, degradation of coastal habitats, and ocean acidification as well as the role of the Indo-Pacific regarding monsoons, droughts, typhoons/extreme weather events, and regional climate variability;

Emphasizing the essential role of IOC and its Sub-Commission for the Western Pacific (WESTPAC) in the promotion of international cooperation on marine scientific research, observations and services, and capacity building in the Indo-Pacific region; and

Having discussed the scientific challenges towards the attainment of the future we want: "**A Healthy and Safe Ocean for Prosperity in the Indo-Pacific region**", we

Acknowledge the following:

1. Despite tremendous efforts made over the last decades, our knowledge about the Indo-Pacific, its marine biodiversity, and its role in climate change and variability still remains limited mainly due to the lack of integrated multi-disciplinary research, and adequate sustained observations in a seamless manner from the local to basin scale.

2. It is essential to foster cooperation among marine scientific institutes, academic faculties, and/or national operational agencies in the Indo-Pacific region, and hence to promote broad campaign with a goal of consolidating our scientific understanding on the critical oceanic processes from the coast to open ocean, from tropics to high-latitude areas, and on the ocean's interaction with atmosphere and solid Earth.

Call for the following:

3. Urgent action to establish the Indo-Pacific Ocean Observations and Services Network (IPON) in the framework of IOC Sub-Commission for the Western Pacific (WESTPAC), realizing a future wherein decisions and actions for the benefit of the Indo-Pacific region are achieved by coordinated, concerted, comprehensive and sustained observations, and services including data and information, forecasting, etc;

4. Creation of the Scientific Steering Committee for Indo-Pacific Ocean Observations and Services Network (SC-IPON) as an arm to guide the development of IPON, promote and enhance IPON among participants in the Indo-Pacific region in order to understand Indo-Pacific oceanic processes and their complex interactions with atmosphere, biosphere, lithosphere and humans, deliver benefits of ocean observations and services to the Indo-Pacific societies, and ensure marine

biodiversity, food security, maritime safety and reduced vulnerability to ocean-related disasters in the region;

5. Heightened recognition from IOC/UNESCO Member States, regional leadership and policy decision makers on the need to establish IPON, which will contribute to underpinning the sustainable development in the region by providing the integrated oceanic information, forecasting and other services;

6. Marine scientific communities to undertake further research on, and sustained observations of, the ocean processes and climate, earth dynamics, and the impacts of climate change and anthropogenic activities on vulnerable marine biodiversity and ecosystems;

7. Continued support for GOOS and other IOC Subsidiary Bodies, and active engagement in, the development of sustained, integrated and multi-purpose observation and information system on ocean processes, earth dynamics and marine ecosystems for improved services to the Indo-Pacific societies through the development of the IPON;

8. Increased assistance to developing nations in the Indo-Pacific region, including Small Island Developing States (SIDS), to continue cultivating marine science talent, developing sustained observations and relevant infrastructure, and sharing the knowledge and data through capacity development activities;

9. Enhanced efforts in capacity building in developing nations in the Indo-Pacific region, in particular through the development of technical assistance programs and materialization of the “IOC Regional Network of Training and Research Centers on Marine Science”.

Express our appreciation for the following

10. The tremendous efforts of IOC/UNESCO, and particularly its WESTPAC, in building the capacity of developing nations, in the Indo-Pacific region for marine research, sustained observations and service underpinning the sustainability of ocean and coastal resources; and

11. The gracious hosting of the Research Directors’ Forum by the Institute of Oceanography of the Vietnam Academy of Science and Technology, and the excellent arrangements that have been provided in Nha Trang.

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