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**IMPLEMENTING THE STRATEGIC ACTION PROGRAMME FOR THE YELLOW SEA LARGE MARINE ECOSYSTEM: RESTORING ECOSYSTEM GOODS AND SERVICES AND CONSOLIDATION OF A LONG-TERM REGIONAL ENVIRONMENTAL GOVERNANCE FRAMEWORK  
(UNDP/GEF YSLME Phase II Project)**

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**Proceedings of the 2<sup>nd</sup> Meeting of the Regional Working Group on Monitoring and Assessment (RWG-A) of the UNDP/GEF YSLME Phase II Project**

*Kunming, PR China*

*27 June 2018*

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## Proceedings of the 2<sup>nd</sup> Meeting of the RWG on Monitoring and Assessment

### Opening of the meeting

1. The 2<sup>nd</sup> Meeting of the Regional Working Group on Monitoring and Assessment (RWG-A) of the UNDP/GEF YSLME Phase II Project was held in Kunming, PR China, on June 27<sup>th</sup>, 2018. Organized by the Secretariat, the meeting was participated by government officials and members of the RWG-A from PR China and RO Korea, a National Coordinator, partners, and Secretariat staff.
2. Mr. Se-Jong JU, a Chair of RWG-A, officially opened the meeting and gave a quick overview of the agenda.
3. Participants were invited to introduce themselves. Each gave a brief description of his/her organization and expertise related to the mandate of the RWG-A. The list of participants is attached to this report as Annex I.

### Organization of the meeting

#### Adoption of agenda

4. Mr. Yinfeng GUO, Project Manager of Secretariat, introduced the agenda and explained in detail the working arrangements and substance of the meeting – 1) Review workplan for 2018 and 2019; 2) Review of recommendations presented by experts during the China-Korea Workshop on Harmful Marine Organisms in Yellow Sea; 3) Discussion on individual and regional activities to be conducted, including review of inception reports prepared by institutions and the MTR consultant; 4) Review of project proposal on the study of *Sargassum horneri*'s ecological impact in west Yellow Sea; 5) TOR for development of climate change adaptation ICM model framework plan; and 6) Review of progress in implementation of NSAPs of PR China and RO Korea.
5. Participants agreed on the working arrangements for the meeting and the provisional agenda was adopted as it is. The final agenda is provided as Annex II.

### Review Workplan for 2018 and 2019

6. The Secretariat presented the project workplan for 2018 and 2019. The previous version has been revised in accordance with the recommendations and decisions made during

the 2<sup>nd</sup> meetings of the MSTP and ICC in March 2018. Below are the activities and timeframe under the mandate of the RWG-A:

**Component 4: Improving Ecosystem Carrying Capacity with respect to Supporting Services**

**Output 4.3.1 Regional strategies adopted and goals agreed; site-based Integrated Coastal management (ICM) plans enhancing climate resilience, in place for selected sites in YSLME; conservation areas and habitats for migratory species identified**

PLANNED ACTIVITIES	TIMEFRAME							
	2018				2019			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Activity 1. Stock-taking of vulnerabilities of coastal communities and ecosystem services in YSLME to impact of climate change								
Activity 2. Study on CC and its impact on YSCWM, coastal and marine ecosystem services and adaptation								
Activity 3. Develop CC adaptation ICM model framework plan or strategic framework plan for 1 coastal city and province								
Activity 4. Study on <i>Sargassum</i> sp. economic implications								

**Output 4.4.2 Established monitoring network; regular basin-wide assessments; enhanced information exchange; periodic scenarios of ecosystem change; allocation of 1% of project budget for IWLEARN activities**

PLANNED ACTIVITIES	TIMEFRAME							
	2018				2019			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Activity 1. Make regional assessment (including trend of introduced species in the region) and make policy-relevant recommendations								
Activity 2. Develop regional strategies for long-term ecosystem forecasts, and conduct modelling and scenario analysis and sharing of estuary data								
Activity 3. Create regional jellyfish monitoring program: Create regional committee to coordinate monitoring, assessment and data sharing, and develop national and regional monitoring methodologies of jellyfish blooms								
Activity 4. Create regional HAB (including macro-algae) monitoring program: Create regional committee to coordinate monitoring, assessment and data sharing. Combine with jellyfish committee develop national/regional monitoring methodologies of HAB								
Activity 5. Establish a comprehensive regional monitoring system: Develop regional monitoring strategies for N/P/Si changes, climate change, jellyfish blooms, and HAB								

7. There were no comments from the Meeting and the agenda was adopted.

Review of China-Korea Workshop on Harmful Marine Organisms in Yellow Sea

8. The Secretariat prepared and presented a summary of key recommendations raised by 26 experts during the China-Korea Workshop on Harmful Marine Organisms in Yellow Sea held on June 26<sup>th</sup>, the day before the RWG-A meeting. Hard copies of the summary report were distributed to the participants for reference. The document is also attached as Annex III.

9. The Chair acknowledged the suggestions made by experts, saying key recommendations addressed will be very helpful for the implementation of project activities. He also pointed out that these recommendations may be considered but are not an obligation to be followed.
10. With regards to the schedule of the 2<sup>nd</sup> workshop, Mr. Sinjae YOO of RO Korea suggested to have the event combined with the Yellow Sea Symposium to improve visibility of the YSLME Phase II Project. The symposium will cover extensive areas of oceanography in the Yellow Sea and is projected to be conducted this year or early next year in RO Korea.
11. Mr. Yinfeng GUO of the Secretariat expressed a concern regarding the physical limitations of the Secretariat in organizing such a meeting in 2018. He said that if the meeting is held this year, it will not be possible for the Secretariat to assist as the office is already organizing several meetings (e.g. Biodiversity Forum in September, Fishery Management Workshop in October, Regional Ocean Governance Workshop in November, and Council Meeting in December). Mr. Guo called on the working group to consider its contribution through presentations and building on conclusions and directions in terms of new research.
12. In response, the Chair clarified that the Secretariat is not asked to organize the symposium. He suggested that YSLME could support the symposium as one of project activities and nominate experts to participate.
13. Mr. Sinjae YOO of RO Korea also conveyed the interests of IOCAS and Inha University to organize the symposium. He suggested that the joint meeting could be held any time next year to avoid conflict of schedule among participating experts.
14. Mr. GUO of the Secretariat acknowledged the recommendation and suggested schedule and agreed to raise the proposed collaboration to the inter-governmental meeting for discussion and approval.

#### Discussion on activities to be conducted

Activity 1 of Output 4.3.1: Stock-taking of vulnerabilities of coastal communities and ecosystem services

15. Mr. Shouqiang WANG, consultant from PR China, introduced the draft of inception report for Activity 1 of Output 4.3.1: Stock-taking of vulnerabilities of coastal communities and ecosystem services in YSLME to impact of climate change. The Meeting was asked to review the relevance of the report with the TOR of activity endorsed by RWG-A.

16. After the presentation, the Chair mentioned some of the factors indicating the vulnerability factor groupings are not applicable for Yellow Sea. For example, “Hispanic, Black and Other Race” under “Race/Ethnicity” can be changed to “Asian.”
17. The Chair also raised a concern over the timeline and budget, which are five months and 8,000USD, respectively. He stated that five months might not be enough to finish all works with limited amounts of budget, compared to other project activities.
18. In response, Mr. WANG of PR China said with the help of experts, the team will try its best to finish on time. Finding of new members who can provide support is also being eyed. As for the budget, other resources from the FIO can be utilized.
19. Mr. WANG also mentioned that for three months, he still has not received any response about the issuance of the consultancy contract from UNOPS. Mr. GUO responded that as per UNOPS’ internal decision, the contract will be issued immediately after the extension of the project, which is expiring on June 30<sup>th</sup>.

Activities 3, 4 and 5 of Output 4.4.2: Developing the monitoring programs of jellyfish and drifting macroalgal blooms and N/P/Si

*Part 1: Developing monitoring programs of jellyfish*

20. Ms. Chuan JIA from the National Marine Environment Monitoring Center (NMEMC) introduced the development plan on Jellyfish Monitoring Program by presenting dominant species in Yellow Sea, monitoring methods, description of tasks, diagram of workflow, and schedule of activities.
21. In her presentation, Ms. JIA delivered the following suggestions on monitoring frequency, coverage and locations along with several questions for discussion:
  - 1) For monitoring regions and sampling locations: Set three sections with five sub-sections each. Put sampling stations within 10 nautical miles away from the shore.
  - 2) For monitoring frequency: Including the two-time jellyfish monitoring for medusa in July and August, is it necessary to have one more monitoring for ephyra in May?
  - 3) For monitoring method: NMEMC suggests using the anchored drift net survey to monitor jellyfish in deep waters because the anchor drift net is not suitable for use in sea deeper than 25 meters.
22. In response to the presentation, Mr. Wonduk YOON of RO Korea made the following comments:
  - Monitoring is advised to be carried out by focusing on jellyfish with dominant population such as *Nimopilema nomurai* and moon jellyfish.
  - There is a need to include the coastal line if NMEMC wants to monitor moon jellyfish. In the presentation, monitoring area is limited to 10 nautical miles from the coastal line. However, there are moon jellyfish within the 10 nautical miles.

- On monitoring methods, sighting survey is not limited to surface water but rather to “euphotic” depth, which can be 1 or 20 meters depending on the stations in the Yellow Sea.
  - Underwater camera does not have limited vision as far as high intensity of light is used for efficiency.
  - With scientific echo sounder, it is easy to discriminate *Nemopilema nomurai* and moon jellyfish. It is also possible to distinguish the size.
  - Plankton sample is not a good way to sample ephyra as ephyra is very fragile.
  - On DNA being not suitable for all harmful species, currently, there are eight DNA probes for several species. With a help of DNA probe, even small pieces of jellyfish can be identified.
  - Fishing gear as one of monitoring methods costs a lot with efforts required. It is worth of reconsidering.
  - *Nemopilema nomurai* is abundant in Bohai Sea and in north western East China Sea near Shanghai. To have a clear spatial distribution map of the species, both sides should be covered since each have different characteristics. By this characteristic, monitoring methods could be different in each side.
  - Intensive sampling schedule is likely to be expected in the second half of May with a possible help of Dr. Jing DONG if ephyra is the one to be sampled.
  - If anchored drift net is used in waters having less than 25 meters in depth and trawl net survey for more than 25 meters in depth, the data collected could be different and useless. The monitoring method to be used should be consistent and same for all.
23. In contrary, Mr. Jinho CHAE of RO Korea said plankton monitoring is very important especially in assuming the origins of jellyfish bloom. In addition, he suggested that among various techniques available for collection of samples, a technique called “fish finder” would be the best to use as it is convenient, fast and precise.
24. Asked regarding the site selection criteria by Mr. Jinho CHAE, Ms. JIA responded that the sampling stations were based on historical data in Yellow Sea without high cost to be applied.
25. Ms. JIA reiterated her suggestion to use fishing gear to monitor moon jellyfish and sighting survey for *Nemopilema nomurai*. Mr. Jinho CHAE, meanwhile, recommended the use of plankton and echo-sound technique to measure the biomass. Mr. YOON also recommended the use of sighting survey by following the TOR which covers extended area (e.g. whole Yellow Sea) and is effective for short time.
26. Ms. Sunyoung CHAE said as per 1<sup>st</sup> RWG-A meeting’s discussion, it was agreed in the TOR that sighting survey should be used as one of the sampling methods using “ship of

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<sup>1</sup> the depth to which significant phytoplankton photosynthesis can take place. It is typically taken to be the depth at which PAR falls to 1 percent of its value just below the surface

opportunity". She raised a concern that if any changes on the type of method is applied, it would create a problem in RO Korea's side because a report to the Ministry of Oceans and Fisheries (MOF) was made to secure funding.

27. Mr. GUO of the Secretariat stressed on the significance of causes of jellyfish bloom such as artificial construction which is worthwhile of considering and also monitoring as a pre-step for developing management tool. Also, current efforts devoted by relevant research institutes should be acknowledged to carry out monitoring program effectively.
28. Mr. YOON of RO Korea explained distribution pattern of *Nemopilema nomurai* in the Yellow Sea and advised to collect ephyra instead of polyp because of its scarcity.
29. After discussion of both sides, jellyfish monitoring program of YSLME is going to be taken by using fishing gear (the anchor drift net) in the shallow marine area (depth <25m) for moon jellyfish, and sighting survey in the abyssal marine area (depth >25m) for *Nemopilema nomurai*.
30. The Chair suggested Ms. Chuan JIA to revise the workplan by reflecting comments provided at the Meeting.

*Part 2: Developing the monitoring program of HAB and drifting macroalgal blooms, and N/P/Si*

31. Mr. Kuishuang SHAO from the NMEMC presented draft monitoring program of HABs in the Yellow Sea. He introduced the objectives, expected outputs, activities, reporting, sampling station, time and frequency, monitoring parameters, methods, fixation, identification, and analysis.
32. Mr. Sangil KIM of RO Korea expressed a concern on sampling method to collect green algae reminding that 10cm by 10cm quadrat is too small as the size should normally be around 50cm by 50cm quadrat. In response, Ms. Jie XIAO of PR China clarified that the area of Mr. Kuishuang SHAO's work covers attached algae in the rocky shores using quantitative sampling methods to quantify the biomass. She also reiterated the fact that average sampling mass depends on seasons and regions where sampling occurs.
33. Mr. Jae Ryoung OH of RO Korea asked questions on chemical analysis of trace metals in water samples and also advised to analyse TOC instead of COD.
34. Mr. Feng LIU agreed on the suggestion to change to 50cm by 50cm quadrat and collect at least three samples for each site.
35. The Chair suggested experts on HABs to discuss more to reach conclusion after lunch break and then shared the outcome of the discussion.



36. Mr. Sinjae YOO of RO Korea also raised a concern on the location of sampling. If the sampling location is too close to the shoreline having high tidal effect, some species including dinoflagellate species showing abundant pattern on their distribution in stratified water will not be accurately sampled and analysed. He suggested to have around three or four stations over the transit to avoid possible misleading of sampling. However, if it requires too much work, an alternative would be to collect samples by weekly before having any big blooms of HAB and try to shorten the frequency of sampling once blooms start. He further suggested to collect sample in stratified waters by avoiding sampling close to shoreline.
37. The Chair suggested to add time table with specific activities to be carried out. Also, description of budget to be needed per activity (e.g. field activity) is advised to be added in the proposal.
38. The Chair asked the experts group on Jellyfish to introduce outcomes of group meeting during lunch break.
39. In response to Chair's request, Ms. Chuan JIA introduced conclusions made that monitoring of moon jellyfish will be conducted by using fishing gear, and sighting survey for *Nemopilema nomurai*.
40. Mr. CHAE of RO Korea suggested to use two monitoring methods as a conventional method – echo sound and plankton net. As for echo sound monitoring method, biomass of jellyfish could be measured and plankton net as a 2<sup>nd</sup> option could be good to collect and identify all juvenile stages of jellyfish.
41. Mr. YOON said data from sighting survey is not that good considering costs but this method covers wide range of areas without requiring long duration of sampling. He also explained the sighting survey being conducted: Pyeongtaek-Lianyungang-Qingdao-Incheon-Yantai-Dalian, indicating possible coverage of areas mid and northern part of Yellow Sea. Upon the availability of ferry boats navigating from Dalian to Qingdao and from Qingdao to Shanghai, PR China could cover the southern coastal areas of China. If the suggestion is applicable, he is willing to provide relevant data collected from RO Korea's side to draw overall picture which enables us to understand distribution of jellyfish in the Yellow Sea.
42. Ms. JIA positively welcomed the suggestion and agreed to cover both sides to create a more organized and better picture through combination of data sets from RO Korea and PR China.
43. Ms. Chuan JIA presented regional monitoring system and opened the meeting for discussion with 3 questions raised – 1) monitoring elements to be analysed and methods to be used; 2) sampling stations covering all Yellow Sea areas or restricted and 3) monitoring frequency having two times per year (March to May, or July to August).

44. Mr. Wonduk YOON of RO Korea emphasized the need to have existing parameters to compare for understanding of the relationship of HAB, N/P/Si and jellyfish. In the sampling site, Haizhuo Bay, however, it is very rare to see jellyfish especially *Nemopilema nomurai*. Considering geographical characteristics of Haizhou Bay being affected by strong winds and other factors as described by several Chinese scientists, the site for sampling is advised to reconsider since it does not look like a representative of the Yellow Sea.
45. In response, Ms. JIA said there is historical data of N/P/Si and HAB in Haizhou Bay. Annual changes can be applied and conclusions can be made accordingly.
46. The Chair reiterated the relationship of issues being raised on jellyfish, HABs and nutrient which are interlinked with each other in terms of occurrence of eutrophication. Considering the limitation in time, he recommended utilizing historical information to get some idea and confirm data collected during the span of the Project's 1-year sighting survey.
47. Considering time allowed, the Chair encouraged the draft version of reports to be revised in accordance with comments provided at the meeting and share with experts of RWG-A as soon as possible.

TOR for the Scientific Committee to coordinate monitoring, assessment and data sharing

48. The Secretariat introduced the draft TOR for the Scientific Committee, which was recommended by member states during the 1<sup>st</sup> RWG-A meeting in 2017. The objective of the TOR is to establish two scientific committees, on jellyfish and HAB (including macroalgal) blooms, to advise the RWG-A group on monitoring, assessment and data sharing, and to assist in developing regional monitoring methodologies.
49. The Chair asked the Secretariat to make some modifications in Members and Qualifications. He suggested to 1) omit "Experience in drafting proposals" and 2) combine "Research experience" and "Familiarity" under one criteria. Mr. Yinfeng GUO of the Secretariat also requested the removal of "approval by ICC" under Terms.
50. Mr. Hao GUO of PR China recommended that "specimen" be added in the data sharing/information exchange. Mr. Wonduk YOON of RO Korea seconded the suggestion, saying the exchange of samples will be a good opportunity for both sides to make comparisons and presentations together.
51. Mr. Yinfeng GUO of the Secretariat requested Jellyfish and HAB experts to review the possible roles and provide feedback on what kind of advice/guidance they would need from the Scientific Committee.

52. Mr. Sangjin LEE of the Secretariat raised a concern about the practicality of the establishment of a scientific committee, pointing out that it might not be a good idea considering limited time allowed.
53. Mr. Sinjae YOO of RO Korea said that according to the draft TOR, the main task of the Scientific Committee is to assist the RWG-A in its tasks. Unless the Meeting adds specific task/s, the scientific committee will only turn out to be a duplication or extension of the existing working group.
54. Mr. Yinfeng GUO further suggested to 1) replace the word “assist” with another term under the possible roles and 2) omit budget details as meeting and travel budgets will be provided for the committees.

#### Membership of monitoring programs

55. Mr. Hao GUO of PR China asked about the nomination of committee members. In response, Mr. Sangjin LEE said it is up for the country to decide and suggested that PR China choose three of its members to assist. The Chair, meanwhile, recommended that member states should nominate an expert who is closely involved in the YSLME Project.
56. Mr. Hao GUO of PR China suggested to add two more people, making it four members per committee. Dr. Jae Ryoung OH, National Coordinator of RO Korea, also recommended to add another expert for N/P/Si.
57. After lengthy discussion, the Meeting agreed to nominate five members per country: two for jellyfish, two for HABs and one for N/P/Si. In total, there would be ten members for the two committees – five from RO Korea and five from PR China.

#### Information and data exchange, and mechanisms

58. Participants were invited to discuss on establishing mechanisms in sharing data and samples, including information released for public domain on the Project website. Mr. Yinfeng GUO recalled that during the 1<sup>st</sup> Meeting of the RWG on Pollution, experts from both countries reached a consensus that there should be clearance by the RWG before any data about the YSLME Project is shared.
59. With regards to exchange of samples, Mr. Wonduk YOON of RO Korea requested the Secretariat to prepare a document specifying a bilateral agreement that the countries could not use the other side’s data without bilateral agreement.
60. In terms of marine samples, Mr. Jae Ryoung OH suggested to create a form with a template indicating: 1) the person who is requesting for the sample, 2) description of

purpose of the request, 3) an agreement that the sample will only be used for the purpose specified, and 4) an acknowledgement describing who provided the sample. Mr. OH said other organizations use the same approach for their library of samples. The Secretariat can use them as an example and modify based on the Project's purposes. If needed, he can provide a draft document.

61. Mr. Yinfeng GUO of the Secretariat requested experts to inform the Secretariat if there are certain information that they don't want to be made available in the Project website. For example, in workshop presentations, participants can specify if the presentation is allowed to be shared for public uses. However, for studies funded by the UNDP/GEF, experts are required to provide presentation and abstract.
62. If the Secretariat is unable to facilitate due to heavy workloads of organizing upcoming activities, the Chair said experts can coordinate amongst themselves. He added that if the Scientific Committee is established, the Committee members can serve as facilitators for the exchange of data and samples between member states. On data sharing, the Chair mentioned that data generated from project contracts should be submitted to the Secretariat in its raw form. Mr. Shouqiang WANG of PR China also requested reciprocal submission of raw data by RO Korea for the meaningful operation of the regional cooperation in YSLME project.

Activity 1 of Output 4.4.2: Regional assessment and make policy-relevant recommendations

63. Ms. Fangyuan QU of PR China introduced a draft of inception report to make regional assessment (including trend of introduced species in the region) and make policy-relevant recommendation.
64. Mr. Sinjae YOO of RO Korea asked on what kind of method and coverage area the FIO will use in estimating the primary productivity.
65. Mr. Shenghao LIU of PR China responded that field research will be conducted in Rizhao or Qingdao Cities. He added they will also use available data from previously published paper on primary production in the Yellow Sea.
66. Again, Mr. YOO from RO Korea raised a concern on possible overestimation of the value of primary productivity addressed in the presentation based on the recent findings he published on Asian large marine ecosystems. He suggested the diagrams in the presentation to be revised based on the revisions reflected in the new publication. He added that if the FIO will try to connect primary productivity and the fishing carrying capacity, unless it is confident about the value of primary activity, the estimate of carrying capacity will be affected and will thereby be unreliable.

67. With regards to the policy-relevant recommendation, Ms. Kyungmin LEE of RO Korea asked for clarifications whether the policy is for both countries' Governments or specific to PR Chinese Government alone.
68. In response, Mr. Shouqiang WANG of PR China said if there are potential partners in RO Korea, the FIO can collaborate in the assessment for both countries. If there's none, FIO will focus only to the PR China Government.

Activity 2 of Output 4.3.1: Study on climate change and its impact on YSCWM, coastal and marine ecosystem services and adaptation

69. Ms. Fangyuan QU of the FIO introduced the TOR for Activity 2 of Output 4.3.1: Study on the relationships between the sea surface temperature changes of YSCWM and structure of plankton communities and development of regional strategy for adaptive management.
70. In her presentation, Ms. Fangyuan QU highlighted the challenges in giving a scientific report due to limitation of data. Sea surface temperature changes in the YSCWM can be easily obtained from transect observations and satellite-derived data. However, structure of plankton communities should be based on the analysis of taxonomy data from plankton samples. In this region, there are no sufficient cruise data to support the study, especially in the long-term effect of climate change. Also, there are many errors of plankton taxonomy data among different sources, exceeding the changes driven by climate.
71. Ms. Sunyoung CHAE of RO Korea asked ways to cooperate with two countries in completing the work activities including producing synthesis report as indicated in the TOR. Mr. Shouqiang WANG responded that the FIO is planning to invite KIOST and KOEM in two of its workshops in PR China and discuss and share their expertise on the specific topics.
72. The Chair requested to add "region" after YSCWM in the title of the TOR to avoid confusions. He also pointed out that the project document states "study change structure of the YSCWM;" however, the study does not focus on the cold-water mass itself but rather on just the surface temperature, which does not fully explain the structural change. He emphasized that if the cold-water mass is not studied, it is not possible to know the dynamic changes, which is an essential property.

Project Proposal for review by the meeting

Activity 4 of Output 4.3.1: Proposal on the study of ecological impact of *Sargassum horneri* in west Yellow Sea

73. The Ms. Jie XIAO, from the FIO-PR China, presented a project proposal on the study of ecological impact of *Sargassum horneri* in west Yellow Sea prepared by Prof. Zongling WANG and herself. In her presentation, she discussed the general process for floating *S. horneri* bloom, benthic populations, floating biomass in ECS, current research on floating *Sargassum* spp. in western Yellow Sea, and proposed TOR.
74. Regarding the issue on limited time and budget, Ms. XIAO responded that their team will not rely on the small budget alone but also on other existing projects supporting the same work in PR China.
75. Mr. Sangil KIM emphasized the importance of population monitoring and shared that in RO Korea's side, scientists are building prediction model to predict future population size. The model can also estimate the amount of drifting *Sargassum* spp. He further suggested that PR China focus on two sites to monitor population dynamics.
76. In response, Ms. XIAO said PR China will keep an eye on the tip of Shandong Peninsula and Jiangsu region, where a high biomass of *S. horneri* was accumulated in winter of 2016.
77. The Chair also recommended that detailed information of budget usage on activities and time schedule should be included, through tables, in the project document for ease of progress tracking (e.g. Corresponding amount of fund per specific activity).

Activity 3 of Output 4.3.1: Develop climate change adaptation ICM model framework plan  
(Activity 3 of Output 4.3.1 by FIO)

78. Ms. Fangyuan QU of PR China introduced a proposal for development of climate change adaptation ICM model framework plan. The objective of the TOR is to develop an adaption strategy of climate change for Dandong City via vulnerability assessment of coastal communities and impact assessment of sea level rising. Jens Erik, Chief Programme Adviser of UN Environment-DHI is eyed as a partner. A draft strategy output will be submitted by October 30, 2019.
79. Mr. Yinfeng GUO raised a question over coordination issues with the municipal government of Dandong. He said there should be initial discussions to evaluate if the project activities are aligned with the local government's plans and to confirm that there is a formal agreement.
80. In response, Mr. Shouqiang WANG responded that Liaoning Province will coordinate with Dandong City implementing a wetland project.
81. Ms. Sunyoung CHAE of RO Korea expressed RO Korea's interest to collaborate with DPRK and PR China in the Project. Mentioning "spotted seal" as a symbol of peace in

YSLME, she said she hopes to develop a cooperation mechanism through KOEM's project for spotted seal habitat enhancement.

82. The Chair asked for clarifications on the potential partner's roles and suggested to add a budget with indication of activities. On the spotted seal topic raised by Ms. Sunyoung CHAE of RO Korea, the Chair said spotted seals might not be suitable for the ICM model framework since the strategy focuses on birds and their food. If there is sufficient interest from KOEM's side, the Chair recommended to add information under the activities and budget in the TOR.

#### Other business

Review of progress in implementation of NSAPs of PR China and RO Korea in relation to the mandate of RWG-A

83. Ms. Sunyoung CHAE presented the evaluation of ROK NSAP implementation, focusing on targets 8 and 11, which are under the mandate of RWG-A. To review, the NSAP was implemented in 2009 and is targeted to finish by 2020 along with the SAP.
84. Considering RO Korea's situation, slight modifications were made in the NSAP. The following are the ongoing and new projects related to Monitoring and Assessment in RO Korea:

	Activity	Relevant ministry	Relevant national project			
			On-going project		New project	
			Project	In kind (1M KRW)	Project	In cash (1M KRW)
8.1	8.1-01 * Set up a regional monitoring system	MLTM	Ongoing 8.1-01 Joint study and regional assessment of the Yellow Sea between ROK and China	800		
8.2	8.2-01 * Monitoring the impacts	MLTM	Ongoing 8.2-01 Evaluation of climate change impacts on the marine environment	2,220		
8.3	8.3-01 * Make regional strategies for long-term ecosystem forecasts	MLTM	Ongoing 8.3-01 Develop regional techniques to forecast climate change in waters surrounding the Korean peninsula and East Asia	270		
	8.3-02 * Develop regional models	MLTM	Ongoing 8.3-02 Develop long-term climate fluctuation forecast techniques	576		
	8.3-03 * Make forecasts	MLTM				

8.4	8.4-01 Create regional jellyfish monitoring program	MLTM & MIFAFF			New 8.4-03 Monitor jellyfish in Yellow Sea via Ship of Opportunity	10
	8.4-02 Conduct regular jellyfish monitoring activities	MLTM & MIFAFF	Ongoing 8.4-01 Study of reasons behind jellyfish blooms and damage control measures	144	New 8.4-03 Monitor jellyfish in Yellow Sea via Ship of Opportunity	245
	8.4-03 Asses the status, trend and damage of jellyfish blooms	MLTM & MIFAFF	Ongoing 8.4-02 Study of management plans for control of harmful marine organisms	690	New 8.4-03 Monitor jellyfish in Yellow Sea via Ship of Opportunity	245
8.5	8.5-01 Conduct regular HAB monitoring activities	MLTM & MIFAFF	Ongoing 8.5-01 Develop algal bloom forecast and prevention techniques	228		
	8G-01 * Establish a comprehensive regional monitoring system	MLTM & MIFAFF				
11.1	11.1-01 improve management of ballast water to avoid introducing exotic species	MLTM	Ongoing 11.1-01 Study to develop ballast water discharge control techniques	240	New 11.1-02 Conduct joint study to identify areas of exchange of ballast water and establish evaluation system	950
	11.1-02 * using alternative energy and technology transfer to reduce CO <sub>2</sub> discharge from vessels (pilot)	MLTM				
11.2	11.2-01 * Analyse gaps between national legislation and international guidelines, provide recommendations	MLTM	Ongoing 11.2-01 Management and technology development on invasive species	120		
	11.2-02 * Conduct national monitoring and exchange information	MLTM	Ongoing 11.2-01 Management and technology development on invasive species	60		
	11.2-03 Make assessment on the trend of the introduced species in the region	MLTM			New 11.2-02 Joint assessment of introduced species' exchange and migration routes; Establish a system to analyse level of harmful impacts	1,190
	11.2-G Mechanism to ensure early stakeholder consultation - public hearings for management plans	MLTM			New 11.2-02 Joint assessment of introduced species' exchange and migration routes; Establish a system to analyse level of harmful impacts	10

85. With regards to RO Korea's workplan, data and information will be collected until August, evaluated until November, and translated from Korean to English until December. The report will be submitted by the end of 2018.
86. Meanwhile, Ms. Fangyuan QU presented the progress of implementation of NSAP related to SAP targets 8-11 in PR China.
87. Below are the following indicators and their corresponding progress status:



Target 8	Indicator	Progress
Better understanding and prediction of ecosystem changes for adaptive management	Continuation of monitoring	yes
	International monitoring network for jellyfish blooms	Only cooperation, no network
	Regular status reports	Yes
	Scenario-based long-term projection of ecosystem changes	Yes
	Development of adaptive management strategies and policy making	Yes
	Status of incorporation of adaptive management of climate change regional strategies and in ICM plans for selected coastal communities	Yes
	Status of Regional Monitoring Network for application of ECBM	Preliminary stage

Target 11	Indicator	Progress
Reduction of the risk of introduced Species	The incidence of disease/parasites and impacts endemic/vulnerable species caused by introduction of non-native species is reduced	No. Number of IAS is still increasing. Affected area of <i>S.alterniflora</i> is still increasing.

88. Files of presentations from two countries are attached separately in the email. Final reports are scheduled to be completed by the end of 2018.
89. Mr. Yinfeng GUO reminded the Meeting that progress reports of NSAP implementation will be presented in the RWG-Governance meeting in November 2018 as part of the regular agenda. With this, he urged both countries to observe proper scheduling to have a complete report to be presented at the meeting. He added that in terms of time range, both countries should be consistent so that it will be easy to consolidate separate reports into single one.

#### Agenda of next RWG-A meeting

90. The Meeting was informed that the next RWG-A meeting will be held tentatively in the third week of April 2019 in Jeju Island, RO Korea. The RWG-A meeting will be held for one day back to back with Yellow Sea symposium and workshop which will be run for two to three days.
91. Ms. Sunyoung CHAE of RO Korea raised a concern that work activities and reports might not be completed by April 2019. In response, the Chair clarified that depending on the

TORs, some contractors or consultants do not need to provide detailed reports. During next year's meeting, reports on progress work can be presented.

Wrap-up and closure of the meeting

92. In the wrap-up, participants were invited to gather for a group photo for documentation.
93. The Chair thanked the participants for their cooperation and patience. The meeting was closed at 6:00 P.M. on 27th June 2018.

## Annex 1: List of Participants

### **2<sup>nd</sup> Meeting of the Regional Working Group on Monitoring and Assessment (RWG-A) of the UNDP/GEF YSLME Phase II Project**

Jin Jiang Hotel, Kungming, PR China, 27 June 2018

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Kunming, PR China, 27 June 2018

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## Annex 2: Programme

### 2<sup>nd</sup> Meeting of the Regional Working Group on Monitoring and Assessment (RWG-A) of the UNDP/GEF YSLME Phase II Project

#### Programme

27 June (Wednesday)	
09:00~09:30	Registration for participants
09:30~09:50	Opening of the meeting <ul style="list-style-type: none"> <li>• Welcome addresses</li> <li>• Introduction of the members and participants</li> </ul>
09:50~10:00	Organization of the meeting <ul style="list-style-type: none"> <li>• Adoption of agenda</li> </ul>
10:00~10:30	Review workplan for 2018 and 2019 (Meeting document #1)
10:30~10:50	Coffee break and group photo
10:50~12:20	Review of China-Korea Workshop on Harmful Marine Organisms in Yellow Sea (To be prepared after workshop as a form of policy brief, addressing coastal and marine environmental issues in Yellow Sea and possible recommendations for policy makers of both PR China and RO Korea)
12:30~14:00	<b>Lunch</b>
14:00~15:30	Discussion on activities to be conducted (Individual Activity: Meeting document #2) <ul style="list-style-type: none"> <li>• Review of inception report of stock-taking of vulnerabilities of coastal communities and ecosystem services in YSLME to impact of climate change (Activity 1 of Output 4.3.1) – Shouqiang WANG will introduce the plan to be carried out for discussion</li> </ul> (Regional Activities: Meeting document #3) <ul style="list-style-type: none"> <li>• Developing the monitoring programs of jellyfish, HAB and drifting macroalgal blooms, and N/P/Si-discussion on network, scientific committee TOR, membership and information and data exchange mechanisms (Activities 3, 4 and 5 of Output 4.4.2, by NMEMC)               <ul style="list-style-type: none"> <li>○ Reflections from the workshop on the key elements of the monitoring programs on jellyfish, HAB and drifting macroalgal blooms, N/P/Si composition, and ecosystem change monitoring (Hao GUO and PMO will introduce key elements found at the WS for further discussion)</li> <li>○ Terms of reference for the scientific committee (PMO will introduce)</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Membership of monitoring programs (Chair will request countries to nominate 3 experts)</li> <li>○ Information and data exchange, and mechanisms (Discussion will be made such as minimum requirement, types, availability of information, data and exchange mechanisms, etc.)</li> <li>● Inception report to make regional assessment (including trend of introduced species in the region) and make policy –relevant recommendations (Activities 1 of Output 4.4.2, by FIO)</li> <li>● Study on the relationships between the sea surface temperature changes of YSCWM and structure of plankton communities and development of regional strategy for adaptive management (Activity 2 of Output 4.3.1, by FIO; originally indicated as Activity 3)</li> </ul>
15:30~15:45	Coffee Break
15:45~16:20	<p>Project Proposal for review by the meeting (Meeting document #4)</p> <ul style="list-style-type: none"> <li>● Proposal on the study of ecological impact of <i>Sargassum horneri</i> in west Yellow Sea (Activity 4 of Output 4.3.1 by FIO)</li> <li>● Review of TOR for development of climate change adaptation ICM model framework plan (Activity 3 of Output 4.3.1, by FIO)</li> </ul>
16:20~16:50	<p>Other Business</p> <ul style="list-style-type: none"> <li>● Review of progress in implementation of NSAPs of PR China and RO Korea in relation to the mandate of RWG-A</li> <li>● Articles to be included in publications</li> </ul>
16:50~17:00	Agenda of next RWG meeting
18:00~	Dinner

## Annex 3: Key Recommendations of experts in China-Korea Workshop on Harmful Marine Organisms in Yellow Sea

### **2<sup>nd</sup> Meeting of the Regional Working Group on Monitoring and Assessment (RWG-A) of the UNDP/GEF YSLME Phase II Project**

*Jin Jiang Hotel, Kunming, PR China, 27 June 2018*

#### **Review of China-Korea Workshop on Harmful Marine Organisms in Yellow Sea**

The following key recommendations have been prepared by PMO, based on suggestions and recommendations made by speakers at the 1<sup>st</sup> China-Korea Workshop on Harmful Marine Organisms in Yellow Sea.

#### **Key recommendations**

##### **Session 1. Jellyfish monitoring and management**

- Jellyfish monitoring using ship of opportunity was proposed. More intense spatiotemporal field monitoring and involvement of model study were suggested by enhancing monitoring schedule and extending monitoring areas (by Wonduk YOON).
- Development of common methodologies enabling comparison studies with monitoring results was suggested. Standard methods which both countries agreed on need to be developed (by Sejong JU).
- Oceanographic approach by taking currents as one of factors need to be attempted in the future studies on jellyfish population dynamics (by Mingjiang ZHOU).
- Communication and collaboration should be strengthened to exchange monitoring data between two countries (by Chaolun LI).
- It was recommended to build a data network “Jellyfish watch in YSLME” (by Chaolun LI).

##### **Session 2. Response measures to harmful marine organisms in Yellow Sea (*Sargassum sp.*)**

- Development of fast identification of the bloom-forming populations of *S. horneri* with an aid of molecular monitoring technique will assist to forecast their distribution and potential biomass at the early stage of golden tide which provides valuable data to make a management policy of massive *Sargassum* rafts influx (by Hyuk-Jae LEE).
- Analysis with additional samples from populations in the East China Sea including Zhoushan region was suggested with development of genetic markers that allows to distinguish invasive from native populations (by Hyuk-Jae LEE).



- Further studies on understanding of the distribution and genetic diversity of golden tide forming populations of *S. horneri* based on our novel DNA markers was suggested to minimize future economic losses and environmental damage by learning to manage and control the *Sargassum* golden tides in the YS (by Feng LIU).
- Enhanced international cooperation was suggested to share monitoring and ecological information (by Sangil KIM)
- Further studies to evaluate management measures against drifting *Sargassum* sp. Were suggested (by Jie XIAO)

#### **(Spartina alterniflora)**

- Establishing monitoring and early warning network system and technical platform was suggested to respond against *Spartina alterniflora* (by Guoxiang LIAO).
- International cooperation was also suggested to strengthen for the development of effective tools and sharing experiences and information (by Guoxiang LIAO).

#### **(HABs)**

- By considering the fact that floating *Sargassum* and *Ulva* populations have appeared in North Yellow Sea since 2014 with increased pattern, a long-term monitoring was suggested to be conducted (by Kuishuang SHAO).
- Having outbreak pattern being affected by various physical, biological and meteorological conditions, investigation of *Cochlodinium polykrikoides* on their ecophysiology, development, rapid detection was turned out to be critical to making plans to reduce potential damages being occurred in marine ecosystem and fisheries (by Jaeyeon PARK).

#### **Session 3. Environmental conditions and climate change impacts in Yellow Sea**

- Long-term and intensive field observation were suggested to be conducted for enough environmental and biological data in the whole water column with more monitoring sites to be set (by Hongjun SONG).
- China-Korea joint-cruises focusing on the summer, autumn and winter blooms along the transect from Changjiang estuary to Jeju Island were suggested (by Hongjun SONG).

#### **Session 4. Future directions for the joint workshop**

- Marine Policy Office of MOF/RO Korea, IOCAS and UNDP/GEF YSLME Phase II Project unanimously expressed interests in organizing the 2<sup>nd</sup> workshop in 2019 to further exchanges on studies of harmful marine organisms in RO Korea.
- To make the workshop more interactive, limiting the number of presentations to allow for more in-depth discussions, pre-workshop in-country consultation and coordination, engagement of Ministry of Natural Resources of PR China, and separate seating arrangement for interest group members by organizers were suggested to make the 2<sup>nd</sup> workshop more effective.
- KOEM was requested to coordinate with YSLME Phase II PMO to determine the venue and date of the workshop in 2019.

## Annex 4: Summary report of the 1<sup>st</sup> China-Korea Workshop on Harmful Marine Organisms in Yellow Sea

On June 25-26, 2018, the 1<sup>st</sup> China-Korea Workshop on Harmful Marine Organisms in Yellow Sea was successfully completed in Kunming, PR China. Featuring the status, trends, causes, countermeasures and future research priorities on jellyfish, harmful algae blooms, drifting macroalgae and cordgrass, and their relationships with climate change, nutrients and other factors, the workshop was attended by over 50 participants from Japan, PR China and RO Korea. Marine Policy Office of Ministry of Oceans and Fisheries of RO Korea, Department of International Cooperation of State Oceanic Administration of PR China, Institute of Oceanology of Chinese Academy of Sciences and UNDP/GFF YSLME Phase II Project hosted the workshop. The event was co-organized by Korean Marine Environment Management Corporation (KOEM), IOCAS, First Institute of Oceanography (FIO) of SOA, National Marine Environment Monitoring Center of SOA and Korean Institute of Ocean and Science and Technology (KIOST).

### **Jellyfish Monitoring and Management**

Monitoring: Based on the eight presentations, five jellyfish species including *Aurelia coerulea* and *Nemopilema nomurai* are identified as the harmful marine organisms with documented impact of stings of swimmers in beach areas, clogging in water intake areas of nuclear power plants and other industrial facilities.

Different monitoring methodologies are used including trawl net, sightinging method onboard ships of opportunity, underwater photographing through SCUBA diving, plankton nets with different diameter in Bohai Sea, mid and northern Yellow Sea, and northeastern East China Sea.

Population dynamics and its routes are studied, with Liaodong Bay as a source of *Nemopilema nomurai* polyps. Horizontal advection was interpreted based on the different spatiotemporal distribution pattern of juveniles and medusa. A south-ward advection was both observed by two countries' scientists. In Bohai Sea, the advection is from inner to outer in spring –summer, and from outer to inner in summer- fall.

Causes: Increase in coastal development and artificial construction is the major cause of jellyfish blooms. Downward-faced floating piers and barges in aquafarm and marina are the most frequented habitats of jellyfish polyps, while other habitats include concrete doc walls, dike ripraps, submersing pillars of industrial facilities, abandoned fishnets and artificial reefs.

Control measures: Results show that elimination of polyps at benthic stage may be an effective way to control size of jellyfish populations. Mid-term management plan has been developed in RO Korea to reduce impact of blooms. Among the chemical, biological and physical measures, waterjet measures prove to be the effective to drop polyps and induce their death. RO Korea is implementing the Jellyfish polyp management programme since 2013 to better control the bloom. Interception, salvage and extending fishing moratorium are among the multiple measures to control the bloom in China. Biofouling selectively suppressed in situ proliferation of scyphozoan polyps. Focus on different generation phase based on selective depression of biofouling for diverse species is proposed by Chinese scientists to treat the bloom fundamentally.

The enzymatic activity was speculated to play an important role in jellyfish sting. And an effective new external drug was introduced to shorten the course of dermatitis according to preliminary investigation.

Recommendation: Joint ferry boat study is proposed by RO Korea to monitor the populations. Yet the meeting also observed that currently there is no standard method for monitoring of different species. Comparison studies of monitoring results of different methodologies is suggested. In addition, oceanography and currents need to be factored into the studies on population dynamics.

### **Seaweed rafts and golden tides associated with *Sargassum horneri***

*Sargassum horneri* is an annual seaweed distributed in the Pacific Northwest coasts and functions as one of the important primary producers in the marine ecosystem. Floating seaweed rafts of *S. horneri* is an indispensable habitat for pelagic fishes and spawning substrate for flying fish and Japanese saury. It is necessary to conserve *S. horneri* bed along Chinese coasts (Zhejiang and Fujian) for sustainable exploitation of fish resources.

Drifting *S. horneri* accumulated along coasts of China and Korea is reported to cause significant economic loss in aquaculture, fisheries and tourism and pose a threat to the native biodiversity and marine ecosystem. Since 2015, the Korean coast has been inundated by unprecedented huge amounts of drifting *S. horneri* rafts, this has caused serious economic losses in tourism-based and aquaculture-based local economies, in addition, the costs of removal ran to several million dollars. In November 2016 to April 2017, the drifting *S. horneri* biomass was observed in the western Yellow Sea along the Jiangsu coasts, a highly unusual sighting along this coastline. Large scale drifting *S. horneri* biomass became stranded on nori cultivation rafts and destroyed the floating nori cultivation infrastructure. A dangerous combination of wave and tide conditions led to an economic loss of at least ¥0.5 billion (Chinese yuan) in nori industry in Jiangsu Province.

Effects of Environmental factors: The variation in maturation of *S. horneri* along the different coastal sites was closely related to the differences in water temperature. Meanwhile, temperature plays the most important role in influencing its seedling length growth rates. When temperature is higher (above 15 degree), seedling grows faster.

Genetic diversity of *S. horneri*: The floating *S. horneri* in the Yellow Sea displayed a very low genetic diversity based on the partial *cox3* and *rbcLS* region sequences. Despite the large-scale spatio-temporal sampling in the Yellow Sea and the use of multiple novel DNA markers, only two forms (haplotypes) of *S. horneri* were identified in the floating *S. horneri* thalli in the Yellow Sea. The novel DNA markers could be used to scan the different populations of *S. horneri* to understand the distribution of the golden tide forming populations and forecast the source of the floating biomass. Population structure analyses with microsatellites revealed two distinct genetic clusters that separate invasive from native populations except the Haenam St.3 sample. These studies aimed to develop *S. horneri* golden tide forecasting system and help reduce ecological and economic damages on marine ecosystem.

Korean researchers are developing an effective clean-up system and utilization of collected *Sargassum*.

Recommendation on monitoring: Based on the specific DNA markers and organelle genomic data, a molecular monitoring technique could be developed and built for fast identification of the bloom-forming populations of *S. horneri* and forecasting their distribution and potential biomass at the

early stage of golden tide. The information should provide valuable data to make a management policy of massive Sargassum rafts influx. Meanwhile, an integrated monitoring system, which includes satellite, aerial, cruise survey, local observation and prediction is suggested to monitor the dynamic of Sargassum.

### ***Spartina alterniflora***

*S. alterniflora* was introduced to China from North America since 1979. It has certain advantages, such as seashore stabilization, greening tidal flats, anti-typhoon for dyke protection, adding blue carbon storage, pollutant digesting, and medicinal value. However, due to its strong adaptability and high reproduction, it spread extensively in the coast of China, especially in Jiangsu coastal wetland, resulting in significant impact on wetland ecosystem health and safety. *S. alterniflora* was listed on the first batch of China invasive species list by Environmental Protection Agency of China in 2003.

Current status: *S. alterniflora* was found in all Provinces from Liaoning to Guangxi, also Hainan and Taiwan Island, along the coast of China. It reached 55,468 ha in 2014. However, Jiangsu Province is most affected by it, Then followed Zhejiang, Shanghai and Fujian Provinces. The spartina area of the four Provinces accounted for 92% area of China. The expansive rate was estimated at 4.3m/y in Zhangjiang Estuary. It shows high competition for tidal habitat with mangroves in southern China.

Control measures: There are three dominant control measures to erase *S. alterniflora* based on physical, chemical and biological methods. All of them might cost much or have uncertain ecological risk. However, one sustainable control technique was proposed to control *S. alterniflora* in southern China, such as transferring *S. alterniflora* to Mangrove (TSM) or to Shell cultivation (TSSC).

Management measures: An integrated treatment measures was applied, combining physical/mechanical, chemical, biological and alternative techniques to control the *S. alterniflora*. Comprehensive utilization has carried out and merchandized in China with Bio-Mineral Liquid totally extracted from *S. alterniflora*, while using the residues for mushroom plantation. It is proved to effective in decreasing uric acid and can be used for gout treatment.

### **Harmful algal blooms (HAB)**

HAB is the proliferation of harmful algae whose rapid growth is matched with changing environmental factors in ecosystem including radiation, nutrients and water exchange. Outbreak of green tide, red tide and golden tide have been frequently recorded in China and Korea in the past 10 years. An bi-macroalgal bloom occurred in western Yellow Sea in China in 2017, which is never been observed in the world, indicating significant change in Yellow Sea ecosystem.

Control measure: Controlling HABs means the effective interruption to the matching relationship between biological factors representing its growth and environmental factors supporting its proliferation for a specific HAB occurrence. Clay flocculation is one promising measure that has been used to control HABs in the field but still has crucial bottlenecks for its popularization in real world cases, including insufficient efficiency for clay to remove HAB organisms, great amount of clay in use, huge cost and plenty of deposits. Surface modification is an effective way to increase the removal efficiency for natural clay. Modified clay technology is proposed as a safe, eco-

friendly, efficient and easy way to control the HAB. It has been listed in the National Standards of China for HAB control.

Toxicity: *Protoceratium reticulatum* can produce Yessotoxin (YTXs), and YTXs is a group of toxins containing disulfuric acid with polycyclic ether chain structure. Toxic dinoflagellates had more toxicity than pure toxin. There was higher toxicity to younger organisms. Toxic algae can change the community structure of plankton.

### **Environmental conditions and climate change impact in Yellow Sea**

Regional climatology, large circulation pattern, ocean warming and acidification and human activity will influence and change the YS ecosystem. Studies have been carried out to investigate the ecosystem change induced and climate impact in YS in both China and Korea.

Ecological impacts: Large scale green tides frequently occurred in past 10 years in Yellow Sea coast. The concentration of N is increasing continuously from 1980s, the concentration of SiO<sub>3</sub>-Si and PO<sub>4</sub>-P exhibited a decreasing trend before 1990s, and then gradually increased. N/P/Si ratio changed in YS in longterm range, with a general increase in N/P, and decrease in Si/N. The chlorophyll-a started to increase from 1990s to now.

Bloom research: Unique spatial heterogeneity of seasonal blooms was driven by physical process in YS. Generalized additive models revealed that water mass is the most important factor controlling the bloom in YS. Spring bloom in the central trough of YS is caused by the seasonal evolution of thermal stratification and nutrients availability, the summer bloom off the estuary region is ascribed to the strong haline stratification and nutrient supply. The autumn bloom in the southeast corner of the YS is caused by Changjiang Diluted Water (CDW), the winter bloom in the southern YS is thought to be related to the compromise between CDW and YS Warm Current.

Foodweb research: *Calanus sinicus* and *Euphausia pacifica*, their preferential diet were analyzed. In spring and summer, they prefer to prey on different organisms.

Eutrophication research: there are several nutrients sources that drive the eutrophication in the YS. The contribution of each sources need to be understood to project the future trend of YS eutrophication.

### **Second China-Korea Workshop on Harmful Marine Organisms in Yellow Sea**

Marine Policy Office of MOF/RO Korea, IOCAS and UNDP/GEF YSLME Phase II Project hailed the workshop as a great success and unanimously expressed interests in organizing the 2<sup>nd</sup> workshop in 2019 to further the exchanges on studies of harmful marine organisms in RO Korea. To make the workshop more interactive, limiting the number of presentations to allow for more in-depth discussions, pre-workshop in-country consultation and coordination, engagement of Ministry of Natural Resources of PR China, and separate seating arrangement for interest group members by organizers were suggested to make the 2<sup>nd</sup> workshop more effective. KOEM will coordinate with YSLME Phase II Project Management Office to determine the venue and date of the workshop.