

1. Background

Seagrass and seaweed beds provide various ecosystem services such as habitats, spawning and nursery grounds and places of feed production for aquatic biota. They also function for seawater purification by absorbing nutrients (nitrogen and phosphorus) and for CO₂ fixation. According to Costanza et al., (1997), economic value of ecosystem services provided by seagrass and seaweed in coastal areas (about 19,000USD/ha/year) is much higher than that in terrestrial biome such as tropical rainforests and freshwater ecosystems (about 2,000 USD/ha/year). In addition, 'Blue Carbon' (CO₂ absorbed by aquatic biota) (2009, UNEP) reports that seagrass and seaweed beds, tidal flats, mangrove forests, and phytoplankton absorb approximately 55% of all CO₂ absorbed by biota on earth. These facts draw attention to seagrass and seaweed beds; not only in terms of ecosystem conservation but also of reduction of greenhouse gas.

In the coastal areas in the NOWPAP member states, while seagrass and seaweed beds have shrunk by landfill in shallow waters, eutrophication, port construction and/or dredging, information on the distribution and changing pattern of seagrass and seaweed is sparse. Considering the current situation of seagrass and seaweed beds and their function to maintain marine biodiversity, an activity for developing habitat maps for coastal ecosystems using remote sensing and GIS techniques was proposed in the NOWPAP Medium-term Strategy (MTS) 2012-2017, and adopted in the 16th NOWPAP Intergovernmental Meeting in 2012. Moreover, the Group on Earth Observation Biodiversity Observation Network (GEO-BON) has established a working group on marine ecosystems, and utilization of remote sensing techniques in habitat mapping of seagrass and seaweed beds and tidal flats is highly expected.

With financial support from the Mitsui and CO., Ltd. Environment Fund, the Northwest Pacific Region Environmental Cooperation Center (NPEC), host organization of NOWPAP CEARAC, has been conducting a research project in the coastal zone of Miyagi Prefecture, Japan to assess damage of seagrass and seaweed suffered from the Great East Japan Earthquake and the Tsunami on 11 March 2011 (UNEP/NOWPAP/CEARAC/FPM 11/Ref5). The research project aims to develop a map to assist recovery process of seagrass and seaweed beds with remote sensing techniques. NPEC also initiated another research project to assess the distribution of seagrass and seaweed beds with remote sensing techniques in Toyama Bay in 2012.

Based on the NPEC's experience and capacity to analyze high resolution satellite images to study seagrass and seaweed distribution, CEARAC proposed a new activity for the 2014-15 biennium to apply remote sensing techniques for seagrass mapping in selected case study areas in the NOWPAP member countries. The proposal was reviewed and adopted at the Eleventh CEARAC FPM held on 11-12 September 2013 in Toyama. It was agreed to propose CEARAC workplan for the 2014-2015 biennium including this activity to the 18th NOWPAP IGM (December 2013). The workplan and budget was then approved by correspondence by the member states in

April 2014.

2. Objective

Objective of this activity is to conduct case studies on the changes of seagrass distribution associated with environmental changes in the NOWPAP member states by applying remote sensing techniques. A manual to detect spatial distribution of seagrass beds will be developed and then validated in selected case study areas.

3. Tasks

3.1 Development of a manual for seagrass and seaweed beds mapping with satellite images

CEARAC concluded a MoU with Dr. Teruhisa Komatsu of Atmosphere and Ocean Research Institute, the University of Tokyo, to develop a manual for seagrass and seaweed beds distribution with satellite images which will be applicable to the NOWPAP sea area. A draft manual was prepared by March, 2015 by Dr. Komatsu and completed after being reviewed by national experts nominated from each NOWPAP member state (UNEP/NOWPAP/CEARAC/FPM 13/Ref2).

3.2 Mapping of seagrass distribution in selected case study areas

The following case study areas (table 1) were selected considering availability of past satellite images archives and on-site observations with the help of the nominated experts by CEARAC FPs.

Table 1. Nominated experts and selected sea areas for the seagrass mapping case studies in the NOWPAP region.

Country	Experts	Selected sea areas
China	Dr. Yang Dingtian State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology, Chinese Academy of Sciences	Swan lake (Head of the Shandong peninsula)
Japan	NPEC	West part of Toyama Bay (Himi), Nanao Bay (West Bay)
Korea	Dr. Jong-Kuk Choi Korea Ocean Satellite Center, Korea Institute of Ocean Science and Technology	Jangheung Bay(Jangheung province)
Russia	Dr. Vasili Zharikov	Eastern section of the Far Eastern

	Pacific Geological Institute, Far Eastern Branch of the Russian Academy of Science	Marine Reserve (Southwest coastal area out of Peter the Great Bay)
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Then, the experts are preparing a seagrass distribution map of each case study area with the manual developed in the task 3.1. When preparing a map, more than two scenes of satellite images (with intervals of several years) should be used in order to show secular changes. Case studies will include the analysis of environmental changes such as temperature, anthropogenic eutrophication, aquaculture, coastal development, rehabilitation activities and their implications on the changes of seagrass distribution.

Case study results will be uploaded on the CEARAC website which may be overlaid on other habitat maps. At the same time, advantage and limitation of developed techniques will be studied to evaluate their applicability to other areas in the NOWPAP region.

4. Expected outcomes

Case study results and the developed manual will be shared among coastal managers in the NOWPAP member states on CEARAC websites to help understand and conserve seagrass and seaweed beds that are important to maintain marine biodiversity in the NOWPAP region. It is also expected that the developed manual may be used to prepare a seagrass and seaweed beds distribution map on a regional scale in a cost-effective manner. This activity will be the first step for developing habitat maps for coastal ecosystems using remote sensing and GIS techniques proposed in the NOWPAP MTS, and the developed techniques are expected to serve as a useful coastal environmental assessment tool in the future.

5. Schedule

The time line of tasks in this activity is shown as follows.

Time	Action	Main body
2014 July	CEARAC FPM12 - Review and approval of the work plan and budget	CEARAC Secretariat and CEARAC FPs
2014 Q4 to 2015 Q1	Selection of case study sea areas in each NOWPAP member state Development of a manual for seagrass and seaweed beds mapping with satellite images	CEARAC Secretariat and Experts of the NOWPAP member states
2015 Q2-3	Case studies on seagrass beds mapping with satellite images	CEARAC Secretariat and Experts of NOWPAP member states
August	Expert meeting - Report and review of case studies CEARAC FPM13 - Review of case studies	Experts and Secretariat CEARAC FPs
Q3	Purchase of archives of satellite images	CEARAC Secretariat and Experts of NOWPAP member states
Q4	Preparation of a case study report on seagrass beds mapping with satellite images	CEARAC and Experts of NOWPAP member states

6. Budget

Task	Timing	Output	To be completed	Main body	Budget (US\$)
Development of a manual for seagrass and seaweed beds distribution with satellite images	2014 Q3-Q4	A manual for seagrass and seaweed beds distribution with satellite images	2015 Q1	NPEC Consultant	4,000
Purchase of archives of high-resolution satellite images	2015 Q1	Archives of high-resolution satellite images	2015 Q3	CEARAC	4,000
Case studies on seagrass and seaweed mapping in selected sea areas in the NOWPAP member states	2015 Q2-Q3	Case study results with maps of seagrass and seaweed beds distribution in selected sea areas	2015 Q3	Expert in China	3,000
				NPEC Consultant	3,000
				Expert in Korea	3,000
				Expert in Russia	3,000
Total					20,000