



Bay of Bengal Large Marine Ecosystem Project



Seagrass conservation and monitoring in Myanmar

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of Food and Agriculture Organization of the United Nations concerning the legal and development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The BOBLME Project encourages the use of this report for study, research, news reporting, criticism or review. Selected passages, tables or diagrams may be reproduced for such purposes provided acknowledgment of the source is included. Major extracts or the entire document may not be reproduced by any process without the written permission of the BOBLME Project Regional Coordinator.

BOBLME contract: LOA/RAP/2014/47

For bibliographic purposes, please reference this publication as:

BOBLME (2015) Seagrass conservation and monitoring in Myanmar. BOBLME-2015-Ecology-50

Seagrass conservation and monitoring in Myanmar

The biodiversity, distribution and coverage of seagrasses in the Tanintharyi and Rakhine



U. Soe-Htun

Independent Consultant

**Antt Maung, Salai Mon, Soe Thi Ha, Soe Tint Aung,
Aung Myo Lwin and U Zau Lunn**

Fauna & Flora International

TCP report no. 26

July 2015



Food and Agriculture Organization
of the United Nations



Norad



THE LEONA M. AND HARRY B.
HELMSLEY
CHARITABLE TRUST



The programme	The Tanintharyi conservation programme is an initiative of Fauna & Flora International's (FFI) Myanmar programme, implemented in collaboration with the Myanmar Forest Department and a number of local, national and international collaborators and stakeholders. FFI Myanmar operates the programme under a MoU with the Forest Department and LOA with the Fisheries Department specifically for marine and terrestrial conservation activities in Tanintharyi Region.
Funding	The implementation of the field activity and the production of this report were done with funding support of the Bay of Bengal Large Marine Ecosystem (BOBLME) Project of the Food and Agriculture Organisation (FAO) of the United Nations. Supporting funding was also provided by European Commission, Helmsley Charitable Trust, Segre Foundation, Lighthouse Foundation and the Arcadia Fund.
Suggested citation	U Soe Tun, Antt Maung, Salai Mon, Soe Thi Ha, Soe Tint Aung, Aung Myo Lwin, and U Zau Lunn (2015). Seagrass Conservation and Monitoring in Myanmar: The biodiversity, distribution and coverage of seagrasses in the Tanintharyi and Rakhine. Report No. 26 of the Tanintharyi Conservation Programme, a joint initiative of Fauna & Flora International (FFI) and the Myanmar Fisheries Department, FFI, Yangon and the Bay of Bengal Large Marine Ecosystem Project (BOBLME).
Author details	U Soe Tun is a retired university professor from Mawlamyine University in Myanmar and one of the country's leading experts on seagrass taxonomy and ecology. U Zau Lunn is FFI Myanmar's Marine Conservation Programme Manager and former lecturer of marine biology at the Marine Science Department of Mawlamyine University. Antt Maung, Salai Mon, Soe Thi Ha, Soe Tint Aung, Aung Myo Lwin are all marine biologists and Myanmar's first coral reef research divers.
Copyright	Reproduction of this report in full or in part is granted for the purposes of education, research or awareness, with the sole provision that the authors and authoring organisations be properly credited.
Cover image	Seagrass beds in Pho Htaung Gyaing along the Rakhine Coast. Credit: FFI Myanmar.
Disclaimer	The contents of this document are the sole responsibility of Fauna & Flora International and can under no circumstances be regarded as reflecting the position of the European Commission or other donors.

Abstract

Seagrasses provide ecological services to marine organisms that contribute towards food security and economic benefits to local communities living around their meadows. However, about 60% of seagrass meadows globally have seen reductions in their distribution since 1980. For this reason, surveys on seagrass taxonomy, distribution and extent were carried out in Myanmar in 14 sites within Myeik Archipelago and along the Rakhine Coast to assess the status of these important habitats. This study follows the guidelines of taxonomic monographs and the Seagrass Net manual to survey species, percent cover and extent. A total of 12 species of seagrasses were recorded, including *Syringodium isoetifolium*, *Cymodocea rotundata*, *C. serrulata*, *Halodule uninervis*, *H. pinifolia*, *Enhalus acoroides*, *Thalassia hemprichii*, *Halophila beccarii*, *H. decipiens*, *H. ovalis* and two new records for Myanmar, *Halophila major* and an undescribed species of *Cymodocea*. Of the 12 species of seagrasses collected in this study, *Halophila pinifolia* was the most commonly observed species and the only one distributed across all 14 study sites. In contrast, *Halophila beccarii* was only recorded at Ma Gyi along the Rakhine Coast. Other unique species distributions include *Halophila major* which was found along the Rakhine Coast and *Cymodocea sp.* was encountered only along the Tanintharyi Coast. The tidal habit of seagrasses between the two coastal regions was also found to differ with seagrass meadows in Tanintharyi most commonly observed in intertidal zones whereas those in Rakhine were recorded in the subtidal zone. In terms of species diversity among the 14 study sites, Ma Gyi and Pho Htaung Gyaing showed the highest in Rakhine with 9 species each while in Tanintharyi, Zar Det Ngye I. (East) and Pa Law Kar Kyan I. contained 8 species each. Highest percentage cover of seagrass meadows was observed at Maung Shwe Lay Gyaing, in Rakhine with 67.00% and the highest coverage in Tanintharyi at Lampi I. (East) with 64.57%. Given the environmental services provided by seagrasses their protection within Myanmar is critical. All areas should be granted a certain level of protection although priority needs to be given to Ma Gyi in Rakhine given its species diversity, being the only site to contain the 'Vulnerable' listed *Halophila beccarii* species and because of its high percentage cover. Such an area should be gazetted as a Marine Protected Area (MPA) along with Pa Law Kar Kyan I., Zar Det Ngye I. (East) and Lampi I. (East) in Tanintharyi, and Ma Gyi, Pho Htaung Gyaing and Maung Shwe Lay Gyaing in the Rakhine given their seagrass species diversity and extent.

Keywords: Biodiversity, conservation, ecological account, monitoring, morphology, local distribution, Myanmar, percent cover, Rakhine Coastal Region, Tanintharyi Coastal Region, seagrasses taxonomy.

Acknowledgements

The first author, U Soe-Htun is very grateful to Dr U Min-Thein, Director (Retd), Microalga Biotechnology Department, Myanmar Pharmaceutical Factory (MPF), Yangon, Myanmar for invaluable guidance in the studies of seagrasses since his surveys in Maungshwelay Gyaing in 1980. We also thank U Thaug Htut and U Zaw Lin Tun, Staff of Marine Science Association, Myanmar (MSAM) for their helpful assistance in the preparations of the manuscript. Funding for this work from the Bay of Bengal Large Marine Ecosystem (BOBLME) Project "Seagrass Monitoring in Myanmar", under a joint project with Fauna & Flora International and BOBLME of the Food and Agriculture Organisation (FAO) of the United Nations, is most appreciated.

Table of contents

1. Introduction	1
2. Materials and methods	1
3. Results	10
4. Discussion.....	30
5. Recommended management actions	32
6. References.....	33
Appendix I A classification system of the seagrasses collected from 14 study sites in the Tanintharyi and Rakhine Coastal Regions of Myanmar.....	36
Appendix II Pictorial guide to the 12 species of seagrass encountered during the current survey	37
Appendix III Taxonomic key to the species of seagrasses collected from the two study areas in Myanmar	43
Appendix IV Ecological account and supplementary survey data.....	44
Appendix V Hawksbill marine turtle, accidentally caught by beach seine net from Taw Wet I. (South). B-C, The stranded dugong at Ma Gyi on 18-6-2015.	50
Appendix VI Seagrass policy brief	51

List of tables

Table 1. Biodiversity of seagrasses distributed in 14 study sites in the Tanintharyi and Rakhine Coastal Regions of Myanmar	11
Table 2. The physical parameters of seagrass meadows in 14 study sites.	11
Table 3. The percentage cover and frequency of the occurrence of seagrasses encountered along 3 cross-transects in 14 study sites in the Tanintharyi and Rakhine Coastal Regions of Myanmar	12
Table 4. Seagrass sites ranked according to uniqueness, species richness and percentage cover	32

List of figures

Figure 1. The survey sites in the Myeik Archipelago, in the Tanintharyi Coastal Region.	4
Figure 2. The survey sites of seagrass areas in the Rakhine Coastal Region	5
Figure 3. The layout of the monitoring cross-transects, A, B and C, with 12 quadrats at the interval of pre-selected random distance along the vertically established transects approximately perpendicular (at right angles) to the water's edge	7
Figure 4. Seagrass Net percentage cover photo guide	8
Figure 5. Recording the percentage cover of seagrasses growing in the intertidal zone in the coastal areas of the Myeik Archipelago of the Tanintharyi	9
Figure 6. Investigating the percentage cover of seagrasses growing in the subtidal zone in the coastal areas of Rakhine.....	9
Figure 7. Map showing the biodiversity and distribution of seagrasses growing along 10 study sites in the Tanintharyi and 4 study sites in the Rakhine Coastal Regions.....	14
Figure 8. Seagrass areas in Myeik Archipelago - Zar Det Gyi I.	15
Figure 9. Seagrass areas in Myeik Archipelago - Zar Det Ngye I. (West)	16
Figure 10. Seagrass areas in Myeik Archipelago - Zar Det Ngye I. (East)	17
Figure 11. Seagrass areas in Myeik Archipelago - Pa Law Kar Kyan I.....	18
Figure 12. Seagrass areas in Myeik Archipelago - Nyaung Wee I.	19
Figure 13. Seagrass areas in Myeik Archipelago - Bo Cho I.....	20

Figure 14. Seagrass areas in Myeik Archipelago - Lampi I. (East)	21
Figure 15. Seagrass areas in Myeik Archipelago - Lampi I. (East)	22
Figure 16. Seagrass areas in Myeik Archipelago - Taw Wet I. (South).....	23
Figure 17. Seagrass areas in Myeik Archipelago - Taw Wet I. (North).....	24
Figure 18. Seagrass areas in Myeik Archipelago - Ohn Kyun I	25
Figure 19. Seagrass areas in Myeik Archipelago - Ma Gyi	26
Figure 20. Seagrass areas in Myeik Archipelago - Pho Htaung Gyaing.....	27
Figure 21. Seagrass areas in Myeik Archipelago - Maung Shwe Lay Gyaing.....	28
Figure 22. The percentage cover of seagrasses along 3 cross-transects in 14 study sites	30

Acronyms used

ASEAN	Association of Southeast Asian Nations
BOBLME	Bay of Bengal Large Marine Ecosystem Project
FAO	Food and Agriculture Organization of the United Nations
FFI	Fauna and Flora International
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
LOA	Letter of Agreement
MPA	Marine Protected Area
MPF	Myanmar Pharmaceutical Factory
MSAM	Marine Science Association, Myanmar
NGO	Non-Governmental Organisation
UNEP	United Nations Environment Programme
USA	United States of America

1. Introduction

Seagrasses are a relatively small group of submerged flowering plants of approximately 72 species, representing less than 0.1% of the angiosperm taxa growing in shallow coasts of the tropical and subtropical regions (Green and Short 2003, Short *et al.*, 2007). The ecological importance of seagrass beds has been well documented and includes the provision of sheltered habitats and crucial feeding, spawning and nursery grounds for economically important species of marine invertebrates and fish species (Dawes 1981, Zieman *et al.*, 1989; Dawes *et al.*, 2004; Adulyanukosol *et al.*, 2006; Nakanishi *et al.*, 2006). Furthermore they are key primary producers, involved in epibenthic and benthic production; provide important nutrients and contaminant filtration, producers of oxygen and recyclers of nutrients (Orth *et al.*, 2006). However, since 1980 about 60% of seagrass populations globally have seen a reduction in their distribution due to habitat destruction and marine pollution (Green and Short 2003; Short *et al.*, 2007).

Seagrasses occur all along three coastal regions of Myanmar, namely Rakhine, Ayeyarwady Delta and the Gulf of Mottama (Martaban) and Tanintharyi. Ten species of seagrasses has been described in Myanmar and include, e.g. *Syringodium isoetifolium* (Ascherson) Danty, *Cymodocea serrulata* (R. Brown) Ascherson et Magnus, *C. rotundata* Ehrenberg et Hemprich ex Ascherson, *Halodule uninervis* (Forsskal) Ascherson, *H. pinifolia* (Miki) den Hartog, *Enhalus acoroides* (Linnaeus f.) Royle, *Thalassia hemprichii* (Ehrenberg) Ascherson, *Halophila beccarii* Ascherson, *H. decipiens* Ostenfeld and *H. ovalis* (R. Brown) Hooker f. (Min-Thein *et al.*, 1979; Soe-Htun *et al.*, 1997; Soe-Htun *et al.*, 2001; Soe-Htun *et al.*, 2009; Novak *et al.*, 2009; Tint Tun and Barry 2011). Their importance to Myanmar fishers is well known with local people calling seagrasses *Leik-Sar-Phat-Myet*, meaning the food of marine turtles. In addition, the seagrass meadows are known to serve as important feeding grounds for the sea cow, *Dugong dugon* which is recognized as endangered species under the IUCN Red list.

Given their importance, both ecologically and economically, and the global decline in seagrass beds, the protection of seagrasses within Myanmar is seen as paramount. The current study was therefore undertaken to provide updated information on the current status, distribution and coverage of seagrasses at select sites within the Tanintharyi and the Rakhine Coastal Regions of Myanmar. This information will be used to guide the creation of Marine Protected Areas within Myanmar to ensure such habitats are conserved and used for long term monitoring of seagrasses. The study was undertaken as part of the Bay of Bengal Large Marine Ecosystem (BOBLME) Project of the Food and Agriculture Organization (FAO) of the United Nations "Seagrass monitoring in Myanmar", a joint project of Fauna & Flora International and BOBLME.

2. Materials and methods

Using past surveys of seagrasses within Myanmar, ten study sites were selected in the Myeik Archipelago along the Tanintharyi Coast (**Figure 1**) and four study sites in Rakhine (**Figure 2**) to gain an understanding of their status and suitability for MPA designation. Surveys were conducted in 2015 between 6th of March and 4th of April in Tanintharyi and from 1st to 31st of May in Rakhine and included the following sites:

Tanintharyi Coast

1. Zar Det Gyi I.

Located in front of the mangrove communities at Lat. 10.02003°N, Long. 98.28963°E. Substrates are muddy sand and sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 23 March 2015.

2. Zar Det Ngye I. (West)

Located in front of the mangrove communities at Lat. 10.11687°N, Long. 98.28199°E. Substrates are muddy sand near shore becoming sand to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 22 March 2015.

3. Zar Det Ngye I. (East)

Located in front of the mangrove communities at Lat. 10.1251°N, Long. 98.3045°E. Substrates are muddy sand inshore and sandy mud at offshore. The percentage cover of seagrasses along the cross-transects was estimated on 24 March 2015.

4. Pa Law Kar Kyan (St. Luke)

Located in front of the mangrove communities at Lat. 10.13461°N, Long. 98.21011°E. Substrates are muddy sand nearshore and sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 21 March 2015.

5. Nyaung Wee I.

Located in front of the mangrove communities at Lat. 10.50319°N, Long. 98.23227°E. Substrates are muddy sand in nearshore, becoming sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 20 March 2015.

6. Bo Cho I.

Located in front of the sandy beach without mangrove communities at Lat. 10.66216°N, Long. 98.26°E. Water depth 5 m. Substrates are muddy sand in nearshore and sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 18 March 2015.

7. Lampi I. (East)

Located in front of the sandy beach without mangrove communities at Lat. 10.70202°N, Long. 98.27984°E. Substrates are muddy sand and sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 19 March 2015.

8. Lampi I. (West)

Located in front of the sandy beach without mangrove communities at Lat. 10.88089°N, Long. 98.07436°E. Substrates are muddy sand nearshore and sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 16 March 2015.

9. Taw Wet I. (South)

Located in front of the mangrove communities at Lat. 11.37642°N, Long. 98.12234°E. Substrates are muddy sand becoming sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 11 March 2015.

10. Taw Wet I. (North)

Located in front of the mangrove communities at Lat. 11.40776°N, Long. 98.12032°E. Substrates are predominantly muddy sand and becoming sandy mud to offshore. The percent cover of seagrasses along the cross-transects was estimated on 11 March 2015.

Rakhine Coastal Region:

11. Ohn Kyun I.

Located in front of the sandy beach without mangrove communities at Lat. 16.388765°N, Long. 94.229125°E. Substrates are muddy sand in nearshore and sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 8 May 2015.

12. Ma Gyi

Located in front of the sandy beach without mangrove communities at Lat. 17.072122°N, Long. 94.451406°E. Substrates are muddy sand nearshore and sandy mud to offshore. The percentage cover of seagrasses along the cross-transects was estimated on 1 May 2015.

13. Pho Htaung Gyaing

Located in front of the mangrove communities at Lat. 17.170547°N, Long. 94.491739°E. Substrates are muddy sand in nearshore and sandy mud to offshore. The percent cover of seagrasses along the cross-transects was estimated on 2 May 2015.

14. Maung Shwe Lay Gyaing

Located in front of the sandy beach without mangrove communities at Lat. 18.305367°N, Long. 94.329312°E. Substrates are muddy sand in nearshore and sandy mud in offshore. The percentage cover of seagrasses along the cross-transects was estimated on 15 May 2015.

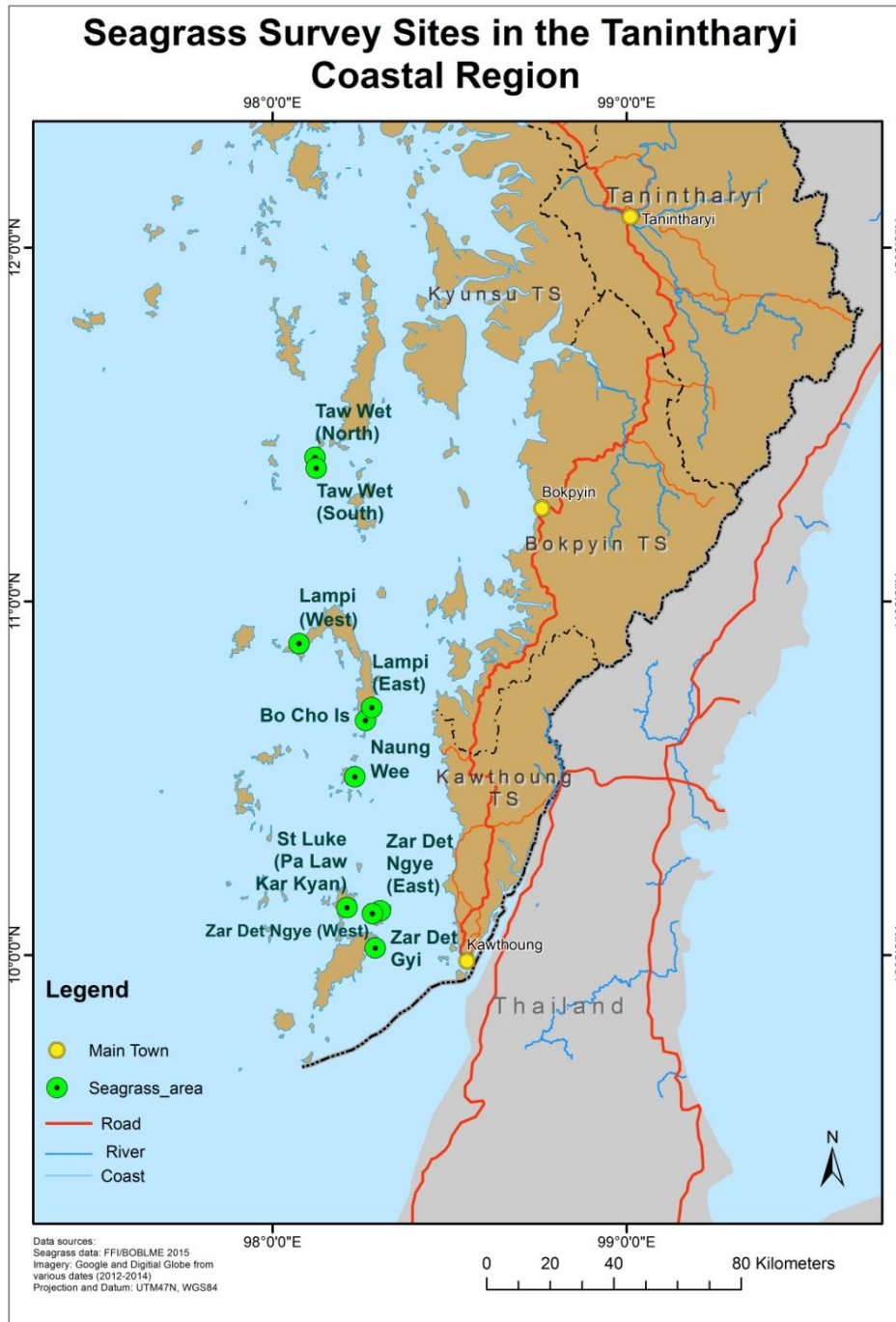


Figure 1. The survey sites in the Myeik Archipelago, in the Tanintharyi Coastal Region.

Seagrass Survey Site in the Rakhine Coastal Region



Figure 2. The survey sites of seagrass areas in the Rakhine Coastal Region

Fresh and live materials of seagrasses growing in the natural beds of 14 study sites were sampled by uprooting the seagrasses with a small trowel or knife from 6 March 2015 to 31 June 2015. Snorkelling or scuba equipment was used for the submersed habitats of seagrasses growing in subtidal zone of the Rakhine Coast in depths between 2-5 m, while in the Myeik Archipelago surveys were conducted during the ebb tide and walked. The collections were initially washed, cleaned and preserved in 10% Formalin in seawater. Samples of seagrasses were examined mainly on the vegetative characters with a dissecting microscope and then pressed on herbarium sheets to

prepare as voucher specimens for each locality. As for taxonomic account, all specimens were identified using the standard monograph of seagrasses prepared by Den Hartog (1970) and Kuo *et al.*, (2006). This study had followed the classification system used by Fortes (1993). All voucher specimens were deposited at the Herbarium of Department of Marine Science, Mawlamyine University, Mawlamyine, Myanmar.

In relation to the ecological account, this study has followed the Seagrass Net protocol (2006), consisting of three fixed, parallel, 50 m cross transects referred to as cross transects A, B and C, with cross transect A closest to shore and C most seaward; B, midpoint of these cross transects were established on a transect laid out seaward, perpendicular to the shore (**Figure 3**). Percentage cover of seagrasses was visually estimated within 12 randomly placed 0.25 m² quadrats along each transect line using a photo guide of percent cover (**Figure 4**). As noted above, these works were done intertidally in the coastal areas of the Myeik Archipelago (**Figure 5**), but sub tidally in the Rakhine coastal areas using snorkelling or scuba equipment (**Figure 6**). Positions and areas of seagrasses for each study site were recorded by GPS with extent being recorded by walking around the seagrass bed taking GPS points every 10 secs. The physical parameters, namely temperature using a mercurial thermometer, salinity using a refractometer, water depths using handheld sounder were measured in the field. The types of substrate were also recorded

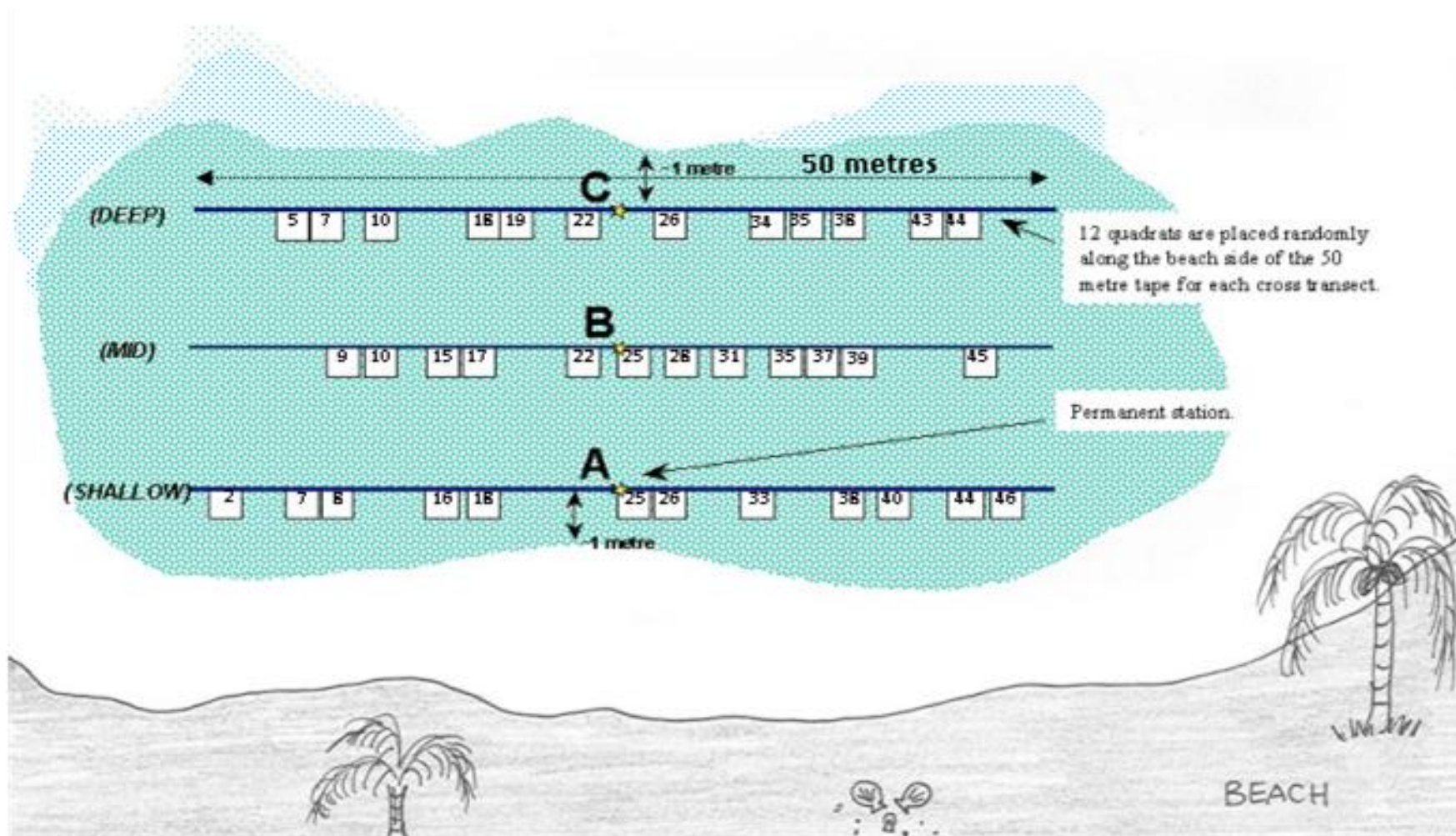


Figure 3. The layout of the monitoring cross-transects, A, B and C, with 12 quadrats at the interval of pre-selected random distance along the vertically established transects approximately perpendicular (at right angles) to the water's edge

(Source: Modified from Seagrass Net 2006)

Seagrass Percentage Cover

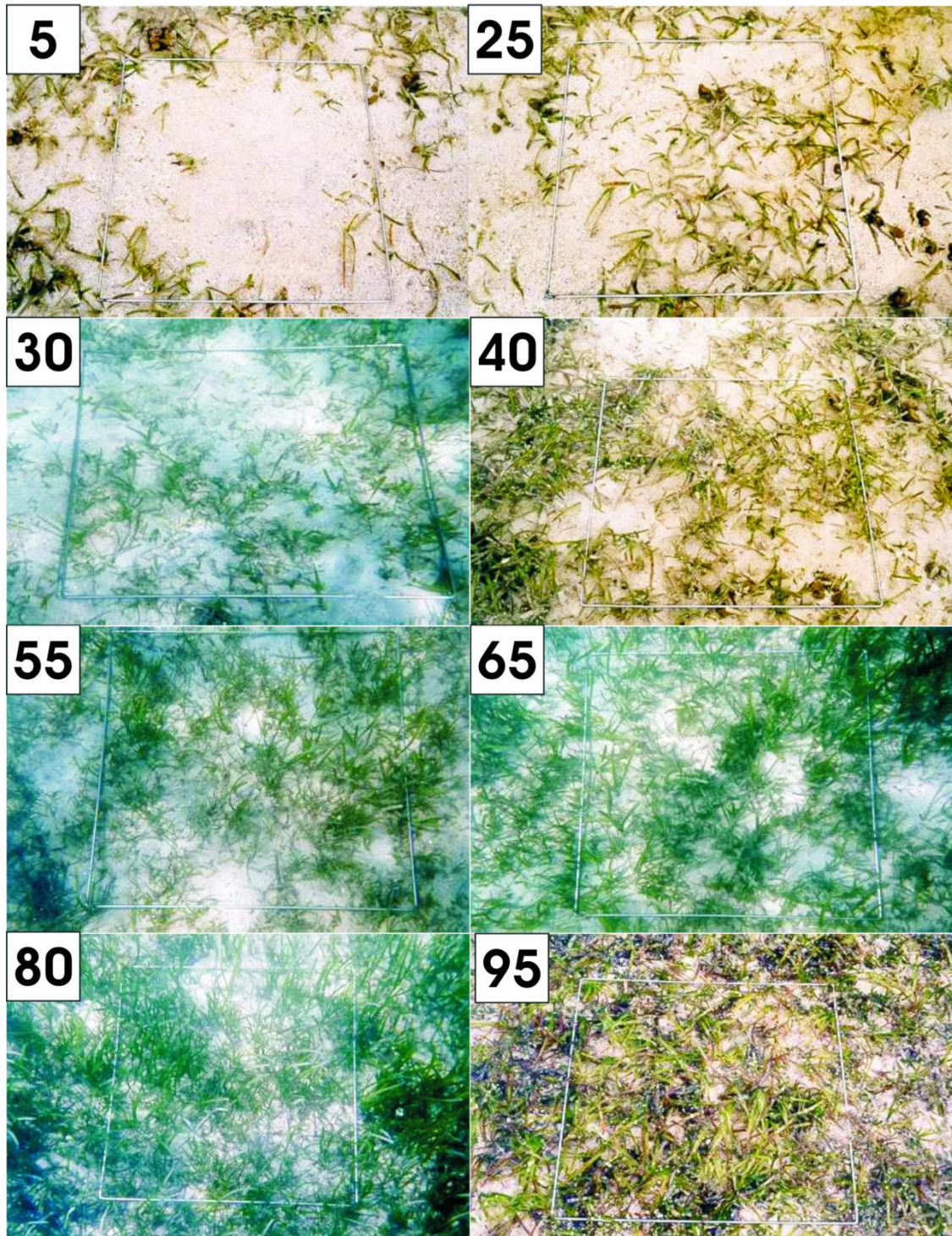


Figure 4. Seagrass Net percentage cover photo guide

(Short *et al.* 2006)



Figure 5. Recording the percentage cover of seagrasses growing in the intertidal zone in the coastal areas of the Myeik Archipelago of the Tanintharyi

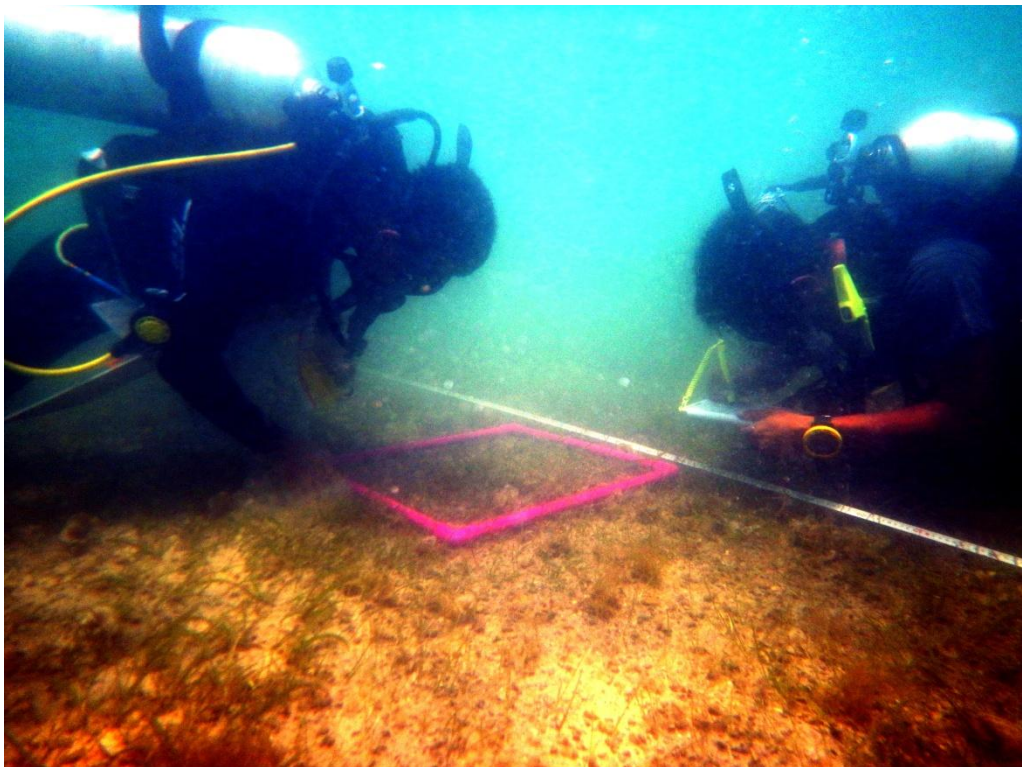


Figure 6. Investigating the percentage cover of seagrasses growing in the subtidal zone in the coastal areas of Rakhine

3. Results

In the present study a total of 12 species of seagrasses were identified including: 1. *Syringodium isoetifolium* (Ascherson) Danty; 2. *Cymodocea serrulata* (R. Brown) Ascherson et Magnus; 3. *Cymodocea rotundata* Ehrenberg et Hemprich ex Ascherson; 4. *Cymodocea sp.*; 5. *Halodule uninervis* (Forsskal) Ascherson; 6. *Halodule pinifolia* (Miki) den Hartog; 7. *Enhalus acoroides* (Linnaeus f.) Royle; 8. *Thalassia hemprichii* (Ehrenberg) Ascherson; 9. *Halophila beccarii* Ascherson; 10. *Halophila decipiens* Ostenfeld; 11. *Halophila ovalis* (R. Brown) Hooker f and 12. *Halophila major* (Zoll.) Miquel (**Table 1**). A detailed account of the taxonomy of these plants including identification guide, ecological account and supplementary survey data can be found within the Appendices of this report. Of these species only one, *Halophila beccarii* is considered 'Vulnerable (VU)' according to the IUCN Red list, with all other species listed as Least Concern (LC).

Of the 12 species of seagrasses collected in this study, *Halophila pinifolia* was the most commonly observed species and the only one to be distributed across all 14 study sites. In contrast, *Halophila beccarii* was only recorded at Ma Gyi along the Rakhine Coast. Other unique species distributions include *Halophila major* which was found along the Rakhine Coast and *Cymodocea sp.* was encountered only along the Tanintharyi Coast. The most frequently observed species along the transects was *Cymodocea rotundata* and the least was *Enhalus acoroides*. *Cymodocea sp.*, *Thalassia hemprichii*, *Halophila beccarii* were not recorded on the transects and only occasionally observed during the survey and considered low in abundance.

The tidal habit of seagrasses between the two coastal regions was also found to differ with seagrass meadows in Tanintharyi most commonly observed in intertidal zones whereas those in Rakhine were recorded in the subtidal zone (**Table 2**). In terms of species diversity among the 14 study sites, Ma Gyi and Pho Htaung Gyaing showed the highest in Rakhine with 9 species each; while in Tanintharyi Zar Det Ngye I. (East) and Pa Law Kar Kyan I. contained 8 species each. Highest percentage cover of seagrass meadows was observed at Maung Shwe Lay Gyaing, in Rakhine with 67.00% and the highest coverage in Tanintharyi at Lampi I. (East) with 64.57% (**Table 3** and Figures 7 to 20). Although no statistical tests were undertaken no clear pattern was observed in terms of species diversity or density from inshore to offshore (**Figure 21**).

Table 1. Biodiversity of seagrasses distributed in 14 study sites in the Tanintharyi and Rakhine Coastal Regions of Myanmar

Sr. no.	Species	Study sites												Total (sites)		
		Tanintharyi Coastal Region								Rakhine Coastal Region						
		Zae Det Gyi I.	Zae Det Ngye I. (W)	Zae Det Ngye I. (E)	Pa Law Kar Kyan I.	Naung Wee I.	Bo Cho I.	Lampi I. (East)	Lampi I. (West)	Taw Wet I. (South)	Taw Wet I. (North)	Ohn Kyun I.	Magyi		Pho Htaung Gyaing	Maung Shwe Lay Gyaing
1.	<i>Syringodium isoetifolium</i>												+	+	+	3
2.	<i>Cymodocea serrulata</i>	+	+	+	+	+	+	+				+	+	+	+	12
3.	<i>C. rotundata</i>	+	+	+	+	+	+	+	+			+	+	+	+	13
4.	<i>C. sp.</i>	+	+	+	+	+	+	+	+	+						10
5.	<i>Halodule univervis</i>	+	+	+	+	+	+			+		+	+	+	+	11
6.	<i>H. pinifolia</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	14
7.	<i>Enhalus acoroides</i>			+	+									+		3
8.	<i>Thalassia hemprichii</i>	+	+	+	+	+	+	+				+	+	+	+	12
9.	<i>Halophila beccarii</i>												+			1
10.	<i>H. decipiens</i>											+	+	+		3
11.	<i>H. ovalis</i>	+	+	+	+	+	+	+		+	+					9
12.	<i>H. major</i>											+	+	+	+	4
Total (biodiversity)		7	7	8	8	7	7	6	3	4	6	7	9	9	7	

Table 2. The physical parameters of seagrass meadows in 14 study sites.

Study site	Physical parameters		
	Temperature (°C)	Salinity (‰)	Depth (m) surveyed
Tanintharyi Coastal Region:			
Zar Det Gyi I.	33	32	0
Zar Det Ngye I. (West)	29	32	0
Zar Det Ngye I. (East)	33	32	0
Pa Law Kar Kyan (St. Luke)	28	32	0
Nyaung Wee I.	33	32	0
Bo Cho I.	30	32	0
Lampi I. (East)	30	32	0
Lampi I. (West)	29	32	0
Taw Wet I. (South)	30	35	0
Taw Wet I. (North)	32	32	0
Rakhine Coastal Region:			
Ohn Kyun I.	29	32	5
Ma Gyi	28	32	3
Pho Htaung Gyaing	29	32	3
Maung Shwe Lay Gyaing	28	32	3

Table 3. The percentage cover and frequency of the occurrence of seagrasses encountered along 3 cross-transects in 14 study sites in the Tanintharyi and Rakhine Coastal Regions of Myanmar

Those species with no records were observed at the site but not found in the transect quadrants.

Sr. no.	Locality (Date)	Position Lat. N, Long. E	Cover (%)/Cross-transect				Species											Total/ Species		
			A	B	C	Total	<i>Si</i>	<i>Cs</i>	<i>Cr</i>	<i>Csp</i>	<i>Hu</i>	<i>Hp</i>	<i>Ea</i>	<i>Th</i>	<i>Hb</i>	<i>Hd</i>	<i>Ho</i>		<i>Hm</i>	
Tanintharyi Coastal Region	1.	Zar Det Gyi I. (23 March 2015)	(Lat. 10.02003°, Long. 98.28963°)	23.33	54.58	56.25	44.72		A: 0	A: 10								A: 1		11/2
									B: 0	B: 12								B: 3		15/2
									C: 1	C: 12								C: 1		14/3
	2.	Zar Det Ngye I. (West) (22 March 2015)	(Lat. 10.11687°, Long. 98.28199°)	18.00	29.25	30.00	25.75			A: 10			A: 0					A: 3		13/2
										B: 6			B: 4					B: 9		19/3
										C: 9			C: 0					C: 2		11/2
	3.	Zar Det Ngye I. (East) (24 March 2015)	(Lat. 10.1251°, Long. 98.3045°)	41.91	55.83	69.58	55.77			A: 12		A: 0						A: 3		15/2
										B: 12		B: 0						B: 9		21/2
										C: 12		C: 5						C: 10		27/3
	4.	Pa Law Kar Kyan I. (21 March 2015)	(Lat. 10.13461°, Long. 98.21011°)	17.75	52.92	43.75	38.14			A: 12								A: 6		18/2
										B: 12								B: 7		19/2
										C: 10								C: 4		14/2
5.	Nyaung Wee I. (20 March 2015)	(Lat. 10.50319°, Long. 98.23227°)	76.25	56.67	46.25	59.72			A: 12			A: 0					A: 0		10/1	
									B: 12			B: 0					B: 0		12/1	
									C: 12			C: 3					C: 12		27/3	
6.	Bo Cho I. (18 March 2015)	(Lat. 10.66216°, Long. 98.26°)	9.67	22.5	30.5	20.89			A: 10		A: 8						A: 10		28/3	
									B: 12		B: 5						B: 9		26/3	
									C: 11		C: 3						C: 11		25/3	
7.	Lampi I.(East) (19 March 2015)	(Lat. 10.70202°, Long. 98.27948°)	78.3	70.83	44.58	64.57			A: 12								A: 4		16/2	
									B: 12								B: 0		12/1	
									C: 12								C: 5		17/2	
8.	Lampi I. (West) (16 March 2015)	(Lat. 10. 88089°, Long. 98. 07436°)	28.83	23.75	3.68	18.75			A: 12										12/1	
									B: 12										12/1	
									C: 11										11/1	
9.	Taw Wet I. (South) (11 March 2015)	(Lat. 11.37642°, Long. 98. 12234°)	29.17	24.17	47.91	33.75					A: 12								12/1	
											B: 11								11/1	
											C: 12								12/1	

Rakhine Coastal Region	10.	Taw Wet I. (North) (8 March 2015)	(Lat. 11.40776°, Long. 98.12032°)	15.83	45.67	60.00	40.5		A: 9	A: 8			A: 2				A: 3		22/4		
									B: 12	B: 2			B: 0				B: 4		18/3		
									C: 12	C: 0			C: 0				C: 4		16/2		
	11.	Ohn Kyun I. (8 May 2015)	(Lat. 16.388785°, Long. 94.229125°)	75.00	70.25	43.75	63.00		A: 12				A: 12					A: 5		29/3	
									B: 3				B: 12					B: 0		15/2	
									C: 0				C: 8					C: 9		17/2	
	12.	Ma Gyi (1 May 2015)	(Lat. 17.072122°, Long. 94.451406°)	22.50	30.67	64.83	39.33	A: 3	A: 4	A: 2			A: 10	A: 6				A: 2		A: 1	28/7
								B: 5	B: 2	B: 8			B: 7	B: 0				B: 0		B: 1	23/5
								C: 9	C: 8	C: 8			C: 9	C: 0				C: 0		C: 0	34/4
	13.	Pho Htaung (2 May 2015)	(Lat. 17.170547°, Long. 94.491739°)	85.67	89.17	25.42	66.75	A: 2		A: 7			A: 11	A: 5	A: 0			A: 0		A: 3	28/5
								B: 0		B: 0			B: 12	B: 0	B: 2			B: 0		B: 0	14/2
								C: 0		C: 0			C: 2	C: 0	C: 0			C: 9		C: 0	11/2
	14.	Maung Shwe Lay (15 May 2015)	(Lat. 18.305367°, Long. 94.329312°)	49.17	81.25	71.67	67.36	A: 3		A: 9			A: 8	A: 1						A: 7	28/5
								B: 4		B: 12			B: 12	B: 0						B: 11	37/4
								C: 0		C: 11			C: 12	C: 0						C: 8	31/3
Total (Frequency of plants)								26	63	269		171	21	2			11	109	28		

Abbreviations: *Si* - *Syringodium isoetifolium*, *Cs* - *Cymodocea serrulata*, *Cr* - *Cymodocea rotundata*, *Csp* - *Cymodocea sp.*, *Hu* - *Halodule univervis*, *Hp* - *Halodule pinifolia*, *Ea* - *Enhalus acoroides*, *Th* - *Thalassia hemprichii*, *Hb* - *Halophila beccarii*, *Hd* - *Halophila decipiens*, *Ho* - *Halophila ovalis*, *Hm* - *Halophila major*; **A, B and C** – Cross-transects

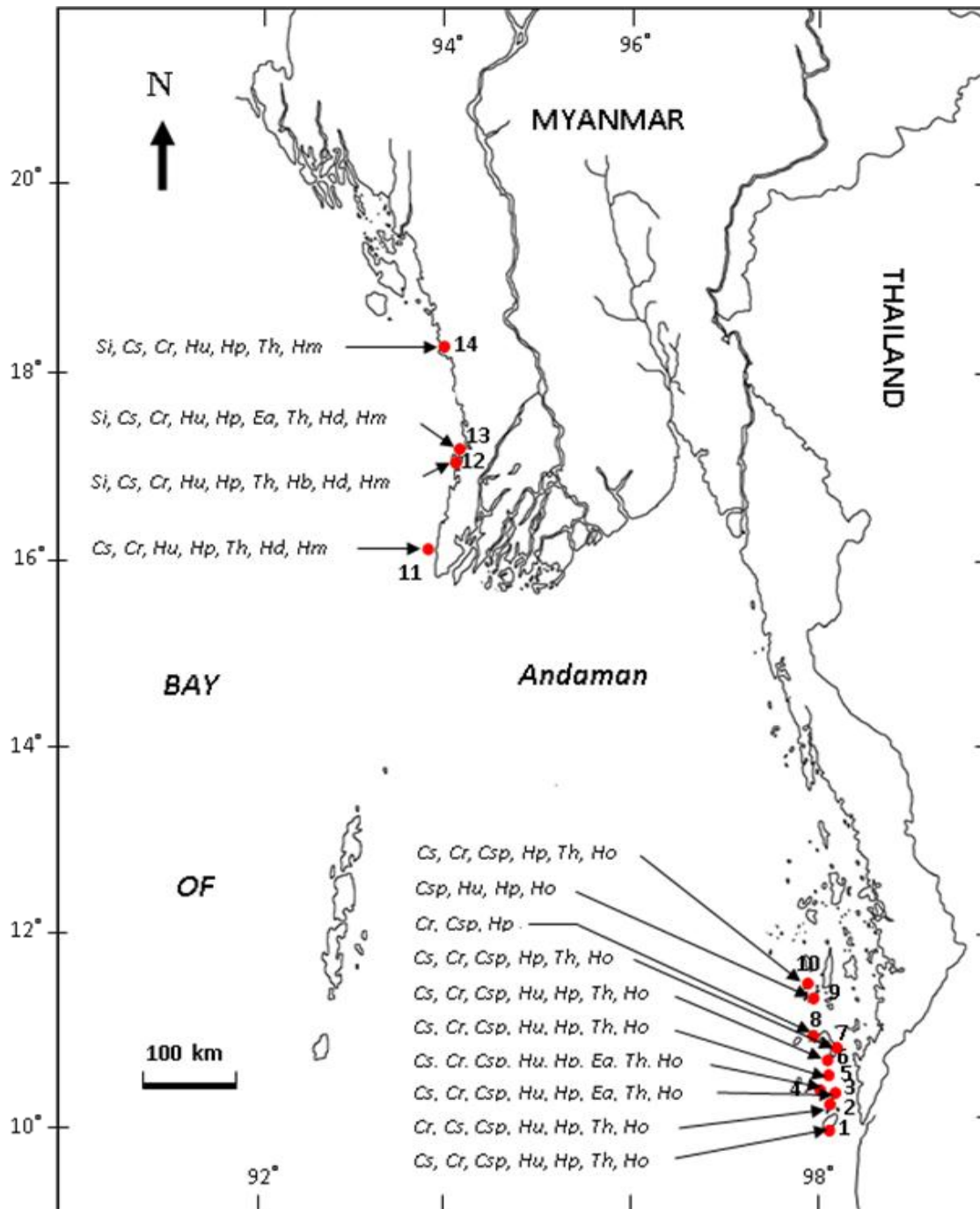


Figure 7. Map showing the biodiversity and distribution of seagrasses growing along 10 study sites in the Tanintharyi and 4 study sites in the Rakhine Coastal Regions

1. Zar Det Gyi; 2. Zar Det Ngye (West); 3. Zar Det Ngye (East); 4. Pa Law Kar Kyan I. (St Luke I.); 5. Nyaung Wee I.; 6. Bo Cho I.; 7. Lampi I. (East); 8. Lampi I. (West); 9. Taw Wet I. (South); 10. Taw Wet I. (North); 11. Ohn Kyun I.; 12. Ma Gyi (Shwe Thaug Yan); 13. Pho Htaung Gyaing and 14. Maung Shwe Lay Gyaing.

Abbreviations: *Si* - *Syringodium isoetifolium*; *Cs* - *Cymodocea serrulata*; *Cr* - *C. rotundata*; *Csp* - *C. sp.*; *Hu* - *Halodule uninervis*; *Hp* - *H. pinifolia*; *Ea* - *Enhalus acoroides*; *Th* - *Thalassia hemprichii*; *Hb* - *Halophila beccarii*; *Hd* - *H. decipiens*; *Ho* - *H. ovalis* and *Hm* - *H. major*.



Figure 8. Seagrass areas in Myeik Archipelago - Zar Det Gyi I.

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B and C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

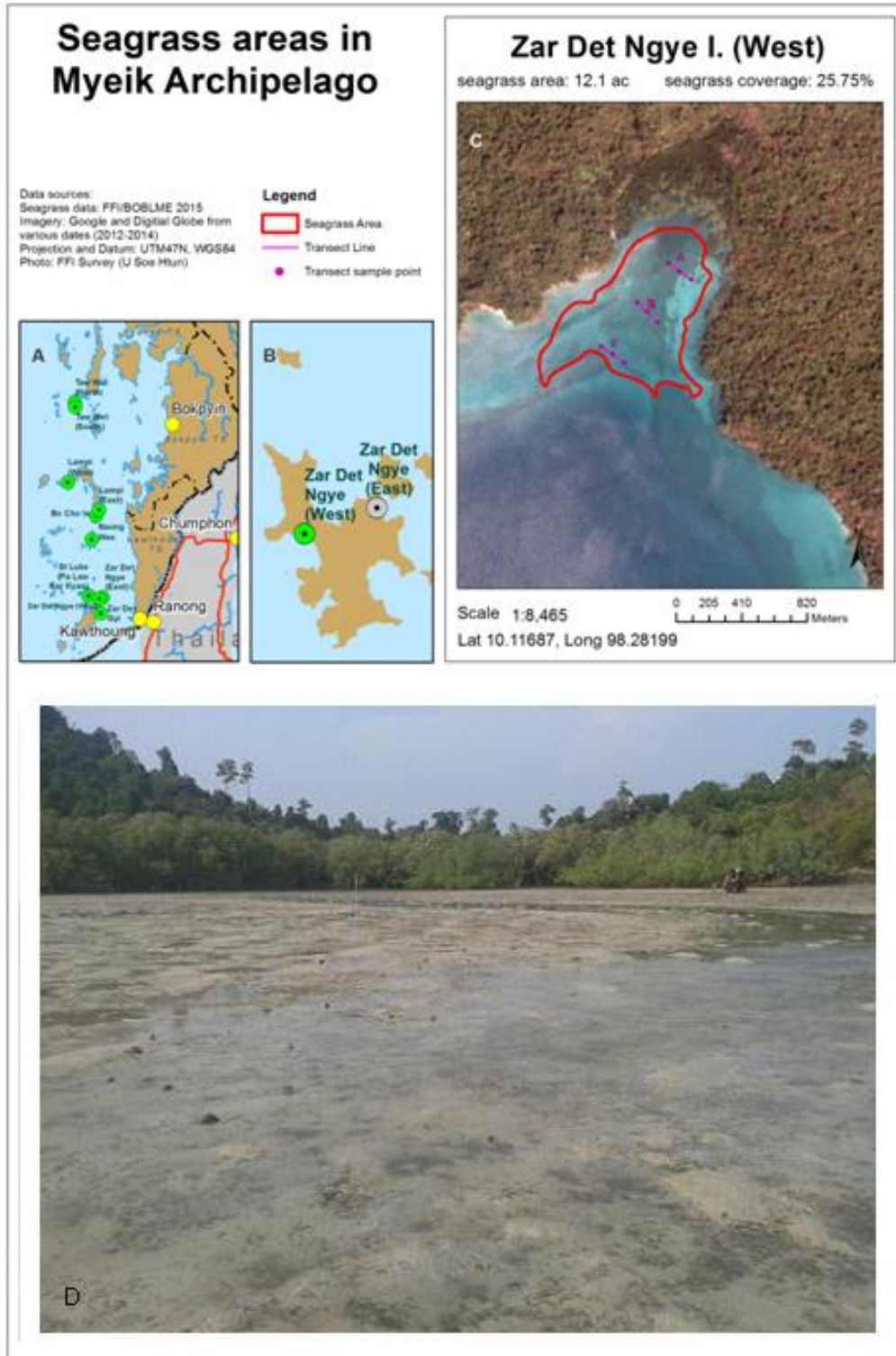


Figure 9. Seagrass areas in Myeik Archipelago - Zar Det Ngye I. (West)

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B and C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow

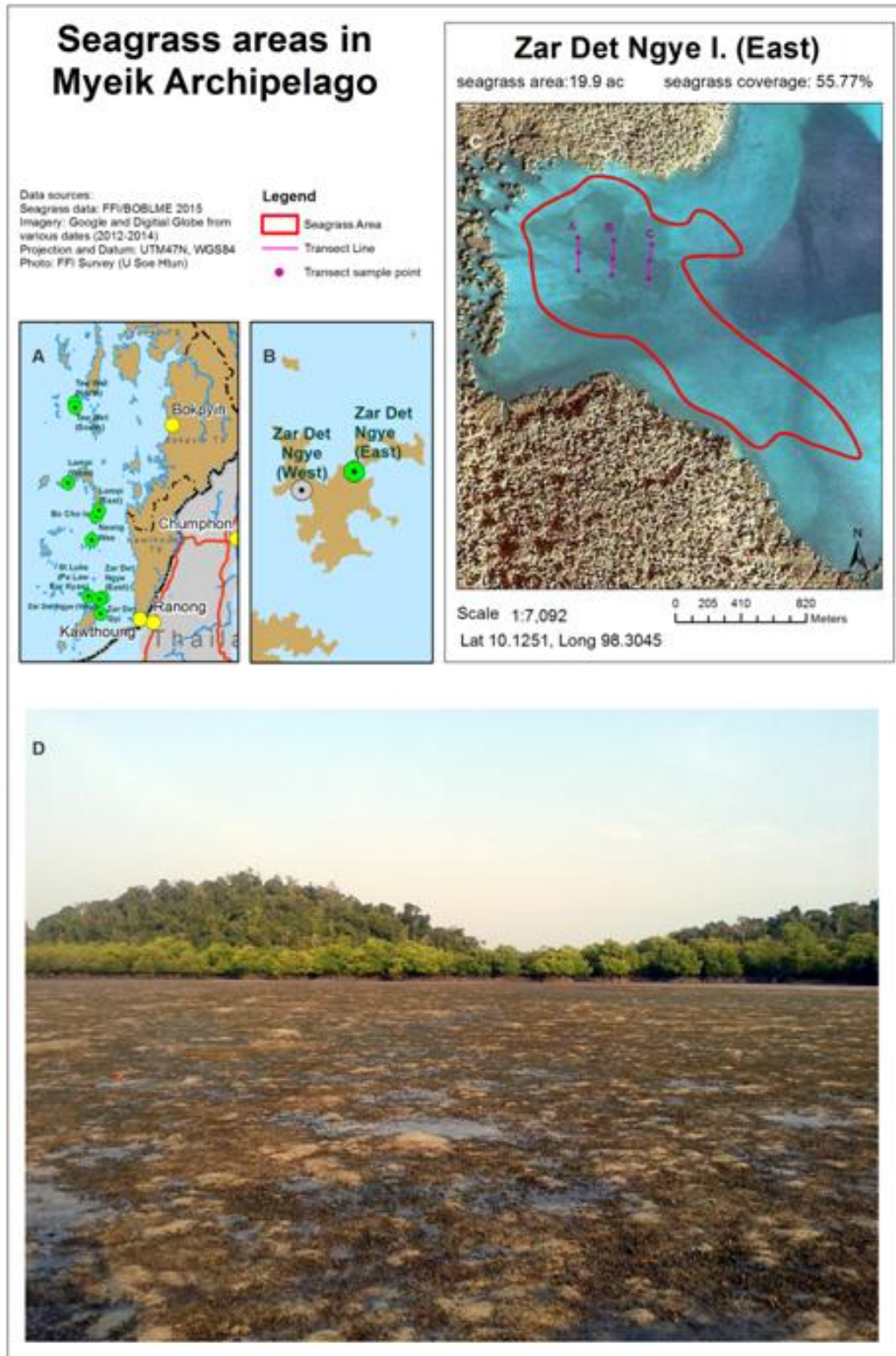


Figure 10. Seagrass areas in Myeik Archipelago - Zar Det Ngye I. (East)

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow

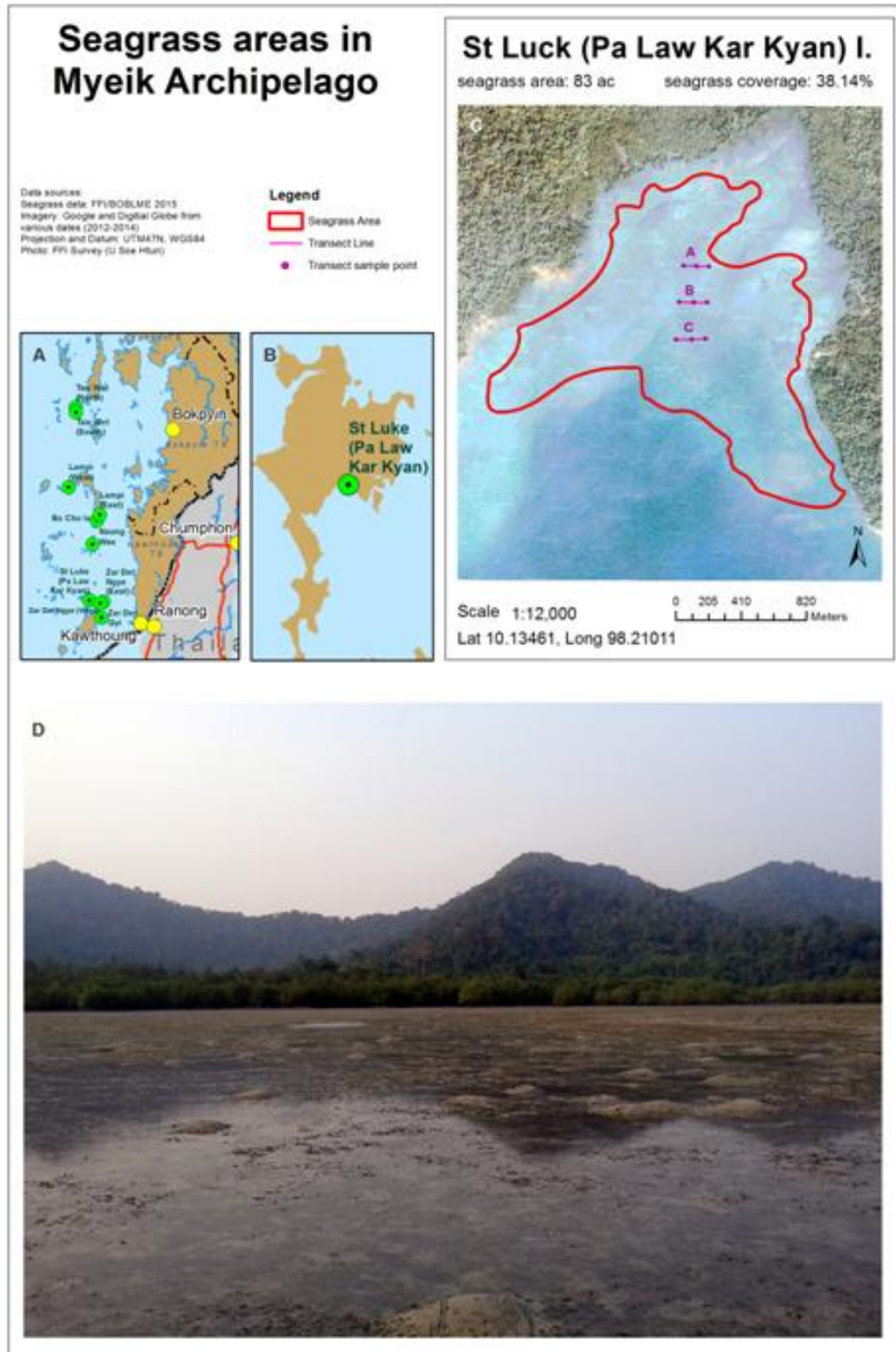


Figure 11. Seagrass areas in Myeik Archipelago - Pa Law Kar Kyan I

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass

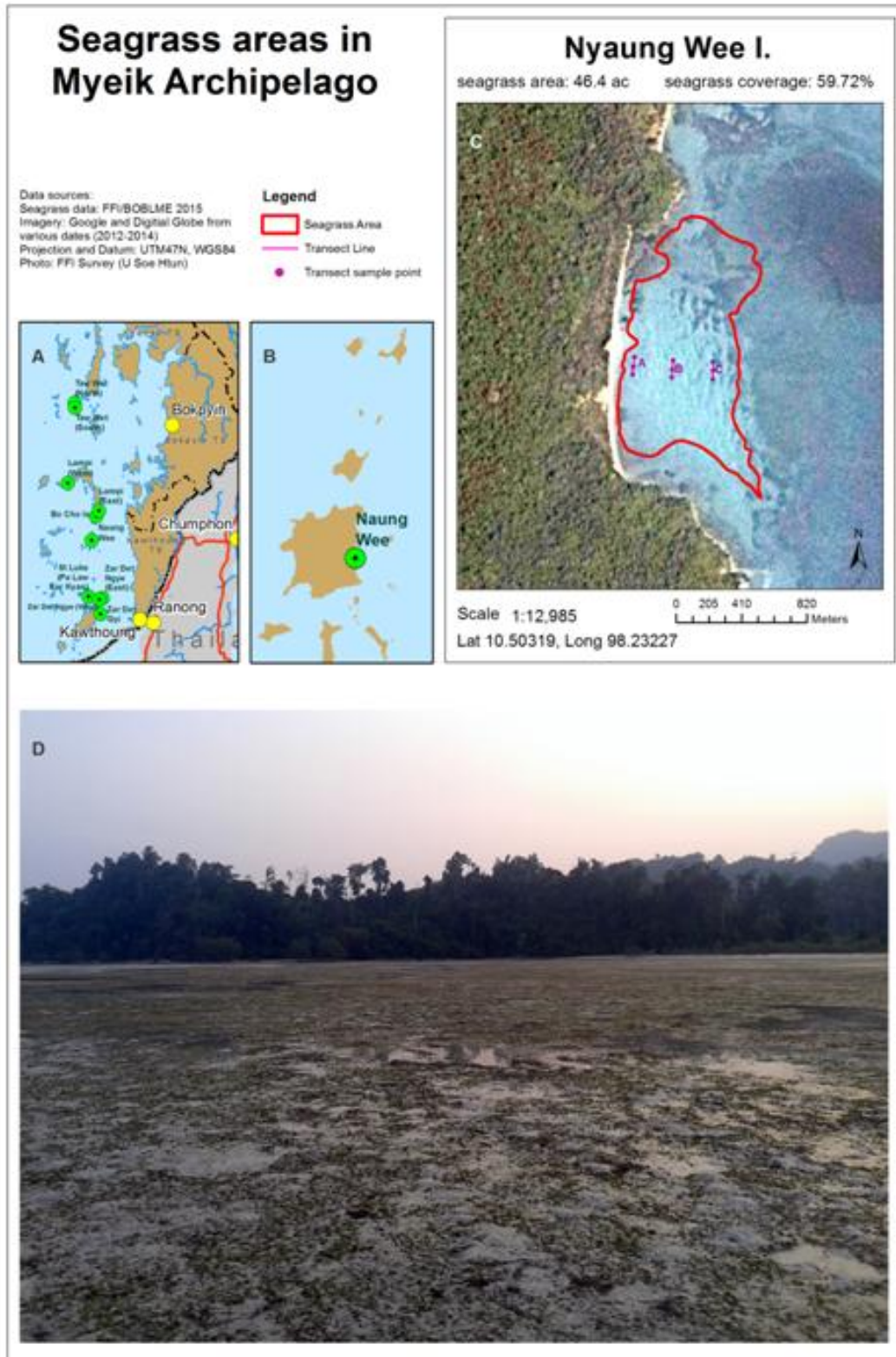


Figure 12. Seagrass areas in Myeik Archipelago - Nyaung Wee I.

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow

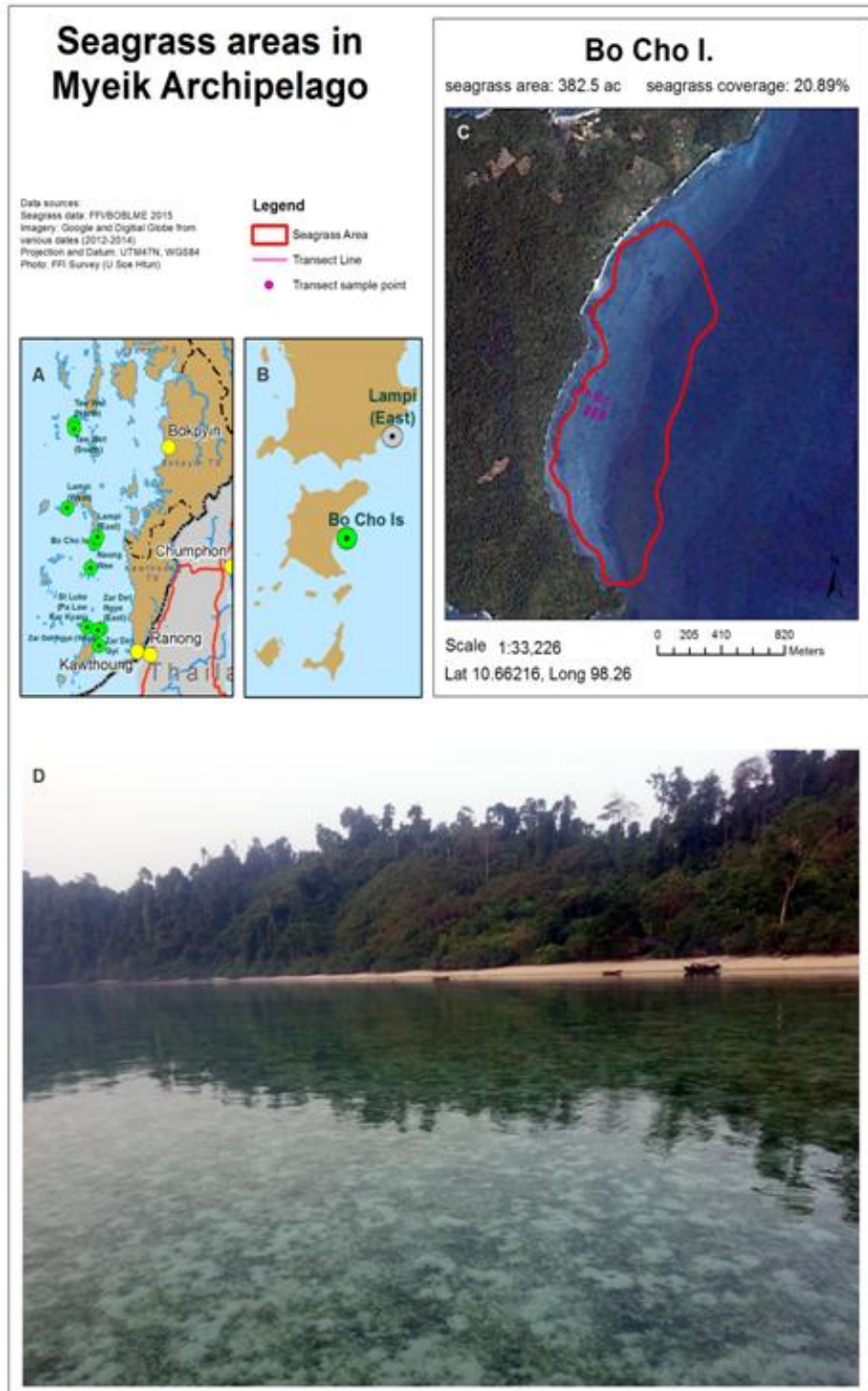


Figure 13. Seagrass areas in Myeik Archipelago - Bo Cho I.

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

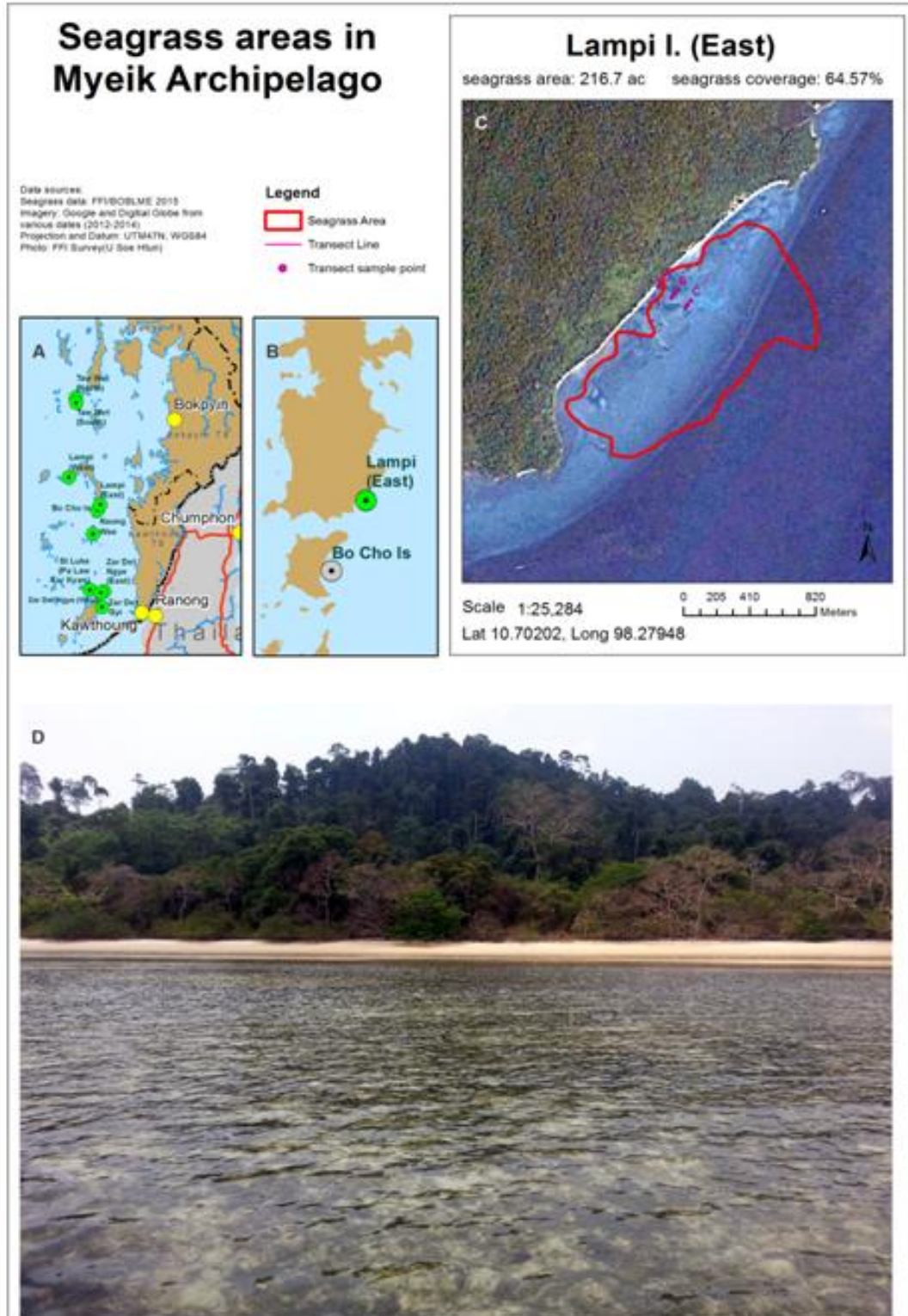


Figure 14. Seagrass areas in Myeik Archipelago - Lampi I. (East)

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

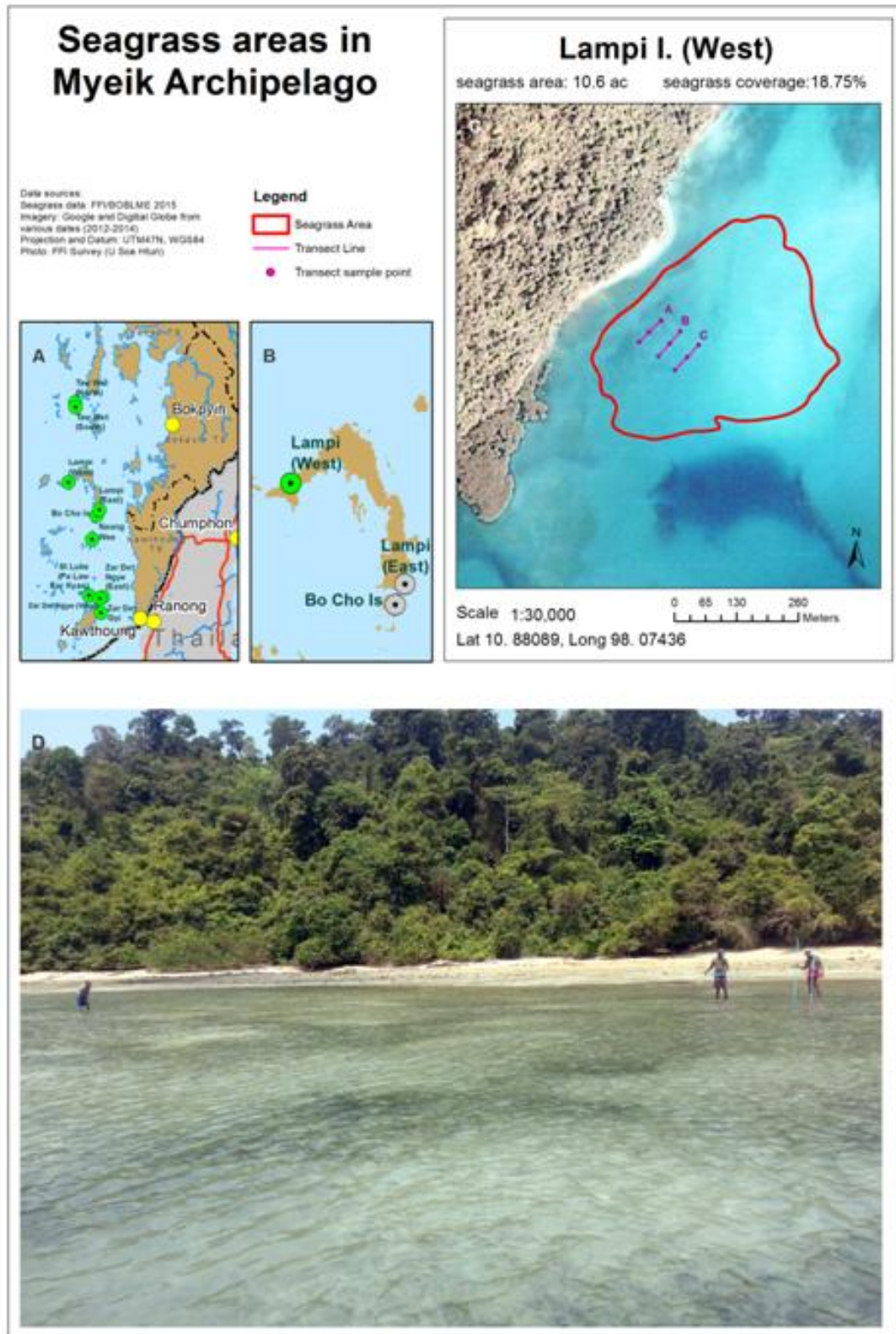


Figure 15. Seagrass areas in Myeik Archipelago - Lampi I. (East)

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

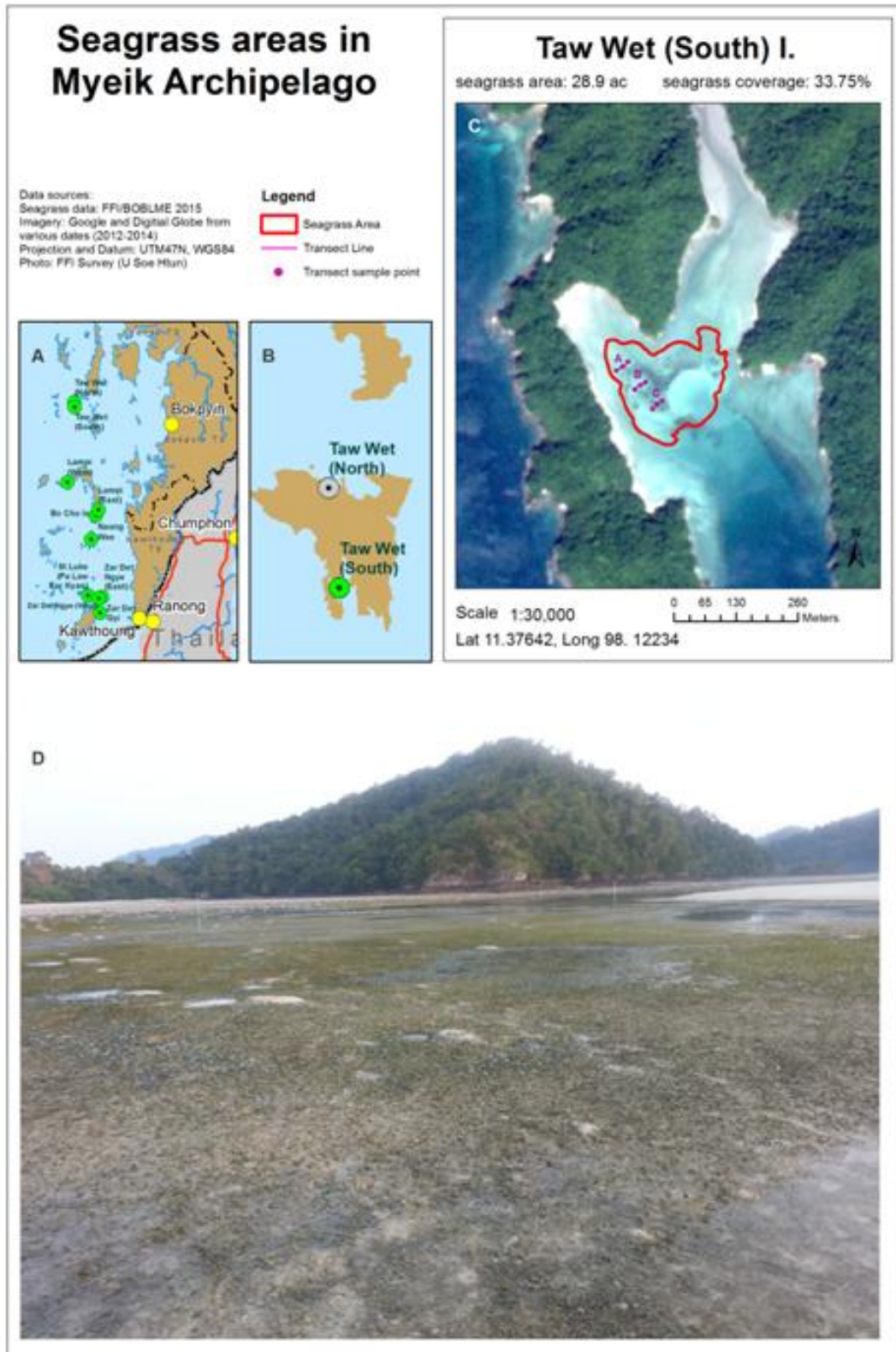


Figure 16. Seagrass areas in Myeik Archipelago - Taw Wet I. (South)

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

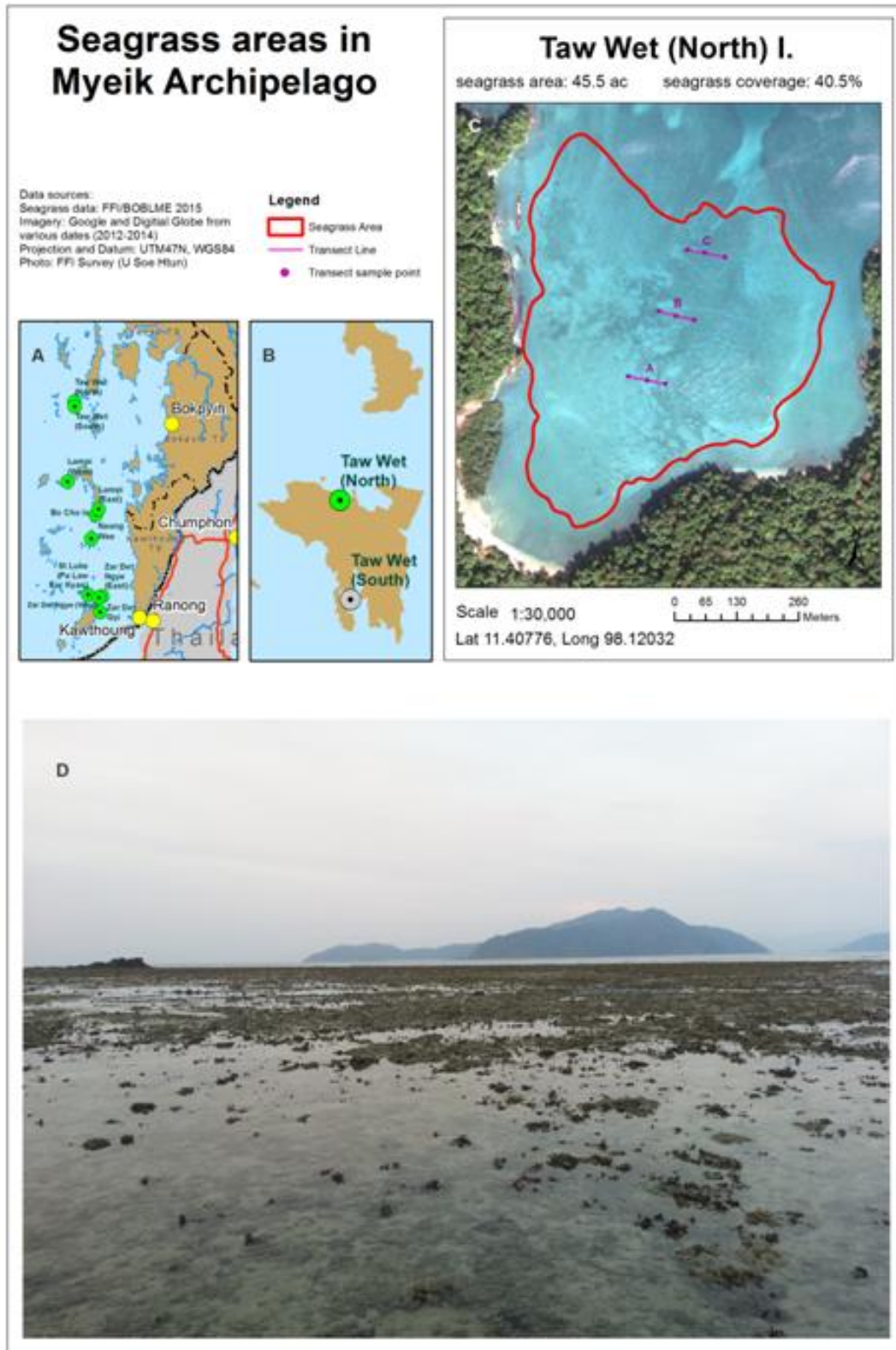


Figure 17. Seagrass areas in Myeik Archipelago - Taw Wet I. (North)

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B, C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

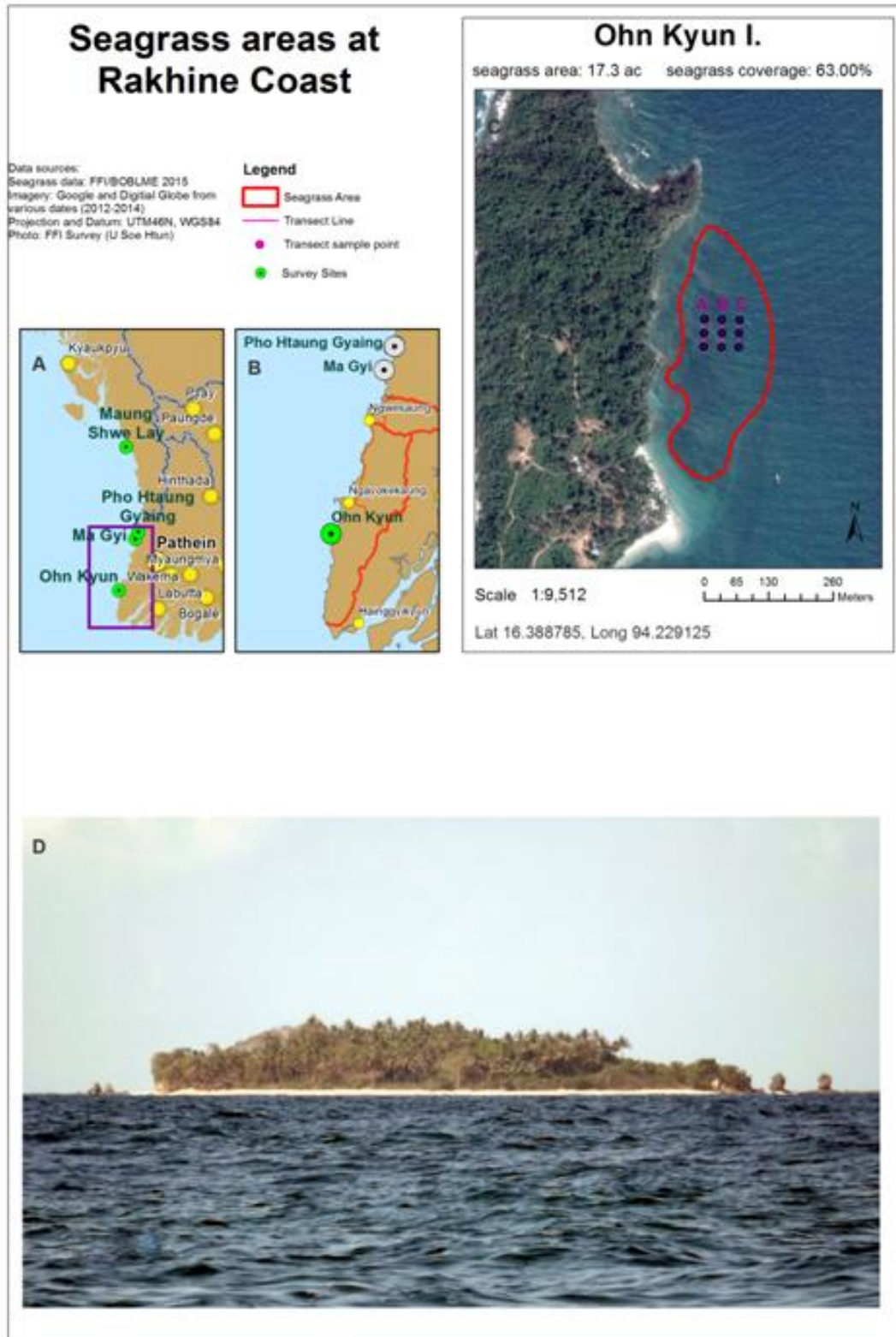


Figure 18. Seagrass areas in Myeik Archipelago - Ohn Kyun I

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B and C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

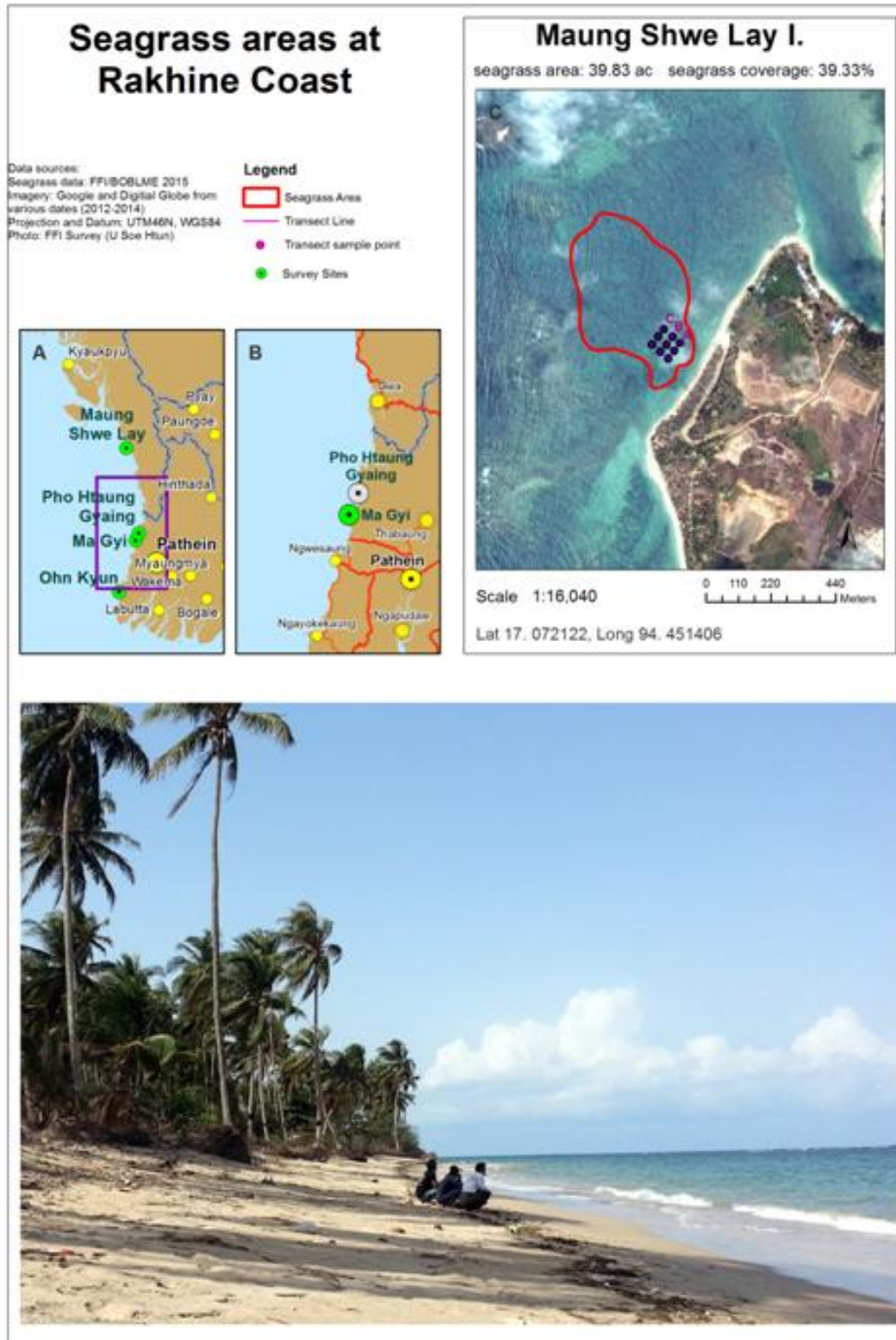


Figure 19. Seagrass areas in Myeik Archipelago - Ma Gyi

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B and C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

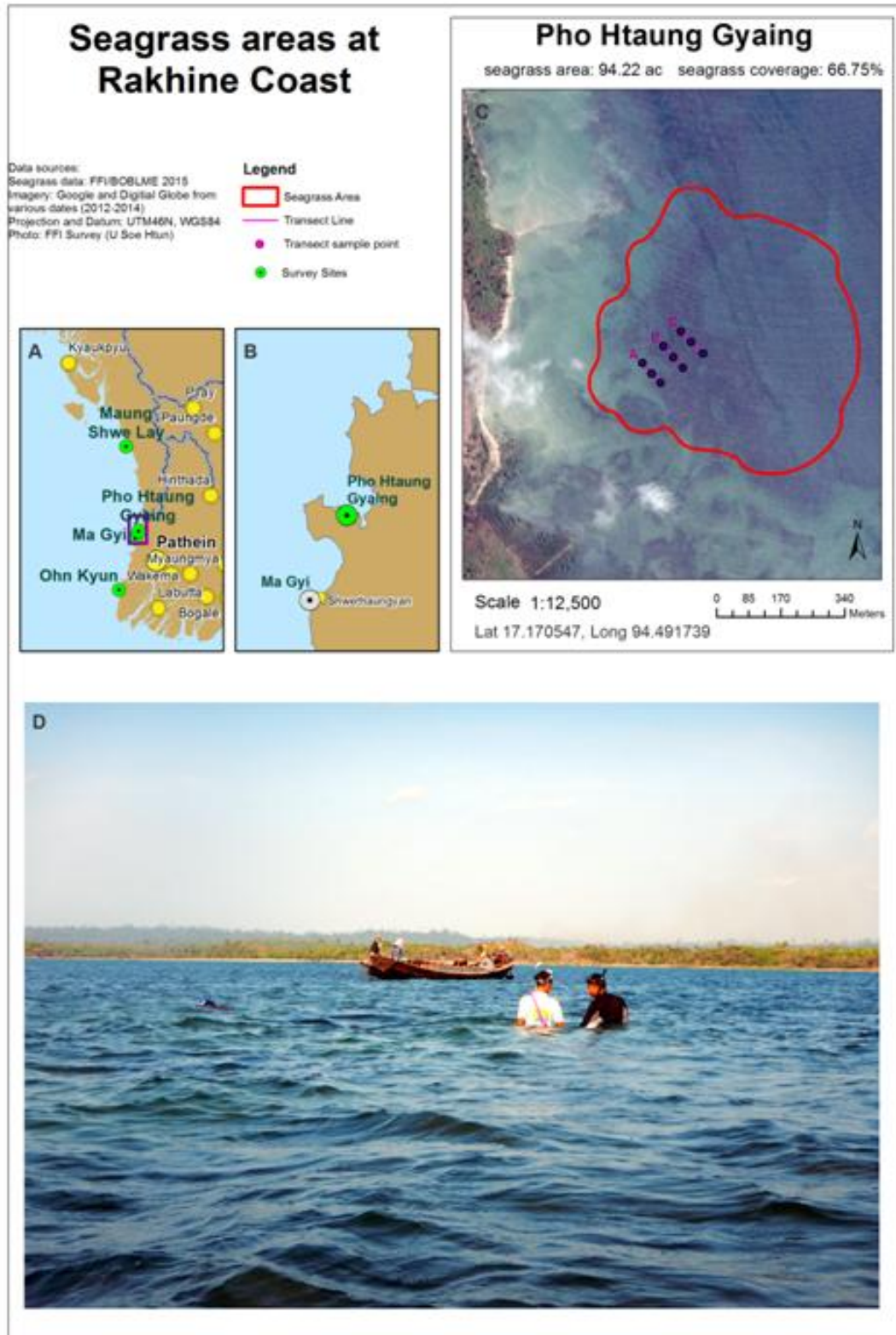


Figure 20. Seagrass areas in Myeik Archipelago - Pho Htaung Gyaing

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A,B and C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.

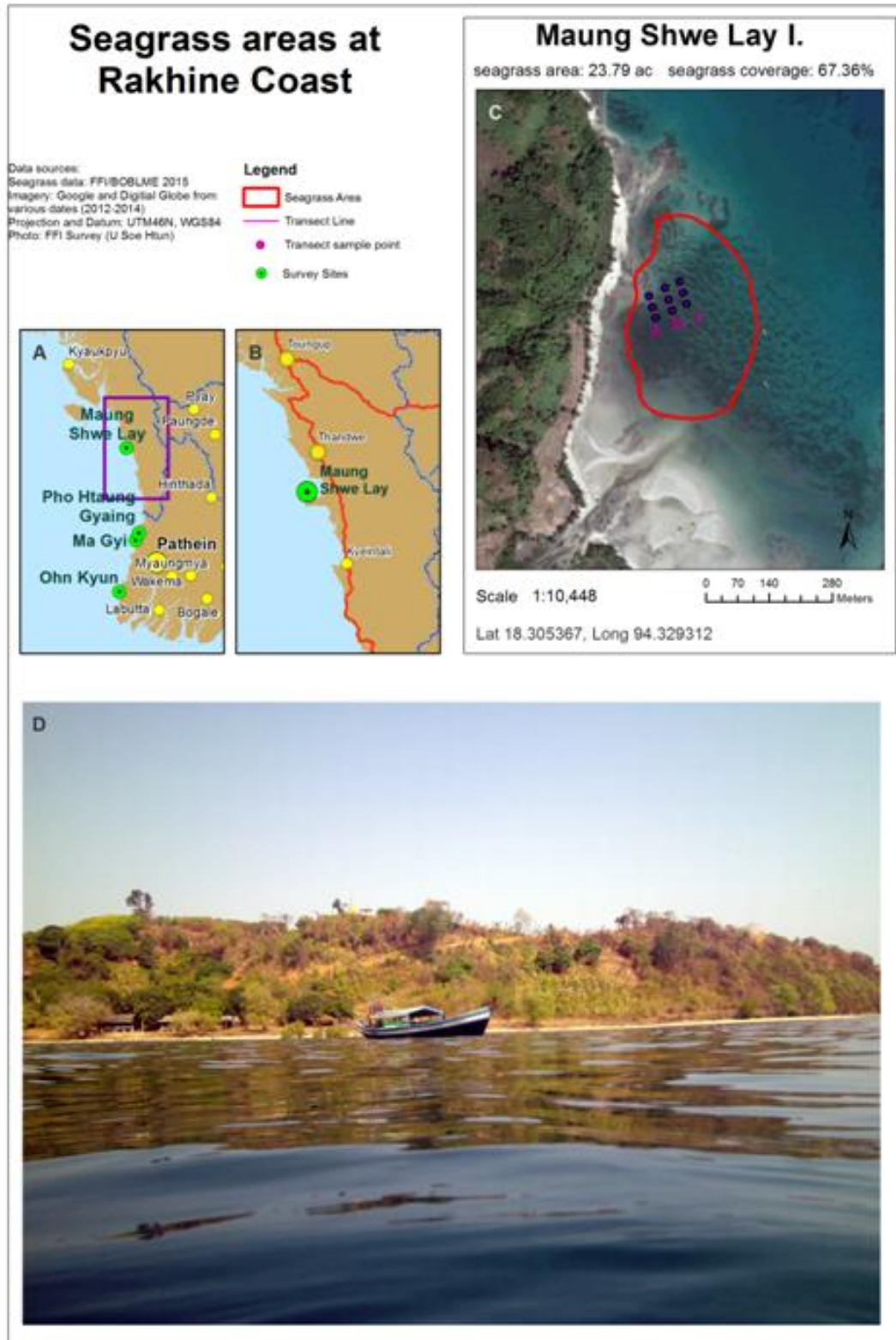
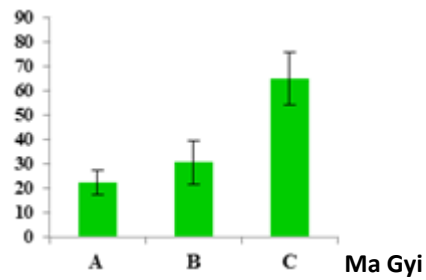
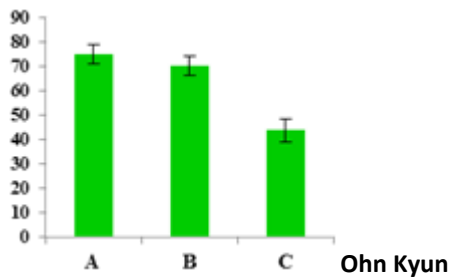
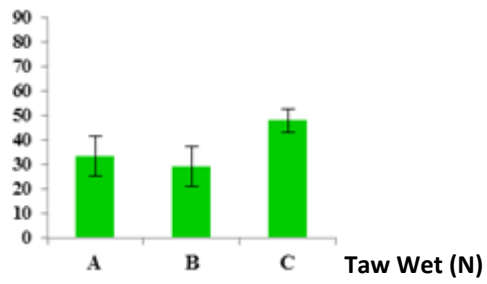
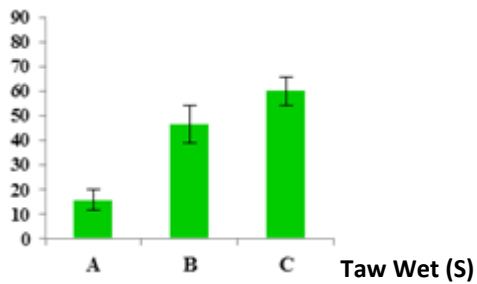
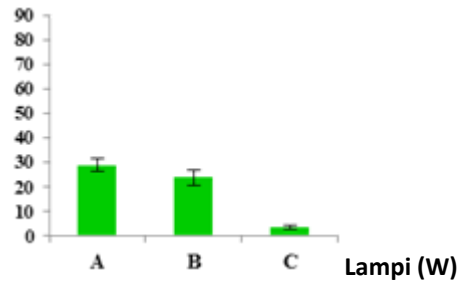
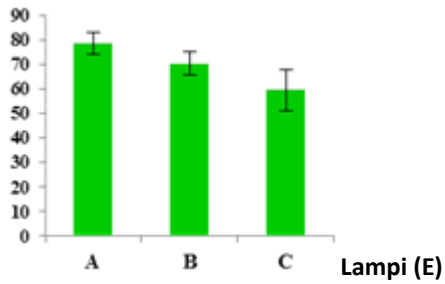
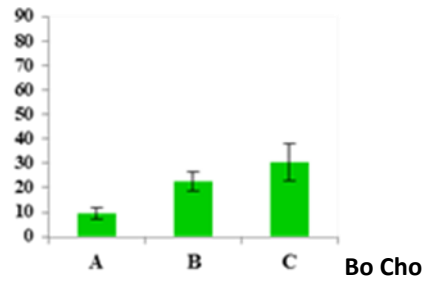
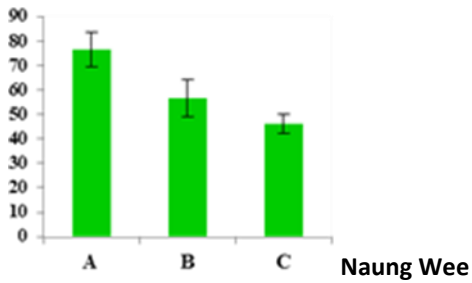
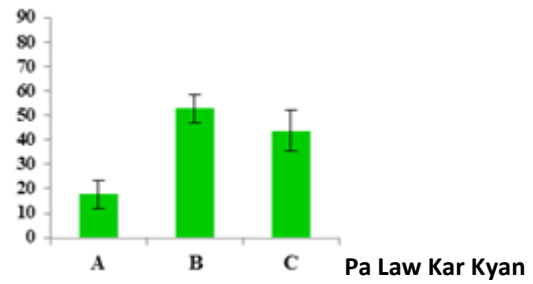
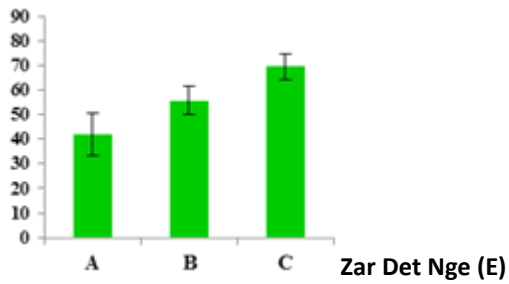
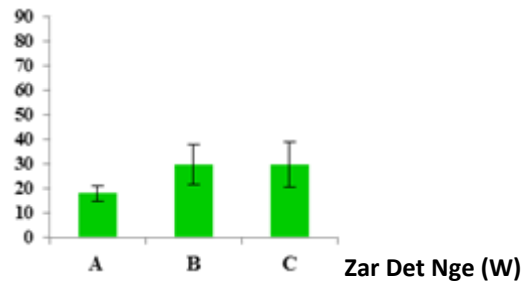
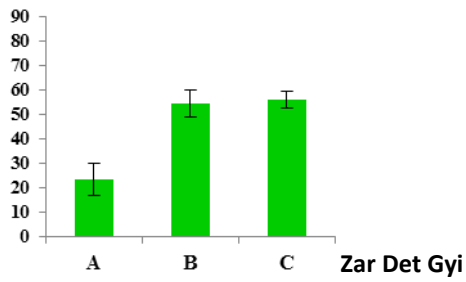


Figure 21. Seagrass areas in Myeik Archipelago - Maung Shwe Lay Gyaing

A. Map showing the general outline; B. Map showing the details; C. Satellite photograph showing cross-transects (A, B and C) and seagrass meadow along with total areas (in red line) and D. Photograph showing the location of the natural seagrass meadow.



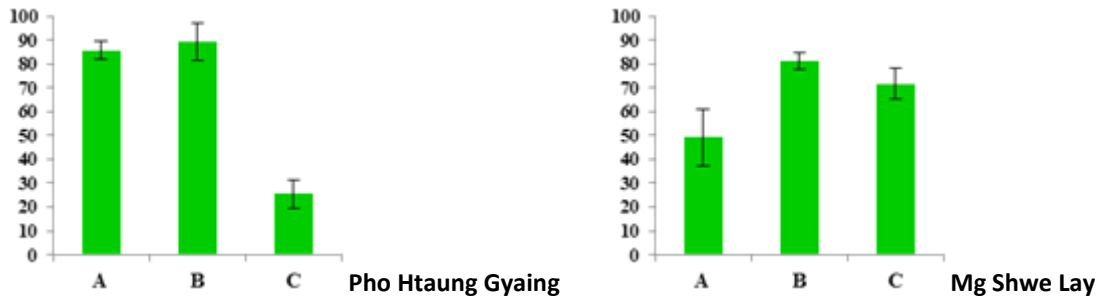


Figure 22. The percentage cover of seagrasses along 3 cross-transects in 14 study sites

Abbreviations: *Si* - *Syringodium isoetifolium*, *Cs* - *Cymodocea serrulata*, *Cr* - *Cymodocea rotundata*, *Csp* - *Cymodocea sp.*, *Hu* - *Halodule univervis*, *Hp* - *Halodule pinifolia*, *Ea* - *Enhalus acoroides*, *Th* - *Thalassia hemprichii*, *Hb* - *Halophila beccarii*, *Hd* - *Halophila decipiens*, *Ho* - *Halophila ovalis*, *Hm* - *Halophila major* ; A, B and C – Cross-transects

4. Discussion

The current study was able to develop an easily replicable baseline for 14 seagrass sites within Myanmar to allow for long term monitoring of seagrass beds and provide the ability to quantitatively measure the impact of management interventions aimed at seagrass conservation. Of the 14 sites surveyed only four had been previously studied using the same methodology (Novak *et al.*, 2009), which were in the Tanintharyi Region, and so comparisons can be made. Of the four only one, Lampi East showed an increase in percentage cover with 64.57% recorded in the current survey compared to 45% in the Novak *et al.* (2009) 2007 surveys. A number of reasons may be responsible for this increase such as a decrease in shrimp and fish catch in the area leading trawlers to search elsewhere for catch or from the increase in presence of Department of Forestry staff at the Lampi Island marine national park headquarters opposite the seagrass bed, resulting in greater support by the NGO community to the MPAs management. Two of the other sites, Taw Wet North and Nyang Wee, did show a decrease in percentage cover but only by 9% and ~11% respectively, with such a result potentially down to transect placement. These sites will however need to be monitored to ensure that its only a statistical error causing this decrease and not anthropogenic impacts such as bottom trawling. The final site, which had previously been surveyed in 2007, was Lampi West and this seagrass bed has seen an extensive loss in percentage cover with 18.75% recorded in this survey compared to 80% cover in 2007. Boat activity in this area was observed to be quite high during the surveys with this part of Lampi Island providing protection for many boats during periods of high winds and as such could be targeted by trawlers when conditions away from the island are unfavourable. These seagrass beds were noted to have a high cover of sand sediments smothering their stems. The current support being provided to manage this Marine national park by organisations such as the Italian NGO Oikos may help to ensure these seagrass beds protection and long term conservation.

In terms of species diversity 12 species of seagrasses were found of which two appear to be new records for Myanmar including *Halophila major* which was found only in the Rakhine sites and an undescribed species of *Cymodocea* which was found only in the Tanintharyi study areas. Specimens of *Cymodocea* were collected and are awaiting identification. In the present study, however, unlike Kress *et al.*, (2003) no specimens of *Zostera marina* were recorded. This species normally occurs in temperate waters and is known to extend into the higher latitudes of Myanmar waters and has previously been found in all three coastal regions of Myanmar. Further surveys are therefore needed to elucidate the status of this species within the country.

Seagrass meadows were mostly in intertidal zone encountered in front of the mangrove communities in Tanintharyi whereas those in Rakhine are commonly found in the subtidal zone in

front of the sandy beaches (except for the seagrass meadow Pho Htaung Gyaing located behind the mangrove swamp). For this reason, the luxuriant growth of seagrasses was observed in all coastal areas of Rakhine due to moderate and favourable environmental parameters but not in coastal areas of Tanintharyi due its natural habitat in the intertidal zone under heavy environmental stresses.

Although Soe-Htun *et al.*, (2001) reported there were no stresses in the meadows of seagrasses in coastal areas of Myanmar, with these ecosystems showing pristine, climax conditions, they are now facing the problems such as smothering by sand as noted above. Such issues can arise from trawlers stirring up sediments or from land-slides where forest areas have been cleared such as those observed on Zar Det Gyi I. In general seagrass beds in Myanmar are exposed to a number of threats including runoff from cities and towns and hazardous wastes and oil dispersals released from industrial zones located in the upper areas of natural seagrass beds are seen as serious threats to these habitats. Bottom trawlers also operate directly through seagrass beds targeting shrimps and other marine species destroying these habitats. Smothering of seagrasses in sediments from sand mining operations in the Myeik Archipelago result in reduced ability of seagrasses to photosynthesize.

Management actions are therefore required immediately to ensure these habitats are not lost which would have devastating consequences for both the aquatic environment and for people's livelihoods. However, given the limited resources available in Myanmar to manage all these areas focus must be steered towards those sites which could be considered key biodiverse areas. Therefore, to prioritise the most important sites and focus management interventions a simple ranking system was developed for the surveyed areas using uniqueness (in terms of species representation), species richness and percentage seagrass cover (**Table 4**). Although all sites should receive some level of protection, six sites stood out in terms of the above parameters with Ma Gyi in Rakhine considered the most important site being 1) one of the most diverse, 2) the only site to contain *Halophila beccarii*, the most threatened of all the 12 species recorded with a ranking of Vulnerable under the IUCN Red list and 3) because of its high percentage cover. Other sites worthy of immediate protection include Pho Htaung, Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Ohn Kyun I. and Maung Shwe Lay. As a first step these sites should be provided some level of protection either as strict no-take MPAs or as carefully managed gear restricted areas with a strong emphasis on bottoms trawlers and other gears with may negatively impact the seagrass.

Such processes can, however, take time and require human capacity and various other resources to manage such interventions. As such a number of required actions have been recommended which are seen as necessary for effective management of seagrasses in Myanmar and designed to guide decision makers in developing conservation plans for seagrass meadows to ensure these habitats are protected (see below).

Table 4. Seagrass sites ranked according to uniqueness, species richness and percentage cover

(1 being the highest priority for protection and 5 the least)

Shaded boxes indicate priority sites

Site	Uniqueness	Species richness	% Cover	Cumulative score	Rank
Zar Det Gyi I.	9	3	2	14	5
Zar Det Ngye I. (West)	9	3	3	15	5
Zar Det Ngye I. (East)	3	2	1	6	3
Pa Law Kar Kyan I. (St. Luke I.)	3	2	2	7	4
Nyaung Wee I.	9	3	1	13	5
Bo Cho I.	9	3	3	15	5
Lampi I. (East)	9	4	1	14	5
Lampi I. (West)	10	5	3	18	5
Taw Wet I. (South)	9	5	2	16	5
Taw Wet I. (North)	9	4	2	15	5
Ohn Kyun I.	3	3	1	7	4
Ma Gyi	1	1	2	4	1
Pho Htaung	3	1	1	5	2
Maung Shwe Lay	3	3	1	7	4

- **Uniqueness:** 1 = site has a species only found here; 2 = site has species found here and at one other site, 3 = site has species found here and at one other site etc.
- **Species richness:** 1 = 9 species; 2 = 8 species; 3 = 7 species; 4 = 6 species; 5 = <5 species
- **% Cover:** 1 = 50-69%; 2 = 30-49; 3 = <29%

5. Recommended management actions

1. Designation of key seagrass areas as Marine Protected Areas (MPAs) linked with wider spatial planning exercises for the two main coastal areas with seagrass beds notably Rakhine and Tanintharyi
2. Encourage international support and form partnerships with regional bodies for the conservation of seagrass ecosystems
3. Share the results of local and regional research on seagrass ecosystem functions and values, and establish national and regional ecological networks and corridors for the management of seagrass ecosystems
4. Provide financial and technical support to various Myanmar institutions such as government departments and universities, including capacity development for community-based biodiversity conservation efforts
5. Improve public knowledge and recognition of the importance of seagrass habitats through nationwide education and awareness programmes targeting policy and decision makers, fishers and local communities and those involved in activities which impact seagrass beds (see a policy brief in **Appendix VI**)
6. Strengthen national, regional and international efforts to ensure invasive alien species are controlled, which could cause great biodiversity loss in seagrass communities, This should include the development of an effective work programme on invasive alien species.
7. Intensify water pollution prevention for industrial hazardous wastes from the special economic zone and regularly examine the water quality standards for coastal and marine

areas by establishing monitoring systems and effective legal frameworks for conservation of seagrass meadows

8. Ensure seagrass conservation is included in any coastal development projects and in all regional/state development plans
9. Undertake further detailed research on seagrass habitats including surveys of the ecosystem services provided by seagrass beds with a special focus on their importance to fisheries
10. Regularly monitor the status of seagrass ecosystems along the coast of Myanmar including on ground surveys and satellite remote sensing analysis
11. Identify the potential impacts on seagrasses from climate change which may cause these habitats to degrade leading to food security issues for local communities

6. References

- Abu Hena, M.K. and Short, F. 2009. A new record of seagrass *Halophila beccarii* Ascherson in Bangladesh. *CMU. J. Nat. Sci.* 8(2): 201-206.
- Adulyanukosol, K. and Poovachiranon, S. 2006. Dugong (*Dugong dugon*) and seagrass in Thailand: present status and future challenges. In: Arai, N. (Ed.), *Proc. 3rd Int. Symp. SEASTAR and Asian Biologging Science*. pp. 41-50.
- Calumpong, H.P., Medalla, S.G. and Menez, E.G. 1985. Taxonomy and distribution of seagrasses in the western coast of the Gulf of Davao, southern Philippines. *The Philippine Journal of Science*. 69-85.
- Cambridge, M.L. 1975. Seagrasses of south-western Australia with special reference to the ecology of *Posidonia australis* Hook F. in a polluted environment. In: Den Hartog, C. (Ed.) *Seagrasses: responses to ecological factors, community structure and dynamics. Aquatic Botany*, 1 (2): pp. 149-161.
- Dawes, C.J. 1981. *Marine Botany*. Wiley. Interscience. 629 pp.
- Dawes, C.J., Phillips, R.C. and Morrison, G. (2004). *Seagrass communities of the Gulf Coast of Florida: Status and ecology*. Florida fish and wildlife conservation commission fish and wildlife research institute and the Tampa Bay estuary program. St. Petersburg, Fl. iv + 74 pp.
- Den Hartog, C. 1970. *The sea-grasses of the world*. North-Holland Publishing Company. Amsterdam: 275 pp.
- Eiseman, N.J. 1980. *An illustrated guide to the seagrasses of the Indian River region of Florida*. Harbor Branch Foundation, Inc. Technical Report 31. 24 pp.
- El Shaffai, A. 2011. *Field guide to seagrasses of the Red Sea*. Roupheal, A. and Abdulla, A. (eds.). First Edition. Gland, Switzerland: IUCN and Courbevoie, France: Total Foundation. viii + 56 pp.
- Fortes, M.D. 1990. Seagrass resources of Southeast Asia: Taxonomy and distribution of seagrasses in the ASEAN region: In: Yap, H.T. (Ed.), *Proceedings of the first ASEAMS symposium on Southeast Asia Marine Science and Environmental Protection. UNEP Regional Sea Reports and studies*. No.116: pp. 15-57.
- Fortes, M.D. 1993. Seagrasses: Their role in marine ranching. In: Ohno, M. and Critchley, A.T. (Eds.), *Seaweed cultivation and marine ranching. Kanagawa International Fisheries Training Center Japan. International Cooperation Agency (JICA)*: pp. 131-151.
- Fortes, M.D. 2013. A review: Biodiversity, distribution and conservation of Philippine Seagrasses. *The Philippine Journal of Science*. 142: 95-111.

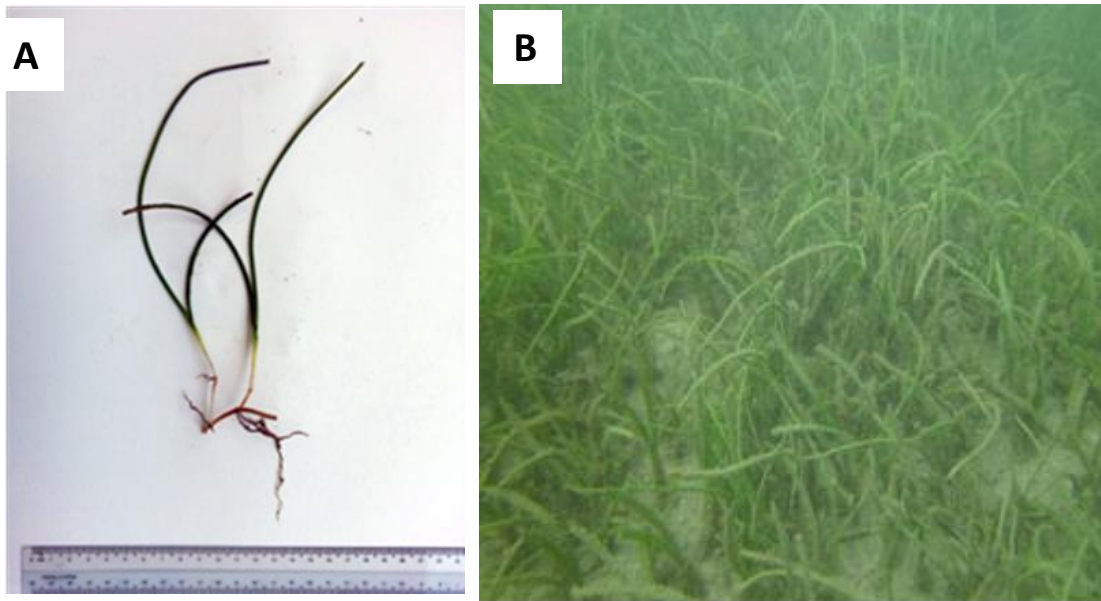
- Green, E.P and Short, F.T . 2003. *World atlas of seagrasses*. UNEP World Conservation Monitoring Centre. University of California Press, Berkeley, USA. 332 pp.
- Japar Sidik, B., Ali, L., Zakaria, M.H., Kusnan, M. and Omar, H. 2000. The seagrass, *Halophila decipiens* (Hydrocharitaceae) from Teluk Kemang, Negeri Sembilan: an update. In: Shariff, M., Yusoff, F.M., Gopinath, N., Ibrahim, H.M. and Nik Mustapha, R.A. (Eds.), *Towards sustainable management of the Straits of Malacca. Proceedings of the International Conference on the Straits of Malacca, 19-22 April 1999*, Malacca, Malaysia. pp. 233-238.
- Kress, W.J., Defilipps, R.A. and Yin Yin Kyi, Daw. 2003. A checklist of the trees, shrubs, herbs, and climbers of the Myanmar. *Contributions from the United States National Herbarium*. 45: 1-590.
- Kuo, J., Kanamoto, Z., Iizumi, H. and Mukai, H. 2006. Seagrasses of the genus *Halophila* Thouars (Hydrocharitaceae) from Japan. *Acta Phytotax. Geobot.* 57(2): 129-154.
- Kuo, J. and den Hartog, C. 2001. Seagrass taxonomy and identification key. In: Short, F.T. and Coles, R.G. (Eds.) *Global Seagrass Research Methods. Elsevier Science B.* 5: pp. 89 - 115.
- Lanyon, J. 1986. *Seagrasses of the Great Barrier Reef*. Great Barrier Reef Marine Park Authority Special Publication Series (3): 54 pp.
- Lewmanomont, K. and Ogawa, H. 1995. Common seaweeds and seagrasses of Thailand. *Faculty of Fisheries, Kasetsart University*: 164 pp.
- Lewmanomont, K., Deetae, S. and Srimanobhas, V. 1996. Seagrasses of Thailand. In: Kuo, J., Philips, R.C. Walker, D.I. and Kirkman, H. (Eds.), *Seagrass Biology: Proc. Int. Workshop, Australia: Rottneest Island, Western Australia 25-29 January 1996*: pp. 21-26.
- Mam, K. 2002. Coral reef and seagrass in Cambodia. *SWS Bulletin*. 19(1): 18-21.
- Min-Thein, U., Aung-Myint, U. and Kyi-Shwe, U. 1979. A list of some noteworthy species of marine algae and Angiosperms from the Andrew Bay, Burma. *Proceedings of the Burma Research Congress*: pp. 10-17.
- Nakanishi, Y., Hosoya, S., Arai, N., Nakanishi, Y., Katsukoshi, K. and Adulyanukosol, K. 2006. The distribution of seagrass meadows and dugong feeding trails in the dry season around Talibong Island, Trang Province, Thailand. In: Arai, N. (Ed.), *Proc. 3rd Int. Symp. SEASTAR2000 and Asian Bio-logging Science*: pp. 55-62.
- Nguyen, X.V., Detcharoen, M., Tuntiprapas, P., Soe-Htun, U, Sidik, J.B., Harah, M.Z., Prathep, A. and Papenbrock, J. 2014: Genetic species identification and population structure of *Halophila* (Hydrocharitaceae) from the Western Pacific to the Eastern Indian Ocean. *BMC Evolutionary Biology*. 14(92): 1471-2148. <http://www.biomedcentral.com>
- Novak, A.B., Hines, E., Kwan, D., Parr, L., Mya Than Tun, Han Win, Short, F.T. 2009. Revised ranges of seagrass species in the Myeik Archipelago, Myanmar. *Aquatic Botany*. 250–252. www.elsevier.com/locate/aquabot.
- Nozawa, Y. 1972. On the sea-grass from Ishigaki Island. *In Japanese*. 2: 56-66.
- Ogawa, H. 1987. Species and distribution of seagrasses in the Visayas, Philippines. In: Umezaki, I. (Ed.) *Scientific survey of marine algae and their resources in the Philippine Islands*: pp. 42-49.
- Orth, R. J., Carruthers, T., J.B., Denisson, W.C., Duarte, C.M., Fourqurean, J.W., Heck Jr., K.L., Hughes, A.R., Kendrick, G.A., Kenworthy, W. J., Olyarnik, S., Short, F.T., Waycott, M. and Williams, S.L. 2006. A global crisis for seagrass ecosystems. *BioScience* 56(12): 987-996. www.biosciencemag.org.
- Short, F.T., McKenzie, L.J., Coles, R.G., Vidler, K.P., Gaeckle, J.L. 2006. *SeagrassNet manual for scientific monitoring of seagrass habitat*. Worldwide Edition. University of New Hampshire Publication. 75 pp.

- Short, F.T., Carruthers, T., Dennison, W. and Waycott, M. 2007. Global seagrass distribution and diversity: A bioregional model. *Journal of Experimental Marine Biology and Ecology*. 350: 3–20.
- Soe-Htun, U., San-Tha-Htun, U., Aye-Mon-Sein, Daw and Ni-Ni-Win, Daw. 1997. A summary report on the seaweeds and seagrasses of the Myeik (Mergui) Archipelago. *Tech. Rep*: 7 pp.
- Soe-Htun, U., San-Tha-Htun, U., Mu Mu Aye, Daw, Ni-Ni-Win, Daw, Lei Lei Win, Daw and Masao Ohno. 2001. Notes on seagrasses along Myanmar Coastal Regions. *Bull. Mar. Sci. Fish., Kochi Univ.* No. 20, pp. 13-22.
- Soe-Htun, U., Mya Kyawt Wai, Daw, Thida Nyunt, Daw, Soe Pa Pa Kyaw, Daw and Mu Mu Aye, Daw. 2009. Seagrass of Myanmar with spatial distribution of the species of ASEAN nations. *Journal of Myanmar Academy of Art and Science*. 7(5): 263-387.
- Thaung Htut 2011. Species composition and distribution of seagrasses in the Magyi (Shwe Thaung Yan) coastal area. Unpublished MSc Thesis. Department of Marine Science, Patheingyi University.
- Tien, N.V. 1998. Species composition and distribution of seagrasses in Vietnam. *Proceedings of the Third International Seagrass Biology Workshop, Philippines*. 307-316.
- Tint Tun and Bendell, B. 2011. Preliminary observation on the seagrasses of Lampi and neighbouring islands of the Myeik Archipelago, Myanmar. Proceedings of the 6th International Symposium on SEASTAR2000 and Asian Bio-logging Science (The 10th SEASTAR workshop) February 23-25. 2010 Phuket, Thailand. pp.85-91.
- Womersley, H.B.S. 1984. The marine benthic flora of southern Australia. Part I. *D.J. WOOLMAN, Government Printer, South Australia*. 329 pp.
- Womersley, H.B.S. and Bailey, A.1970. Marine algae of the Solomon Islands. *Philosophical Transactions of the Royal Society of London*, 259B: pp. 257-352, 26 figures in text and on plates 24-27.
- Young, P.C. and Kirkman, H. 1975. The seagrass communities of Moreton Bay, Queensland. *Aquat. Bot.* 1: 191-202.
- Zieman, J.C. and Zieman, R.T. 1989. The ecology of the seagrass meadows of the west coast of Florida: A community profile. *U. S Fish Wild. Serv. Biol. Rep.* 85 (7.25): 155 pp.

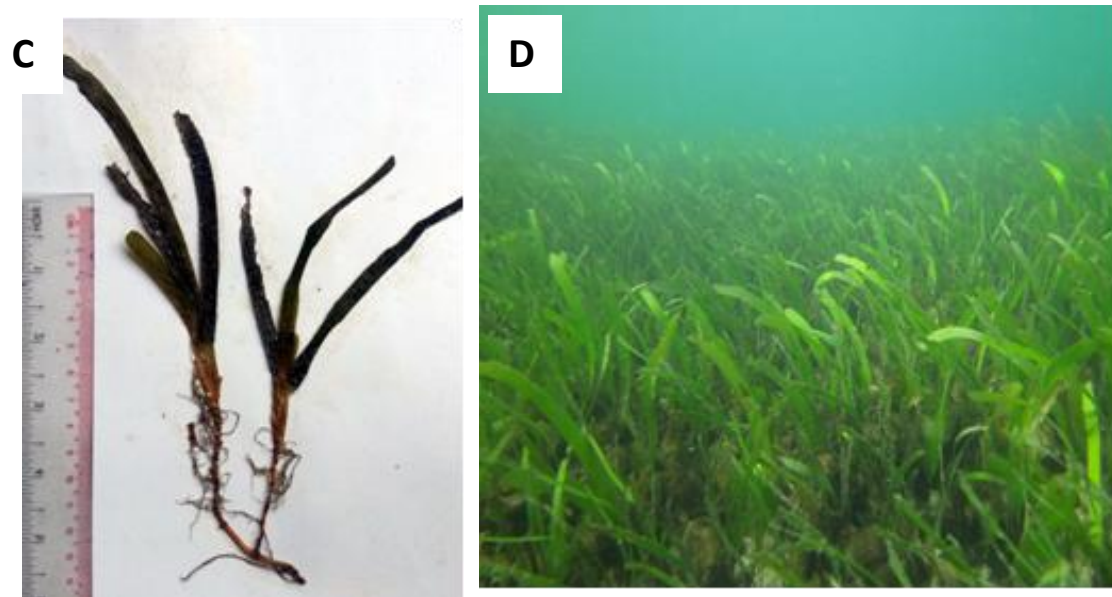
Appendix I A classification system of the seagrasses collected from 14 study sites in the Tanintharyi and Rakhine Coastal Regions of Myanmar.

Family	Genus	Sr. no.	Species
Cymodo-ceaceae	<i>Syringodium</i> Kützing	(1)	<i>S. isoeti-folium</i> (Ascherson) Danty
	<i>Cymodocea</i> König	(2)	<i>C. rotundata</i> Ehrenberg et Hem-prich ex Ascherson
		(3)	<i>C. serrulata</i> (R. Brown) Ascherson et Magnus
		(4)	<i>C. sp.</i>
	<i>Halodule</i> Endlicher	(5)	<i>H. univervis</i> (Forsskal) Ascherson
		(6)	<i>H. pinifolia</i> (Miki) den Hartog
Hydrocha-ritaceae	<i>Enhalus</i> Rich	(7)	<i>E. acoroides</i> (Linnaeus f.) Royle
	<i>Thalassia</i> Banks and Solander ex König	(8)	<i>T. hemprichii</i> (Ehrenberg) Ascherson
		<i>Halophila</i> Du Petit-Thouars	(9)
	(10)		<i>H. decipiens</i> Ostenfeld
	(11)		<i>H. ovalis</i> (R. Brown) Hooker f.
	(12)		<i>H. major</i> (Zoll.) Miquel

Appendix II Pictorial guide to the 12 species of seagrass encountered during the current survey



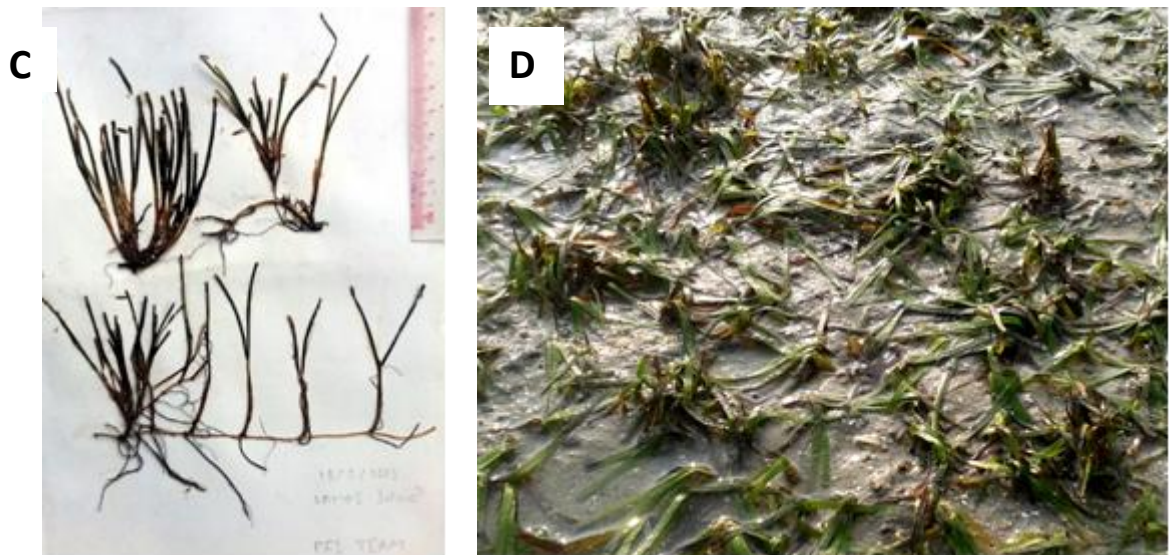
Syringodium isoetifolium: A. Habit and B. The natural bed



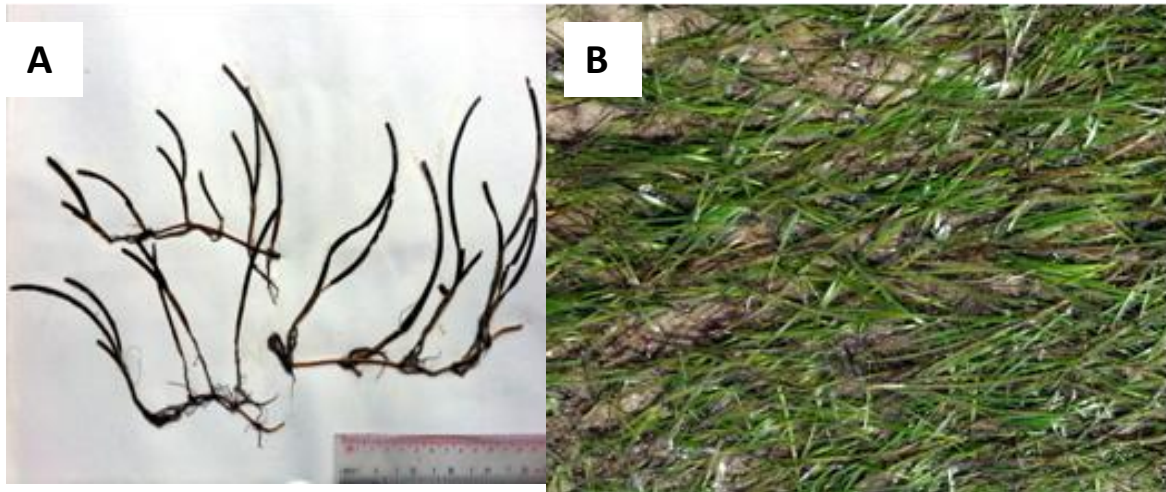
Cymodocea serrulata: C. Habit and D. The natural bed



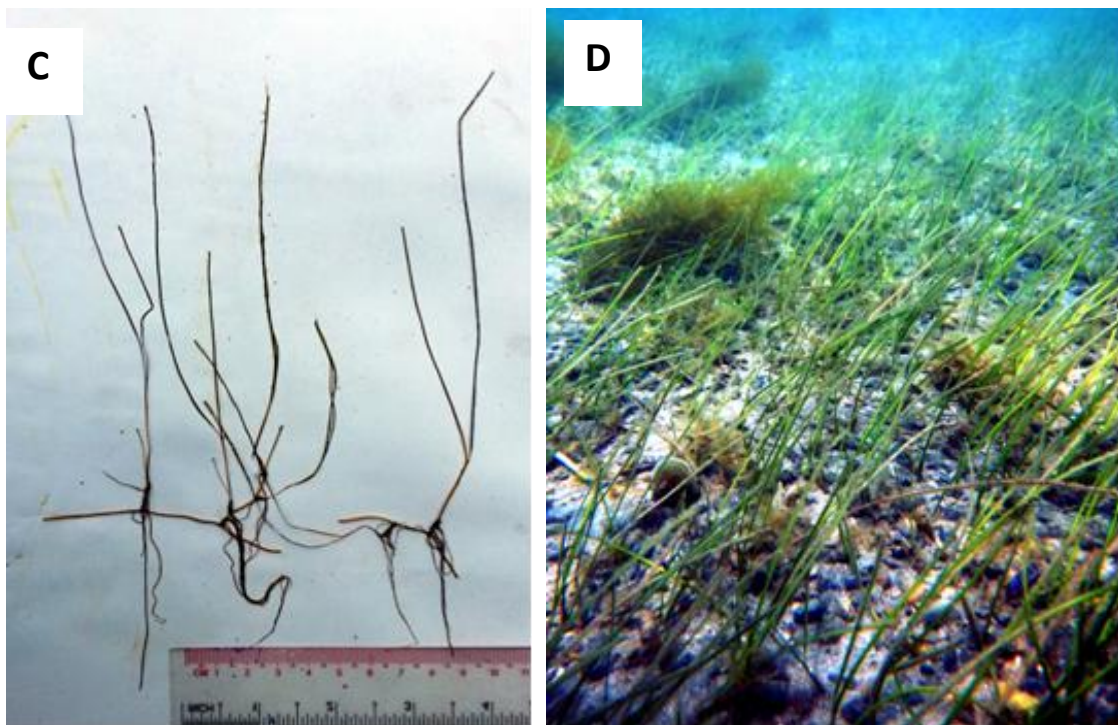
Cymodocea rotundata: A. Habit and B. The natural bed



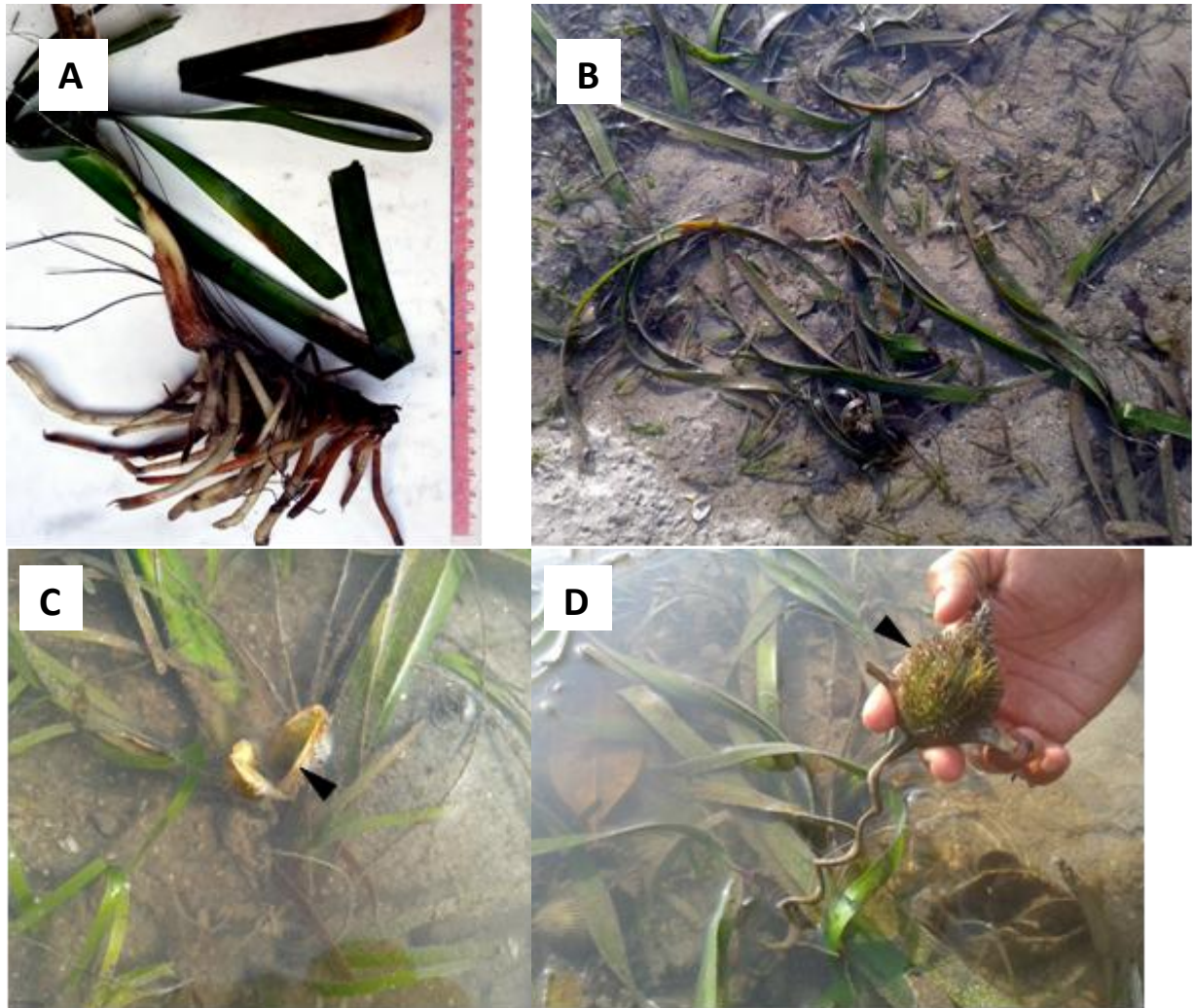
Cymodocea serrulata: C. Habit, and D. The natural bed



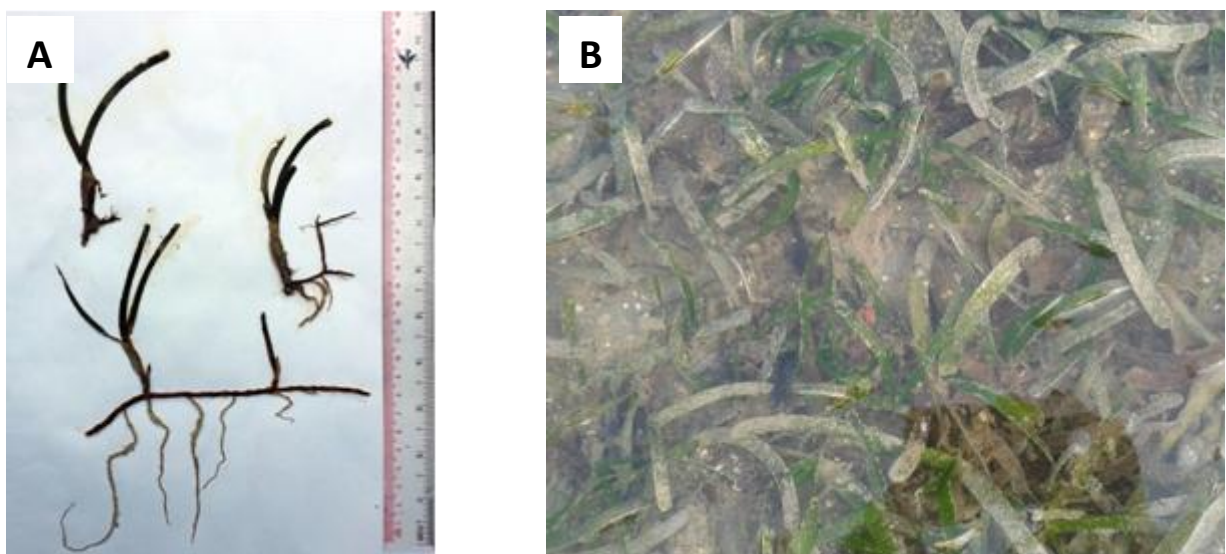
Halodule uninervis: A. Habit and B. The natural bed



Halodule pinifolia: C. Habit and D. The natural bed

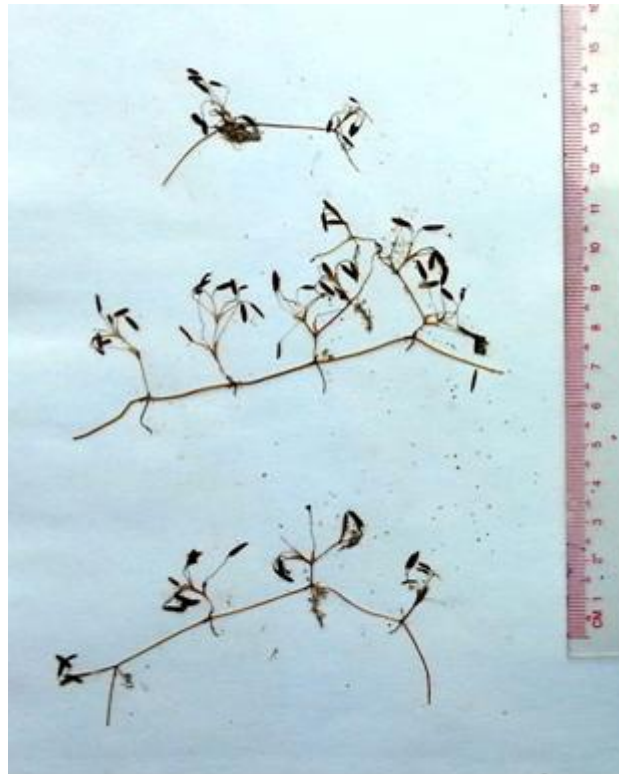


Enhalus acoroides A. Habit, B. The natural bed, C. Female flower (arrow - head) and D. Fruit (arrowhead)



Thalassia hemprichii: E. Habit, and F. The natural bed

A



Halophila beccarii. A. Habit

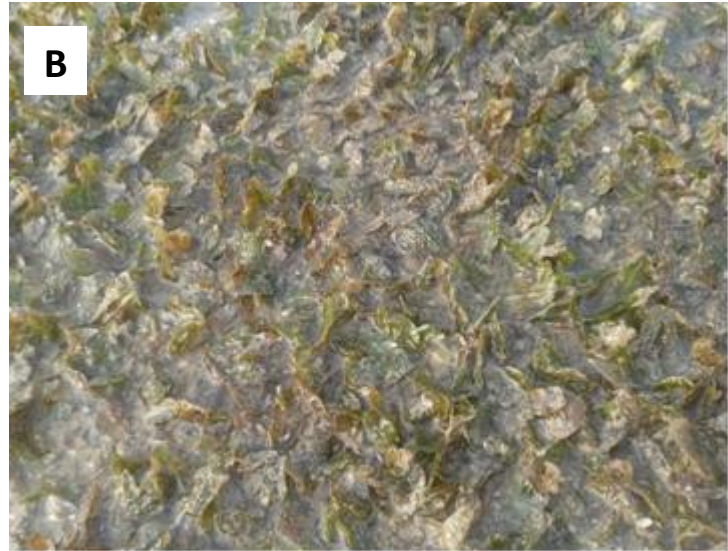
B



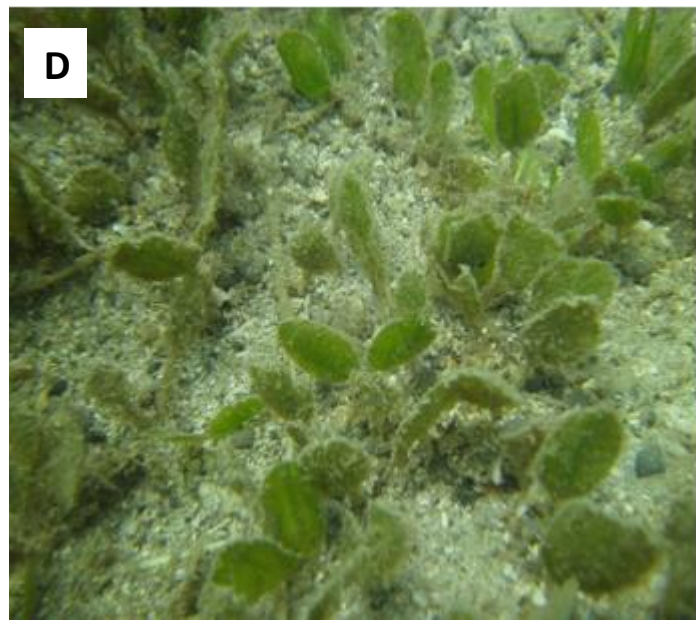
C



Halophila decipiens: B. Habit, and C. The natural bed



Halophila ovalis: A. Habit, and B. The natural bed.



Halophila major: C. Habit, and D. The natural bed

Appendix III Taxonomic key to the species of seagrasses collected from the two study areas in Myanmar

1.
 - 1a. Leaf blade cylindrical.....*Syringodium isoetifolium*
 - 1b. Leaf blade flat.....2
2.
 - 2a. Leaves strap-shaped.....3
 - 2b. Leaves paddle-shaped.....9
3.
 - 3a. Leaves with ligula.....4
 - 3b. Leaves without ligula.....8
4.
 - 4a. Leaf tip distinctly serrated;*C. serrulata*
 - 4b. Leaf tip smoothly rounded;5
5.
 - 5a. Leaf tip smoothly rounded6
 - 5b. Leaf tip bi-or tri-dentate7
6.
 - 6a. Leaves normally issued, greater than 3 mm wide; stems long and firm*C. rotundata*
 - 6b. Leaves cymosely aggregated, less than 3 mm wide; stems short and deciduous.....*C. sp.*
7.
 - 7a. Leaf tip tri-dentate, the black central leaf vein not split at the tip.....*Halodule univervis*
 - 7b. Leaf tip bi-dentate, the black central leaf vein split into two at the tip*H. pinifolia*
8.
 - 8a. Leaves 10-15 mm wide with ribs at the margin*Enhalus acoroides*
 - 8b. Leaves 4-10 mm wide without ribs at the margin.....*Thalassia hemprichii*
9.
 - 9a. Leaves linear to lanceolate, 1-3 mm wide with 1-3 paralleled veins*Halophila beccarii*
 - 9b. Leaves lanceolate to oblong, 3-10 mm wide with 6-20 cross-veins.....10
10.
 - 10a. Leaves margin serrate, with hairs on one or both sides of the blade*H. decipiens*
 - 10b. Leaves margin entire, smooth without hairs on one or both sides of the blade.....11
11.
 - 11a. Leaves with 14-17 paired cross veins; the distance between the intra-marginal vein and the lamina margin ratio 1:12 to 1:16*H. ovalis*
 - 11b. Leaves with 18-20 paired cross veins; the distance between the intra-marginal vein and the lamina margin ratio 1:20.8 to 1:25.6*H. major*

Appendix IV Ecological account and supplementary survey data.

1. *Syringodium isoetifolium* (Ascherson) Danty

References - Den Hartog 1970: 177-183, figs. 50-51; Nozawa 1972: 59, figs. 2D, pl. 1D; Cambridge 1975: 156; Young and Kirkman 1975: 198; Calumpong *et al.*, 1983: 83, figs. 6A-B; Lanyon 1986: 34-35, fig. 12; Ogawa 1987: 44-45, figs. 3A, 3B; 1989: 60-61; Fortes 1990: 21, fig. 1, Fortes 1993: 134, fig. 3; Lewmanomont and Ogawa 1995: 152; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: 45; Soe-Htun *et al.*, 2001:16-17, fig. 6, Soe-Htun *et al.*, 2009: 365, figs. 2-3; Mam 2002: 18-21; Thaug Htut 2011:12-13, figs. 2a-b; El Shaffai 2011: 24-26; Fortes 2013: 98, figs. 2A-B.

Description - Plants erect; the rhizome 1 mm thick, with internodes, 1.4-2.5 cm long; each node giving a shoot with 1-3 leaves; leaves terete, tapering to the tip, 5.5-12.5 cm in length (or longer), 1 mm wide, base covered by leaf sheath, 1-3 cm long.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 3 study sites such as Ma Gyi, Pho Htaung Gyaing (Table 1, Fig. 22). A total of 26 plants of *Syringodium isoetifolium* were observed in the monitoring transects at 3 study sites such as Ma Gyi (A: 3, B: 5 and C: 9 with a subtotal of 17 individuals); Pho Htaung Gyaing (A: 2, no plants in B and C with a subtotal of 2 individuals) and Maung Shwe Lay Gyaing (A: 3, B: 4 and C: 0 with a subtotal of 7 individuals) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region- No data; (2) The Rakhine Coastal Region- Ma Gyi, Pho Htaung Gyaing, Maung Shwe Lay Gyaing.

2. *Cymodocea serrulata* (R. Brown) Ascherson et Magnus

References - Den Hartog 1970: 171-176, figs. 48, 49a; Nozawa 1972: 59, figs. 2E, 3C, pl. 1E; Young and Kirkman 1975: 198; Calumpong *et al.*, 1983: 81, figs. 3A-B; Lanyon 1986: 12-15, figs. 3-4; Ogawa 1987: 44, figs. 1D, 2D; 1989: 60, fig. 1D; Fortes 1990: 24, fig. 6, Fortes 1993: 136, fig. 8; Lewmanomont and Ogawa 1995: 143; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: 47; Soe-Htun *et al.*, 2001:15, fig. 3, Soe-Htun *et al.*, 2009: 365, figs. 6-7; Mam 2002: 18-21; Thaug Htut 2011: 20-22, figs. 6a-b; Fortes 2013: 100, figs. 7A-B-C; El Shaffai 2011:15-17.

Description - Erect plants moderate in size; the rhizome 1mm in diameter, slightly larger than *C. rotundata*, internodes 2.2-3.3 cm long; shoots with 2-3 leaves at each node with lingula; leaf blade linear, flat, 4-13 cm long, 4.5-5.5 mm wide, margin entire with 9-15 nerves, apex serrulate, tapering at the base, leaf sheaths 1.5-3.0 cm long.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 12 study sites such as Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East) and Taw Wet (North) in the Myeik Archipelago of the Tanintharyi Coastal Region; Ohn Kyun, Ma Gyi, Pho Htaung Gyaing and Maung Shwe Lay Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22). A total of 63 plants of *Cymodocea serrulata* were observed in the monitoring transects at 4 study sites such as Zar Det Gyi (A: 0, B: 0 and C: 1 with a subtotal of 1 individual); Taw Wet I. (North)(A: 9, B: 12 and C:12 with a subtotal of 33 individuals), Ohn Kyun I. (A: 12, B: 3 and C: 0 with a subtotal of 15 individuals and Ma Gyi (A: 4, B: 2 and C: 8 with a subtotal of 7 individuals) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region - Zar Det Gyi I., Zar Det Ngye I. (West and East), Pa Law Kar Kyan I., Nyaung Wee I., Bo Cho I., Lampi I. (East); Taw Wet (North); (2) The Rakhine Coastal Region - Ohn Kyun I., Shwe Thaug Yan (Ma Gyi), Pho Htaung Gyaing, Maung Shwe Lay Gyaing.

3. *Cymodocea rotundata* Ehrenberg et Hemprich ex Ascherson

References - Den Hartog 1970: 166-171, figs. 47, 49b; Womersley and Baily 1970: 343; Nozawa 1972: 58-59, figs. 2C, 3D, pl. 1C; Calumpang *et al.*, 1983: 81, figs. 2A-B; Lanyon 1986: 10-12, figs. 2-3; Ogawa 1987: 44, figs. 1C, 2C; 1989: 59-60, figs. 1C, 2A; Fortes 1990: 24, fig. 7, Fortes 1993: 137, figs. 2, 9; Lewmanomont and Ogawa 1995: 142; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: 47; Soe-Htun *et al.*, 2001: 14-15, fig. 2, Soe-Htun *et al.*, 2009: 365, figs. 4-5; Thaug Htut 2011:18-19, fig. 5a-b; El Shaffai 2011:12-14; Fortes 2013: 101, figs. 8A-B-C.

Description - Erect plants moderate in size; the rhizome cylinder, internodes 0.8-2.2 cm long; erect shoots with 2-4 leaves, borne at the nodes with lingula; leaf blades, linear, flat, 6-15 cm long, 1.5-5.0 mm wide, apex obtuse, leaf margin entire with 8-10 nerves, leaf sheath 1.3-1.7 cm long.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 13 study sites such as Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East), Lampi I. (West) and Taw Wet (North) in the Myeik Archipelago of the Tanintharyi Coastal Region; Ohn Kyun, Ma Gyi, Pho Htaung Gyaing and Maung Shwe Lay Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22).

A total of 269 plants of *Cymodocea rotundata* were observed in the monitoring transects at 9 study sites such as Zae Det Gyi I. (A: 10, B: 12 and C: 12 with a subtotal of 34 individuals); Zae Det Ngye I. (West) (A: 10, B: 6 and C: 9 with a subtotal of 25 individuals); Zae Det Ngye I. (East)(A: 12, B: 12 and C: 12 with a subtotal of 36 individuals); Pa Law Kar Kyan I. (A: 12, B: 12 and C: 10 with a subtotal of 34 individuals); Nyaung Wee I. (A: 12, B: 12 and C: 12 with a subtotal of 36 individuals); Bo Cho I. (A: 10, B: 12 and C: 11 with a subtotal of 33 individuals); Lampi I. (East)(A: 12, B: 12 and C: 12 with a subtotal of 36 individuals); Lampi (West) I. (A: 12, B: 12 and C: 11 with a subtotal of 35 individuals); Taw Wet I. (North)(A: 8, B: 2 and C: 0 with a subtotal of 10 individuals) in the Tanintharyi Coastal Region; Ma Gyi (A: 2, B: 8 and C: 8 with a subtotal of 18 individuals); Pho Htaung Gyaing (A: 7, no plants in B and C with a subtotal of 7 individuals) and Maung Shwe Lay Gyaing (A: 9, B: 12 and C:11 with a subtotal of 32 individuals) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region- Zar Det Gyi I., Zar Det Ngye I. (West and East), Pa Law Kar Kyan I. (St. Luke Island), Nyaung Wee I., Bo Cho I., Lampi I. (East and West), Taw Wet I. (North); (2) The Rakhine Coastal Region - Ohn Kyun, Ma Gyi, Pho Htaung Gyaing, Maung Shwe Lay Gyaing.

4. *Cymodocea* sp.

References - No data.

Ecological note - The field samplings of seagrasses revealed that this plant was commonly distributed in 10 study sites such as Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East), Lampi I. (West) and Taw Wet (North) in the Myeik Archipelago of the Tanintharyi Coastal Region (Table 1, Fig. 22). There were no plants of *Cymodocea* sp. in cross-transects of 14 study sites (Table 2).

Description - Plants moderate in size; intervals of internode m - 1.5-6.0 cm long; one root per node; rhizome creeping, less than 1 mm in diameter; erect shoots with 2-3 leaves at each node, densely aggregated and formed cymosely; leaf blade linear, falcate, 1.5-9.5 cm long, 1.5-2 mm wide, petioles - 0.1-1.1 cm long with lingula, leaf-tip obtuse; remnants of many scars of liberated shoot distinct, old shoots usually deciduous from main stem.

Local distribution - (1) The Tanintharyi Coastal Region- Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Naung Wee I., Bo Cho I., Lampi I. (East and West), Taw Wet I. (South and North); (2) The Rakhine Coastal Region - No data.

5. *Halodule uninervis* (Forsskal) Ascherson

References - Den Hartog 1970: 147-153; Womersley and Baily 1970: 343; Nozawa 1972: 57, figs. 1A-B, 2B, pl. 1B; Calumpong *et al.*, 1983: 82, figs. 5A-B; Lanyon 1986: 18-19, fig. 6; Ogawa 1987: 43, figs. 1B, 2B; 1989: 59, fig. 1B; Fortes 1990: 23, fig. 4, Fortes 1993: 135, fig. 6; Lewmanomont and Ogawa 1995: 146; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: Soe-Htun *et al.*, 2001: 16, fig. 5, Soe-Htun *et al.*, 2009: 367, figs. 8-9; Mam 2002: 18-21; Guiry 2007; Thaung Htut 2011:16-17, fig. 4a-b; El Shaffai 2011: 21-23; Fortes 2013: 99, figs. A-B.

Description - Rhizome not exceeding than 1 mm thick; the internodes 1.8-3.5 cm long; erect shoot arising 1-3 flat, linear blades at each node with lingula; leaf blades flat, 13-25 cm long, 1-2 mm wide, margin entire, the black central vein at the leaf tip, which does not splits into two at the apex, leaf sheath present, 1.5-3.0 cm long.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 11 study sites such as Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I. and Taw Wet (South) in the Myeik Archipelago of the Tanintharyi Coastal Region; Ohn Kyun, Ma Gyi, Pho Htaung Gyaing and Maung Shwe Lay Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22). A total of 171 plants of *Halodule uninervis* were observed in the monitoring transects at 7 study sites such as Zar Det Ngye I. (East)(A: 0, B: 0 and C: 5 with a subtotal of 5 individuals); Bo Cho I. (A: 8, B: 5 and C: 3 with a subtotal of 16 individuals); Taw Wet I. (South)(A: 12, B: 11 and C: 12 with a subtotal of 35 individuals) in the Tanintharyi Coastal Region; Ohn Kyun I. (North)(A: 12, B: 12 and C: 8 with a subtotal of 32 individuals); Ma Gyi (A: 10, B: 7 and C: 9 with a subtotal of 26 individuals); Pho Htaung Gyaing (A: 11, B: 12 and C: 2 with a subtotal of 25 individuals) and Maung Shwe Lay Gyaing (A: 8, B: 12 and C:12 with a subtotal of 32 individuals) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region- Zar Det Gyi I., Zar Det Ngye (West and East), St. Luke I., Naung Wee I., Bo Cho I., Taw Wet I. (South); (2) The Rakhine Coastal Region- Ohn Kyun I., Ma Gyi, Pho Htaung Gyaing, Maung Shwe Lay Gyaing,

6. *Halodule pinifolia* (Miki) den Hartog

References - Den Hartog 1970: 158-160, fig. 44; Nozawa 1972: 57-58, figs. 1C-G, pl. 1A; Calumpong *et al.*, 1983: 82, figs. 4A-B; Lanyon 1986: 20-21, Ogawa 1987: 43, figs. 1A, 2A; 1989: 59, fig. 1A; Fortes 1990: 23-24, fig. 5, Fortes 1993: 136, fig. 7; Lewmanomont and Ogawa 1995: 145; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: Soe-Htun *et al.*, 2001: 15-16, fig. 4, Soe-Htun *et al.*, 2009: 367, figs. 10-11; Mam 2002: 18-21; Thaung Htut 2011:4-15, fig. 3a-b; Fortes 2011: 100, figs. A-B-C; El Shaffai 2011: 18-20.

Description - Plants small; the rhizome less than 1 mm, with internodes, 1.5-5.4 cm long; nodes bear erect shoots, each with 2-3 leaves; leaf blades flat, 4-25 cm long, not more than 1 mm wide, the black central vein at the leaf tip, which splits into two at the apex, lingua present at each node.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 14 study sites such as Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East), Lampi I. (West), Taw Wet (South) and Taw Wet (North) in the Myeik Archipelago of the Tanintharyi Coastal Region; Ohn Kyun, Ma Gyi, Pho Htaung Gyaing and Maung Shwe Lay Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22). A total of 21 plants of *Halodule pinifolia* were observed in the monitoring transects at 6 study sites such as Zae Det Ngye I. (West)(A: 0, B: 4 and C: 0 with a subtotal of 4 individuals); Nyaung Wee I. (A: 0, B: 0 and C: 3 with a subtotal of 3 individuals); Taw Wet I. (North)(A: 2, B: 0 and C: 0 with a subtotal of 2 individuals) in the Tanintharyi Coastal Region; Ma Gyi (A: 6, B: 0 and C: 0 with a subtotal of 6 individuals); Pho Htaung Gyaing (A: 5, B: 0 and C: 0 with a subtotal of 5 individuals) and Maung Shwe Lay

Gyaing (A: 1, B: 0 and C:0 with a subtotal of 1 individual) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region- Zar Det Gyi I., Zar Det Ngye I. (West and East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East and West), Taw Wet I. (South and North); (2) The Rakhine Coastal Region- Ohn Kyun I., Ma Gyi, Pho Htaung Gyaing, Maung Shwe Lay Gyaing.

7. *Enhalus acoroides* (Linnaeus f.) Royle

References - Den Hartog 1970: 215-222, fig. 60; Womersley and Baily 1970: 343; Nozawa 1972: 59-62, figs. 3A, pl. 1F; Calumpong *et al.*, 1983: 83, figs. 7A-B; Lanyon 1986: 16-17, fig. 5; Ogawa 1987: 45, figs. 3C-E; 1989: 61-62; Fortes 1990: 28-29, fig. 14, Fortes 1993: 140, figs. 2, 16; Lewmanomont and Ogawa 1995: 144; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: 49; Soe-Htun *et al.*, 2001:17, fig. 7, Soe-Htun *et al.*, 2009: 368, fig. 12; Mam 2002: 18-21; Thaug Htut 2011:30-31, fig. 11a-b; El Shaffai 2011: 30-34; Fortes 2013: 101, figs. A-B.

Description - Plant erect; the rhizome thick, about 1-2 cm in diameter with tough black fibres; shoots pronounced at the node, with 3-6 leaves; leaf blades flat and linear, 70-180 cm long, 0.8-2.0 cm wide, with 35-55 nerves and ribs at the margin, apex obtuse, base narrow without lingula, margin slightly serrulate in young leaves.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 3 study sites such as Zar Det Ngye I. (East) and Pa Law Kar Kyan I. (St. Luke I.) in the Myeik Archipelago of the Tanintharyi Coastal Region; Pho Htaung Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22). A total of 2 plants of

Enhalus acoroides were observed in the monitoring transects at 1 study site: Pho Htaung Gyaing (A: 0, B: 2 and C: 0 with a subtotal of 2 individuals) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region- Zar Det Ngye I. (East), St. Luke I.; (2) The Rakhine Coastal Region- Pho Htaung Gyaing.

8. *Thalassia hemprichii* (Ehrenberg) Ascherson

References - Den Hartog 1970: 232-238, fig. 61; Womersley and Baily 1970: 343; Nozawa 1972: 62, figs. 2F, 3B, pl. 2G; Fortes 1990: 29, fig. 15, Fortes 1993: 141, fig. 17; Calumpong *et al.* 1983: 85, figs. 10A-B; Lanyon 1986: 36-37, fig. 13; Ogawa 1987: 45-46, figs. 4A, 4B; 1989: 62-63; Lewmanomont and Ogawa 1995: 153; Soe-Htun *et al.*, 2009: 368-369, figs. 13-14; Thaug Htut 2011:22-25, fig. 7a-b; El Shaffai 2011: 47-49; Fortes 2013: 101, figs. A-B.

Description - Plants moderate in size; intervals of internode - 1.9-9.0 cm long; one root per node; rhizome creeping, less than 1 mm in diameter, distichously arranged and formed dendroid in shape; leaf blade linear, falcate, 1.5-15.0 cm long, 1.5-2.0 mm wide, petioles-0.1-1.1 cm long without lingula, leaf-tip obtuse, sometimes serrulate, nerves 8-11, joined by perpendicular cross veins with 9-13 nerve. Leaf tip rounded with very fine serrulations. A common species characterized by a thick rhizome prominently marked by several shoot scars between successive erect shoots with numerous relatively short internodes and a short erect stem bearing 2-6 leaves.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 12 study sites such as Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East) and Taw Wet (North) in the Myeik Archipelago of the Tanintharyi Coastal Region; Ohn Kyun, Ma Gyi, Pho Htaung Gyaing and Maung Shwe Lay Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22). There were no plants of *Thalassia hemprichii* in the monitoring cross-transects of 14 study sites (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region- Zar Det Gyi I., Zar Det Ngye I., St. Luke I., Naung Wee I., Bo Cho I., Lampi I. (East), Taw Wet (North); (2) The Rakhine Coastal

Region- Ohn Kyun I., Shwe Thaug Yan (Ma Gyi), Pho Htaung Gyaing, Maung Shwe Lay Gyaing.

9. *Halophila beccarii* Ascherson

References - Den Hartog 1970: 261-263; Fortes 1990: 27, fig. 11, Fortes 1993: 139, fig. 13; Lewmanomont and Ogawa 1995: 147; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: 52; Soe-Htun *et al.*, 2001: 17-18, fig. 8, Soe-Htun *et al.*, 2009: 369, figs. 15-16; Abu Hena and Short 2009: 203, plate 1; Thaug Htut 2011:24-25, fig. 8a-b; Fortes 2013: 103, figs. A-B.

Description - Plants small; the rhizome less than 1mm in diameter with internodes 1.1-1.6 cm long; each node bears petiolated leaves; leaf blades linear to lanceolate, 5.5-7.5 mm long, 1.5-2.0 mm wide, petiole 8-14 mm long, apex acute, base attenuate, margin entire, with 1-3 paralleled veins and no cross-veins.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed only in 1 study site, Ma Gyi in the Rakhine Coastal Region (Table 1, Fig. 22). There were no plants of *Halophila beccarii* in the monitoring cross-transects of 14 study sites (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region- No data; (2) The Rakhine Coastal Region - Magyi.

10. *Halophila decipiens* Ostenfeld

References - Den Hartog 1970: 254-258; Eiseman 1980:12, fig. 5; Lanyon 1986: 24-25, fig. 7; Womersley 1984: 61-64, figs. 10A-C, 11A-C; Fortes 1990: 26, fig. 8, Fortes 1993: 137, fig. 10; Lewmanomont and Ogawa 1995: 148; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Japar Sidik, Ali, Zakaria, Kusnan and Omar 2000: 233-238, fig. 1a-b, 2a-c; Kuo and den Hartog 2001: 51; Soe-Htun *et al.*, 2001: 18, fig. 9, Soe-Htun *et al.*, 2009: 369, figs. 17-18; Mam 2002: 18-21; Dawes, Phillips and Morrison 2004: 51, fig. A.1-1; Kuo *et al.*,2006: 131, figs. 1A-G; Thaug Htut 2011:25-27, fig. 9a-b; Fortes 2013: 102, figs. 11A-B; El Shaffai 2011: 35-37.

Description - Plants small; the rhizomes less than 1 mm in diameter; internodes 1.2-2.7 cm long; leaf blades lanceolate to oblong, 1.0-1.7 cm long, 3-6 mm wide; margin finely serrated, with conspicuous midrib and persistent cross-veins, apex obtuse, petiole 1.0-1.7 cm long, base unclosed by a pair of transparent scale.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 3 study sites such as Ohn Kyun, Ma Gyi and Pho Htaung Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22). A total of 11 plants of *Halophila decipiens* were observed in the monitoring transects at 2 study sites such as Ma Gyi (A: 2, B: 0 and C: 0 with a subtotal of 2 individuals) and Pho Htaung Gyaing (A: 0, B: 0 and C: 9 with a subtotal of 9 individuals) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region - No data; (2) The Rakhine Coastal Region - Ohn Kyun I., Magyi, Pho Htaung Gyaing.

11. *Halophila ovalis* (R. Brown) Hooker f.

References - Den Hartog 1970: 240-251, fig. 62; Womersley and Baily 1970: 344; Nozawa 1972: 62, figs. 3E-G; pl. 2H; Cambridge 1975: 158; Young and Kirkman 1975: 200-201, fig. 4; Calumpang *et al.*, 1983: 84, figs. 8A-B; Lanyon 1986: 26-27, fig. 8; Womersley 1984: 64, figs. 11D-G; Ogawa 1987: 46; 1989: 63; Fortes 1990: 25, fig. 9, Fortes 1993: 138, figs. 2, 11; Lewmanomont and Ogawa 1995: 150; Lewmanomont, Deetae and Srimanobhas 1996: 21-26; Tien 1998: 307-316; Kuo and den Hartog 2001: 50; Soe-Htun *et al.*, 2001: 18-19, fig. 10, Soe-Htun *et al.*, 2009: 369-370, figs. 19-20; Kuo *et al.*,2006: 138, figs. 4A-G; Mam 2002: 18-21; Thaug Htut 2011:27-29, fig. 10a-b; Fortes 2013: 102, figs. 12A-B; El Shaffai 2011: 36-40; Nguyen *et al.*, 2014: 6, figs. A-B-C-D-E.

Description - Plants small; the rhizome less than 1mm in diameter, slightly larger than *H. decipiens*, internodes 1.8-2.4 cm long; erect shoot at each node, bearing a pair of

petiolated leaves; leaf blades lanceolate to obovate or elliptic, 1.5-2.2 cm long, 7-10 mm wide, margin entire, apex obtuse, base rounded, petiole 2.2-3.0 cm long, midrib prominent with 14-17 cross-veins, the distance between the intra-marginal vein and the lamina margin ratio 1:12 to 1:16.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in 9 study sites such as Zar Det Gyi I., Zar Det Ngye I. (West), Zar Det Ngye I. (East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East), Taw Wet (South) and Taw Wet (North) in the Myeik Archipelago of the Tanintharyi Coastal Region (Table 1, Fig. 22). A total of 109 plants of *Halophila ovalis* were observed in the monitoring transects at 8 study sites such as Zae Det Gyi I. (A: 1, B: 3 and C: 1 with a subtotal of 5 individuals); Zae Det Ngye I. (West) (A: 3, B: 9 and C: 2 with a subtotal of 14 individuals); Zae Det Ngye I. (East)(A: 3, B: 9 and C: 10 with a subtotal of 22 individuals); Pa Law Kar Kyan I. (A: 6, B: 7 and C: 4 with a subtotal of 17 individuals); Nyaung Wee I. (A: 0, B: 0 and C: 12 with a subtotal of 12 individuals); Bo Cho I. (A: 10, B: 9 and C: 11 with a subtotal of 30 individuals); Lampi I. (East)(A: 4, B: 0 and C: 5 with a subtotal of 9 individuals) and Taw Wet I. (North)(A: 3, B: 4 and C: 4 with a subtotal of 11 individuals) in the Tanintharyi Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region - Zar Det Gyi I., Zar Det Ngye I. (West and East), Pa Law Kar Kyan I. (St. Luke I.), Nyaung Wee I., Bo Cho I., Lampi I. (East), Taw Wet I. (South and North); (2) The Rakhine Coastal Region - No data.

12. *Halophila major* (Zoll.) Miquel

Description - Plants moderate in size; slightly larger than *H. ovalis*, perennial; rhizomes slender to robust, fleshy, transparent, internodes 25-40 mm long, 1-2 mm diameter; roots up to 50 mm long, 1.5 mm diameter. Scales 2, glabrous, margins entire, petiole scale 3-5 x 1-2 mm, rhizome scale 4-55 x 1.0-2.5 mm; leaves petiolate, fleshy, purple to light green, 15-30 mm long, leaves bright to dark green, ovate, oblong to elliptic, 15-25 mm long, 9-11 mm wide, L:W ratio 1-3:1; apex acute or acuminate; base cuneate to attenuate, symmetrical: margins entire; surface glabrous; distance between intra marginal veins and lamina margin ratio 1:20.8-25.6; cross-veins distinct, 18-20, distance between adjacent cross veins 0.7-1.25 mm wide.

Reference - Kuo *et al.*, 2006: 136, fig. 3; Nguyen *et al.*, 2014: 6, figs. A-E.

Ecological notes - The field samplings of seagrasses revealed that this plant was commonly distributed in four study sites such as Ohn Kyun, Ma Gyi, Pho Htaung Gyaing and Maung Shwe Lay Gyaing in the Rakhine Coastal Region (Table 1, Fig. 22). A total of 28 plants of *Halophila major* were observed in the monitoring transects at 4 study sites such as Ohn Kyun I. (A: 5, B: 0 and C: 9 with a subtotal of 14 individuals); Ma Gyi (A: 1, B: 1 and C: 0 with a subtotal of 2 individuals); Pho Htaung Gyaing (A: 3, B: 0 and C: 0 with a subtotal of 3 individuals) and Maung Shwe Lay Gyaing (A: 7, B: 11 and C: 8 with a subtotal of 26 individuals) in the Rakhine Coastal Region (Table 2).

Local distribution - (1) The Tanintharyi Coastal Region - No data; (2) The Rakhine Coastal Region - Ohn Kyun I., Ma Gyi, Pho Htaung Gyaing, Maung Shwe Lay Gyaing

Appendix V Hawksbill marine turtle, accidentally caught by beach seine net from Taw Wet I. (South). B-C, The stranded dugong at Ma Gyi on 18-6-2015.



Appendix VI Seagrass policy brief



Seagrass policy brief: Myanmar

July 2015

Ecological importance of seagrass

Seagrass meadows provide crucial shelter and feeding grounds for many marine species including dugongs and turtles and serve as important spawning and nursery grounds for a variety of marine invertebrates and fish species which people rely on both commercially and for consumption. Seagrasses are one of the key primary producers of oxygen which support an array of aquatic fauna and act as important carbon sinks. They also play an important role in controlling erosion in coastal areas through stabilizing sediments.

Species diversity

A total of 12 species of seagrasses have been recorded in Myanmar including *Syringodium isoetifolium*, *Cymodocea rotundata*, *C. serrulata*, *Cymodocea sp.*, *Halodule uninervis*, *H. pinifolia*, *Enhalus acoroides*, *Thalassia hemprichii*, *Halophila beccarii* (IUCN Red list: Vulnerable), *H. decipiens*, *H. ovalis* and *H. major*. The areas with the highest diversity of seagrasses within Myanmar include Zar Det Ngye I. (East) and Pa Law Kar Kyan I. (St. Luke I.) in the Myeik Archipelago and Ma Gyi and Pho Htaung Gyaing along the Rakhine Coast. Although only one species is listed as Vulnerable and most others are listed as under the IUCN Red list as Least Concern, many have populations which are decreasing.

Threats to seagrass beds in Myanmar

- Runoff from cities and towns and hazardous wastes and oil dispersals released from industrial zones located in the upper areas of natural seagrass beds are seen as serious threats to these habitats.
- Bottom trawlers operating directly through seagrass beds targeting shrimps and other marine species. Indirect threats from such activities include an increase in sedimentation which can smother these habitats.
- Sand mining in the Myeik Archipelago which can indirectly threaten seagrass beds with an increase in turbidity in the waters resulting in reduced ability of seagrasses to photosynthesize.

Recommended management actions

To ensure these critical habitats are protected and to guide decision makers in developing conservation plans for seagrass management, the following management actions have been recommended for implementation to assure that the seagrass beds will continue to deliver important ecosystem services:

1. Designation of key seagrass areas as Marine Protected Areas (MPAs) linked with wider spatial planning exercises for the two main coastal areas with seagrass beds notably Rakhine and Tanintharyi.
2. Encourage international support and form partnerships with regional bodies for the conservation of seagrass ecosystems.
3. Share the results of local and regional research on seagrass ecosystem functions and values, and establish national and regional ecological networks and corridors for the management and conservation of seagrass ecosystems.
4. Provide financial and technical support to various Myanmar institutions such as government departments and universities, including capacity development for community-based biodiversity conservation efforts.
5. Improve public knowledge and recognition of the importance of seagrass habitats through nationwide education and awareness programmes targeting policy and decision makers, fishers and local communities and those involved in activities which impact seagrass beds.
6. Strengthen national, regional and international efforts to ensure invasive alien species are controlled, which could cause great biodiversity loss in seagrass communities. This should include the development of an effective work programme on invasive alien species.
7. Intensify water pollution prevention for industrial hazardous wastes from the special economic zone and regularly examine the water quality standards for coastal and marine areas by establishing monitoring systems and effective legal frameworks for conservation of seagrass meadows.
8. Ensure seagrass conservation is included in current and future coastal development projects and in all regional/state development plans.
9. Undertake further detailed research on seagrass habitats including surveys of the ecosystem services provided by seagrass beds with a special focus on their importance to fisheries;
10. Regularly monitor the status of seagrass ecosystems along the coast of Myanmar including on ground surveys and satellite remote sensing analysis.
11. Identify the potential impacts on seagrasses from climate change which may cause these habitats to degrade leading to food security issues for local communities.



ပင်လယ်မြက်ဆိုင်ရာပေါ်လစီအနှစ်ချုပ်၊ မြန်မာ

ဇူလိုင်၊ ၂၀၁၅

ပင်လယ်မြက်ခင်းများသည် ရေဝက်၊ ပင်လယ်လိပ်နှင့် ပင်လယ်ငါးများအတွက် အရေးပါသော နေထိုင်ကျက်စား ခိုလှုံရာ နေရာဖြစ်သည့်အပြင် လူသားများအတွက် စီးပွားရေးအရနှင့် နေ့စဉ်စားသုံးရန်အရေးပါသော ပင်လယ်ငါးသယံဇာတများ နှင့် ပင်လယ်နေကျောရိုးမဲ့သတ္တဝါများ၏ သားပေါက်ရာနှင့် သားပေါက်များ နေထိုင်ကျက်စားရာ နေရာများဖြစ်ပါသည်။ ပင်လယ်မြက်များသည် ရေသတ္တဝါများအတွက် အရေးပါသော အောက်စီဂျင်ထုတ်ပေးရာ အဓိကနေရာတစ်နေရာ ဖြစ်သည့်အပြင် ကာဘွန်စုပ်ယူရာ အရေးပါသော နေရာလည်းဖြစ်ပါသည်။ ထို့အပြင် ကမ်းခြေဒေသများရှိမြေသားများကို တည်ငြိမ်အောင်ထိန်းပေးနိုင်ခြင်းကြောင့် ကမ်းခြေရေတိုက်စားမှုပြဿနာကိုထိန်းပေးရန်အတွက်လည်း အရေးပါပါသည်။

မြန်မာနိုင်ငံရှိပင်လယ်မြက်ပျံ့နှံ့နေမှု

မြန်မာနိုင်ငံတွင် *Syringodium isoetifolium*, *Cymodocea rotundata*, *C. serrulata*, *Cymodocea* sp., *Halodule uninervis*, *H. pinifolia*, *Enhalus acoroides*, *Thalassia hemprichii*, *Halophila beccarii* (IUCN Red List: Vulnerable), *H. decipiens*, *H. ovalis*, *H. major* အပါအဝင် ပင်လယ်မြက်မျိုးစိတ် (၁၂)မျိုး တွေ့ရှိရပါသည်။ လေ့လာမှုများအရ ပင်လယ်မြက်အများဆုံးတွေ့ရှိရသောဒေသများမှာ တနင်္သာရီကမ်းရိုးတန်းဒေသတွင် ဇာဒက်ငယ်ကျွန်း(အရှေ့) နှင့် ပလောကာကြမ်း(ဇလုံ)ကျွန်း၊ ရခိုင်ကမ်းရိုးတန်းဒေသတွင် မန်ကျည်းနှင့် ဖိုးထောင်ချိုင့် တို့ဖြစ်ပါသည်။ ပင်လယ်မြက်ခင်းများ၏အရေအတွက်မှာ လျော့နည်းလာနေပြီဖြစ်သော်လည်း IUCN Red List အရ မျိုးစိတ် (၁)မျိုးတည်းသာ Vulnerable အဆင့်တွင်ရှိပြီး ကျန်မျိုးစိတ်များမှာ Least Concern အဆင့်တွင်သာ သတ်မှတ်ထားပါသည်။

မြန်မာ့ပင်လယ်မြက်ခင်းများအားအန္တရာယ်ချိန်းခြောက်မှုများ

- မြို့ပြများမှ စွန့်ထုတ်ပစ်သောရေဆိုးများ၊ စက်မှုရုံများမှ စွန့်ထုတ်သော အန္တရာယ်ရှိသည့် အညစ်အကြေးများနှင့် စွန့်ပစ်စက်သုံးဆီများသည် သဘာဝပင်လယ်မြက်ခင်းများကို လွန်စွာအန္တရာယ်ချိန်းခြောက်နေပါသည်။
- ပင်လယ်မြက်ခင်းများတွင်နေထိုင်ကျက်စားသော ပုစွန်နှင့် အခြားသတ္တဝါများကို အဓိကရည်ရွယ်၍ဖမ်းဆီးသည့် ကြမ်းပြင်ဒရပ်ဆွဲပိုက်လှေများသည် သဘာဝပင်လယ်မြက်ခင်းများကို လွန်စွာအန္တရာယ်ချိန်းခြောက်နေပါသည်။ ထို့အပြင် သွယ်ပိုက်၍ခြိမ်းခြောက်နေသောအချက်မှာ ဤကဲ့သို့ဖမ်းဆီးမှုကြောင့် အနည်ကျမှုပိုများလာကာ ပင်လယ်မြက်ပေါက်သောအောက်ခြေကြမ်းပြင်များ ခြောမွေလာပြီး ပင်လယ်မြက်များကောင်းစွာ မပေါက်နိုင်တော့ချေ။

- မြိတ်ကျွန်းစုဒေသတွင်ပြုလုပ်နေသော သဲသောင်တူးခြင်းလုပ်ငန်းကြောင့် သွယ်ဝိုက်၍ခြိမ်းခြောက်နေသောအချက်မှာ ရေပိုမိုနောက်ကျိလာပြီး ပင်လယ်မြက်များအတွက် အလင်းရောင်ရရှိမှုနည်းလာကာ အလင်းရောင်အသုံးပြု၍ အစာချက်လုပ်နိုင်အား နည်းလာစေပါသည်။

စီမံခန့်ခွဲမှုဆိုင်ရာလုပ်ဆောင်ရန်အကြံပြုချက်များ

ဤပေါ်လစီ၏အခြေခံအဖြစ် ပင်လယ်မြက်ခင်းများကို သေချာစွာထိန်းသိမ်းသွားရန်နှင့် ဆုံးဖြတ်ချက်ချသူများအတွက် ပင်လယ်မြက်စီမံခန့်ခွဲရေးဆိုင်ရာ ထိန်းသိမ်းရေးအစီအစဉ်များစီစဉ်နိုင်ရန်လမ်းညွှန်အဖြစ် စီမံခန့်ခွဲမှုဆိုင်ရာ အကြံပြုချက်များကို စာရင်းပြုစုထားပါသည်။

- ၁။ ရခိုင်နှင့် တနင်္သာရီကမ်းရိုးတမ်းဒေသရှိ အဓိကပင်လယ်မြက်ခင်းများရှိရာနေရာများကို အဏ္ဏဝါကာကွယ်ရေပြင် (Marine Protected Area) များတည်ထောင်ကာ ပိုမိုကျယ်ပြန့်သော ဒေသလုံးဆိုင်ရာထိန်းသိမ်းရေးအစီအစဉ်နှင့် ချိတ်ဆက်ရေး၊
- ၂။ ပင်လယ်မြက်ဂေဟစနစ်ကို ထိန်းသိမ်းရန်အတွက် အပြည်ပြည်ဆိုင်ရာမှပံ့ပိုးမှုများကို လက်ခံရန်နှင့် ဒေသတွင်းအဖွဲ့အစည်းများနှင့် ပူးပေါင်းဆောင်ရွက်ရေး၊
- ၃။ နိုင်ငံအတွင်းနှင့် ဒေသအတွင်းပြုလုပ်သော ပင်လယ်မြက်ဂေဟစနစ်၏လုပ်ဆောင်မှုနှင့် တန်ဖိုးများဆိုင်ရာ သုတေသနရလဒ်များကို ဖြန့်ဝေပေးခြင်း၊ နိုင်ငံအတွင်းနှင့် ဒေသလုံးဆိုင်ရာ ပင်လယ်မြက်ဂေဟစနစ်ကို စီမံခန့်ခွဲနိုင်ရန်အတွက် ဂေဟစနစ်ကွန်ယက်နှင့် စင်္ကြံများတည်ထောင်ရေး၊
- ၄။ မြန်မာနိုင်ငံအတွင်းရှိ အဖွဲ့အစည်းများဖြစ်သည့် အစိုးရဌာနဆိုင်ရာများနှင့် တက္ကသိုလ်များသို့ ပြည်သူလူထုအခြေပြု ဇီဝမျိုးစုံမျိုးကွဲထိန်းသိမ်းရေးဆိုင်ရာကြိုးပမ်းအားထုတ်မှုများအတွက် အရည်အသွေးမြှင့်တင်ခြင်းဆိုင်ရာသင်တန်းများ ပို့ချပေးခြင်းအပါအဝင် ငွေကြေးနှင့် နည်းပညာ ထောက်ပံ့ပေးရေး၊
- ၅။ ပြည်သူလူထုအား ပင်လယ်မြက်ခင်းများ၏အရေးပါမှုကိုသိရှိစေရန်နှင့် ဗဟုသုတပိုမိုရစေရန်အတွက် ပေါ်လစီနှင့် ဆုံးဖြတ်ချက်ချသူများ၊ ရေလုပ်သားများ၊ ဒေသခံပြည်သူများနှင့် ပင်လယ်မြက်ခင်းရှိရာဒေသများတွင် လုပ်ငန်းလုပ်ဆောင်နေသောသူများအားရည်ရွယ်ပြီး နိုင်ငံလုံးဆိုင်ရာ ပညာပေးအစီအစဉ်များ ပြုလုပ်ပေးရေး၊
- ၆။ ပင်လယ်မြက်ဂေဟစနစ်ကျင့်ရုံ ဇီဝမျိုးစုံမျိုးကွဲ လျှော့ကျမှုကိုဖြစ်စေသော ပြင်ပမှမျိုးစိတ်သစ်များဝင်ရောက်လာမှုကို ထိန်းသိမ်းရန်အတွက် နိုင်ငံလုံးဆိုင်ရာ၊ ဒေသလုံးဆိုင်ရာနှင့် အပြည်ပြည်ဆိုင်ရာကြိုးပမ်းအားထုတ်မှုများကို မြှင့်တင်ပေးရေး၊ ဤအစီအစဉ်တွင် ပြင်ပမှမျိုးစိတ်သစ်များဝင်ရောက်လာခြင်းကို တားဆီးရန်အတွက် ထိရောက်သော အစီအစဉ်များ စီစဉ်ရမည်ဖြစ်ပါသည်။
- ၇။ ပင်လယ်မြက်ခင်းများကို ထိန်းသိမ်းရန်အတွက် ပင်လယ်ကမ်းခြေဒေသများနှင့် အဏ္ဏဝါရေပြင်များ၏ ရေအရည်အသွေးပုံမှန်စစ်ဆေးရေးနှင့် အထူးစီးပွားရေးဇုန်များမှ စွန့်ထုတ်သော အန္တရာယ်ရှိသည့် အညစ်အကြေးများကြောင့် ရေညစ်ညမ်းမှုကို ထိရောက်စွာတားဆီးရေးအတွက် ထိရောက်သော ဥပဒေမူဘောင်များနှင့် လေ့လာစောင့်ကြည့်ရေးစနစ်များရေးဆွဲရေး၊
- ၈။ ပြည်နယ်နှင့်တိုင်းဒေသကြီး ဖွံ့ဖြိုးရေးအစီအစဉ်များ၏ ပင်လယ်ကမ်းခြေဒေသဆိုင်ရာ ဖွံ့ဖြိုးရေးအစီအစဉ်များတွင် ပင်လယ်မြက်ထိန်းသိမ်းရေးဆိုင်ရာ အစီအစဉ်များ ပါဝင်စေရေး၊

- ၉။ ပင်လယ်မြက်များ၏ ငါးလုပ်ငန်းအပေါ်အရေးပါမှုကို အထူးပြု၍လေ့လာရန်နှင့် ဂေဟဝန်ဆောင်မှုဆိုင်ရာ လုပ်ဆောင်ပေးမှုများကိုလေ့လာရန်အပါအဝင် ပင်လယ်မြက် ရေရှည်လေ့လာရေးဆိုင်ရာအစီအစဉ်များ ရေးဆွဲရေး၊
- ၁၀။ လက်တွေ့မြေပြင်လေ့လာရေးနှင့် ဂြိုဟ်တုခါတ်ပုံများမှတစ်ဆင့်လေ့လာရေးများ အပါအဝင် မြန်မာ့ပင်လယ် ကမ်းရိုးတမ်းတစ်လျှောက်ရှိ ပင်လယ်မြက်ခင်းဂေဟစနစ်များအခြေအနေကို ပုံမှန်လေ့လာရေး၊
- ၁၁။ ရာသီတုပြောင်းလဲမှုကြောင့် ပင်လယ်မြက်ဂေဟစနစ်များပျက်စီးလာစေပြီး ဒေသခံပြည်သူလူထုအတွက် စားနပ်ရိက္ခာပြဿနာကိုဖြစ်စေနိုင်သဖြင့် ပင်လယ်မြက်ခင်းများတွင် ရာသီဥတုပြောင်းလဲမှုကြောင့်ဖြစ်နိုင်သော အခြေအနေများကို လေ့လာဆန်းစစ်ရေး၊



Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand are working together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project to lay the foundations for a coordinated programme of action designed to better the lives of the coastal populations through improved regional management of the Bay of Bengal environment and its fisheries.

The Food and Agriculture Organization (FAO) is the implementing agency for the BOBLME Project.

The Project is funded principally by the Global Environment Facility (GEF), Norway, the Swedish International Development Cooperation Agency, the FAO, and the National Oceanic and Atmospheric Administration of the USA.

For more information, please visit www.boblme.org



Food and Agriculture
Organization of the
United Nations



Norad

