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Seagrass conservation and monitoring in Myanmar
The biodiversity, distribution and coverage of seagrasses in the Tanintharyi and Rakhine

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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
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

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Suggested citation


Author details

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Cover image

Seagrass beds in Pho Htaung Gyaing along the Rakhine Coast. Credit: FFI Myanmar.

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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 becarii, 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 becarii 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 becarii 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 Thaung 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.
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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 sea grass 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 Taninthary 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 Taninthary and from 1st to 31st of May in Rakhine and included the following sites:

**Taninthary 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.

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-transsects 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-transsects 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-transsects was estimated on 15 May 2015.
Figure 1. The survey sites in the Myeik Archipelago, in the Tanintharyi 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)
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

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Species</th>
<th>Study sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tanintharyi Coastal Region</td>
</tr>
<tr>
<td>1</td>
<td>Syringodium isoetifolium</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Cymodocea serrulata</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>C. rotundata</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>C. sp.</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Halodule univervis</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>H. pinifolia</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>Enhalus acoroides</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>Thalassia hemprichii</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>Halophila beccarii</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>H. decipiens</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>H. ovalis</td>
<td>+</td>
</tr>
<tr>
<td>12</td>
<td>H. major</td>
<td></td>
</tr>
<tr>
<td>Total (biodiversity)</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Study site</th>
<th>Physical parameters</th>
<th>Ｍａｙｙｕｚｉｃｈｉ ｉｎｆｏｒｍａｔｉｏｎ ｊａｂｂａｉ ｉｎｆｏｒｍａｔｉｏｎ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temperature (°C)</td>
<td>Salinity (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depth (m) surveyed</td>
</tr>
<tr>
<td>Tanintharyi Coastal Region:</td>
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<tr>
<td>Zar Det Gyi I.</td>
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</tr>
<tr>
<td>Zar Det Ngye I. (West)</td>
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<td>32</td>
</tr>
<tr>
<td>Zar Det Ngye I. (East)</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td>Pa Law Kar Kyan (St. Luke)</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td>Nyaung Wee I.</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td>Bo Cho I.</td>
<td>30</td>
<td>32</td>
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<tr>
<td>Lampi I. (East)</td>
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<td>Lampi I. (West)</td>
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<td>32</td>
</tr>
<tr>
<td>Taw Wet I. (South)</td>
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<td>Taw Wet I. (North)</td>
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<td>32</td>
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<tr>
<td>Rakhine Coastal Region:</td>
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<td>Ohn Kyun I.</td>
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<td>Ma Gyi</td>
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<tr>
<td>Pho Htaung Gyaing</td>
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<td>32</td>
</tr>
<tr>
<td>Maung Shwe Lay Gyaing</td>
<td>28</td>
<td>32</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Locality (Date)</th>
<th>Position</th>
<th>Cover (%)/Cross-transect</th>
<th>Species</th>
<th>Total/Species</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lat. N, Long. E</td>
<td></td>
<td>Si</td>
<td>Cs</td>
<td>Cr</td>
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<td></td>
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<tr>
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<td>Rakhine Coastal Region</td>
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<td>Total (Frequency of plants)</td>
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<td>26</td>
<td>63</td>
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**Abbreviations:** Si - Syringodium isoetifolium, Cs - Cymodocea serrulata, Cr - Cymodocea rotundata, Csp - Cymodocea sp., Hu - Halodule univeris, 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


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.
Pho Htaung Gyaing
Mg Shwe Lay

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

<table>
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<tr>
<th>Site</th>
<th>Uniqueness</th>
<th>Species richness</th>
<th>% Cover</th>
<th>Cumulative score</th>
<th>Rank</th>
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<td>3</td>
<td>2</td>
<td>14</td>
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<tr>
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<td>3</td>
<td>3</td>
<td>15</td>
<td>5</td>
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<tr>
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<td>1</td>
<td>6</td>
<td>3</td>
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<td>2</td>
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<td>7</td>
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<tr>
<td>Bo Cho I.</td>
<td>9</td>
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<td>16</td>
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<td>Pho Htaung</td>
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<td>5</td>
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<tr>
<td>Maung Shwe Lay</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>4</td>
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</tbody>
</table>

- 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


## Appendix I

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

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<th>Genus</th>
<th>Sr. no.</th>
<th>Species</th>
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</thead>
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<td>Syringodium Kützing</td>
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<td><em>S. isoeti-folium</em> (Ascherson) Danty</td>
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<td>Cymodocea König</td>
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<td><em>C. rotundata</em> Ehrenberg et Hem-prich ex Ascherson</td>
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<td></td>
<td>(3)</td>
<td><em>C. serrulata</em> (R. Brown) Ascherson et Magnus</td>
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<td>(4)</td>
<td>C. sp.</td>
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<td></td>
<td>Halodule Endlicher</td>
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<td><em>H. univeris</em> (Forsskal) Ascherson</td>
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<td>Hydrocha-ritacea</td>
<td>Enhalus Rich</td>
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<td><em>H. pinifolia</em> (Miki) den Hartog</td>
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<td></td>
<td>Thalassia Banks and Solander ex König</td>
<td>(7)</td>
<td><em>H. acoroides</em> (Linnaeus f.) Royle</td>
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<td></td>
<td>Halophila Du Petit-Thouars</td>
<td>(8)</td>
<td><em>T. hemprichii</em> (Ehrenberg) Ascherson</td>
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<td></td>
<td></td>
<td>(9)</td>
<td><em>H. beccarii</em> Ascherson</td>
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<td>(10)</td>
<td><em>H. decipiens</em> Ostenfeld</td>
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<td>(12)</td>
<td><em>H. major</em> (Zoll.) Miquel</td>
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</table>
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
Halophila beccarii. A. Habit

Halophila decipiens: B. Habit, and C. 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; ........................................................*C. rotundata*  

5.  
5a. Leaf tip smoothly rounded .................................................................6  
5b. Leaf tip bi-or tri-dentate ................................................................7

6.  
6a. Leaves normally issued, greater than 3 mm wide; stems long and firm ..............*C. sp.*  
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) Danyt


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 Gy, 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 Gy (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 Gy, 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; Thaung 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 1 mm 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 Gy 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 Gy, 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 Gy (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 Gy (A: 4, B: 2 and C: 8 with a subtotal of 7 individuals) in the Rakhine Coastal Region (Table 2).

3. *Cymodocea rotundata* Ehrenberg et Hemprich ex Ascherson


**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. (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 Gy, 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 33 individuals); Taw Wet I. (South and North) in the Rakhine Coastal Region (Table 1, Fig. 22).


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 and West) 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.

5. *Halodule unineris* (Forsskal) Ascherson


**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 unineris* 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


**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, lingula 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).


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


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 Ngyë I. (East) and Pa Law Kar Kyan I. (St. Luke I.) in the Myeik Archipelago of the Tanintharyi Coastal Region; Pho Htang Gyaing in the Rakhine Coastal Region (Table 1, Fig. 2). A total of 2 plants of *Enhalus acoroides* were observed in the monitoring transects at 1 study site: Pho Htang Gyaing (A: 0, B: 2 and C:0 with a subtotal of 2 individuals) in the Rakhine Coastal Region (Table 2).


8. *Thalassia hemprichii* (Ehrenberg) Ascherson


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 Gyì I., Zar Det Ngyë I. (West), Zar Det Ngyë 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 Htang Gyaing and Maung Shwe Lay Gyaing in the Rakhine Coastal Region (Table 1, Fig. 2). There were no plants of *Thalassia hemprichii* in the monitoring cross-transects of 14 study sites (Table 2).

9. *Halophila becarii* Ascherson


**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 becarii* in the monitoring cross-transects of 14 study sites (Table 2).

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

10. *Halophila decipiens* Ostenfeld


**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 Htauang 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 Htauang 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 Taninthary Coastal Region - No data; (2) The Rakhine Coastal Region - Ohn Kyun I., Magyi, Pho Htauang Gyaing.


**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. 2). 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: 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).


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.


**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. 2). 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 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 smoother 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 costal 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.
စားဖိုးများအတြက္ အေရးပါသော ဗိဓ်ထုတ္ေပးရာ အဓိကေနရာတစ္ေနရာ ျဖစ္သည့္အျပင္ ကာဘြန္စုပ္ယူရာ အေရးပါသော ေနရာလည္းျဖစ္ပါသည္။ ထို႔အျပင္ ကမ္းေျခေဒောလ်မ်ားကို တည္ၿငိမ္ေအာင္ထိန္းေပးႏိုင္ျခင္းေၾကာင့္ ကမ္းေျခေရတိုက္စားမႈျပသနာကိုထိန္းေပးရန္အတြက္လည္း အေရးပါပါသည္။

စားဖိုးများလွယ်စွာေျဖစ္ရာတွင္ 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 အမ်ား၀င္ျခင္းေၾကာင့္ အသားအားအေျခားျပားသော ရေနာရီအထားမ်ားတွင္မ္းရာ၀င္ျခင္း သောကားပါသည်။

စားဖိုးများအေနရာ ကိုလိုလျားစွာေျဖစ္ရာတွင္ IUCN Red List အား ေဖာ်ထားျခင္းေၾကာင့္ Vulnerable အေနရာအား ေဖာ်ထားသော စားဖိုးများ အေနရာ Least Concern အေနရာအား ေဖာ်ထားသည်။

စားဖိုးနားအေနရာအစားမ်ားတွင္ ျဖစ္ရာ

- စားဖိုးအေနရာအစားမ်ား လွယ္စွာေျဖစ္ရာတွင္ စားဖိုးအေနရာအစားမ်ား လွယ္စွာေျဖစ္ရာတွင္ စားဖိုးအေနရာအစားမ်ား
- စားဖိုးအေနရာအစားမ်ား လွယ္စွာေျဖစ္ရာတွင္ စားဖိုးအေနရာအစားမ်ား လွယ္စွာေျဖစ္ရာတွင္ စားဖိုးအေနရာအစားမ်ား
• ဗဟုသုတပိုမိုရေစရန္အတြက္ ေပၚလစီႏွင့္ ဆံုးျဖတ္ခ်က္ခ်သူမ်ားႏွင့္ ပင္လယ္ျမက္ခင္း႐ိွရာေဒသမ်ားတြင္ လုပ္ငန္းလုပ္ေဆာင္ေနသာသူမ်ားအားရည္႐ြယ္ၿပီး ႏိုင္ငံလံုးဆိုင္ရာ ပညာေပးအစီအစဥ္မ်ားျပဳလုပ္ေပးေရး，

၁။ ပင္လယ္ျမက္ခင္းမ်ားကို ေပးေရးဆဲြေရး，

၂။ ျပည္နယ္ႏွင့္တိုင္းေဒသႀကီး ဖံြ႔ၿဖိဳးေရးအစီအစဥ္မ်ား၏ ပင္လယ္ကမ္းေျခေဒသဆိုင္ရာ ဖံြ႔ၿဖိဳးေရးအစီအစဥ္မ်ားတြင္ ပင္လယ္ျမက္ထိန္းသိမ္းေရးဆိုင္ရာ အစီအစဥ္မ်ား ပါှင္ေစေရး，

၇။ ဗဟုသုတပိုမိုရေစရန္အတြက္ အချင့်အရာမုန္မုံမှာ အေျခခံအျဖစ္ ပင္လယ္ျမက္ခင္းမ်ားကို ေသခ်ာစြာထိန္းသိမ္းရန္ႏွင့္ ဆံုးျဖတ္ခ်က္ခ်သူမ်ားအတြက္ ပင္လယ္ျမက္စီမံခန္႔ခဲြေရးဆိုင္ရာ ထိန္းသိမ္းေရးအစီအစဥ္မ်ားစီစဥ္ႏိုင္ရန္လမ္းညႊန္အျဖစ္ စီမံခန္႔ခဲြမႈဆိုင္ရာ အႀကံျပဳခ်က္မ်ားကို စာရင္းျပဳစုထားပါသည္။
၉။ ပင်လယ်မ်ား၏ ငါးလုပ်ငန်းအေပၚအေရးပါမႈကို အထူးျပဳ၍ေလ့လာရန္ႏွင့္ ေဂဟှန္ေဆာင္မႈဆိုင္ရာ လုပ္ေဆာင္ ေပးမႈမ်ားကိုေလ့လာရန္အပါအှင္ ပင်လယ္ျမက္ ေရ႐ွည္ေလ့လာေရးႏွင့္ ျမန္မာ့ပင်လယ္ကမ္း႐ိုးတမ္းတစ္ေလွ်ာက္႐ိွ ပင်လယ္ျမက္ခင္းေဂဟစနစ္မ်ားအေျခအေနကို ပံုမွန္ေလ့လာေရး၊ ြန။ လက္ေတြ႔ေျမျပင္ေလ့လာေရးႏွင့္ ျမန္မာ့ပင်လယ္ ရာသီတုေျပာင္းလဲမႈေၾကာင့္ ပင်လယ္ျမက္ခင္းမ်ားပ်က္စီးလာေစၿပီး ေဒသခံျပည္သူလူထုအတြက္ စားနပ္ရိကၡာျပသနာကိုျဖစ္ေစႏိုင္သျဖင့္ ပင်လယ္ျမက္ခင္းမ်ားတြင္ ရာသီဥတုေျပာင္းလဲမႈေၾကာင့္ျဖစ္ႏိုင္ေသာ အေျခအေနမ်ားကို ေလ့လာဆန္းစစ္ေရး၊
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.

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