Seagrass Assessment Report of Semporna PCA
WWF-Malaysia Semporna PCA Project

February 2011
Seagrass Assessment Report of Semporna Priority Conservation Area

by

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Facilitating Collaborative Management of Coral Reefs and Adjacent Ecosystems with Tourism and Fisheries

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Introduction

Seagrasses are aquatic flowering plants (monocotyledonous angiosperms) that form meadows in nearshore brackish water or marine waters in temperate and tropical regions. There are 60 species of seagrasses described globally, within 12 genera, 4 families and 2 orders; many of which are found in the Indo-Pacific region. Australia has the highest diversity with more than half of the total seagrass species in the world (McKenzie 2001); followed by the Philippines with 19 species (WRI, 2010); Malaysia with 14 species (Zakaria 2003); and Indonesia with 13 species (Kuriandewa 2008).

Seagrasses are distributed along the coasts of Malaysia in patches or meadows. The 14 seagrass species recorded are: *Enhalus acoroides*, *Halophila beccarii*, *H. decipiens*, *H. ovalis*, *H. minor*, *H. spinulosa*, *H. pinifolia*, *H. uninervis*, *Cymodocea rotundata*, *C. serrulata*, *Thalassia hemprichii*, *Syringodium isoetifolium*, *Ruppia maritima* and *Thalassodendron ciliatum* (Bujang, 2006).

Seagrasses are complex in morphological structure (Figure 1) and possess multiple ecological functions. They are associated with shallow inter-tidal habitats, mangrove areas, coral reefs, semi-enclosed lagoons and shoals; and have the ability to tolerate a wide range of salinity. As a complex and high productivity ecosystem, seagrass beds provide food, habitats and nursery grounds for a variety of invertebrates, fish and turtles. They also stabilize sediments, recycle nutrients to improve water clarity and contribute to shoreline protection via wave attenuation (Koch et al. 2006). Additionally, seagrasses enhance biodiversity and trophic transfer to adjacent habitats.

![Figure 1: Morphological structure of seagrasses](Source: www.seagrasswatch.org)
A recent study estimated the annual economic value of seagrass at $3,500 per hectare (Loney, 2009). Most of the marine fishing families in Semporna PCA are highly dependent on seagrass habitats (Stakeholders of Semporna, 2009) that are accessible for “gleaning”; a fishing activity conducted during low tide by walking on seagrass beds or shallow reefs to collect edible marine resources such as shellfish, spider conch (*Lambis sp.*) or *kahanga* as it is locally known, sea urchin, clam, sea cucumber, stingray, eel and fish. Gleaning is commonly practised by women and children (Figure 2).

![Figure 2: Women and children gleaning on seagrass beds on Mabul Island during low tide.](image)

The high diversity of marine life in seagrass habitats is also becoming an attraction for marine tourism in Semporna PCA. In addition to fishing, marine tourism is one of the main economic activities in Semporna. SCUBA diving to appreciate the interesting marine life associated with seagrass beds can provide a similar enjoyment to diving on coral reefs. Examples of fascinating marine life that can be found in seagrass habitats are marine turtle, seahorse, nudibranch, flamboyant cuttlefish, stonefish, stingray, snake eel and striped catfish (Appendix 1).

Seagrass ecosystems are often overlooked as a fragile ecosystem with a high priority for conservation. They are also highly impacted by anthropogenic activities and natural disturbances which result in declines in seagrass coverage and density. Despite the high dependence of Semporna PCA’s marine tourism and fisheries on the ecological services provided by seagrass habitats, there appears to be little appreciation for this ecosystem. Seagrass habitats continue to be negatively impacted by unsustainable coastal development of resorts, houses and jetties as well as sedimentation and pollution from human waste.
The ecological services of seagrass ecosystems need to be highlighted to the government and local communities to enable the planning and implementation of sustainable marine resources management. For this to happen, scientific information on the ecosystem is needed. Thus, this assessment seeks to establish and document baseline ecological information of Semporna PCA’s seagrass habitats including specific threats and socio-economic benefits to the fishing communities and tourism industry.

Geographic scope
Between May 2009 and August 2010, assessments were carried out by WWF-Malaysia Semporna PCA Team, volunteers, local villagers and dive operators. A total of 18 sites were surveyed with 54 transects that were representative of most major seagrass beds in Semporna PCA (Map 1). Seagrass beds at the Tun Sakaran Marine Park and Sipadan Island Park fall under the management and jurisdiction of Sabah Parks. Therefore, they were not surveyed under this project because research in these parks is conducted by the research unit of Sabah Parks.

Map 1: Seagrass sites assessed in the Semporna PCA.
Materials and Methods

The seagrass assessment methodology used was based on the Seagrass-Watch protocol for monitoring intertidal seagrass habitats (McKenzie, 2001). Representation of major seagrass areas and accessibility were the two main criteria for site selection.

Four seagrass health and ecological indicators were considered in the assessment:
1) Percentage of seagrass coverage estimated in a fixed size quadrat indicating the density and abundance of seagrass species.
2) The number of species identified indicating seagrass species diversity in the survey site.
3) Percentage of algal coverage estimated in a fixed size quadrat where high algal densities may indicate overloading of nutrient content in water (phosphorus and nitrogen).
4) Canopy height is a general indicator for three-dimensional structure of seagrass beds that has implications on the biomass and richness of associated fish communities (Hori et al, 2009).

Materials:
1. 2.5m x 2.5m quadrat
2. 50m fibreglass measuring tape
3. Compass
4. Clipboard
5. Waterproof paper with printed data sheet
6. Pencil
7. 30cm ruler
8. Magnifying glass
9. Camera with underwater housing
10. Seagrass species code, ID and coverage percentage field guide
General steps for seagrass assessment:

1. Select a study site and lay out the three 50m transects parallel to each other, 25m apart and perpendicular to shore. (Figure 3)
2. Use 2.5m x 2.5m quadrat to estimate seagrasses coverage for every 5m along the 50m transect.
3. Take a photograph of the quadrat as vertical as possible, with frame, label and tape measure at 5m, 25m and 45m distance along the transect.
4. Describe sediment composition.
5. Estimate seagrass coverage percentage within quadrat using Seagrass Percentage Cover photo guide (Appendix 6)
6. Identify seagrass species using Seagrass Species Codes field guide (Appendix 8 and 9).
7. Measure canopy height.
8. Estimate algae coverage percentage using Algal Cover Percentage photo guide (Appendix 7)
9. Describe other features and ID/ count of macrofauna.
10. Take a seagrass specimen if uncertain of its identification.

Figure 3: Layout of seagrass assessment transects and quadrats (McKenzie et al, 2001)


Results

Eight species of seagrass were identified in Semporna PCA in contrast to the 14 species recorded in Malaysia (Zakaria 2003) and 60 species worldwide (McKenzie, 2001). The seagrass species recorded were Enhalus acoroides (Ea), Thalassia hemprichii (Th), Halophila ovalis (Ho), Cymodocea rotundata (Cr), Cymodocea serrulata (Cs), Halodule pinifolia (Hp), Halodule uninervis (Hu) and Syringodium isoetifolium (Si).

The most frequently encountered species were Thalassia hemprichii (45%), Enhalus acoroides (16%), Cymodocea serrulata (11%), Cymodocea rotundata (8%) and Halophila ovalis (3%) (Chart 1). These 5 species were found in all the survey sites and identified as dominant species in 11 out of 16 survey sites (Table 1). The most dominant and widely distributed species in Semporna PCA, Thalassia hemprichii, is a major part of the diet of green turtles (Chelonia mydas) and dugongs (Dugong dugon) (Figure 4).

![Seagrass Species Composition in Semporna PCA](chart1.png)

**Chart 1**: Seagrass species composition in Semporna PCA.

![Figure 4: Green turtle (Chelonia mydas) feeding on Thalassia Hemprichii at Sipadan Island.](figure4.png)
Table 1: Seagrass species distribution and record from surveys in Semporna PCA.

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<tr>
<th>Family / Species</th>
<th>Northern Reefs</th>
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<td>Syringodium isoetifolium</td>
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Species distribution indicator: D = Dominant; C = Common; R = Rare (Applicable only to seagrass found in the quadrats)

Chart 2: Seagrass species composition on each site.
Chart 3 shows that the seagrass beds in Semporna PCA were in fair condition with an overall average seagrass coverage percentage of 31.67%. The highest average percentage of seagrass coverage was recorded at Kulapuan Island with 62%, while Timun Mata Island has the lowest seagrass coverage with only 3% (Map 2).

Map 2 and Table 2 illustrate that distance from mainland may be one of the factors affecting the density of seagrass coverage in several survey sites in Semporna PCA. Distance from the mainland has strong influence on water turbidity and substrate types that in turn influence seagrass density. However, there may be other factors contributing to seagrass density, such as density of island inhabitants, waste discharge, availability of nutrients, and algal coverage.
Map 2: Status of seagrass coverage in Semporna PCA.
It was observed that seagrass coverage increased with distance from the beach (Chart 4). Seagrass coverage is generally low at the starting point because in most cases this is where strong wave activity and constant shifting sand movement occur. These conditions damage seagrasses and hamper growth. Seagrass coverage gradually increased from 5m until about 25m from shore. Beyond 25m, towards the reef crest area, with increasing depth and attenuated sunlight, seagrass coverage slowly decreases. However, there are variations among the sites due to differences in sea floor topography of the area.
The average seagrass canopy height for all sites was 11.17cm. The highest average canopy height was recorded at Bum-bum 1 at 28.67cm. The lowest average canopy height was recorded at Timbun Mata at 1.33cm (Chart 5). Average canopy height is influenced by the type of seagrass species occurring in the quadrat. For example, the tallest seagrass species in Semporna is *Enhalus acoroides*, which can grow from 30 to 150cm in height. The shortest species found in Semporna is *Halophila ovalis* that grows from 1 to 3cm in height.

Average algal coverage for all sites was 8.44%, indicating low levels of nutrient overloading. However, there were sites with high average algal coverage: Si Amil (28.64%) and Pantau-pantau (25.91%) are mostly covered by filamentous algae. The lowest average algal coverage was 0.65% at Sepanggau Island (Chart 6).
Average Canopy Height of Seagrasses

Chart 5: Average canopy height of seagrass distributed in Semporna PCA.

Average Algal Cover Percentage

Chart 6: Average algal coverage percentage in Semporna PCA.
Discussion

Seagrass habitats in Semporna PCA can be considered to be in fair condition with an average coverage percentage of 31.67% and moderate levels of diversity with 8 species recorded from 18 sites. There is some possibility that *Halophila dicipiens* (Hd) and *Halophila minor* (Hm) may be overlooked as both are small and difficult to distinguish from *Halophila ovalis* (Ho). In addition to the total species recorded in Semporna PCA, *Halophila spinulosa* (Hp) was sighted at 3m depth during a dive at Bum-bum Island (Figure 5). This species was not observed during the formal surveys.

Figure 5: *Halophila spinulosa* at Bum-bum Island 3m depth

Seagrasses are highly adapted to submerged environments. To provide oxygen to their roots and rhizomes, seagrasses require some of the highest levels of light needed by any plant group worldwide; approaching 25% of incident radiation in some seagrass species, compared to 1% or less for other angiosperm species (Dennison *et al.* 1993). This means that seagrasses are extremely sensitive in response to environmental changes, especially with altered water clarity. The water clarity might be one of the factors contribute to the density of seagrass in Semporna.

In addition, seagrass ecosystems play crucial roles in nutrient recycling and carbon absorption; critical for combating climate change. The increase in seagrass knowledge is an important step in the fight against climate change and its incorporation into the world’s climate strategy (Bergen 2009).

Environmental, biological, and extreme climatological events have been identified as causes of seagrass loss worldwide. Global climate change has resulted in increased sea surface temperature and sea level; increased frequency and intensity of storms and associated surge and swells; regional shifts in water; as well as more localized impacts such as increased loading of sediment, contaminants, and nutrients (Orth *et al.*, 2006). The major threats
observed in Semporna PCA were mostly localized impacts such as sediment and nutrient loading; building or jetty overshadowing seagrass beds; and impacts from boating activities. Several sites have been observed to be impacted by extreme weather events, particularly during storm and typhoon seasons.

Removing identified causes of seagrass loss is the best solution, complemented with the rehabilitation of seagrass beds. There have been a few success stories of seagrass rehabilitation. An example can be found in Calancan Bay, Philippines where transplanting was carried out to restore heavily damaged seagrass beds. However, unless damaging impacts are removed, seagrass beds affected by pollution and siltation cannot be restored. Additionally, restoration of seagrass beds on a meaningful scale is extremely time consuming and expensive. Hence, it is better to preserve natural seagrass habitat and adopt a preventive approach (Talbot 2001).
Recommendation and Next Steps

1) Long-term monitoring programme
Establish a long-term programme involving stakeholders for seagrass habitat monitoring. A regular and systematic monitoring programme is necessary to assess the status of seagrass.

2) Capacity building
Provide training to increase capacity for carrying out seagrass assessment among stakeholders including local villagers, tourists, dive operators and government agencies as part of the effort to foster a collaborative management of marine resources in Semporna PCA.

3) Information dissemination, education and publication
Develop a set of annual report cards for specific seagrass beds and disseminate information about status and importance of seagrass in Semporna PCA.

4) Resource mapping and survey
Habitat mapping throughout the entire Semporna PCA is needed to detect changes of seagrass habitat size and provide useful zoning information for decision makers in Semporna PCA. A completed Total Economic Valuation (TEV) study of seagrass beds complements ecological information, and is important in efforts to raise awareness and economic appreciation for the seagrass ecosystem.

5) Water quality management
Seagrass health is tied closely with good water quality. Excessive nutrients in the water put seagrass at a disadvantage with algal overgrowth. However, the proximity of seagrass beds to coastal areas makes seagrass vulnerable to pollution from human waste. Therefore, monitoring water quality to detect increased levels of nutrient loading is also an essential part of seagrass monitoring, and effort must be put into improving wastewater treatment on islands and coastal areas.

6) Policy and legislation
The susceptibility of seagrass to coastal construction and boating activities makes it necessary to regulate human activities in areas where seagrasses are found.
References


Appendix 1: Marine Animals Associated with Seagrass Beds

Figure 6: Example of marine animals found in seagrass beds.

a) striped catfish (*Plotosus lineatus*)

b) false clown anemone fish (*Amphiprion ocellaris*)

c) robust ghost pipefish (*Solenostomus cyanopterus*)

d) spider conch (*Lambis sp.*)
Appendix 2: Seagrass Species Distribution and Habitats Diagram

Figure 7: Indo-Pacific Seagrass Species Distribution and Habitats (Fort 2007)
Appendix 3: Seagrass Species Distribution Map in Sabah Waters

Figure 8: Seagrass species distribution in Sabah waters (Edang et. al, 2008).
Appendix 4: Seagrass Species Distribution List in Sabah Waters

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<td>Halophila beccarii</td>
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<td>6</td>
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<td>1</td>
<td>11</td>
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</table>

Table 3: Seagrass species distribution list in Sabah waters (Edang et. al, 2008)
# Seagrass-Watch WP Monitoring Data Sheet

**Source:** Seagrass-Watch Manual

**Observer:**

**Date:**

**Location (Country):**

**Site No.:**

**Transect No.:**

**Start Time:**

**End Time:**

<table>
<thead>
<tr>
<th>Quadrat (metres from transect origin)</th>
<th>Sediment (eg. mud/sand/shell)</th>
<th>Comments (eg. 10b. mud whels, 4t sea cucumbers)</th>
<th>Total % Seagrass Coverage</th>
<th>% Cover of each species</th>
<th>Canopy Height (cm)</th>
<th>Total % Cover Algae</th>
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<tbody>
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<td>4 (15m)</td>
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<td>5 (20m)</td>
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<td>6 (25m)</td>
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<td>7 (30m)</td>
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<td>8 (35m)</td>
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<td>9 (40m)</td>
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<td>10 (45m)</td>
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<td>11 (50m)</td>
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</tbody>
</table>

**End of transect (GPS reading):**

**Latitude:**

**Longitude:**

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Appendix 5: Seagrass-Watch Monitoring Data Sheet
Appendix 6: Seagrass Percentage Cover Field Guide

Seagrass Percentage Cover

Source: Seagrass-Watch Manual
Appendix 7: Algal Percent Cover Standards Field Guide

Algal percent cover standards

Source: Seagrass-Watch Manual
## SEAGRASS SPECIES CODES

<table>
<thead>
<tr>
<th>Code</th>
<th>Species</th>
<th>Description</th>
</tr>
</thead>
</table>
| Cs   | *Cymodocea serrulata* | - Serrated leaf tip  
- Wide leaf blade (5-9mm wide)  
- Leaves 6-15cm long  
- 13-17 longitudinal veins |
| Cr   | *Cymodocea rotundata* | - Rounded leaf tip  
- Narrow leaf blade (2-4mm wide)  
- Leaves 7-15 cm long  
- 9-15 longitudinal veins  
- Well developed leaf sheath |
| Ea   | *Enhalus acoroides* | - Very long ribbon-like leaves with inrolled leaf margins  
- Thick rhizome with long black bristles and cord-like roots  
- Leaves 30-150 cm long |
| Th   | *Thalassia hemprichii* | - Short black bars of tannin cells on leaf  
- Thick rhizome with scars between shoots  
- "Sickle" shaped leaves  
- Leaves 10-40 cm long |
| Hu   | *Halodule uninervis* | - Trident leaf tip  
- 1 central vein  
- Usually pale rhizome, with clean black leaf scars |
| Hp   | *Halodule pinifolia* | - Rounded leaf tip  
- 1 central vein  
- Usually pale rhizome, with clean black leaf scars |

**Hx** | Hu or Hp species cannot be distinguished (i.e., not sure of the ID)

Compiled by the Marine Plant Ecology Group, Northern Fisheries Centre Cairns, Australia July 2002

Source: Seagrass-Watch Manual
Appendix 9: Seagrass Species Code Field Guide 2

SEAGRASS SPECIES CODES

**Ho**
*Halophila ovalis*
- 12 or more cross veins
- no hairs on leaf surface

**Hm**
*Halophila minor*
- Less than 12 pairs of cross veins
- Small oval leaf blade

**Hy**
*Ho or Hm species cannot be distinguished (i.e., not sure of the ID)*

**Si**
*Syringodium isoetifolium*
- Cylindrical in cross section
- leaf tip tapers to a point
- Leaves 7-30cm long

**Hd**
*Halophila decipiens*
- Small oval leaf blade 1-2.5cm long
- 6-8 cross veins
- Leaf hairs on both sides

**Tc**
*Thalassodendron ciliatum*
- cluster of leaves on elongate shoot
- “Sickle” shaped leaves with serrated tip
- ligule present
- rhizome “woody”

Compiled by the Marine Plant Ecology Group, Northern Fisheries Centre CAIRNS, AUSTRALIA July 2002

Source: Seagrass-Watch Manual
Appendix 10: Field Assessment Photos

Figure 9: (a) Syringodium isoetfolium; (b) Halodule uninervis; (c) Healthy seagrass bed at Mabul Island; (d) Seagrass bed with algal overgrowth related to nutrient loading; (e) Dense seagrass bed on Mabul island; (f) Low density of seagrass.
Appendix 11: Seagrass Herbarium for Semporna PCA

Figure 10: (a) Syringodium isoetifolium; (b) Thalassia hemprichii; (c) Syringodium isoetifolium; (d) Cymodocea rotundata; (e) Enhalus acoroides; (f) Halophila ovalis
Appendix 12: Percentage of Seagrass Coverage in Northern Reefs 1

Percentage of Seagrass coverage at Timbun Mata, Semporna

Percentage of Seagrass coverage at Larapan, Semporna

Percentage of Seagrass coverage at Bum-bum 1, Semporna
Appendix 13: Percentage of Seagrass Coverage in Northern Reefs 2

Percentage of Seagrass coverage at Pantau-Pantau, Semporna

Percentage of Seagrass coverage at Kulapuan, Semporna

Percentage of Seagrass coverage at Pom-pom, Semporna
Appendix 14: Percentage of Seagrass Coverage in Northern Reefs

Percentage of Seagrass coverage at Pandanan, Semporna

Percentage of Seagrass coverage at Mataking, Semporna

Percentage of Seagrass coverage at Timba-timba, Semporna
Appendix 15: Percentage of Seagrass Coverage in Northern Reefs 4

Percentage of Seagrass coverage at Boheyan, Semporna

Percentage of Seagrass coverage at Omadal, Semporna
Appendix 16: Percentage of Seagrass Coverage in Southern Reefs 1

Percentage of Seagrass coverage at Sepanggau, Semporna

Percentage of Seagrass coverage at Si Amil, Semporna

Percentage of Seagrass coverage at Denawan, Semporna
Appendix 17: Percentage of Seagrass Coverage in Southern Reefs 2

Percentage of Seagrass coverage at Mabul, Semporna

![Graph showing percentage of seagrass coverage at Mabul, Semporna.](image)

Percentage of Seagrass coverage at Gus ungan, Semporna

![Graph showing percentage of seagrass coverage at Gus ungan, Semporna.](image)

Percentage of Seagrass coverage at Nusa Tengah, Semporna

![Graph showing percentage of seagrass coverage at Nusa Tengah, Semporna.](image)
Appendix 18: Percentage of Seagrass Coverage in Southern Reefs 3

Percentage of Seagrass coverage at Menampilik, Semporna

Quadrat (metres from transect origin)

Total % seagrass coverage
Appendix 19: Percentage of Seagrass Coverage in Semporna PCA

![Graph showing percentage of seagrass coverage in Semporna PCA]
WWF-Malaysia (World Wide Fund for Nature-Malaysia), the national conservation trust, currently runs more than 75 projects covering a diverse range of environmental protection work aimed at conserving our natural resources to secure our good quality of life and our children’s bright future.

WWF’s mission is to stop the degradation of the planet’s natural environment and to build a future in which humans live in harmony with nature by:
1. Conserving the world’s biological diversity
2. Ensuring that the use of renewable natural resources is sustainable
3. Promoting the reduction of pollution and wasteful production

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