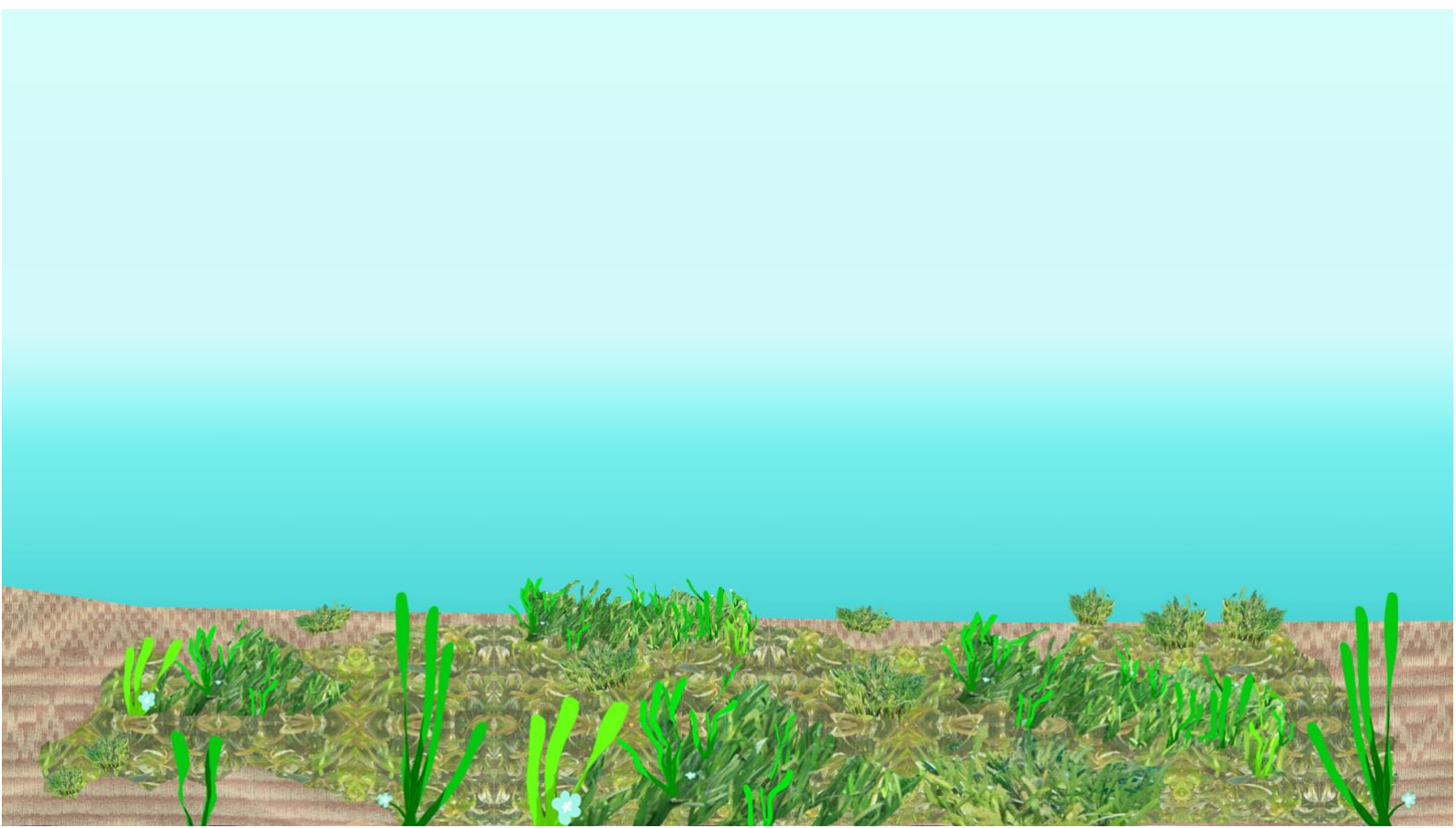


# Maldives Seagrass Monitoring Network

## Monitoring Methods

Developed and supported by:



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### Contact Information

For analysis and technical support

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## INTRODUCTION

### What are seagrasses?

Seagrasses are underwater flowering plants that grows in shallow marine waters around the world. Seagrass meadows are globally recognized for their ecosystem values as a valuable carbon sink, oxygen producer, nutrient filter, sediment stabilizer, coastal protector, food source for megafauna and nursery habitat for ecologically and economically important fish species.

Seagrass has historically been a highly undervalued ecosystem in the Maldives, considered as a nuisance by the tourism industry rather than celebrated for its importance. The #ProtectMaldivesSeagrass campaign was launched on World Seagrass Day, 1 March 2019, to spread the message that tourism and seagrass can co-exist, with extraordinary benefits to guest experience. Within six months, 25% of the Maldives resorts and various local and international organizations joined the campaign. The campaign was also officially endorsed by the Ministry of Tourism. To learn more about this campaign, please visit [www.protectmaldivesseagrass.com](http://www.protectmaldivesseagrass.com).

### Standardized seagrass monitoring protocols for Maldives

Very little is known about the seagrass in the Maldives. Seagrass monitoring is currently done very haphazardly and results are not compiled for regional or national analyses. The islands in the Maldives are geographically dispersed over 800 km and it is a challenge for decision makers to gather information needed for conservation and resource use management.

Maldives Underwater Initiative at Six Senses Laamu, and Blue Marine Foundation has been working with the Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER) at James Cook University (JCU), and the Centre for Sustainable Aquatic Ecosystems, Murdoch University, Australia to standardize seagrass monitoring methods for nation-wide use, based on the monitoring experiences from Laamu Atoll.

Recognizing that different organizations have different capacities and resources to invest in monitoring, we propose three different levels of investment that can be brought together into a uniform assessment and scoring system. They are:

#### Level 1: Is seagrass here?

This is a simple record of the presence of seagrass in an area. Primary data to be recorded are the GPS location and the species of seagrass. This level of monitoring can be done without much experience, using the identification guides provided here or by Project Seagrass on the 'Seagrass Spotter' application.

#### Level 2: Small scale assessment of 50m x 50m areas

This is a spatially restricted scale of monitoring which is ideal for those who may not have the resources or desire for large scale monitoring approach. This should be permanently marked transect sites representative of the overall meadow (ideally two sites in each island). Surveyors can select the sites based on traditional use of the meadow or disturbance concerns (e.g. proximity to harbor, sewage pipe or reclamation site). Level 2 surveys should be conducted annually or bi-annually on the same monsoonal periods once conditions are settled.

#### Level 3: Meadow scale assessment

This is the desired monitoring method for spatially variable seagrass meadows and can be useful to understand the long-term trends and changes to the area. However, the basic technique and monitoring done at an individual quadrat level remains the same and standard as level two.

## HOW TO JOIN THE MALDIVES SEAGRASS MONITORING NETWORK

### Use the standardized protocols

We invite everyone conducting seagrass research in the Maldives (academics, environmental surveyors, marine biologists, local NGOs and community groups) to follow these standardized monitoring protocols so that the surveys can be brought together into a uniform assessment and scoring system in order to understand the status of seagrass in the Maldives.

The protocols and resources will be publicly available at:

<https://bluemarinefoundation.sharepoint.com/:f:/s/Projects/EiB8OB24NXhAohjSvidvz0ABDvK6TCe7kSqxsZ93rzJSQ?e=F57sY7>

### Submit your data

We invite everyone conducting seagrass research in the Maldives to submit their monitoring data to the National Coral Database. If you are unable to submit your data to this platform please send it via email to [shaha@bluemarinefoundation.com](mailto:shaha@bluemarinefoundation.com).

The information will be used to compile an Annual Seagrass Monitoring Report for the Maldives. All the contributors will be acknowledged and the report will be shared for network partners feedback before sharing publicly.

### Entering data to the Coral Database

The Coral Database is a web based database developed by the Maldivian Government to consolidate and host environmental information. As a fully developed protocol for collecting marine information, levels 2 and 3 of the Seagrass Monitoring protocol have been integrated in to the Coral Database.

To view public data hosted by the database, please visit <https://coraldatabase.gov.mv/>. To enter seagrass monitoring data into the database please first register your organization and then yourself at the database or email [hana.amir@mmri.gov.mv](mailto:hana.amir@mmri.gov.mv) for further information.

## MONITORING METHOD

### LEVEL 1: IS SEAGRASS HERE?

This is a simple record of the presence of seagrass in an area. Primary data to be recorded are the GPS location and the species of seagrass. This level of monitoring can be done without much experience, using the identification guides provided here or by Project Seagrass on the 'Seagrass Spotter' application.

#### Equipment needed:

- Phone with GPS, or GPS and camera
- Access to Seagrass Spotter (mobile application or website <https://seagrassspotter.org>)

#### Method workflow:

##### Option 1 - Seagrass spotter web portal

1. Take a photograph of seagrass you encounter. If your camera/phone is not waterproof, you may take a sample to photograph above water.
2. Note down the location on a map or write the GPS coordinates
3. Login to Seagrass Spotter web portal, and enter the sighting as follows:
  - Upload
  - Open Image
  - Enter GPS coordinates OR drop a mark on the map
  - Enter date sighted
  - Enter species OR 'Help me identify'
  - Add more information OR Upload Now

##### Option 2 - Seagrass spotter app

1. When you encounter seagrass, open the app and select 'Take a sighting' and follow the procedure.

See Annex 1 for the seagrass species recorded in the Maldives, and other species that may occur here.

## MONITORING METHOD

### LEVEL 2: SMALL SCALE ASSESSMENT OF 50m x 50m AREAS

This is a spatially restricted scale of monitoring which is ideal for those who may not have the resources or desire for large scale monitoring approach. This level of information will help to understand whether the condition of the area is stable, improving or declining.

This should be permanently marked transect sites representative of the overall meadow (ideally two sites in each island). Sites shall be selected based on the traditional use of the meadow or disturbance concerns (e.g. proximity to harbor, sewage pipe or reclamation site). Level 2 surveys should be conducted annually or bi-annually on the same monsoonal periods once conditions are settled.

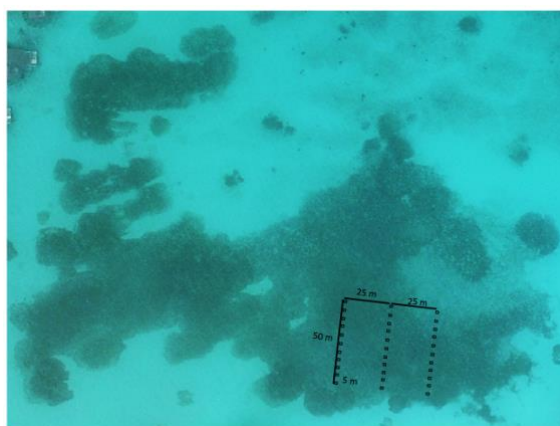
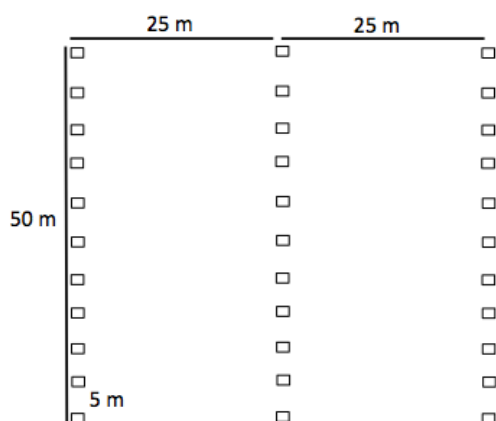
#### Equipment needed:

- Phone with GPS, or GPS and camera
- 0.5m x 0.5m quadrat
- Data sheets
- Reference sheets
- Clip board
- Pencil
- Ruler
- Transect tape 50m (optional)
- Mask and snorkel

#### Method workflow:

1. Select a 50m x 50m relatively homogenous area (low variability, even topography) in your survey area. Within this area, three transects of 50m should be laid parallel to each other, 25m apart and perpendicular to the beach. The survey consists of recording seagrass variables within 0.5m x 0.5m quadrats that are placed along the transect lines.

If you are not using a transect tape, make sure the start of the survey points are marked, and proceed using paces or kick cycles.



2. The start points of the survey should ideally be marked using permanent markers. Take the GPS coordinates of the start and end points of each transect line.

3. Place the quadrats every 5m along the transect line (total 11 per transect line) until all 33 quadrats are completed. Below is the '**quadrat data collection procedure**'. Refer to the Data Recording Sheet which has the following headings:
- **Transect No. :** This is only applicable for level 2 permanent monitoring sites.
  - **Quadrat No. :** Record the individual quadrats separately in order of survey.
  - **GPS Coordinates:** For level 2, only record for the first and last quadrat of each transect. For Level 3, record for all quadrats.
  - **Depth:** This is only applicable for level 3 boundary mapping, but if you have the time and resources, it will be useful to record this information for all the quadrats.
  - **% Seagrass Cover:** Estimate the total percentage of the seabed within the quadrat that is covered by seagrass. Use the percent cover photograph sheet as your guide (Annex 3), estimating cover as accurately as possible.
  - **% Seagrass Species Composition Total 100%):** Identify the seagrass species within the quadrat and determine the percentage contribution of each species (total needs to be 100%). Use the Maldives Seagrass Species guide for identification (Annex 2)
  - **Canopy Height (cm)-** Using the ruler touching the sediment, hold the leaves in a bunch to make the leaves stand up vertically and record the tallest common height of seagrass leaves. Repeat three times.
  - **Algae Cover %:** Macroalgae not attached to the seagrass leaves but may be attached to rocks, shells or be adrift. Estimate the total percentage of the seabed within the quadrat covered by macroalgae (independent of seagrass cover).
  - **Epiphyte Cover (0/L/M/H):** Epiphytes are algae attached to the seagrass leaves and often give the blade a furry appearance. Estimate the average epiphyte cover as follows, using the epiphyte cover reference sheet as your guide (Annex 4):
    - Zero: No epiphytes present
    - Low: epiphytes present but a lot of green seagrass leaf visible
    - Medium: many epiphytes present and little green seagrass leaf visible
    - High: seagrass leaf completely covered
  - **Sediment Type:** Dig your finger in to the top centimetre of the substrate and feel the texture. Describe sediment by noting the grain size in order of dominance (e.g. sand/ rubble/ mud)
  - **Photo:** should be taken directly above at 45-60 degrees vertically to provide a permanent record.
  - **Remarks:** Record any megafauna and other interesting fish or invertebrate species observed in the meadow. Also record other important site information, such as resource use and impacts.
4. Check whether all relevant information in the data sheet is complete. Enter the data to the digital data sheet and upload in the folder.

## **MONITORING METHOD**

### **LEVEL 3: MEADOW SCALE ASSESSMENT**

This is the desired monitoring method for spatially variable seagrass meadows and can be useful to understand the long-term trends and changes to the area of seagrasses. This method maps the boundary of seagrass areas or meadows and spreads assessment sites throughout the meadow. However, the basic technique and monitoring done at an individual quadrat level remains the same and standard as level two.

#### **Equipment needed:**

- Phone with GPS, or GPS and camera
- 0.5m x 0.5m quadrat
- Data sheets
- Reference sheets
- Clip board
- Pencil
- Ruler
- GIS software OR Google Earth Pro (optional)
- Materials to map the seagrass boundary (walking, boat, satellite imagery, swimming)

#### **Method workflow:**

There are 3 key steps in this method:

- a. Preliminary seagrass mapping: Find historical information or imagery to help identify where your seagrasses are
- b. Map the boundary of your seagrass meadows
- c. Scatter your seagrass assessment sites throughout your mapped seagrass meadow

#### **Preliminary Seagrass mapping**

1. If available use drone photography or Google Earth Pro to get an idea of where seagrass meadows are located. If you have really recent imagery you can actually use this data to produce your seagrass meadow map. It may be helpful to check the historical seagrass coverage of the area available from previous environment assessment reports or the historical information tab on Google Earth Pro. If using a drone, geo-reference the image using GIS software. This will help you to plan your field sampling.

#### **Mapping your seagrass meadow- OPTION 1**

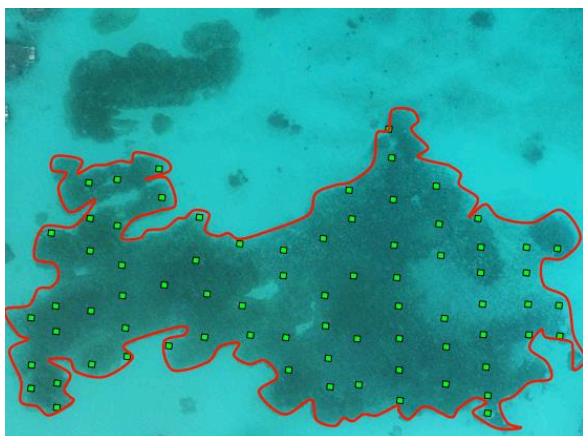
2. Using a GPS, ground truth the boundary of the seagrass meadow or seagrass patches by walking, swimming or boating around the defined edge (remember to keep your GPS in a dry bag) to verify the presence of seagrass in areas outlined in point 1. If no imagery available for point 1 you can just use this field-based step to produce your seagrass meadow map.
3. As you track the perimeter, record the position of the boundary with your GPS or phone as frequently as required to produce an accurate boundary map from the points. This will change with smaller meadows requiring sites to be marked more frequently, or complex meadows where the boundary changes direction a lot. In general the more mapping sites you collect the easier it will be to construct the map at the end of the survey.

4. After completing the boundary mapping, disperse quadrats haphazardly throughout the meadow, following the 'quadrat data collection procedure', and record the GPS coordinates of each data point. If you have a highly variable seagrass meadow then place more sites within the mapped meadow to account for this.
5. Check whether all relevant information in the data sheet is complete. Enter the data to the digital data sheet and upload in the folder.

### **Mapping your seagrass meadow- OPTION 2**

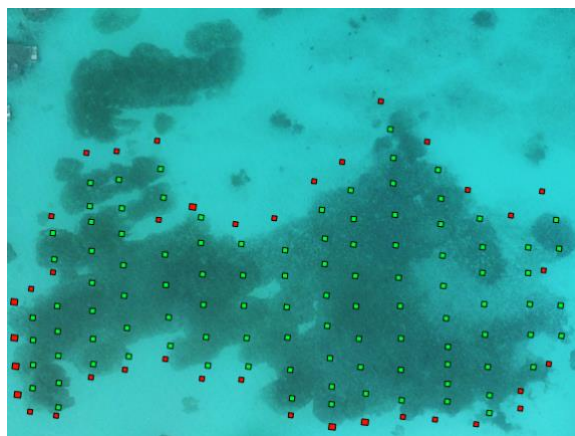
Where you can't easily see the meadow boundary from the surface or with imagery and the techniques described above you can produce a meadow area map by strategically placing sites throughout the meadow.

2. Starting at one side of the meadow, place quadrats in one direction of travel from just outside the meadow and follow the 'quadrat data collection procedure'. Record the GPS coordinates of each data point. Continue into the meadow and until the quadrats no longer contain seagrass.
2. Repeat this parallel to the first line of travel until the meadow area is defined by blank quadrats surrounding the meadow boundary.
3. Check whether all relevant information in the data sheet is complete. Enter the data to the digital data sheet and upload in the folder.



#### **LEFT (Level 3-Option 1)**

The red line indicates ground-truthed meadow boundary, green boxes indicate quadrats



#### **RIGHT (Level 3-Option 2)**

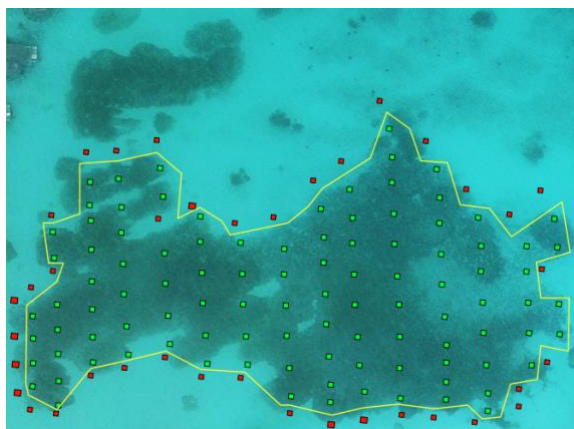
Green boxes indicate seagrass present, red boxes indicate bare sand

## OUTPUTS AND ANALYSIS OPTIONS

1. Make your seagrass map: You can do this using Google Earth Pro or other GIS software such as Q-GIS (freely available).

Level 3 option 1: Trace a boundary by linking your GPS points on the software.

Level 3 option 2: Draw a line (polygon) between the perimeter data points with seagrass and the points without seagrass (see picture below).



**Example of Level 3 option 2 map output**

Green boxes indicate quadrats where seagrass were present, red boxes indicate quadrats with bare sand. The yellow line indicates the estimated meadow boundary

2. Analysis: There are advanced statistical options to analyse change. For more information on this contact the Seagrass Ecology Group at James Cook University, Australia or Centre for Sustainable Aquatic Ecosystems at Murdoch University, Australia for advice and assistance (see contact information).

## **OPTIONAL FISH SURVEYS**

The first priority is mapping and characterizing seagrass meadows, however if you have the time and resources it will be useful to begin to investigate the role of seagrasses as a habitat for commercially important reef fish, and as a nursery ground. These surveys could be incorporated to seagrass monitoring levels 2 and 3.

### **OPTION 1- Underwater Visual Census (UVC) belt transect**

- Swim along a 50m transect line (transect tape or permanent markers) at a constant swimming speed and record any fish observed 2.5m on either side of the transect line.
- Identify species to the lowest taxonomic level achievable. Record the life stage of each individual (either juvenile or adult).

### **OPTION 2- Stationary Remote Underwater Video (RUV)** (this method is favored to record cryptic, canopy dwelling individuals)

- Attach a GoPro camera, angled slightly downwards, attached to a weighted tripod placed on the seabed and deploy the camera for 40 minutes, with the first 10 minutes of footage discarded to limit disturbance effects.
- Identify species captured on video to the lowest taxonomic level achievable. Record the life stage of each individual (either juvenile or adult).

Maldives Seagrass Monitoring Network

Data Recording Sheet

Island : .....

Date: ...../...../.....

Observer: .....

Site Name: .....

Transect No.	Quadrat No.	GPS Coordinates	Depth (m)	% Seagrass Cover	% Seagrass Species Composition (total 100%)				Canopy Height (cm)			Algae Cover %	Ephiphyte 0/H/M/L	Sediment Type	Photo

Remarks :

# MALDIVES SEAGRASS SPECIES

**Th**

*Thalassia hemprichii*

- ribbon-like, curved leaves 10-40cm long
- leaf tip rounded, slightly serrated
- short black tannin cells, 1-2mm long, in leaf blade
- thick rhizome with scars between shoots



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**Tc**

*Thalassodendron ciliatum*

- erect stem up to 65cm long bearing leaf cluster
- rhizome tough and woody
- ribbon-like, sickle-shaped leaves with ligule
- round, serrated leaf tip
- often found attached to rock or coral substrate



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**Si**

*Syringodium isoetifolium*

- narrow spaghetti-like leaves
- cylindrical in cross section, 1-2mm diameter
- leaves contain air cavities
- leaf tip tapers to a point
- leaves 7-30cm long



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**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



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**Hp**

*Halodule pinifolia*

- rounded leaf tip
- 1 central vein
- usually pale rhizome, with clean black leaf scars



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**Hu**

*Halodule uninervis*

- trident leaf tip, not rounded
- 1 central vein
- Rhizome usually pale, with small black fibres at the nodes
- narrow leaf blades 0.25-5mm wide



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**Cs**

*Cymodocea serrulata*

- serrated leaf tip
- wide leaf blade (5-9mm wide)
- leaves 6-15cm long
- 13-17 longitudinal veins
- robust/strong rhizome



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**Ho**

*Halophila ovalis*

- 8 or more cross veins
- no hairs on leaf surface
- leaf margins smooth
- leaf 5-20mm long



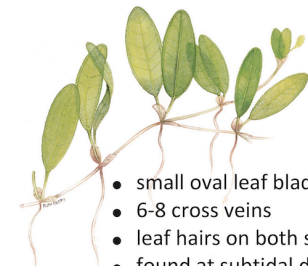
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## Other possible species

**Hd**

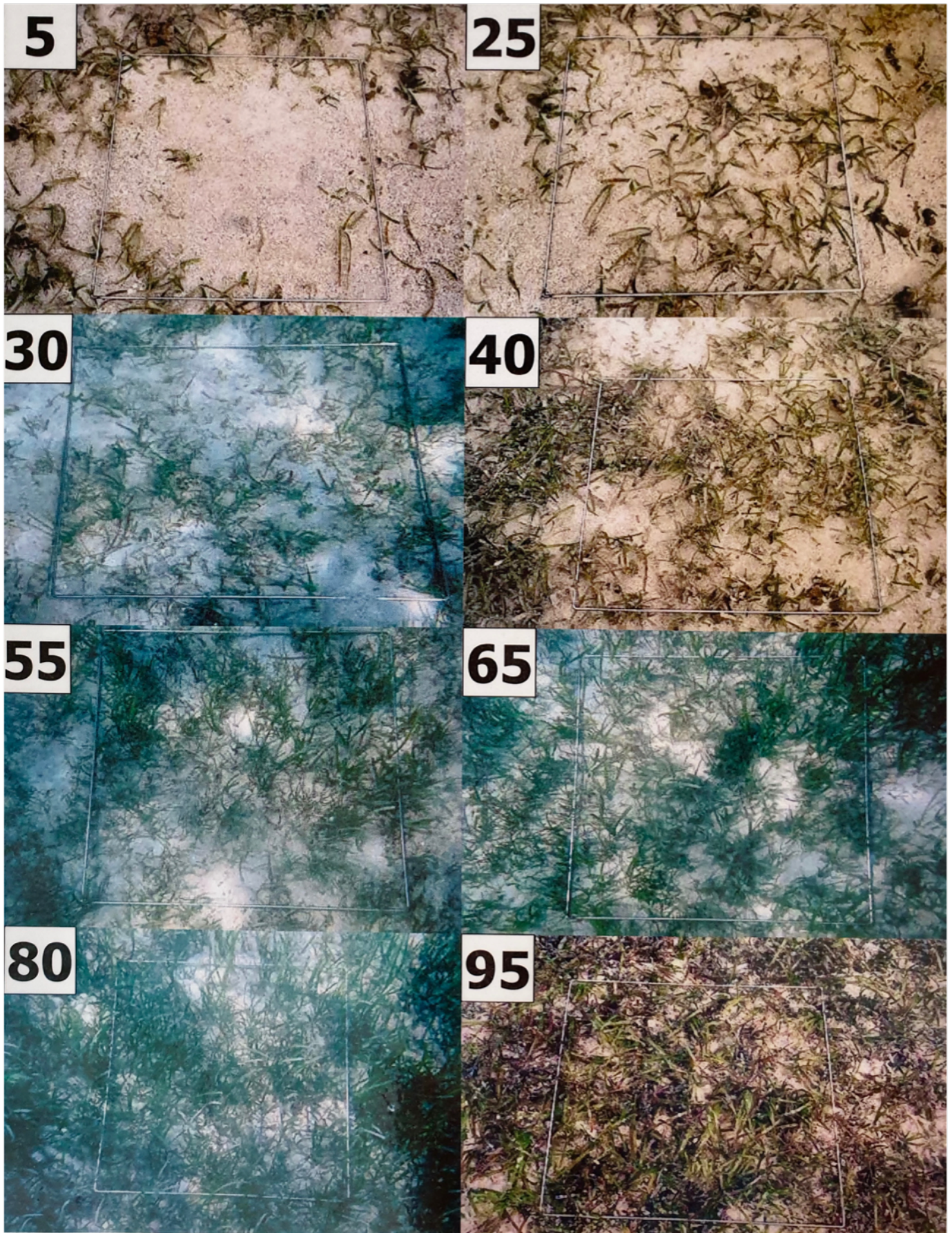
*Halophila decipiens*

- small oval leaf blade 1-2.5cm long
- 6-8 cross veins
- leaf hairs on both sides
- found at subtidal depths



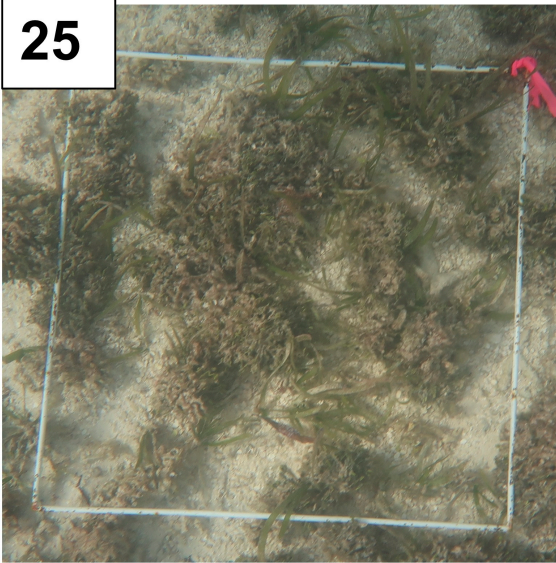
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# Percentage Cover Reference

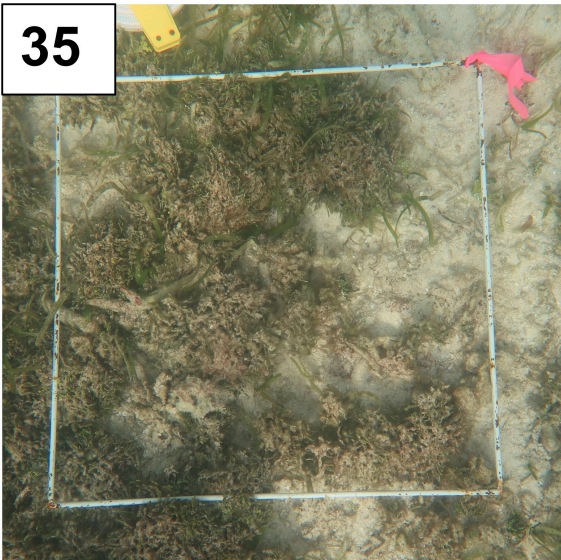


## Algae Reference

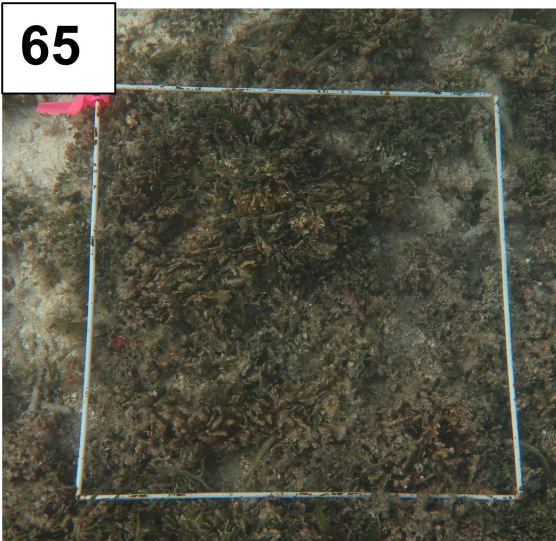
25



35



65



## Epiphyte Reference

Low



Medium



High

