Seagrass Training Manual

General objective of the training

Participants will study seagrass biology, learn seagrass taxonomy, discuss seagrass ecology, gain knowledge of monitoring and become skilled at conducting a field monitoring event. This training course is for scientists/managers who plan to establish new monitoring sites, lead and co-ordinate monitoring events, map seagrass meadows, conduct data entry, and raise seagrass awareness among local communities/end users.

Specific objectives

At the end of the training, all participants must:

- Understand the characteristics of seagrasses, their biology and ecology;
- Understand where different species occur and why;
- Understand the functions, roles and importance of seagrasses;
- Know the main gaps in the sub-region in seagrass management and be able to propose solutions to fill those gaps;
- Have an understanding of the threats to these seagrasses;
- Know key management initiatives at the sub-regional level;
- Be confident communicators and develop targeted messages for different audiences.

Module 1: Seagrasses at a glance- learning about their biology and ecology

What are seagrasses? Where are they found? How many species exist in West Africa?

Seagrasses are flowering plants that grow in sediment on the sea floor with erect, elongate leaves and a buried root-like structure (rhizomes). Please see the Figure 1 below for the morphological characteristics of seagrasses, many of which are used for taxonomic purposes.

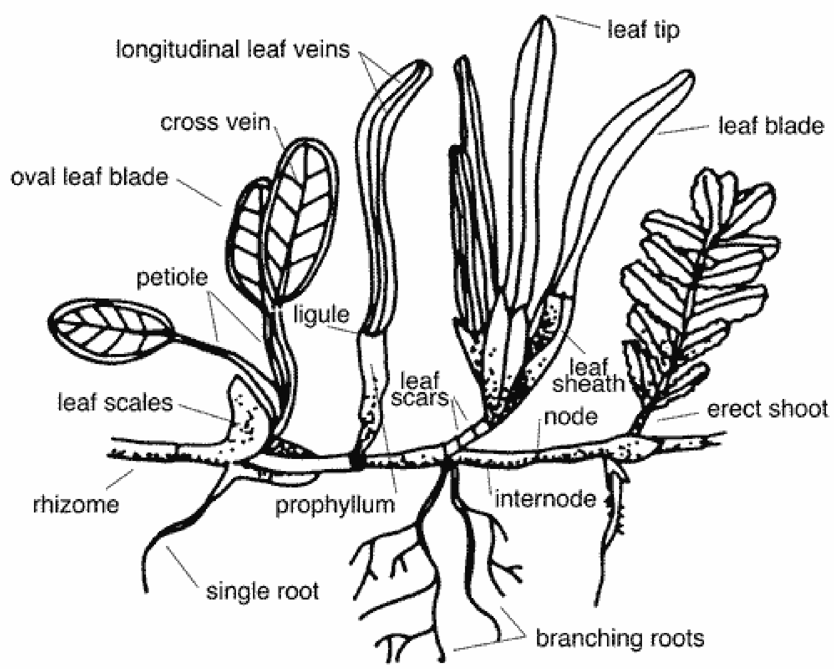

Figure 1. Composite illustration demonstrating morphological features used to distinguish main seagrass taxonomic groups (adapted from Lanyon, 1986).

There are around 70 described species of seagrasses worldwide, within 12 genera, 4 families and 2 orders. There are 3 recorded species of seagrass in *West Africa,* ***Zostera noltii, Cymodocea nodosa*** and ***Halodule wrightii***. The small number of species however, does not reflect the importance of seagrass ecosystems which provide a sheltered, nutrient-rich habitat for a diverse flora and fauna. At the broadest level, seagrasses are differentiated into temperate and tropical species (Fig. 2). Seagrass species can also differ in terms of the breadth of their distributional ranges (broad vs. restricted), their reproductive strategies (e.g. rapid seeding, seed banks and vegetative reproduction), the degree of their persistence (ephemeral vs persistent), physiology (e.g. growth dynamics, nutrient cycling and response to disturbance) and in their ecological interactions (e.g. influence of grazing, leaf canopy structure, detritus production and epiphyte production). Assemblages of seagrass species give rise to a series of dynamic and temporally and spatially variable seagrass meadows. Changes in the species composition of seagrass meadows may indicate slow but important changes in the environment, and are a suggested indicator for water and habitat quality indices.

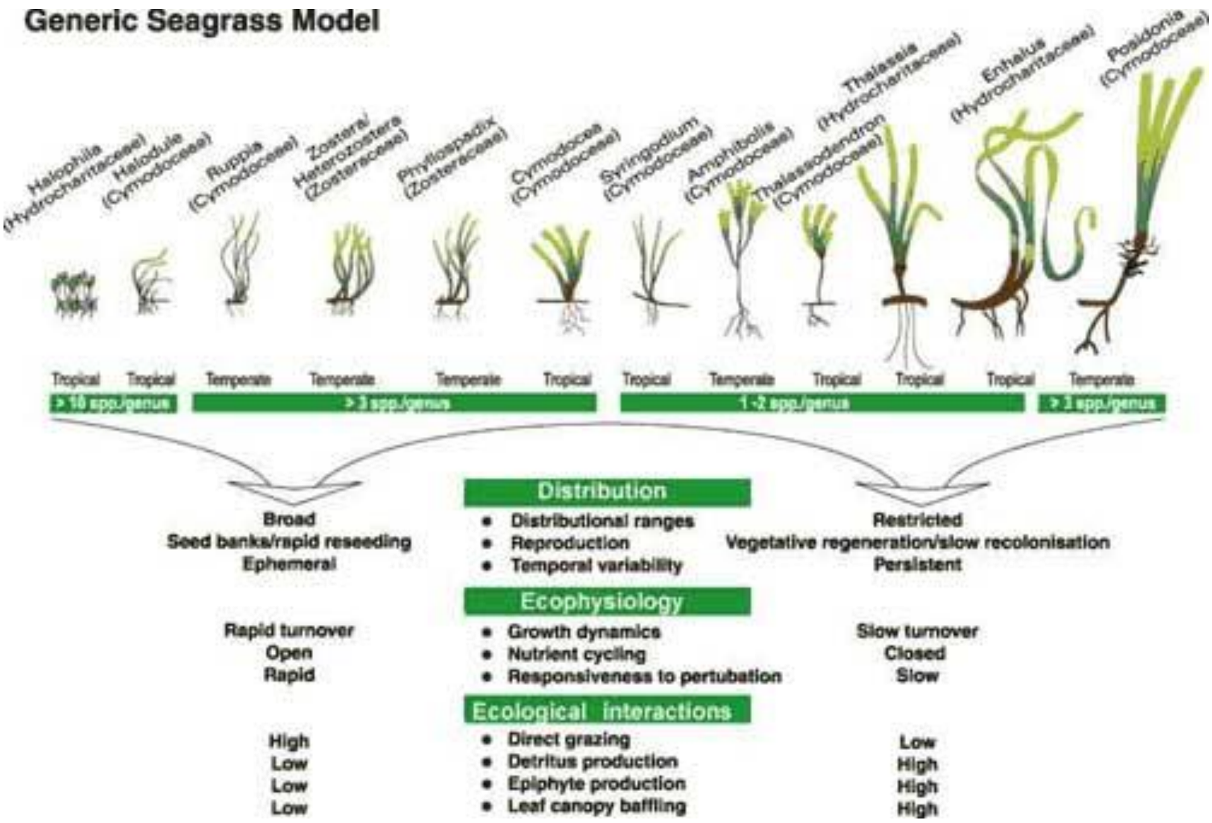

Figure 2. Generic Seagrass model: grouping of seagrasses on the basis of growth forms (from Marine Botany, Centre for Marine Studies, University of Queensland).

Seagrasses occupy a variety of coastal habitats. Seagrass meadows typically occur in most shallow, sheltered soft-bottomed marine coastlines and estuaries. These meadows may be monospecific or may consist of multispecies communities, sometimes with up to 12 species present within one location, for example in South-East Asia. The depth range of seagrass is usually controlled at its deepest edge by the availability of light for photosynthesis. Exposure at low tide, wave action and associated turbidity and low salinity from fresh water inflow determine seagrass species survival at the shallow edge. Seagrasses survive in the intertidal zone especially in sites sheltered from wave action or where there is entrapment of water at low tide, (e.g., reef platforms and tide pools), protecting the seagrasses from exposure (to heat, drying) at low tide. Most tropical species, like in West Africa, are found in water less than 10 m deep. Seagrasses are often closely linked to other habitat types. In the tropics the associations are likely to be interactions with mangrove forests and coral reef systems. A number of environmental parameters are critical to whether seagrass will grow and persist. These include physical parameters that regulate the physiological activity of seagrasses (temperature, salinity, waves, currents, depth, substrate and day length), natural phenomena that limit the photosynthetic activity of the plants (light, nutrients, epiphytes and diseases), and anthropogenic inputs that inhibit access to available light for growth (nutrient and sediment loading). Various combinations of these parameters will permit, encourage or eliminate seagrass from a specific location.

Practical exercise: Seagrasses in West Africa, where to find them and how to identify them.

Zostera noltii:

Cymodocea nodosa:

Halodule wrightii:

Module 2. The importance of and threats to seagrasses

The habitat complexity within seagrass meadows enhances the diversity and abundance of animals. Seagrasses on reef flats and near estuaries are also nutrient sinks, buffering or filtering nutrient and chemical inputs to the marine environment. The high primary production rates of seagrasses are closely linked to the high production rates of associated fisheries. These plants support numerous herbivore- and detritivore-based food chains, and are considered very productive meadows of the sea. The associated economic values of seagrasses are very large, although not always easy to quantify. Seagrass/algae beds are rated the 3rd most valuable ecosystem globally (on a per hectare basis), only preceded by estuaries and wetlands. The average global value of seagrasses for their nutrient cycling services and the raw material they provide has been estimated at US $ 19,004 ha^{-1} yr^{-1} (Costanza et al. 1997). This value would be significantly greater if all the services, benefits and goods provided by seagrasses had been included.

Ecosystem services, benefits and goods provided by seagrasses

Seagrass ecosystems provide a wide variety of services that support human well-being around the world. It is estimated that at least 1 billion people live within 100 km of a seagrass meadow. Seagrasses play a significant global role in supporting food security, mitigating climate change, supporting biodiversity, purifying the water, and controlling diseases. Because of these services and benefits, seagrasses are believed to be one of the most valuable and important coastal marine ecosystems on the planet for humans.

Food security
Seagrass support essential commercial and artisanal fisheries, and the communities and economies that rely on them. Seagrass meadows are of fundamental importance to world fisheries production of both vertebrates and invertebrates in a variety of ways. Seagrass meadows provide valuable nursery habitat to over 1/5th of the world's largest fisheries. In cases where seagrass is in close proximity to communities, the seagrass meadow is often a fishing habitat important for local food supply. Invertebrate gleaning fisheries occurring within seagrass meadows are considered to be an accessible fishing activity mainly due to their shallow near-shore environment and the ease of collecting such fauna.

Maintaining a healthy climate
Seagrass account for less than 0.2% of the world's oceans but are responsible for 10% of the carbon stored in the oceans annually. Up to 19.9 Pg organic carbon is stored in seagrass ecosystems; twice as much as the carbon stored in temperate and terrestrial forests. This makes them a vital component in combating global climate change.

Improving water quality
Seagrass meadows contribute to human and ocean health. Seagrass produce oxygen as a byproduct of photosynthesis, which helps rid the waters they grow in of pathogens and bacteria that could be harmful to human health. Seagrass meadows also regulate the chemistry of seawater by the uptake of dissolved carbon dioxide. This helps regulate the pH

of seawater, making it less acidic and less harmful to marine organisms with calcium carbonate skeletons such as corals and crustaceans.

Supporting rich biodiversity
Seagrass form habitats that support an amazing array of plants and animals. Crustacean and fish abundances are seven to twenty times higher in seagrass meadows compared to adjacent bare sand areas. Many species of commercially important mangrove and reef fish rely on seagrass meadows as nurseries and foraging grounds. Seagrass are also an essential food source for endangered species such as sea turtles, manatees, and dugongs.

Cultural benefits and sense of place
Globally, there are many traditional livelihoods and cultural traditions that are intricately linked to seagrass meadows. Seagrass meadows are an important cultural resource for coastal communities, and are intrinsic to the socio-economic-cultural landscape of these communities. Seagrass meadows also provide many educational, recreational, and tourism benefits and opportunities.

Threats to seagrasses and Successful management of seagrasses across the globe

Loss of seagrasses has been reported from most parts of the world, sometimes from natural causes, e.g., high energy storms, or "wasting disease". More commonly, loss has resulted from human activities, e.g., as a consequence of eutrophication or land reclamation and changes in land use. Anthropogenic impacts on seagrass meadows are continuing to destroy or degrade these coastal ecosystems and decrease their yield of natural resources. It is important to **document seagrass species diversity distribution and abundance**, to be able to identify areas requiring conservation measures. Responsive management based on adequate information will help to prevent any further significant areas and species being lost. In order to determine the importance of seagrass ecosystems and to detect changes that occur through perturbations (man-made and natural), it is necessary to **first map the distribution and density of existing seagrass meadows**. These findings must be monitored to determine natural variability in the extent of seagrasses (e.g., seasonal dieback) before estimates of loss or gain due to perturbation can be made. Coastal management agencies need to know what levels of change are likely to be ecologically or economically important, and sampling designs for baseline and monitoring surveys need to be sufficient to measure changes that are statistically significant. **Spatial and temporal changes in seagrass abundance and species composition** must be measured and interpreted with respect to prevailing environmental conditions. These may need to be measured **seasonally**, **monthly**, or **weekly**, depending on the nature of their variability, and the aims of the study. Physical parameters important to seagrass growth and survival include light (turbidity, depth), sediment type and chemistry, and nutrient levels. Seagrass meadows should be mapped as a first step toward understanding these communities. Detailed studies of changes in community structure of seagrass communities are essential to understand the role of these communities and the effects of disturbance on their composition, structure and rate of recovery.

Discussion (split in groups and discuss the following):

1) How are seagrasses managed in West Africa, in your country, at your site?

2) What are the ways/means to raise awareness for managers and policy-makers?

Module 3. Mapping and Monitoring seagrasses

Session 1. Collating existing datasets

Participatory mapping of the presence of seagrasses with the following stakeholders:

• Experts in biodiversity and local communities (fishermen) in the area
• Other experts and key players

Session 2. Rapid assessment and mapping of seagrass distribution

• Determining area size and appropriate scale
• Defining the edges
• Collecting presence/absence data

Session 3. Monitoring the status of seagrasses

Designing the monitoring plan and deciding the frequency (once a year minimum to quarterly maximum)

A) Fixed transects
B) Spots within a defined area

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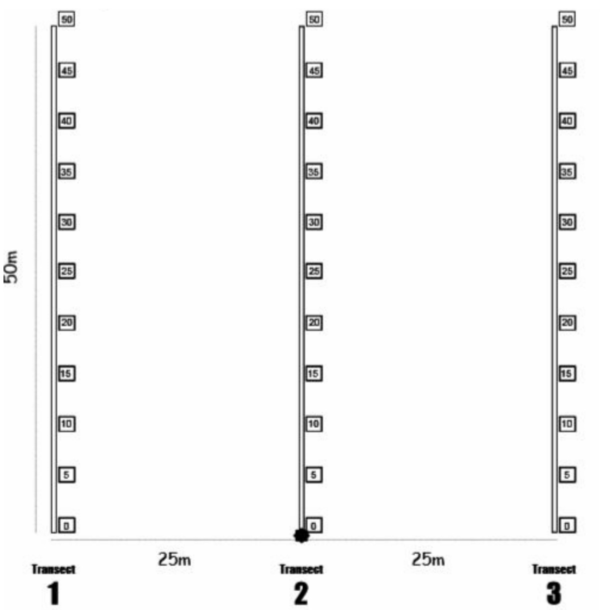
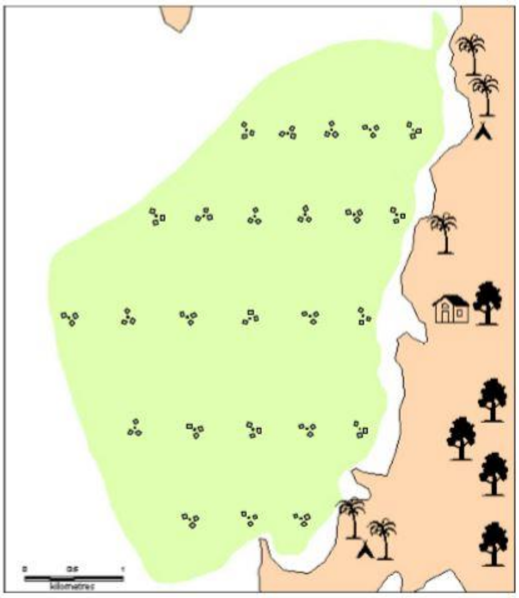


B) Spots within a defined area



Module 4. Data Collection and Analysis

Session 1. Data collection

Step 1. Prepare the site

A) Lay out the three 50 m transects parallel to each other, 25m apart and perpendicular to the shore (like the site layout above). Take a GPS reading at the beginning to the transect.

B) Choose a number of spots across the meadow as part of a gridded sampling, not randomly. Spots should be located 100-500m apart (depending on the site size). Place 3 quadrats 50 cm x 50 cm, haphazardly around the spot, within a 5m radius.

Step 2. Take a photograph of the quadrat

From an angle as vertical as possible and include the entire quadrat. Avoid having any shadows or patches of reflection. Photographs are usually taken at the 5m, 25m and 45m along each transect, or at any quadrats of particular interest.

Step 3. Describe sediment composition

Dig your fingers into the top centimetre of the substrate and feel the texture. Describe the sediment by noting the grain size (e.g. sand, fine sand, mud, shells).

Step 4. Estimate % seagrass coverage

Estimate the total % cover of seagrass within the quadrat.

Step 5. Estimate seagrass species composition and coverage

Identify the species of seagrass within the quadrat and estimate the % contribution of each species to the total cover.

Step 6. Measure Canopy Height

Measure the canopy height of the dominant species ignoring the tallest 20% of leaves. Measure from the sediment to the leaf tip of at least 3 shoots.

Step 7. Provide any further comments

For example, estimate % cover of algae or epiphytes in the quadrat, which may cover the seagrass blades. Record flower density or shoot density.

If you take a seagrass sample, please make sure you have all the plant parts, including rhizomes, roots, and flowers if present. Put the sample in a plastic bag with seawater.

Session 2. Data input and analysis

Practical exercise:

- How to add your data points to GIS
- How to create a map
- How to analyse your monitoring data