Tanzania SMART Seas - SAM Program

MANGROVEMONITORING PROTOCOL

The monitoring protocol was adapted from Wagner 2004 – used in Mnazi Bay (IUCN Eastern Africa Programme. "Assessment of Marine Biodiversity, Ecosystem Health, and Resource Status in Mangrove Forests in Mnazi Bay Ruvuma Estuary Marine Park". Wagner GM et al 2004). This document is in the SAM Tanzania Dropbox.

The Wagner et al 2004 study was based on the methods from English et al 1994 (ASEAN-Australian Marine Science Project: Living Coastal Resources. Australian Institute of Marine Science, Townsville. 368 pp.)

Site Selection& Frequency of Monitoring

- At each *marine reserve* or *marine park*, there should be 3 sites chosen spanning the reserve or park and 3 sites chosen outside the reserve or park but within 10 km of the boundary. If a reserve is located close to a park (e.g. within 50 km), the reserve may use sites in the general use of the marine park as a comparison. The reason we need sites outside the park or reserve is that there is no way to judge how well management is doing at protecting mangroves if we do not have an adequate number of control sites (unmanaged or outside a full closure).

- Choose sites that are spread out in different areas. These do not have to be the best or the worst sites – but try to capture what is in your park in terms of species. However, you might also want to consider use. If you know certain areas are more frequently used in a park, these might make sense to monitor. Or, if most of your park has one group of species, but there is a unique site, you might want to include the unique sites as more rare (and therefore possibly more threatened). In the end, it doesn't really matter what sites you choose as long as you are consistent in monitoring the same sites, because we will be tracking trends over time and using the data as an early warning system that could trigger more intensive research.

Month	MPA Sites Visited
January	Site 1 (MPA), Site 4 (non-MPA)
February	Site 2 (MPA), Site 5 (non-MPA)
March	Site 3 (MPA), Site 6 (non-MPA)
April	Site 1 (MPA), Site 4 (non-MPA)
May	Site 2 (MPA), Site 5 (non-MPA)
June	Site 3 (MPA), Site 6 (non-MPA)

July	Site 1 (MPA), Site 4 (non-MPA)
August	Site 2 (MPA), Site 5 (non-MPA)
September	Site 3 (MPA), Site 6 (non-MPA)
October	Site 1 (MPA), Site 4 (non-MPA)
November	Site 2 (MPA), Site 5 (non-MPA)
December	Site 3 (MPA), Site 6 (non-MPA)

It is important that in any given month, at least one MPA site and one non-MPA site are visited so that the data can compared (e.g. it would be a problem if all MPA sites were visited first then all non-MPA sites later).

Marking of Sites & Initial Measurements of Zones

- It is useful if you can take a GPS location at each location you will start your monitoring each month. This could be a point on either the landward or seaward part of the forest. From this point, you will work through each of the zones. Note that any smart phone has GPS capability – though you might have to download a basic application (app).

- It would be useful to also mark one tree at the start point at each location. You can do this with some paint on the bark of the tree.

- The first time you assess a new location, you will need to measure the length of the zone (from water to land edge of the zone). Mangrove zones are identifiable by the dominant type of tree present (e.g. *Avicennia marina*). When the type of dominant tree ends, that is where the zone changes. There may be some small overlap areas, where there are two dominant tree types for a short space. In that case, measure the zone to the middle of the overlap area. The zone length for each zone should be measured in meters (with centimeters indicated to two decimals – e.g. 10.45 meters) and this should be stored in a database and written on each data sheet prior to arriving at the site.

- Once a year (e.g. the first time a site is visited in a given year), it is important to re-measure the zone because zone areas may change if there is sea level rise or extensive erosion or sediment deposition.

Where to place 10 x 10 m^2 plot in each zone

- Within each zone, and at each site visit, we will collect data on mangrove density within a single 10 x 10 m^2 plot.

- The team decided (at our SAM field meeting in Tanga in November 2017) to move the plot location each month rather than have a fixed plot location. The rationale for this is that we want to involve community members in monitoring. However, once they become aware of the plot location, they may actually avoid harvest in the plot to try to preserve it for monitoring, but we want accurate data on plot condition, including prevalence of cutting.

- Thus, prior to each site visit, we need to choose a specific location to place the plot. We will do this using a random number generator online. An easy to use random number

generator is found at https://www.random.org/. To use this, you need to enter the minimum and maximum number. These numbers will always be 1 and the length of your zone in meters (no decimals). Thus, if your zone is 20.64 meters long, you would put in 1 as the minimum number and 20 as the maximum number. When you hit the button "generate", the program spits out a random number. This will be the meter point along your transect that you will start your plot. YOU MUST GENERATE THIS RANDOM NUMBER BEFORE YOU GO IN THE FIELD and write it on your datasheet for EACH ZONE.

- When in the field, lay out your measuring tape from your start location (marked by GPS and paint) to the specified meter mark generated as a random number. When you get to this location, go to the nearest mangrove tree (this may be ahead or behind you, and to the right or the left). The nearest tree will serve as the bottom left corner of your plot. Thus, from this point, you will measure 10 m to the right, and 10 m away from your start point (see diagram below). This will be the plot in which you will measure density for that zone. Include the nearest tree you used in your plot.
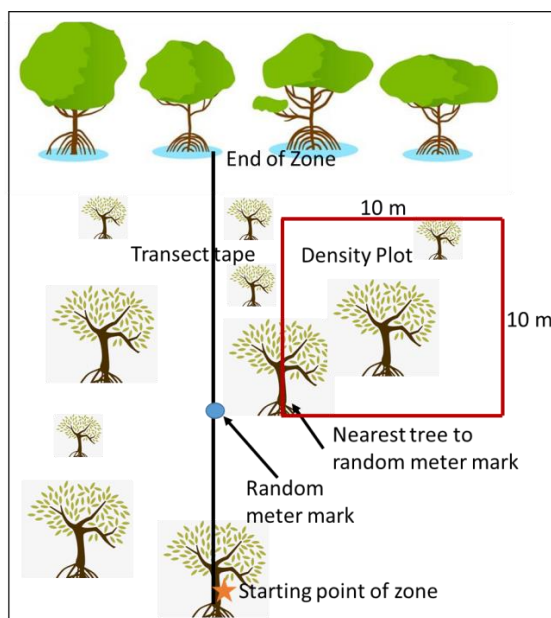

- As you go around the 10 x 10 m^2 area of your plot, use either a meter tape or a rope to mark the boundaries so that you can clearly see where they are. Leave the tape or rope in place until you are done with the plot so there are no errors about what is in or outside of the plot.

Determining Mangrove Density

- As noted above, in each zone, you will count the number of mangroves within one 10 x 10 m (100 m^2 plot) in the zone. Determine the location of the plot as described above using a random number generator. Mark the outside border of the plot with a rope or tape measure around the plot so the boundaries are clear.

- Within each plot, count the number of mangroves BY SPECIES in each of the following categories:
  - Number of seedlings (<1 m tall)
  - Number of saplings (>1 m tall and <4 cm girth at chest (=breast) height)
  - Number of adult trees (> 4 cm girth at chest height)
- Also count the number of mangroves BY SPECIES that are:
  - Cut (any size class)
  - Dead (any size class)

- Notes about above categories
  - Saplings are >1 m tall and <4 cm girth at chest (or breast) height. This means that at the height of your chest, if you wrap a measuring tape around them, they will be greater than 4 cm in circumference (distance around the tree). Because different people have different chest heights, you might want to carry a 1 m pole and always use the same height. Do not estimate the 4 cm circumference. Carry a 4 cm rope or line with you so that you can measure this accurately.
  - Cut trees are those that have clearly been harvested (are a stump with the branches cut). Count all cut trees in the plot including new and old cuts.
  - Dead trees are trees that are fully dead (have not leaves and are not alive). Do not include "diseased" trees in the dead count. If you feel trees are diseased in the zone, note this in the comments section at the end of the data sheet.

- Notes about counting:
  - Count only trees that have their trunk or part of their trunk in the plot. If only the roots (rhizomes) are in the plot, but not part of the main trunk, do not count the tree. Similarly, if only the leaves and branches of a tree are in the plot, do not count the tree.
  - Be very careful when counting seedlings. These are easy to miss. Thus, you will need to use a SYSTEMATIC SEARCH of the plot to be sure you did not miss these. Do this by having 3-4 people walk side by side through the plot, and each search a band of the plot. For example, if you have 4 people searching the plot, each will search a band of 2.5 meters. Before you start the search, make sure you clearly indicate the start and end points of their band on either side of the plot by measuring it on both sides (see diagram below).
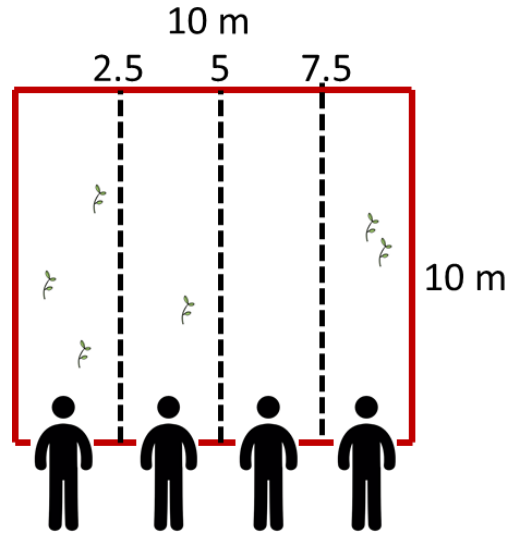
- Within each zone, also note the number of people you see in the zone (not including your team of surveyers), even if these people are not cutting or doing any other mangrove related activity. This gives us a sense of human presence in that zone.

- Repeat the above procedure for each of the zones until you have covered all mangrove zones (see schematic below).