

Establishing a Coral Monitoring Site

Goals:

- 1. Find a good location and establish a transect**
 - Site should have ample healthy target species in relatively close proximity
 - Good place to anchor nearby
 - Transect should be well marked at beginning and end and have accurate 0m and 50m GPS points
 - Deploy an EnvLogger which gives us temperature data over time that can be linked to bleaching and disease.
 - Helps identify 0m transect marker for relocating site

- 2. Tag, photograph and map corals**
 - Find healthy individuals of target species
 - Map location relative to central transect such that we can relocate corals
 - A picture is worth a thousand words! These allow us to easily find the corals and document their health/ tissue/condition over time

- 3. Sample Tagged Colony**
 - Assess molecular changes in one individual over time and connect those changes to its visible health. The samples we take can be used to look at all parts of the holobiont (the coral animal, photosymbionts and microbiome).

- 4. Conduct coral survey**
 - Documents scleractinian community composition over the same 30 x 1m transect.
 - Gives us data on overall reef health and a picture of what is happening on a community wide level. Is there bleaching, paling, or a disease spreading? More predation?
 - We survey every time we sample. These demographic and condition data allow us to document the reef at the moment of sampling.
 - Take photo quadrats. One photo every meter for first 30m of the transect. Allows for analysis of benthic composition including non target species capturing a broader picture of phenomena like bleaching, storm damage, disease, and phase shifts. Allows us to measure changes in percent cover.
 - Documents scleractinian community composition over the same 30 x 1m transect.



CBC30N PSTR 6 at three time points

Mock Schedule for Establishing a Coral Site

Jump in water on snorkel if possible

- Identify if target species are present and in a high enough density

Dive 1: 60-90 mins

- lay transect
- identify healthy corals of target species and tag, photograph and map and sample them
- photograph datasheets underwater

Surface: 20-30 mins (or for determined surface interval depending on site depth)

- process coral samples (ASAP)
- photograph datasheet with tube labels
- water+snack

*if not finished tagging (if you are taking samples) you will finish tagging and sampling then surface and process again before continuing

Dive 2: 45-90 mins

- set up cinder blocks at 0m and 50 m (and cow tags if using)
- deploy EnvLogger
- coral survey
- photo quadrats
- roll up transect/ clean up site



Goal 1: Finding a GOOD location to establish a transect

The goal is to establish a 50 meter transect that has a fairly high density of the target species within 5 meters of either side of the transect

- **Elements of a good site:**

- mostly coral reef continuously on a single compass heading for 50m
- relatively high density of large-ish healthy individuals of target species.

- **We are looking to tag between 7-10 healthy individuals of the following species:**

- *Montastrea cavernosa* (MCAV)
- *Pseudodiploria strigosa* (PSTR)
- *Orbicella faveolata/ complex* (OFAV/ORBI)
- *Porites asteroites* (PAST)
- *Diploria labyrinthiformis* (DLAB)
- *Meandrina meandrites* (MMEA)
- *Siderastrea sidera* (SSID)
- *Colpophyllia natans* (CNAT)



Other things to consider:

- How long does it take to get to this site?
- Can you get there/ anchor in inclement weather?
- Is the site heavily trafficked by dive tourism operations?
- Is this site only accessible if you have access to a buoy?

Establishing a transect

*Refer to [SCTLD Packing List: New Site Setup](#) for materials checklist + buddy pair equipment lists

- **Attach transect where you want to have the 0m marker**

- Roll out transect to 50m **following a single compass heading**
 - it is helpful if some of the colonies you plan to tag fall directly under the transect
 - make a note of the heading
 - either on the first dive or the second **place markers** at beginning and end of the transect. **We favor cinder blocks but rebar and PVC also work well.**
 - **please DO NOT** leave flagging tape - it fouls easily and there is no need to put more plastic in the ocean!
 - Examples of site markers from four sites:



Deploy EnvLogger at 0m

Deploy an EnvLogger at the 0m transect marker. Make sure that the logger mission is running and that it is appropriately named. You will need a phone with the EnvLogger app to do this. More information on how to start an [EnvLogger mission can be found here](#)



Site Metadata to Collect:

- Location
- Site Name
- Date established
- Transect #
- Start & End GPS Points
- Start Depth (ft)
- End Depth (ft)
- Length of transect
- Heading from start
- Markers? (Where and what do they look like- take photos!)
- Number of live tagged corals
- Notes (where is there are good anchor point?)

Goal 2: Tagging, Mapping and Photographing Corals

Tagging and Mapping Corals

Choosing a coral:

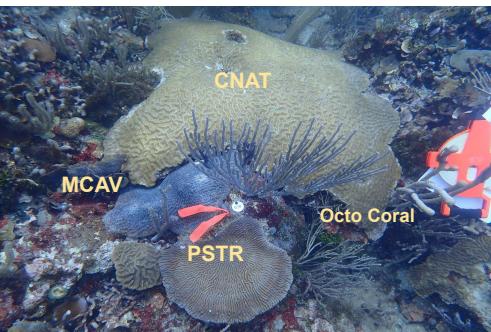
- a target species
- large enough to be non- destructively sampled over time
- appears healthy
- within 5m of the transect
- nice bare hard surface nearby to attach tag
- BONUS: under the transect, and/or distinctive elements like shape, gorgonians and



Corals in Belize with distinctive shapes, clear tag locations and close to the transect



Tagged MMEA in Bocas del Toro, Panama. Nice hard, clear substrate close to the coral



PAN_BDT_T4_PSTR_20

Above you have a nice context photo that shows a distinctive grouping of corals, second is of the tagged coral close up with the tag visible. The top photo could actually be zoomed out even more!

Tagging a coral

- find a bare hard spot either on the coral or directly beside it (see photos to the left for well tagged corals)
- take a uniquely numbered aluminum tag and a fluted masonry nail and hammer tag into substrate

Tips for tagging !

- different types of substrates require different sized nails, if the substrate is really crumbly, longer nails ~2-2.5" are better.
 - **Use fluted masonry nails. ALWAYS.**
- choose a **consolidated substrate**. Do not put it on something that can easily move, be covered by sand, overgrown by a sponge or is about to crumble.
- try to put the **tag very close to the coral** - scouring the ocean floor for a piece of rubble a tag is attached to or looking for a colony half a meter away is a nightmare and often leads to incorrectly sampled individuals.
- look for isolated **individuals** - not 2-3 of the same species, unattached but next to each other - this also leads to missampling
- all corals at a single site should have a **unique tag number** - replicate sites within a country or greater region can have repeats, but when you are relocating it is essential anywhere you could reach in a single dive have a unique number.

- Place a fishing weight with flagging tape next to the tag
- **White balance camera (need a refresher? [Here it is!](#))**
- **Take the following photos:**

- 1st : close up of tag
- 2nd: photo of whole coral with your back to 0m
- 3rd: Zoomed out photo with your back to 0m
- More: with at least one showing the coral and the location of the tag+flagging tape

Reefs can be crowded! Make sure it is clear which *individual* is the tagged/sampled colony especially if there are two of the same species directly next to each other!

These photos will serve two purposes: 1) we will use one close up with the tag included and one zoomed out (back to 0m) for the **relocation photo books**. For the zoomed out photo think about reef elements you might want to include in the frame that will make it easier to re-find the coral in the future. 2) We will use these photos as a **visual record of condition and % tissue**.

A clearly tagged PAST in Belize means that despite drastically visually changing , we can still re-locate it!



05/2022

09/2023

12/2023

06/2024

06/2025

Goal 2: Tagging, Mapping and Photographing Corals cont.

Mapping Corals

Accurately mapping a tagged coral is the ONLY way you will reliably relocate it.

Mapping data is recorded on the [Coral Fate Tracking Fieldsheet](#)

Tag #	Species	Meter # (distance along transect)	Meters 90°	Direction (R or L)	Max Diameter	Max Height	% Mortality	Notes

Tag: unique tag number

Species: write the species code of tagged coral (PAST, PSTR, MCAV, MMEA, CNAT, DLAB, SSID, OFAV/ORB)

Meter #: (A) the distance away from 0m on the central 50 m transect – if you swim from the coral 90° to the central 50m transect what meter mark does it hit on the central transect?

Meters 90°: (B) distance from the coral when you swim 90° to the central transect – if working in a buddy pair can be helpful for the person tagging/sampling to hold the clip end of the measuring transect tape while the “mapper” swims to the transect

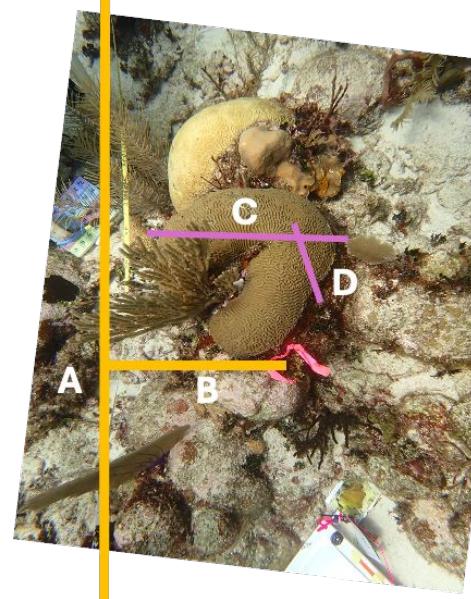
Direction (R or L): with your back facing towards 0m is the coral on the Right or Left side of the central 50m transect. **This is the #1 mapping error.**

Max Diameter: (C) distance (cm) across longest axis of the entire colony, including dead skeleton

Max Height: (D) Maximum height (cm) of coral measured perpendicular to substrate

% Mortality: Estimated percent mortality, including old mortality

Notes: anything that might be worth noting that could affect health – boring sponge? damsel farming? knock a piece of the colony off while sampling? Note it!



0m Marker

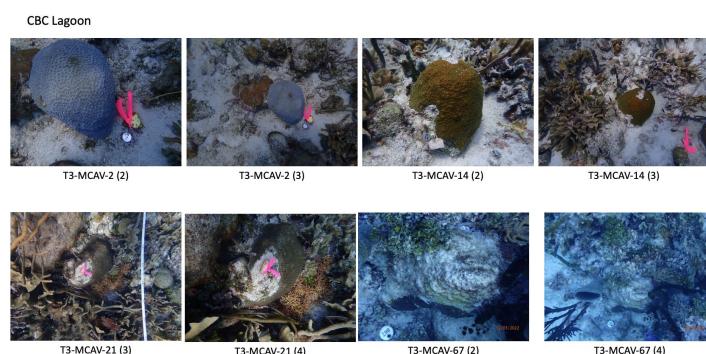
Goal 2 objectives (Tagging, Mapping, Photographing and Sampling) are best done in a team of two. The most efficient way to split tasks is

Diver 1: Tags coral, samples coral, fills out Molecular Sampling Datasheet

Diver 2: Maps distances, measures coral, fills out Fate Tracking Datasheet, photographs coral

The mapping data allow us to create sitemaps which we print on underwater paper.

Maps paired with underwater photobooks have allowed us to have a nearly 100% relocation rate.



Goal 2: Re-Sampling Tagged Coral Colonies Protocol

Sampling the colony

- You will use the [Coral Molecular Sampling Sheet](#) to document this process.
 - make a note of the Pill Box # - often times we are using many boxes that look similar!
- Write down the **Tag #** and **Species**
- Then **note the condition of the colony**. Since we are just setting up the site - normally these colonies should be Healthy. If tagging during a bleaching or paling even use the appropriate health status CLP= Color Loss Paling, CLB=Color Loss Bleaching or DC=Discoloration
 - for help or more details read the [Assessing Health Status](#) protocol
 - If a colony has more than one condition document each and then add them together
 - ex: CLP, CLB, 5%,15%
- **To sample the coral** - take two ¼" leather punch samples from the side of the colony (slightly overlapping so there is only one scar)
 - taking a sample from the side allows the coral to heal more rapidly because the scar doesn't fill with sediment
- Place both samples from an individual coral in the same compartment of a numbered pill box and make note of the **compartment #** on the datasheet
- Note the time on the datasheet in 24hr format - ex: 3:00pm = 15:00
- Regardless of sample type, wipe the leather punch on your wetsuit or in the sand between samples



See something? Heavy predation by snails? Damsel farming? Knocked over the colony while sampling?

Put it in the "Notes" column for that tagged colony



Sample Processing Protocol

If less than 20 minutes from station: can return to station to process if you like

- Always store coral samples (the entire pill box) in a shaded bucket of sea water
 - (especially if transporting to station)
 - **KEEP DISEASE AND HEALTHY SAMPLES IN SEPARATE BUCKETS**
- The most important things about sample processing:



- Once in the lab/ or processing on the boat you will need a 50 ml tube of alcohol and a propane blow torch. You will also need cryovials pre-labelled for the site.
- Best to work in a team of two- one person processing and one person writing the tube labels on the "Molecular Sampling Sheet" you filled out underwater
- Sterilize forceps by dipping in alcohol then flaming. Wait a moment for the tweezers to cool. Remove sample from labeled pill box with forceps and place in pre-labeled cryovial . Repeat sterilization between each pill box compartment/individual coral.
- ** if using Dry Shipper : Wrap each dry tube with tinfoil and put into dry shipper.
- RNALater samples must be stored at room temperature overnight and may sit out unfrozen for up to one week, after which they must be frozen at -20C.



OH NO... blow torch isn't working?

Look for back up flames! There should be at least two flame sources on the boat at all times. **Always keep an extra lighter in a dry bag!** Worse comes to worse, dip the tweezers/ forceps in 10% bleach and then rinse in DI H₂O.



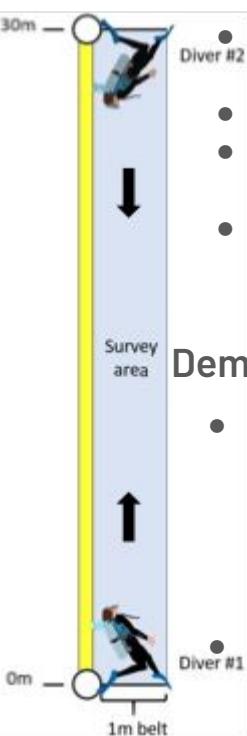
Pro tip: keep 2 x 50mL falcon tubes of EtOH/alcohol because they spill!

Goal 4: Coral Survey Protocol

*Refer to [SCTLD Packing List: Established Site](#) for materials checklist

For more detailed information go to this protocol's source: MarineGEO Coral Reef Habitat Monitoring (2021) Harper, Leah, Tennenbaum Marine Observatories Network, MarineGEO, Smithsonian Institution. <https://doi.org/10.25573/sekc.14714175.v1>

Overview & Set Up



Transect will be laid along a pre-existing path. We will survey a 1m belt of the first 30m of the transect on the right hand side (if you are hovering at 0m and looking towards 30m) If two divers are doing the survey they will start at opposite ends and work towards each other and communicate to ensure that corals aren't counted twice or skipped. Divers should tally all corals within the belt on their demographics datasheet. When they encounter a coral with a condition, they should tally that coral on the demographics datasheet, then conduct the detailed survey on the conditions datasheet.

Demographic Survey

- Count, measure (with your PVC "coral stick") then tally all scleractinian corals with live tissue that fall within the 1m belt (Use your meter stick as a reference to measure 1m). Include corals with live tissue directly under the tape.
- Search crevices for cryptic corals, and include any corals found on overhangs that are situated above the belt. If a coral has live tissue that falls within the belt transect, measure all of that colony's live tissue with your marked coral stick, even if portions lie outside the transect.
- Tally each coral by species under the appropriate size class. Size classes are (in cm): 1-4cm juvenile ; 1-4cm isolate ; 5-10 ; 11-20 ; 21-40 ; 41-80 ; >80 ; 0 (recent total mortality)
- Measure coral across the longest axis of the live tissue. If an individual has several tissue isolates separated by dead skeleton, estimate the size of the total tissue area if isolates were combined (to prevent overestimating a colony's contribution of live coral



Do not tally/include:

- dead skeleton in the measurement. (Measuring only live tissue prevents misrepresenting colonies as large if only a small tissue isolate is remaining.)
- encrusting hydrozoans (ex: *Millepora alcicornis*) in the survey.

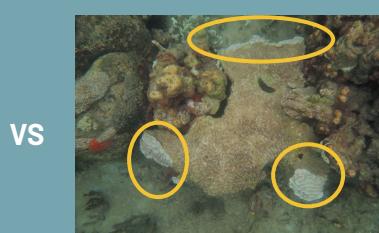


What if a once large colony has only patches left?

When the closest distance between the two tissue isolates that are >4cm in diameter exceeds the maximum diameter of the larger isolate, count and measure as separate corals.



Tissue isolate



VS

Separate corals



There is A LOT of one type of coral all together...

Monospecific, continuous thickets can be measured as one large colony when individuals are difficult to distinguish. (e.g., in the Caribbean, this strategy may be employed with *Acropora cervicornis*, *Porites porites*, *Agaricia tenuifolia* etc.)



Acropora cervicornis



Porites porites

Single colonies

Goal 4: Coral Survey cont.

Coral Conditions Sheet

- Does a coral in the belt have one of the following?
 - Tissue Loss
 - Color Loss
 - Discoloration
 - Growth Anomaly
- If YES, perform an assessment.



Need help with assessing coral health?

We got you.

Protocol for Assessing Health Status

You do not need to document a coral on the Conditions datasheet which has any of these conditions (ex tissue loss or discoloration) because of an "incidental" cause for the condition from biotic and abiotic factors such as:

- tissue loss from sedimentation, corallivory, or boring sponges
- discoloration from sponge or octocoral interactions
- growth anomalies from damsel fish predation or gall crabs

- If the tissue loss, color loss, or discoloration does not have an obvious external cause (like the things listed above), tally the coral on the Demographics datasheet, then record the following on the Conditions datasheet (each category is a column)

Need help figuring out how to make all these assessments?

Check out the **decision tree** on the back of this sheet

A coral can have more than one condition.

(Ex: colony has a tissue loss lesion, but remaining live tissue is bleached.) Record all conditions in the same row of your conditions datasheet. Separate conditions using a comma. Fill out the subsequent relevant columns (e.g. percent affected, distribution) for each condition you listed in the same order. Separate with commas.



DLAB	CLP,CLB	20,80
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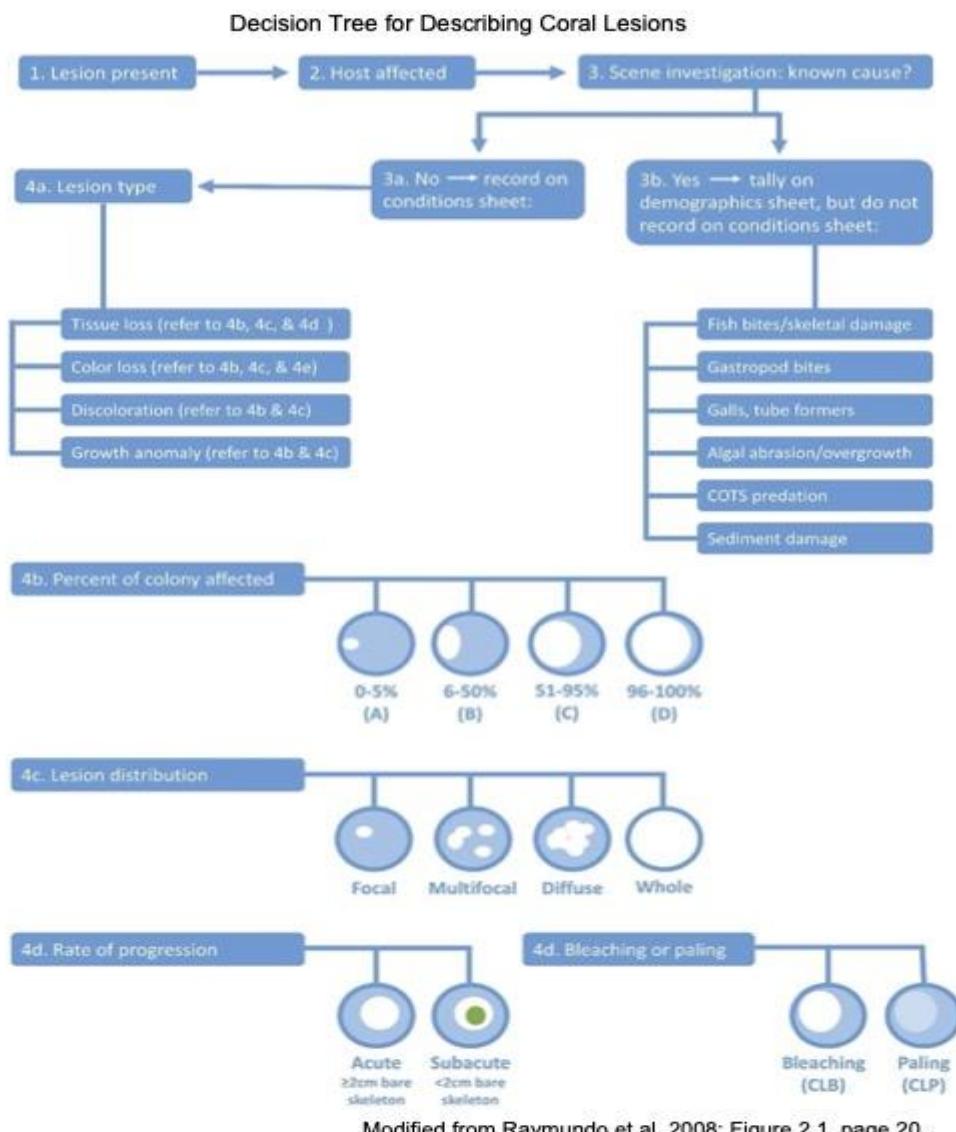
SSID	TL,DC	15,15
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- **Coral species ID**
- **Maximum diameter (cm)** across longest axis of the entire colony, including dead skeleton
- **Maximum height (cm)** of coral measured perpendicular to substrate
- Estimated **percent mortality**, including old mortality unrelated to the observed condition
- **Condition code:**
 - **TL**:tissue loss
 - **CLP**:colorloss-paling
 - **CLB**:colorloss-bleaching
 - **DC**:discoloration
 - **GA**:growth anomaly
- **Distribution** of the condition on the individual: focal "F", multifocal "MF"
- For tissue loss only, describe as acute "A" (clean skeleton >2cm) or subacute "SA" (clean skeleton <2cm)
- In "**Notes**" section, put the **JPEG # of the photo of the condition** and any other observations

Goal 4: Coral Survey cont.



Coral Demographics



What if SO MANY corals are bleaching it would take a whole Conditions Sheet (or more!) to document?

We will always decide if we are going to alter a protocol as a group. If underwater, confer with your dive buddy.

If there is a mass paling/ bleaching event we can always draw a line down the size class columns up to 20cm, splitting each size category in to two sections. The left of your split column will become the "Bleached" section and the right "Healthy" section. Tally corals on your survey as you normally would but instead of recording a CLB coral on the Demographics AND Conditions sheet, you will ONLY tally it on the left part of the split column on the Demographics sheet.

Species	CBC BLC		CURLWNT		E SHILLING		F. MURISON	
	1-4cm Juvenile	1-4cm Isolate	1-4cm	5-10cm	11-20cm	21-40cm	41-80	>80
AAGA								
ATEN								
ACER								
CNAT								
DSTO								
DLAB								

If a coral is >20 cm record CLP/CLB on the Demographics AND Conditions

If a lot of individuals from specific species are bleaching ex: ATEN, AAGA, PAST, PPOR just split the columns for these specific species, not all species

*put a little "B" at the top of the side for bleached just in case! Just split the first 4 size categories!

Goal 4: Coral Survey cont.

Photoquadrats

- These allow us to analyze the benthic composition including non target species capturing a broader picture of phenomena like bleaching, storm damage, disease, and phase shifts. Also allows us to measure changes in percent cover.
- One person should swim from 0m-30m and take one photo every meter with the transect numbers visible and centered in the photo. Stay about 1m above the transect. Camera should be white balanced.

