# CSTARS Field Protocol

## Version 1.1, updated January 2025

## Water Quality

### Materials

- YSI
- Datasheet
- Clipboard
- Pencil

### Field Methods

1. Collect water quality data before walking around the site to ensure that movement of sediment does not affect data accuracy.
2. Stand in the middle of the site, lower the YSI probe into the water approximately 1-1.5 ft, avoiding the seafloor, to take a surface level water quality reading.
3. Wait for the readings on the YSI to stabilize (a few minutes); turbidity and DO are good measurements to look at for stabilization.
4. Record the Dissolved oxygen, pH, Temperature, Salinity, Specific conductance and turbidity of water in appropriate units on your datasheet.

## Seine Net

### Materials

- **Seine Net (4 x 25ft, mesh size 0.25in)**
- **Tub**
- **Bubbler**
- **Fish viewing box**
- **Fish nets**
- **Sieve**
- **Fish ID field Guide**
- **Datasheet**

### Field Methods

1. Identify a location to sample on the seaward side of a living shoreline breakwater at high tide. 3-4 people are needed to conduct this sampling, and 1-3 seines will be conducted per site depending on linear feet of site (refer to cheat sheet in clip board for the correct number of seines/site).


    a. Minimize disturbance in the water before the seine net is pulled to reduce scaring fish, etc.
2. Two people will hold each end of the seine net poles (one on each end) and enter the water to be perpendicular to a living shoreline breakwater. The person closest to shore will remain ~3 meters from the breakwater.
3. One of the seiners will hold the small end of a transect tape while another person walks out 10 meters parallel to the shoreline to indicate where the seine will end. All other field crew members should stay in this area (where the seine will end) to help with pulling up the seine.
    a. Always measure out distances with a transect tape for consistency.
4. Ensure the seine net is taut, the lead weights are at the bottom (submerged in the water) and floats are on the surface. Angle seine poles ~45 degree angle away from the direction the seiners are walking so that the lead line is slightly ahead of the float line.
5. The 2 people holding the seine will begin walking parallel to the living shoreline breakwater at a rapid pace, stopping after ~10 meters.
    a. At the same time, people who are not actively seining, should get ready for fish collection by filling up one of the tubs with water, turning on the bubbler and getting other materials together so that fish identification can begin immediately.
6. After 10m the sampler closest to the breakwaters will stop and the person on the outside (most seaward) will pivot in an arc toward the sampler by the breakwater.

7. 1-2 people who are not actively seining should start walking toward the inside of the net to corral the fish inside.
8. Once both seiners get across from each other again, they should "close" the seine net by crossing poles and "trap" the other samplers and fish inside.
9. The samplers inside the net will count down (e.g., 1,2,3) and swiftly grab the bottom of the net (where the chain is), folding the net in half to close like a purse. At the same time, the two seiners should swiftly turn their handles 180 degrees, flipping the net up and trapping any fish inside.
10. If the shore is not blocked by reefs, the seiners may choose to pull the net up on shore. In this case, anyone who is not actively seining should still walk to the middle of the net as it is being pulled up shore and close it up like a purse so that fish do not spill out on the shore.
11. Transfer fish collected in seine to tub(s) filled with ambient water and a bubbler to begin species identification. Dump the net into the tub in sections to ensure all fish make it into the tub for identification. For large catches use multiple tubs.
12. Double check the net to ensure all fish and other animals are accounted for.
13. Begin species identification and counts and record each species and the number of each species on the datasheet.
    a. If a fish is not readily identifiable, place the fish in the Fish viewer box and take a photo. Write the photo # of the fish in place of a name on the datasheet. After the photo is taken, release fish back to the collection site.
14. Once a fish is identified, return it to the collection site to minimize handling time.
15. Once seining is complete and all species are identified, shake seine out to remove any vegetation and sand. Then roll up and store on shore or back in the truck.
16. Rinse seine net with fresh water upon return to the lab before using at a different location.

## Minnow Trap

### Materials

- Pre-made bait bags
- Minnow traps (6 traps needed, but ensure extras are available)
- PVC poles with line and carabiners
- Buoys with line and carabiners
- Tub
- Bubbler
- Fish viewer box

- Field Camera
- Datasheet

## Field Methods

1. Prepare the traps while other samplers are taking water quality or cleaning up the seine gear. At least 2 samplers will be needed for this method.
2. The minnow traps come in 2 pieces so you should have 12 total baskets. Place pre-made bait bags in 6 minnow trap baskets. Fit two sides of the minnow trap together by slipping the side with 2 prongs into the other. You should have two hooks on the front ready to be clipped shut.
3. Taking the PVC poles fitted with line and carabiners, clip the minnow trap closed on the front hooks. Ensure minnow trap is secure.
4. Traps will be deployed adjacent to the reefs being sampled for other metrics to minimize disturbance of the traps. It does not matter which side of the reef you choose, but place in an area that will not be disturbed from other sampling.
5. At each reef (3 per site), deploy 1 minnow trap seaward of the reef (green line) and 1 minnow trap behind or to the side of the reef (purple line).
    a. For sites with plantings or prelim sites, deploy 1 trap per area. (3 traps per site)
6. Deploy all 6 traps at the same time before individual sampling of reefs occur and let soak for 1 hour. This will allow the minnow traps to soak for the full time.
7. Bundle the minnow trap line in one hand and have the minnow trap ready to toss in the other. Toss the minnow trap in the desired location, ensuring that the trap lay horizontally so that both open holes are available for fish to swim into.
8. Insert the PVC stake into the sediment making sure it is secure. Soak the minnow trap for 1 hour, depending on tide conditions. Letting traps soak during low tide could result in death or suffering to aquatic organisms.
    a. Ensure the openings on each side are covered by water. If they are not covered by water, do not deploy and note this on the datasheet.
9. Once the minnow traps are ready for collection, pull the minnow traps up, unclip the carabiner and empty the fish into a bucket of ambient water with a bubbler running.
10. Begin species identification and counts and record each species and the number of each species on the datasheet.
11. Once a fish is identified, return it to the collection site to minimize handling time.
    a. If a fish is not readily identifiable, place the fish in the Fish viewer box and take a photo. Write the photo # of the fish in place of a name on the datasheet. After the photo is taken release fish back to the collection site.
12. Rinse minnow traps and line with fresh water and throw away pantyhose pouch upon return to the lab before using the traps at a different location.

## Sediment Accretion Pole

### Materials

- **Bamboo stakes**
- **Meter sticks**

### Field methods

1. The sediment height poles will be placed at Q1-24 sampling and continually monitored throughout the project.
2. Upon arrival to the site during Q1-24, place a sediment pole behind the three reefs you will be sampling for the project. Hammer the sediment pole securely into the seafloor. Take an initial measurement of the stake for Q1-24.
3. To measure vertical sediment accumulation each other quarter, measure from the bottom of each stake to the top. Make sure to measure without pushing the meter stick into the sediment.
    a. This stake must be permanent to record sediment height. If you install a stake and it is gone the next time you sample that site, reinstall a new bamboo stake and rerecord the initial measurement (only once).
    b. If you are unable to leave this stake at the site or you have replaced the stake once and then cannot find it again, skip this step for all future sampling.
4. Repeat this measurement at every stake at each reef.

## Sediment Accretion Plate

### Materials

- Plastic plate cut approx 10in x 10in outfitted with paracord
- GPS or RTK
- Meter stick
- **Datasheet**

### Field Methods

1. The sediment plates were installed in Q4-24.
2. At the time of installation, dig a ~30cm hole behind each sampled reef, place the plate inside the hole and refill it with sediment. There should be about 50cm of paracord sticking out of the hole. Take an initial measurement of the paracord.

3. To measure the sediment accretion, pull the string up from the ground taut (but not hard enough to pull the plate out of place). Place the meterstick at the sediment surface next to the paracord. Record the length of the paracord.
    a. Avoid pressing the meter stick into the sediment as this will make numbers inaccurate. Lightly set the meter stick on top of the sediment and measure.
    b. The sediment plate must be permanent to record sediment height. If you install a sediment plate and it is gone the next time you sample that site, reinstall a new sediment plate and rerecord the initial measurement (only once).
    c. If you are unable to leave the plate at the site or you have replaced the plate once and then cannot find it again, skip this step for all future sampling.
4. Repeat this measurement at every sediment plate at each reef.

## Shoreline Change

### Materials

- Transect Tape
- GPS
- **Datasheet**
- **Bamboo stakes**

### Field Methods

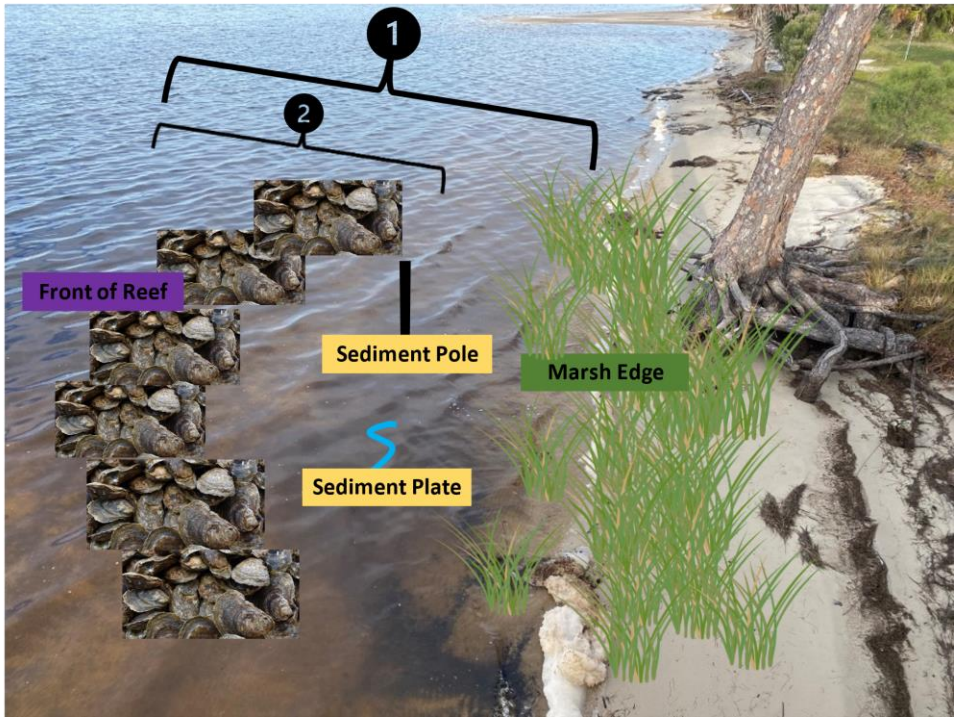
1. Refer to Graphic for transects.
2. To measure the Front of Reef to Marsh Edge (labeled 1 in graphic):
    a. Use the transect tape to measure from the marsh edge to the front edge of the reef structure and record distance in meters. Marsh edge is characterized by where marsh vegetation starts.

b. If the marsh vegetation starts seaward of the reef, measure from the front of the reef to the start of the vegetation and record the measurement as a negative number.

**Reef Transects**

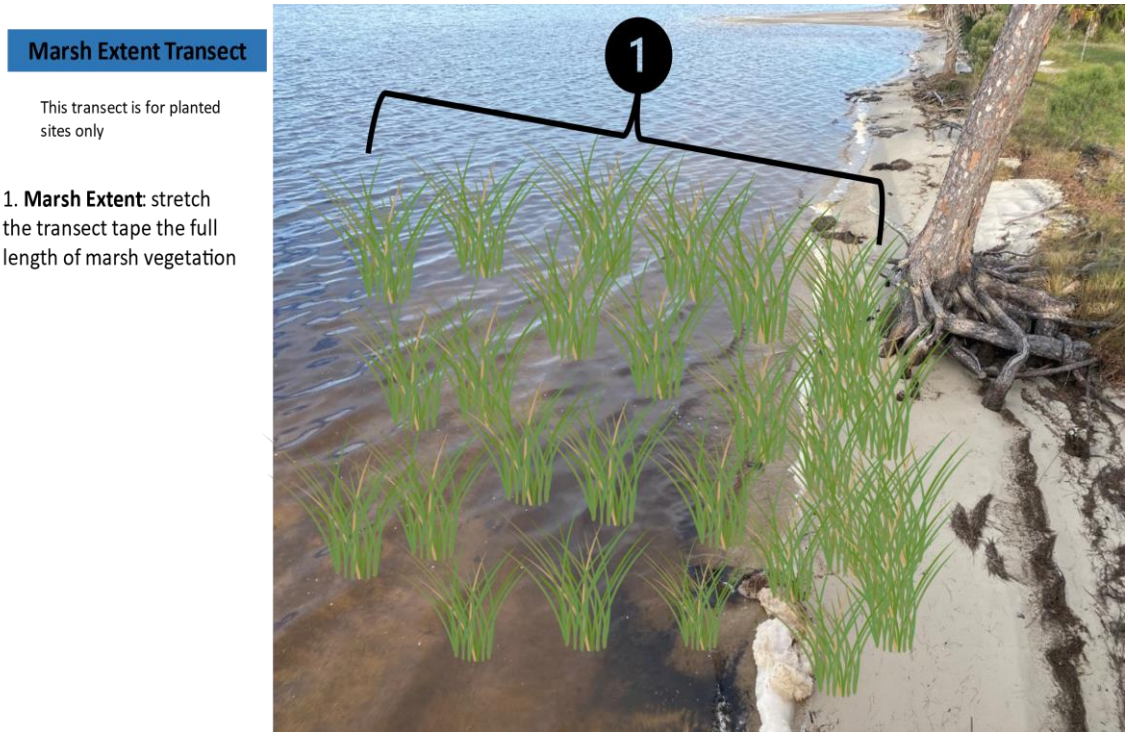
Transects are for shoreline building methods

1. **Marsh Edge to front of reef**: stretch the transect tape from the marsh edge (where marsh vegetation starts) to the front of the reef (furthest seaward point of the reef sampled).
2. **Sediment Pole to front of reef**: stretch the transect tape from the permanent sediment pole (behind reef) to the front of the reef.
   - *if the reef does not have a sediment pole skip this measurement




3. To measure Front of Reef to Sediment pole and plate (labeled 2 in graphic):
4. Use the transect tape to measure from the front edge of the reef structure to the previously installed sediment pole and sediment plate behind the reef and record distances.
   a. If the sediment pole or plate is gone and has already been reinstalled (see sediment pole methods), write NA for measurement on the data sheet.
5. For planted sites only:

a. To measure Marsh Extent: Use transect tape to measure from the start of marsh vegetation in the water to the end of the marsh vegetation on the shore. This measurement should extend through the entire "area" sampled.




See Figure below for details.

6. Record all measurements on datasheet

# Reef Height

## Materials

- 2-meter sticks with levels
- Datasheet

## Field Methods

1. To measure reef heights, take measurements in front (seaward) of the reef using meter sticks outfitted with a level. Take 3 measurements: one on each end and one in the middle.
2. Place one meter stick horizontally on top of the reef with the level facing up. Ensure the bubble is in the center.
3. Place another meter stick perpendicular to the horizontal one. Ensure the horizontal stick is level by ensuring the bubble remains in the center. Measure the

height of the horizontal meter stick. Repeat for the middle and other end of the reef.

4. Measure height in centimeters and repeat at all 3 reefs per site.
5. Record on datasheet.

## Oyster Density, Recruitment and other Fauna

### Materials

- **Meter stick**
- **Reef ID cards**
- **10-gallon tub (3 ideally)**
- **Gloves**
- **Calipers**
- Small Quadrat- 0.0625$m^2$
- **Snorkel**
- **Pan Sieve**
- **Forceps**
- **Camera**
- **Datasheet**

### Field Methods Oyster bags or Limestone rock

1. Use these methods for reefs with oyster bags or light weight limestone rock that can be easily lifted and placed into a tub. For all other substrates, see Field Methods for Quadrats.
2. Haphazardly select 3 bags or rocks per reef: one bag or limestone rock from each side of the reef and one in the middle.
3. Quickly place bag or rock into a 10-gallon tub.
4. Label reef ID cards with the site and place in tub. Take a picture of the sample on the side that it lands using the Oyster reference photo methods. This will be the "flat" photo.
5. Count the number of live oysters and number of dead oysters on the visible sides of the sample. Estimate percent cover of spat for "flat" side.
    a. Dead oysters should be counted only if they are still hinged and open, no half shell.
    b. Consider spat to be any live oyster <10mm
6. Once you have counted all oysters on the "flat" side, count the live/dead/spat on the rest of the sample and record. This will be the "other" measurements on the datasheet.

7. Take 2 more photos of the sample, one for depth height and one for the "back" side of the sample. (see Oyster photo methods for details.)
8. Measure 10 random live oysters on the entire sample (flat and other sides) using calipers. Spat included.
9. Visually assess other fauna in tub and on sample and record presence of each species. . For species that are unknown, take a photograph for ID back at the lab. Look for organisms such as mussels, barnacles, amphipods, worms, crabs, Gobies, etc
10. After you are finished, return the sample of your living shoreline back to the place where you found it,
    a. If the bottom is muddy and you cannot see anything, leave the remains of the sample in the bottom of the tub and gently pour the remains of the tub into a pan sieve.
    b. Keep the sieve partially in the water to prevent harm to any aquatic life.
    c. Using forceps, pick through the sieved shell and sediment to try to find any smaller species you may have missed (E.g., worms and amphipods). Record presence of species in the datasheet.
11. Repeat 3x at every reef sampled.
12. Record data on datasheet.

### Field Methods Quadrats

1. If the reef is made of heavy limestone rock that cannot be safely lifted into a tub, oyster bags that are falling apart or is a different type of reef structure use this method to sample oysters.
2. Haphazardly throw a 0.0625$m^2$ quadrat on each end of the reef and in the middle.
3. Once the quadrat is in place, count all visible live and dead oysters (recently dead).
    a. May need to use a snorkel to view the oysters if the reef is submerged.
4. Estimate percent cover of spat in quadrat.
5. Measure 10 random live oysters on the entire sample using calipers. Spat included.
6. Visually assess any species located in quadrat and record them in fauna.

## Oyster Bag Photos

### Materials

- **Waterproof phone case or camera**
- **Reef ID cards**

### Field Methods

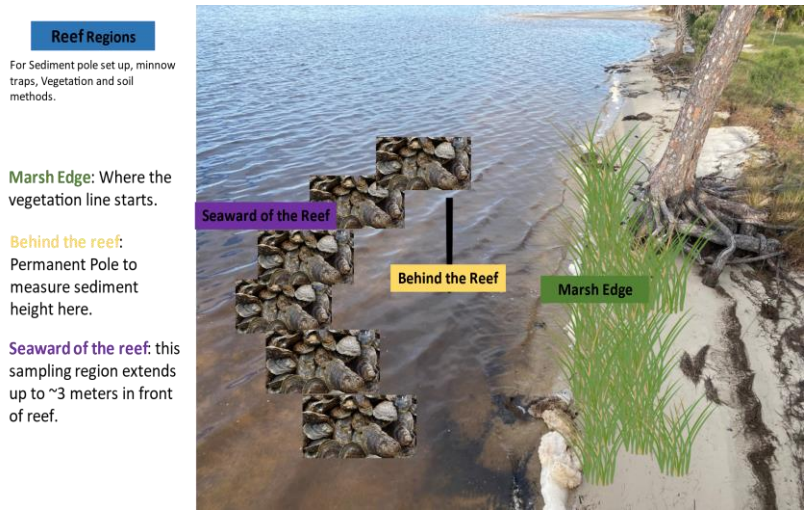
1. **If possible, have a crew member be solely dedicated to taking photos during oyster methods.**
2. **Label Reef ID cards with the site name.**

3. For sites with Oyster bags only. Follow Oyster methods of the protocol.
4. Place each bag or sampled (3 per reef) in the tubs, place Reef ID cards on the corner of the tub along with a meter stick and take a photo.
5. The first photo will be the "flat" photo. Make sure whoever is counting the sample has finished counting all oysters on the "flat" side before moving on to other photos.
6. Next, place a vertical meter stick (with the measurements visible to the camera) behind the sample to indicate depth. ID card should still be in the corner of the tub. Take photo.
7. Lastly, flip the sample over to the other side and take the last photo just like the first. This will be for the "other" counts on the datasheet.
    a. Make sure that all 3 photos are taken per sample and that the "flat" and "other" photos correspond to the datasheet counts.
8. Check each photo to ensure that both the ID card and meter stick are in view of the photo and readable.
9. Write the photo # beside each oyster bag on the datasheet.

## Vegetation % Cover and Density

### Materials

- Large Quadrat- 0.25m$^2$
- Small Quadrat- 0.0625m$^2$
- Field guide to aquatic and marsh plants
- Datasheet
- Snorkel
- Fins




### Field Methods

1. Sample 3 quadrats per region (see photo). Toss the large (0.25m$^2$) quadrats haphazardly first to determine percent cover and species, then the small quadrat (0.0625m$^2$) inside the large one to count total live density shoots of all vegetation.
2. Stand behind the reef looking towards shore and haphazardly throw a large quadrat in the Marsh region (region 1 in above figure).

3. Determine percent cover of vegetation (including SAV) in the quadrat area.
4. Record the presence of other species in the quadrat (fish, crabs, snails, etc).
5. After percent cover and fauna is recorded, haphazardly throw the small 0.0625$m^2$ quadrat into the .25$m^2$ quadrat and count each individual shoot of vegetation (live and dead) per species. Take note of the species of vegetation on your datasheet.
6. Measure the stem height of one shoot (of dominant species) in the center of your smaller quadrat. Use a meter stick to measure the height of the shoot. Record this measurement in cm.
7. Before moving on to the next quadrat, take a soil core in the small quadrat. See Soil sampling methods for details.
6. Repeat at each region at 3 different reefs at the site.

## Soil Sampling

### Materials

- **60 mL syringes (pre-cut and labeled)**
- **9-10 Whirl Paks**
- **Cooler with ice**
- **Datasheet**

### Field Methods (all quarters but summer)

1. Take soil subsamples from the same quadrats sampled for vegetation. The person entering data should hand syringes and whirl paks to the person counting the quadrats.
2. Sub samples for each region will be homogenized and placed into 1 bag per region (e.g., all 3 subsamples from marsh edge will be placed in a single whirl pak bag) in the field. At the end of sampling, you should have 9 whirl paks of sediment, 1 from each region (3) per reef.
3. Use modified 60ml syringes to extract soil samples. Start with the plunger of the syringe down. Insert the bottom of the syringe into the sediment 5 cm (~40 cc) and slowly pull up. If necessary, tilt the syringe back when lifting the sample up so that no sediment escapes.
4. Use the plunger to push the soil sample into the whirl pak.
5. Use the same whirl pak per region and reef (so site X reef 1 marsh would have 1 bag with 3 soil core samples in it).
    i. Use the same whirl pak per region and reef (so at one site, reef 1 marsh bag would have 3 soil core samples in it that were taken from each of the 3 quadrats sampled in the area.
5. Seal whirl pak bag and place on ice in a cooler until transported to the lab.
6. Repeat this sampling 3 times at each region of the reef, for at total of 9 whirl paks of sediment, 1 from each region (3) per reef (3).

## Field Methods (summer)

1. Ensure cooler is filled with plenty of ice to keep samples cool.
    a. Ensure frozen icepacks are added to cooler if needed.
2. Ensure Styrofoam cooler, shipping label(s), box, and packing tape are in the vehicle.
    a. May vary depending on use of a sample runner or how long sampling takes.
3. During soil sampling, collect 2 syringe cores- one for denitrification and one for C:N. Ensure these cores are taken next to each other in the small quadrats used to take shoot counts.
4. After collecting the sample, place into cooler into a larger, gallon size ziplock for the respective bag type (C:N or denitrification).
5. After sampling is completed for that day for all sites, prepare the denitrification samples for shipment by:
    a. Make soil bags as small as possible while still ensuring a good seal.
    b. Layer icepacks and soil samples starting with a layer of icepacks on the bottom of the Styrofoam cooler and ending with ice packs on the top.
6. Ensure the cooler can close and adjust as needed.
    a. tape the cooler to ensure it stays sealed during shipping.
    b. Place sealed cooler into box; seal box
    c. Add datasheet with metadata for sites- ESPECIALLY the salinity
    d. Place shipping label on box
    e. Take to nearest UPS store ASAP (before 5pm CT).
7. Ensure you get to UPS store before the cutoff time for next day air shipping (this is generally 5pm CT for all of the stores identified)
    a. Send email to Charles Schutte with the data for the sites and the shipping information for tracking.