

Standard Operating Procedure (SOP) #8

Conducting Marine Fish Surveys

Version 1.01 (July 15, 2021)

Change History

New Version #	Revision Date	Author	Changes Made	Reasons for Change	Previous Version #
1.01	7/15/2021	Kim Weisenborn, Sheila McKenna, Kelly Kozar	Minor updates to content. No anchoring	Updates to outdated SOP references. No longer anchor at any of parks where protocol implemented and standard 4 letter code with WoRMS used. Added field datasheets to appendix.	1.0

Only changes in this specific SOP will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, changes made, and reason for the change along with the new version number.

Purpose

This SOP explains how to conduct Marine Fish surveys to quantify species richness, fish abundance, and estimate total length to derive biomass. The SOP assumes that a monitoring site has been previously established as outlined in SOP #7 Selecting and Marking Subtidal Transect Locations, and will detail relocating the monitoring site, laying out the transect line, and performing the fish survey. This SOP is designed to be completed by a single diver with the co-located Benthic Marine Community protocol diver serving as a buddy. Any dive equipment mentioned in this SOP is intended to be used as a guideline only and use of this equipment, while shown to be effective, is not intended as an endorsement of any particular manufacturer or model.

General Procedure

The amount of time needed to complete a survey is approximately 15-20 minutes along a 25 m transect in ideal conditions making one to two passes along the transect. The number of passes is dependent on the survey region and the richness of the fish assemblage. With more depauperate fauna such as Hawaii only one pass is required. At NPSA and WAPA two passes are necessary to survey the greater number of fish species. All safety precautions will be followed as outlined in SOP

#3 Safety Protocol.

Equipment

For a complete list of equipment needed to carry out this procedure, refer to Appendix SOP 1.a of SOP #1 Before the Field Season. Observers will want to ensure that all equipment is ready prior to the scheduled survey dive day. For more detailed information on protocol prior to dive day, please see SOP #6 Pre-dive Equipment Preparations.

Field datasheets used for this protocol can be found in [Appendix SOP 8.a](#). Datasheets should be photocopied or printed onto plastic paper for use underwater.

Relocating the Monitoring Site

Step by step procedures:

1. Navigate by boat, or surface swim, to a transect start point using a GPS (Global Positioning System) unit which has the transect start point stored as a Waypoint. If surface swimming, put the GPS in a transparent waterproof container attached to a surface float (e.g. inner tube with dive flag) that has a line and a bottom weight to attach at the transect start point (see SOP #4 Using Garmin® GPS Units for information on using a GPS).
2. Approximately 3 meters from the site, carefully but quickly lower a surface float marker or Pelican® surface float from the boat with a bottom weight (~ 1 kg) so that it comes to rest as close as possible to the transect start pin.
3. If a permanent mooring buoy-line is available nearby, use it to securely tie off boat's bow line. Then, locate the deployed surface float by taking a compass bearing to it. If live boating be sure to follow all instructions of the boat captain and ensure communication, including hand signals and other procedures as per safety documents (e.g., SOP #3 Safety Protocol, GAR and JHA) are followed.
4. Check to ensure that all dive gear is in working order and that the primary and secondary regulators as well as power inflation devices are working correctly. This procedure also ensures that the divers' air is turned on.
5. Check to make sure that a transect tape and datasheets are in hand before entering the water or that other personnel are available to hand these items safely to the diver.
6. Put on dive gear and enter the water.
7. Retake a compass bearing to the surface float if needed. For detailed procedures on GPS and taking bearings see SOP #4 Using Garmin® GPS Units.
8. If a surface float is used, swim to the float and descend down the line.

Locate Transect Pin, Lay Transect Line and Conduct Fish Survey at Permanent Sites

Step by step procedures:

1. Underwater, locate the bottom float marker.
2. Both divers begin a systematic search for the transect start pin with one cable tie at KALA, NPSA, and WAPA or two cable ties at KAH0; clean the pin of fouling organisms as needed using gloved hand, scrub, or wire brush. If necessary, move the bottom float marker to the vicinity of the transect start pin.
3. Secure the brass clip end of the transect line/tape around the start pin.
4. Once the transect line is secured, take the known compass bearing to the end point of the transect, pulling the transect line out as you swim ensuring to keep the line as taut as possible.
5. For NPSA and WAPA the fish diver progresses down the transect at a constant speed and enumerates, to the lowest possible taxon, all fish greater than 20 cm total length. Total length (TL) of each fish is also estimated to the nearest centimeter.
6. On this first pass of the fish survey, the corridor for fish considered “on the transect” is 4 m wide and 4 m high but is visualized out to the end of the transect. Any fish outside this corridor is not included in the survey, though large or interesting fish should be noted.
7. Nomenclature should follow the latest accepted taxonomic name for the genus and species as per World Registry of Marine Species¹ and the PACN Benthic Marine and Marine Fish database four letter standard fish species code (Brown and Others 2020²)
8. Once at the end of the transect loop the line around the end pin twice so that it does not slip and loosen. The transect should now be installed such that the line is straight, suspended just above the bottom and taut over its entire length. This should reflect a runtime of approximately 5-8 minutes.
9. Turn and start the second pass of the survey by returning along the now laid transect line. On this section only fish less than 20 cm are counted and sized. The corridor is also reduced to 2 m wide and 4 m high. Again, note any large or noteworthy fish, but do not include them in the data. This section should take approximately 10-12 minutes, giving you a runtime to complete the survey of 15-20 minutes.

¹ An authoritative classification and catalogue of marine names, <http://www.marinespecies.org/> (accessed 15 July 2021).

² Pacific Island Network Benthic Marine and Marine Fish Monitoring Dataset, <https://irma.nps.gov/DataStore/Reference/Profile/2285036> (accessed 15 July 2021).

10. For more detail on the sampling design rationale, see Chapter 2 of the Marine Fish Monitoring Protocol³ and Brainard et al. (2007).
11. For the more depauperate fauna at KAHO and KALA, the transect dimensions are 25 m length X 5 m width. Only one pass is required and all fish are enumerated and sized within the corridor.
12. Once the fish (and benthic) surveys are complete, reel up the transect line.

Lay Transect Line and Conduct Fish Survey at Temporary Sites

Step by step procedures:

1. Navigate to the temporary site and deploy the Pelican® surface float with a bottom weight (~1 kg) or other surface marker buoy or have the divers disembark from the boat directly above the site.
2. Upon arriving at the temporary site, randomly determine the compass bearing of the transect that is parallel to the shoreline. This can be done on the boat or at the surface prior to beginning the dive. Typically, there are only 2 possible bearings along a depth contour, but this can be adjusted slightly when the divers descend down the float line and scan for homogeneous habitat along with the direction of the substrate contour.
3. As there are no pins at temporary transect locations, tie one end of the transect line securely around a dead coral colony or piece of rubble nearest the bottom weight. The tie-off location will be the first available piece of dead coral or rubble along the selected compass bearing of the transect.
4. Once the line is secured, swim the known compass bearing enumerating and sizing fish as before (see above) until 25 m of transect lines has been released. Pull the line taut and extend out several additional meters. Holding the tape taut, find a dead coral colony or piece of rubble suitable to tie off the line. Loop the line around the rubble twice so that it does not slip, causing it to loosen. Tie off securely. The transect should now be installed such that the line is straight, suspended just above the bottom and taut over its entire length. Make sure to record the compass bearing of the transect lines from the starting point to facilitate plotting of the transects in ArcGIS®.
5. Return along the transect documenting fish species and sizes as noted above in the permanent sites section.
6. In the case of KAHO and KALA, one pass is sufficient so once the fish diver has completed their survey then the benthic diver can commence their work.

³ Pacific Island Network, Marine Fish Monitoring Protocol, <https://irma.nps.gov/DataStore/DownloadFile/430121> (accessed 15 July 2021).

7. Once the fish (and benthic) surveys are complete, reel up the transect line.

General Considerations for Fish Surveys:

1. All fish should be counted only if they are completely within the boundaries of the transect.
2. Fish should be sized individually but with large schools the number of individuals in a range of sizes will suffice.
3. On the initial pass there is no maximum fish size, although very large fish (i.e. greater than 2 m) should be highlighted as they may confound the overall data.
4. On the return pass there is no minimum fish size because it is important to document new recruits. However, 3 cm may be the practical limit so minimum size will be revisited after several years of data collection.
5. Always try to look ahead for wary fish that may depart quickly from the area, but be careful that fish beyond the transect are not being surveyed.
6. Be careful to note if fish leave the area, so that they are not double counted if they return.
7. On the return pass for smaller fish, try to look into cracks, crevices, and corals to look for smaller, wary, and cryptic species.
8. On both sections of the survey swim fish should be identified to the species level. If species level is not possible try to identify to the lowest taxon possible and take a photograph of the specimen if practical and only if doing so will not disrupt further data collection.
9. Since each park has different fish assemblages, individual parks should customize the datasheet for data collection based on the most prevalent species encountered. Doing so speeds data collection and ensures less time is spent looking down on the datasheet.

Literature Cited

Brainard et al. 2007. Coral reef monitoring report. 2002 – 2006. NOAA—Coral Reef Ecosystem Division.

Pacific Island Network and Others. 2021. Pacific Island Network Benthic Marine and Marine Fish Monitoring Dataset. Pacific Island Network. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2285036> (accessed 15 July 2021).

Appendix SOP 8.a Marine Fish Monitoring datasheets

Each park uses a field datasheet customized for the fish found in their park. This appendix contains the fish datasheet and the list of species names and fish codes found on each park's datasheet.