SOP 8
Baited Remote Underwater Video (BRUV)

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Protocol Reference

CSULB and TBF. 2021. Fish Cameras Standard Operating Procedures. Unpublished protocols. The Bay Foundation, Los Angeles, CA. https://cms.santamonicabay.org/wp-content/uploads/2021/03/L3-Estuarine-Wetland-Manual-V.2_FINAL_web.pdf

Objective

The community assemblage of fish is a key indicator of ecological condition in estuaries. Understanding estuarine fish communities requires measures of fish density and species richness. We recommend three methods for quantifying fish species richness and abundance with the following prioritization:

1) Fish seines (SOP 9)
2) **BRUVs (SOP 8)**
3) Baited Traps (SOP 10)

This SOP provides a standard approach to fish species abundance estimates using an underwater baited video setup. This approach focuses on benthic and water column fish abundance.

Materials

1. PVC pipe, 6 ft, white
2. PVC pipe, 0.5 m, clear
    a. https://www.amazon.com/gp/product/B01F2UDNLK/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1&pldnSite=1
3. PVC primer and cement, with T-fitting
4. Nylon
5. Bait: chopped shrimp and squid
6. Knife and cutting board, for bait
7. GPS
8. Micro SD card, 64-GB and adapter
9. GoPro camera
    a. https://www.amazon.com/gp/product/B08JHFLL4Z/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1&pldnSite=1
10. Battery extension packs
11. Secci disk for visibility estimate (optional but recommended)
12. Waterproof GoPro cases
    a. https://www.amazon.com/gp/product/B08JVF6S49/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1&pldnSite=1
13. GoPro attachments (Figure 1.)
    a. https://www.amazon.com/gp/product/B01LCLVBU8/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1&pldnSite=1
14. External hard drive (approx. 1TB per season needed)

Figure 1. Go-pro attachments needed for BRUV.

Figure 2. Picture of constructed BRUV with shrimp bait in pantyhose.

We recommend deploying the BRUVs right when you arrive at the field site. BRUVs need to be deployed at each sampling zone for about 2 hrs. We recommend deploying cameras so they are visible to shore crew.

The mouth dynamics of lagoonal systems will influence video quality. For example, closed conditions will affect the effectiveness of BRUVs due to poor visibility. If visibility is poor and no fish are seen on the camera footage, this should be marked as a failed sampling event. We recommend returning to the estuary when the mouth is open or visibility improves. A BRUV with zero captured fish does not mean the estuary does not have fish.

Following BRUV retrieval, we recommend viewing the video on a computer by quickly skimming the video. The goal is to ensure that 1) the video is high enough quality to see the bait, 2) the bait is within the field of view, and 3) the video did not randomly cut off. If the BRUV does not meet these criteria, then a second attempt should be made by redeploying the BRUVS the following day.

FIELD METHODS

1. If possible, a minimum of **2 BRUVs** (Figure 2) should be deployed at each sampling zone.
    a. If equipment is limiting, then one BRUV could be used.
2. Secure GoPro camera to PVC T-frame as pictured in Figure 2.
    a. Fasten GoPro to attachments (base + 1 larger attachment + 1 smaller attachment), and secure camera to the arm of the T-frame using zip ties (3).
3. Cover zip ties with electrical tape (Figures 3 and 4) if using zipties.
4. Chop shrimp and squid (or other available bait) and place in a bag made of nylon.
    a. We recommend standardizing bait across sites.
    b. For Bight and EMPA, squid will be used.
5. Place bait approximately 0.3 m from GoPro, ensuring that its position is visible on camera.
6. Samples should be collected at low-to-mid tide, when oyster beds are minimally submerged (if oyster beds are present). Ideally, this would be done consistently on an ebbing or flooding tide.
7. At each site, place the base of the T-frame into the sediment 1 m into the subtidal (as noted on site map), at a randomly selected position along the shoreline facing away from shore (towards deeper water).
8. Set up Go Pro with standard settings. These will vary with model number.
    a. For Go Pro 9's, setting should be 1080p resolution and 60 frames per second
    b. For ho Pro 10's, setting can be 4000 resolution and 60 frames per second
9. Record for two hours, the maximum recording time for Go Pro HERO9 or older models with battery extension pack.
10. Recollect camera(s). Transfer files to an external hard drive using an SD card converter. Ensure all cameras are cleared and that both cameras and battery packs are charged before the next sampling date.
    a. When transferring the videos, it is useful to double check the visibility and camera angle to ensure that the video is usable. If the bait is not visible, data from this video will not be counted. The video should be repeated if possible.
11. Record the time in, time out, and depth of each BRUV on the datasheet
12. For each sampling location, the following should be filled out on the datasheet
    a. Project id, site id, and estuary name
    b. Station number

c. Date
d. Latitude and longitude of each camera setup

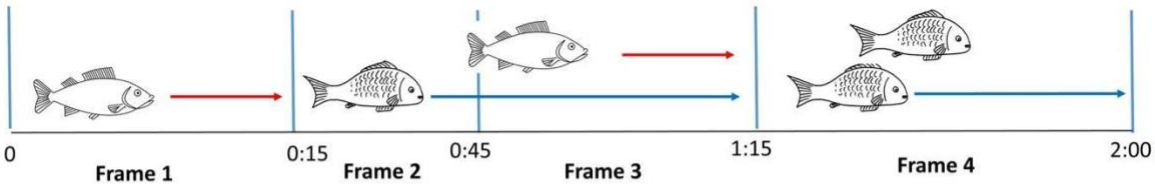
Figure 3. Black tape covering zip ties on BRUV, as well as 3D printed attachment options.

Figure 4. More tape additions to secure GoPro attachments.

VIDEO ANALYSIS

$MaxN_{species}$ is an abundance estimate often used in video analysis to account for bias associated with fish entering and leaving the camera's field of view (Cappo et al., 2003; Wakefield et al., 2013; Mallet & Pelletier, 2014). It is considered a conservative measure of abundance, as it may underestimate the size of larger schools of fish, but it prevents individual fish from being counted multiple times and gives a reliable minimum abundance within the sampling area for many species (Schobernd et al., 2013).

1. The first 5 minutes of each video should not be counted as this is the time it typically takes for the sediment to settle. Fish in this timeframe can be noted, but any fish in this time period should not be counted as data (Figure 5).
2. To be processed, the bait should be visible in the video. If it is not visible due to water quality or if the camera angle is incorrect, this should be noted in the metadata, but the data from this video will not be counted. If possible, the video should be repeated in the same season.
3. Analyze each 2-hour video sample using VLC media player at up to 3x speed.
4. For each fish passing through the frame of view, record ID to the lowest taxonomic level possible, as well as the time it enters and leaves the field of view.
    a. Watching and then rewatching the video is a useful way to determine if the fish enter and leave the video as a solo group or if another fish or school of fish enter while the first fish or school of fish is still in the frame.
5. Abundance should be estimated overall for the 2-hour session and by species for the two-hour session as $MaxN_{species}$, the maximum number of individuals present in the field of view at one time.
    a. Schooling fish (when numbers are in the hundred) can be recorded as a school instead of trying to count all fish.
6. Total time on camera for each species as well as species richness, overall video period MaxN, and MaxN by each species should be reported for each sampling period video (Figure 5).
    a. MaxN: The maximum number of fish in a given frame regardless of species (e.g.if there were 3 bat rays in the frame, then n=3) (e.g. if there were 3 bat rays and 2 mullets in the frame, then MaxN = 5).
    b. MaxNs: The maximum number of fish in a given frame by species (e.g. if there were bat rays and 2 mullets in the frame, then MaxNs = 3 for rays and MaxNs =2 for mullet; every species in a row)



Frame #	Time	Species	MaxN	MaxNs	Notes
1	0 – 0:15	Red fish	1	1	
2	0:15 – 0:45	Blue fish	1	1	
3	0:45 – 1:15	Red fish	2	1	
3	0:45 – 1:15	Blue fish	2	1	
4	1:15 - 2	Blue fish	2	2	

Figure 5 Example of 4 data frames with associated scoring of MaxN and MaxNs.

References

Wakefield, C. B., Lewis, P. D., Coutts, T. B., Fairclough, D. V., & Langlois, T. J. 2013. Fish assemblages associated with natural and anthropogenically-modified habitats in a marine embayment: comparison of baited videos and opera-house traps. PloS one, 8(3), e59959.

Mallet, D., & Pelletier, D. 2014. Underwater video techniques for observing coastal marine biodiversity: a review of sixty years of publications (1952–2012). Fisheries Research, 154, 44-62.

Cappo, M., Harvey, E., Malcolm, H., & Speare, P. 2003. Potential of video techniques to monitor diversity, abundance and size of fish in studies of marine protected areas. Aquatic Protected Areas-what works best and how do we know, 455-464.

Schobernd, Z. H., Bacheler, N. M., & Conn, P. B. 2013. Examining the utility of alternative video monitoring metrics for indexing reef fish abundance. Canadian Journal of Fisheries and Aquatic Sciences, 71(3), 464-471.

QUALITY ASSURANCE/ QUALITY CONTROL (QA/QC)

SCCWRP will provide training for all field teams prior to the start of the sampling period. This training will include how to construct and deploy BRUV camera setups. Training

will occur in the field and will also serve as an intercalibration exercise to insure that all field teams are collecting and interpreting data in the same way. Following initial training, each team will explore their specific systems with wildlife specialists appointed by the landowners (Fish and Game, etc.) to identify areas of sensitive habitat that should be avoided during sampling. These trainings will be set up to determine specific routes to sampling areas that can be adhered to during each sampling event. The Lead Scientist from each organization will be responsible for ensuring that their field personnel have been trained properly on all field methods and procedures that will be used during the survey. It will be their responsibility to review the Field Operations Manual with their field crews, and to make sure that each person understands that these procedures must be followed during the survey. Personnel that cannot perform a required operation will not participate in conducting that operation.

All data collected on the data sheet should be entered clearly. Field crews should double check that all BRUV cameras recorded video. Team Leaders should also double check that the Data sheets have been completely filled out before leaving a transect site.