Standard Operating Procedures (4.2): Fish Minnow Trap and Enclosure Trap

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Standard Operating Procedures:
Fish Minnow Trap and Enclosure Trap

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Protocol Suitability Evaluation

A habitat suitability table containing appropriate estuarine wetland habitat types (of those evaluated) to implement the fish minnow trap and enclosure trap protocol is displayed in Table 1. Both protocols require consistent tidal or flooded influence; thus, emergent salt marsh is possible, but only during high tide conditions. A comparative assessment of cost, effort, and data quality are shown in Table 2. A matrix of additional detailed categorical evaluations of the fish minnow trap and enclosure trap protocol can be found in Appendix 4.1A.

Table 1. Appropriate habitat types for fish beach seine survey protocols.

	Habitat Types					
Survey Protocol	**Tidal Channel**	**Mud/sand flat**	**Emergent salt marsh**	**Non-tidal salt marsh**	**Salt pan**	**'Degraded' / fill**
Minnow Trap	X	X	X (high tide)			
Enclosure Trap	X	X	X (high tide)			

Table 2. Categorical assessment of cost/effort and data quality for fish minnow trap and enclosure trap survey protocols.

	Evaluation Metric	Minnow Trap	Enclosure Trap	Notes
Time / Effort	Office Preparation Time	30-60 minutes	30-60 minutes	Gather equipment, site selection
	Equipment Construction Time (one time)	10-30 minutes	> 60 minutes	Minnow traps largely pre-constructed; enclosure traps require assembling
	Field Time (per station)	10-30 minutes	> 60 minutes	For both, more fish will require more time
	Laboratory Time (per station)	0 minutes	0 minutes	Not applicable, unless post quality control checks on species identifications are necessary
	Post-Survey Processing / QAQC Time	10-30 minutes	10-30 minutes	----
	Minimum Repetition (site-dependent)	Many Repetitions	Many Repetitions	As fish are highly mobile and variable, repetitions are encouraged but may be time/effort limited
	Relative Cost (equipment and supplies)	> $100	> $100	Minnow traps can be purchased constructed; enclosure traps will need to be made by hand
Survey / Data Quality	Accuracy (at a survey area level)	Low	Medium-Low	----
	Precision (at a survey area level)	Medium	Medium	Heavily species-dependent for both protocols
	Qualitative-Quantitative Score	Quantitative	Quantitative	Relative to time deployed for minnow traps
	Subjectivity-Objectivity Score	Objective	Objective	----

Resulting Data Types

The application of the fish minnow trap and enclosure trap protocol will yield quantitative data displayed as abundances by species or size frequency distributions across multiple time scales. These data are useful to identify targeted species or guilds within particular wetlands, sub-areas, or habitats and to potentially identify the uses or functions of a particular wetland area by specific fish species (e.g., nursery). Both survey methods are targeted towards specific guilds of fish.

Objective

Defining the fish assemblage of a wetland can be difficult, due to the highly mobile nature of the fauna. Fish are often among the first organisms to rapidly colonize restored habitats (Zedler 2001). Wetlands act as nursery habitat for commercially and recreationally important species such as halibut (Beck et al. 2001), and are an assessable component of food web complexity, vertebrate diversity, overarching water quality conditions, and/or anthropogenic stressors (WRP 2006). For example, indicator fish such as the federally endangered tidewater goby prefer tidally restricted or calmer, brackish conditions (Swenson 1997).

The primary purpose of this sampling method is to quantitatively assess the distribution and relative abundances of targeted fish guilds in intertidal wetland habitats using two protocols. While each type of fish sampling equipment exhibits some degree of preferential capture or limitations to specific fauna, minnow traps (Figure 1) tend to capture highly mobile fish species, whereas enclosure traps are targeted towards fish associated with benthos. As such, the general understanding of the fish community and location are key factors in planning these surveys. Minnow traps have been highly successful at capturing typical marsh fish species attracted to bait (e.g., California killifish), while enclosure traps are generally better at capturing fish who reside in benthos or burrows in sediment (e.g., Gobiidae). Additional survey methods are recommended to assess broader fish species richness or diversity (e.g., fish beach seine SOP 4.1).

Equipment

Equipment and supplies needed for both surveys include:

1. GPS and extra batteries
2. Rulers or fish measuring board
3. Aquarium nets (at least two, more are preferable)
4. Buckets and plastic containers (at least two large buckets are recommended, with multiple other containers of varying sizes)
5. Camera and extra batteries or phone with camera application
6. Scale (optional) Note: weighing of fish can be quite time consuming, may result in additional mortality and can be calculated fairly accurately using standard length; alternately, a subset of fish may be weighed, and the data extrapolated.
7. Datasheets (Appendix 4.1B)
8. Tarp (optional for protection of the transport vehicle) and to lay out at a station, if desired

Figure 1. Deployed minnow trap.

Helpful hint: If night fishing is part of the project or site monitoring goal, additional equipment will be necessary, including flashlights, headlamps, lanterns, and/or glowsticks.

Additional supplies for minnow trap survey:

1. Minnow traps and clip (however many the monitoring program requires to be deployed simultaneously; Figure 2)
    a. Minnow traps can be purchased from any fishing store or online and are relatively cheap ($15)
2. Line or rope to attach to shore
3. PCV stake to attach line
4. Pantyhose (optional)
5. Dog food / cat food
    a. Other bait can also used (e.g., squid or shrimp) but should be consistent among sites
6. Marking flags (optional)
7. Zip ties (optional)

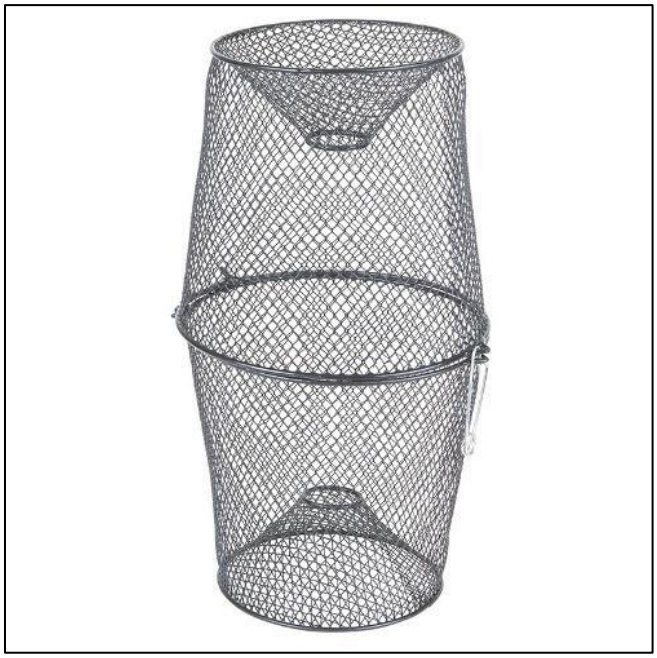

Figure 2. Minnow trap.

Additional supplies for enclosure trap survey (Figure 3): *

1. 3 mm thick sheets of translucent (white) polypropylene plastic (0.9 m in height); two plastic sheets may be needed (standard size is 2.4 x 1.2 m)
2. Lead weights (1.8 kg)
3. Wetsuits or waders / dive or surf booties
4. BINKE nets (benthic ichthyofauna net for coral/kelp environments); see Anderson and Carr 1998 or recommendations in Steele et al. 2006 for specifics. Long-handled large aquarium nets are an alternative option than building a custom BINKE net; however, aquarium nets are far less effective at capturing fish and will require more effort (repetitions) to capture most fish.
5. Long-handled aquarium dip nets (large mouth)

** Supplies recommendations for enclosure traps follow those from Steele et al. 2006 for the 0.5 m^2 sampling area (best recommendation for combination of effectiveness and logistics) or the 0.43 m^2 sampling area, which only will require one sheet of plastic to construct. For 0.5 m^2, the final trap dimensions should be 0.80 m diameter and 2.5 m circumference.*

Figure 3. Enclosure trap being deployed (left), and BINKE net (right).

Field Preparation

Site selection for fishing stations should follow guidelines developed for the SONGS Wetland Monitoring Program (CCC 2006). Many programs throughout California follow those guidelines, which were based on protocols developed by Dr. Joy Zedler. These guidelines recommend sampling multiple stations per estuary spaced a minimum of 100 m apart to decrease chances for spatial autocorrelation. The stations should cover the range of tidal conditions of the estuary (e.g., creeks, channels, and/or basins).

While minnow traps come largely assembled (just need to be clipped or locked), enclosure traps require construction and may vary depending on the monitoring program goals. Enclosure traps should be assembled in the lab prior to field deployment, following protocols and recommendations from Steele et al. 2006. Enclosure traps, also known as drop traps, throw traps, and drop samplers, are bottomless containers of various sizes and shapes that rapidly enclose a known volume of water, trapping mobile animals within them (Steele et al. 2006). The trapped animals can then be removed with nets. Enclosure traps have a higher catch efficiency than most traditional fishing gear (e.g., seines, trawls) (Steele et al. 2006).

Equipment described above should be collected prior to the field shift. Batteries for all electronic devices should be checked and replaced as needed, and relevant data sheets should be printed and attached to the clipboards. *Helpful hint: Waterproof paper can help reduce potential damage to field data sheets, though it is more expensive.*

Field Methods

June and September are recommended as the targeted survey months to coincide with peak fish abundances, but additional survey times (e.g., March or December) may be added by individual site

needs or if additional time may be allocated (Zedler 2001). Sampling should not be conducted within 72 hours of a rain event due to the shift in freshwater conditions.

Minnow trap protocols:

1. Cut approximately 6 in (or 15 cm) sections from the pantyhose, and tie one end if both ends are open. Place one handful of dog or cat food in the pantyhose pouch.
2. Fit two sides of the minnow trap together, but do not clip shut. Lower the filled pantyhose pouch into the assembled minnow trap with enough of the open end to tie a knot remaining outside the minnow trap once it is clipped shut. *Helpful hint: while pantyhose are not required, they are recommended so that the bait does not break apart or is just eaten from the outside of the trap*.
3. Close the minnow trap securely with the clip and tie the pantyhose pouch to the clip with the remaining extra pantyhose on the outside of the minnow trap. *Helpful hint: Zip ties may also be used to ensure the minnow trap securely remains shut through the collection process, but scissors or a knife must be available to open the traps once collected*.
4. Cut a line or rope long enough to ensure the minnow trap will be submerged in the desired location but can also be accessible on land (usually about 4-5 meters). Tie one end of the line using a bowline knot to the clip. The minnow trap is now ready for deployment.
5. 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 (Figure 4).
6. Tie the remaining line onto a PVC stake or marker flag using a clove hitch, and place marker flag into the ground. The duration of the minnow trap remaining in the field depends on your location, tidal conditions, and monitoring program objectives.
7. Once the minnow traps are ready for collection, pull the minnow traps up, unclip the opening (or cut the zip tie if used) and empty the fish into a bucket of water.
8. Rinse minnow traps and line with fresh water and throw away pantyhose pouch.

Figure 4. Deployed minnow trap.

Note: if the survey area is tidal, a medium-high tide is desirable. If the minnow trap is deployed during low tide, the tide may be too low for fish to reach the entrance hole, or potential hypoxia may expose the collected subjects to stressful or fatal conditions. In tidal areas, the maximum duration of time a minnow trap should be deployed is about six hours. Shorter time frames (3-4 hours) may prevent overcrowding in the minnow trap, or predation.

Enclosure trap protocols (follow methods developed by Steele et al. 2006 for the SONGS monitoring program, CCC 2006):

1. Construct the enclosure trap and BINKE nets in advance of fieldwork (see Steele et al. 2006)
2. Deploy enclosure trap by tossing into appropriate habitat area, allowing to sink, and then pressing firmly into the mud. Enclosure trap should be deployed in water at a lower depth than the maximum height of the plastic, such that the fish cannot escape over the lip of the trap. Pressing the trap into the mud will ensure that benthic fish are retained in the trap (Figure 3).
3. Use the BINKE net to sweep the entire enclosure area, trying to stick as close to the walls of the enclosure trap as possible, and pressing it several centimeters into the sediment before snapping closed and removing. Try to shift the sediment out as much as possible before transferring fish to the buckets.
4. Repeat the BINKE net sweeps until you have 1-3 fishless net sweeps (be consistent; the number should be determined by program objectives, effort, and density of fish in each wetland area)
5. Replicate stations (depends on monitoring program objectives, but due to a high level of variability, replication is recommended)

Note: previous studies have determined that burrow-dwelling fish species are still effectively captured using the enclosure trap method (Steele et al. 2006). No chemicals are recommended by this protocol.

Fish identification and measuring protocols:

1. Transfer fish immediately from the minnow traps or enclosure traps into buckets filled with seawater. Identify to species and measure each fish using fish field guides (Miller and Lea 1972, Allen et al. 2006). Appendix 4.1C is an abbreviated fish guide for southern California tidal marshes.
2. If there are fewer than 30 individuals of a species, all fish standard lengths (most anterior part of the upper or lower jaw to caudal peduncle) should be measured to the nearest millimeter (Merkel and Woodfield 2007, City of Los Angeles 2005). If more than 30 individuals of a given species are collected in a single deployment of either survey method, there are two options for measuring (Alternative 1 and 2, below).
    a. Alternative 1: Only the first 30 “randomly” selected individuals of each species will be measured. The remaining fish of that species (> 30) should be counted and held for release in the buckets. This method is not preferred because there is no way to truly determine a random assortment of fish sizes. Grabbing fish at “random” can lead to selection of larger individuals. Small handheld nets swung around without looking into the buckets can assist in reducing selectiveness.

   b. Alternative 2: Measure every fish of a given species of interest (e.g., flatfish, special status species, warm water, or specialized species, etc.).
3. Fish that are too small (e.g., gobies ≤ 10 mm) to accurately identify in the field should be labeled as juveniles.
4. After being counted and measured, fish should be transferred to a release bucket (or released immediately) (Figure 5).
5. Once a trap has been fully counted and measured, any retained fish may be released outside of the immediate station area (to avoid recapture). Some surveyors choose to hold fish in the release bucket until all fishing is completed, ensuring that the bucket is not too hot or holding too many fish, but this can increase mortality. Repeat steps 1-5 for all stations.
6. (Optional) record macroinvertebrate catch data. Programs should be consistent in this level of data collection across surveys. Many wetland monitoring programs count and record macroinvertebrates of specific species such as crabs (e.g., *Cancer* spp., *Portunus* spp., etc.), invasive species (e.g., oriental shrimp, *Palaemonetes* sp.), or other species of concern.
7. Complete the datasheet including start time, duration of survey, cloud cover, and precipitation (Appendix 4.1B).

Laboratory Methods

Not applicable.

Data Entry and QAQC Procedures

Data should be entered in the field using the appropriate data sheet (Appendix 4.1B). All required fields should be completed in full, and the data recorder should assign their name at the top of the document(s). Data should be transferred to the appropriate electronic database within three days, and the hard copies filed in labeled binders. Electronic copies of all data should be housed on an in-house dedicated server and backed up to a cloud-based or off-site server nightly. Hard copies should be saved for five years. Electronic copies should be saved indefinitely.

Quality Assurance and Quality Control (QAQC) procedures should be conducted on all data. QAQC procedures should be conducted by the QA Officer and include a thorough review of all entries, double checking of all formulas or macros, and a confirmation that all data sheets, Chain-of-Custody forms, and field notes are filed appropriately with electronic back-up copies available. QAQC should verify that the entered data match the hard copies of the field data sheets. Any discrepancies should be corrected, and the initial data entry technician notified.

Data Analyses

After data have been entered, corrections made, and QAQC procedure completed, data can be used in multiple analyses. Examples include abundances by species, size frequency distributions, species presence or abundance by station or wetland, etc. If length-weight ratios are developed for individual species, then biomass estimates can be conducted. Note that survey methods collect disparate data. While multiple combinations of survey methods may contribute to an overall master species list, the

data should not be compared quantitatively for abundances. Individual stations (e.g., for minnow traps) may be compared to each other or over time, if consistent effort (deployment time) was used.

Health and Safety Precautions

Care should be taken when handling species with spines (e.g., sculpin, stingrays) or sharp teeth (e.g., lizardfish). Additionally, appropriate attire and clothing should be worn for comfort and warmth in exposure to cold water for extended periods of time, e.g., wetsuit or waders. Bivalves or other invertebrates with sharp features can also be present in survey areas.

Figure 5. Surveyors measuring and counting fish from deployed trap.

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Contact Information

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APPENDIX 4.1A

	Evaluation Metric	Minnow Trap	Enclosure Trap	Notes
	Correlation to L2 CRAM	Attribute 2	Attribute 2	Hydrology-dependent
Personnel Requirements	Specialty Equipment or Clothing Required	Many Specialty Items	Many Specialty Items	Minnow traps, aquarium nets, enclosure traps, BINKE nets, fish measuring board
	Ease of Transport (amount or weight of supplies)	Many or Heavy Items / Difficult	Many or Heavy Items / Difficult	Both sampling methods require bulky supplies, but not heavy
	Ease of Implementation	Easy	Medium	Enclosure traps may require field calibration
	Expertise / Skill Level	Some Technical Knowledge	Some Technical Knowledge	Familiarity with species identifications is required
	Number of Personnel	2 +	> 2	----
	Training Requirements	None	None	Recommended that someone with enclosure trap experience join the field team the first time
	Seasonality of Survey Time	Spring and Fall	Spring and Fall	Both seasons are required to capture the breadth of fish activity and species diversity; spring will capture juveniles
	Suggested Frequency	Semi-annual	Semi-annual	Or more frequent, project-dependent
Survey / Data Quality	Type of Output	Numerical	Numerical	----
	Active or Passive Monitoring Style	Active	Active	----
	Specialty Computer Software Required	No	No	----
	Availability of Online / External Resources	Many	Many	----
Potential Limitations	Wetland Type Applicability	Bar-built and Estuarine	Bar-built and Estuarine	Must have tidal influence or prolonged water exposure
	Images or Multi-Media Required	Images Required	Images Required	Photos are also helpful for species identifications
	Degree of Impact / Disturbance	Low Disturbance	Medium Disturbance	Walking and dragging nets through tidal channels will disturb sediments
	Vegetation Height Limitation	Not Applicable	Not Applicable	Both protocols effective in SAV environments
	Appropriate for Tidal / Wet Habitats	Yes	Yes	----
	Tide Height	Medium to High Tide Only	Medium Tide	Implementation within flood and ebb tides may be possible in full tidal environments; enclosure traps are height limited, minnow traps must stay submerged
	Regional or Broad Implementation *	Occasionally Used	Occasionally Used	----
	Potential for Hazards / Risk	Low Risk	Low Risk	----
	Restrictions	Special Status Species	Special Status Species	----

** based on monitoring literature review*

APPENDIX 4.1B

FISH SAMPLING DATA SHEET

Sampling Program Information	
DATE:	GEAR:
STATION:	PAGE: __of__
STAFF:	
WEATHER:	

Rep	Start time / Stop time	Haul length
1	/	
2	/	
3	/	
4	/	
5	/	

#	REP	SPECIES	SL (mm)	WT (g)	#	REP	SPECIES	SL (mm)	WT (g)
1					36				
2					37				
3					38				
4					39				
5					40				
6					41				
7					42				
8					43				
9					44				
10					45				
11					46				
12					47				
13					48				
14					49				
15					50				
16					51				
17					52				
18					53				
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23					58				
24					59				
25					60				
26					61				
27					62				
28					63				
29					64				
30					65				
31					66				
32					67				
33					68				
34					69				
35					70				

**** measure first 30 of each species**

**** additional counts on back**

COMMENTS:

APPENDIX 4.1B

#	REP	SPECIES	SL (mm)	WT (g)
71				
72				
73				
74				
75				
76				
77				
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112				
113				
114				
115				

#	REP	SPECIES	SL (mm)	WT (g)
116				
117				
118				
119				
120				

1.	**SPECIES:** ___________________________		
2.	30 individuals measured?		(y / n)
3.	COUNT (> 30 but < 100)		(#)
4.	BATCH WT (> 30 but < 100)		(g)
5.	BATCH WT (remaining)		(g)

1.	**SPECIES:** ___________________________		
2.	30 individuals measured?		(y / n)
3.	COUNT (> 30 but < 100)		(#)
4.	BATCH WT (> 30 but < 100)		(g)
5.	BATCH WT (remaining)		(g)

1.	**SPECIES:** ___________________________		
2.	30 individuals measured?		(y / n)
3.	COUNT (> 30 but < 100)		(#)
4.	BATCH WT (> 30 but < 100)		(g)
5.	BATCH WT (remaining)		(g)

1.	**SPECIES:** ___________________________		
2.	30 individuals measured?		(y / n)
3.	COUNT (> 30 but < 100)		(#)
4.	BATCH WT (> 30 but < 100)		(g)
5.	BATCH WT (remaining)		(g)

1.	**SPECIES:** __________________________		
2.	30 individuals measured?		(y / n)
3.	COUNT (> 30 but < 100)		(#)
4.	BATCH WT (> 30 but < 100)		(g)
5.	BATCH WT (remaining)		(g)

1.	**SPECIES:** __________________________		
2.	30 individuals measured?		(y / n)
3.	COUNT (> 30 but < 100)		(#)
4.	BATCH WT (> 30 but < 100)		(g)
5.	BATCH WT (remaining)		(g)

NOTES:

Appendix 4.1C

CLIO

Clevelandia ios

Arrow goby

Dorsal spines (total): 4 - 5; Dorsal soft rays (total): 15 - 17; Anal spines: 0; Anal soft rays: 14 - 17. Caudal rounded

FUPA

Fundulus parvipinnis

California killifish

Max 11cm; squarish tail fin; small pelvic fin, long anal w/ 11-13 rays: olive-green above, and a yellowish brown below

HYGU

Hypsopsetta guttulata

Diamond turbot

Max 46.0 cm; flattened/compressed body; triangular shape

PACA

Paralichthys californicus

California halibut

Max 152.0 cm; typically weighs 6 to 50 pounds (3 to 23 kg); flattened/compressed body; both eyes on one side of head

MUCE

Mugil cephalus

Striped mullet

bluish-gray/greenish above, silver along the sides, white on ventral surface; 6-7 black horizontal bars along sides; no lateral line; pectoral fins high on shoulders, pelvic fins abdominal

ATAF

Atherinops affinis

Topsmelt

silver, w/shiny silver lateral band; blue or green coloration dorsally; gills = golden-yellow; eyes small and beady; top lip folded down; long pelvic fins

GIMI

Gillichthys mirabilis

Longjaw mudsucker

Max 21.0 cm; first dorsal fin is relatively small, with 4-8 spines; second dorsal fin is larger, with 10-17 rays

GAAF

Gambusia affinis

Mosquitofish

small and stout, dull grey, robust fish with a rounded tail and a terminal and upward-pointing mouth

Appendix 4.1C

LEAR	ILGI	URHA	POLA
Leptocottus armatus	*Ilypnus gilberti*	*Urobatis halleri*	*Poecilia latipinna*
Pacific staghorn sculpin	**Cheekspot goby**	**Round stingray**	**Sailfin molly**
Max 46.0 cm, spines just anterior of gills, stripes on fins, slightly dorsally flattened	Max 6.4 cm; shadow spot anterior to pectoral fin	nearly round pectoral fin disc; brown or grayish above; pale yellow spots or reticulations; underside white to yellowish; tail short and stout, with a long, thick, serrated stinging spine	body oblong; head small and dorsally flattened, w/small, upturned mouth; caudal peduncle broad & large, rounded, and sometimes tipped with black