Southern California Bight
2023 Regional Marine Monitoring Survey
(Bight'23)

Sediment Quality Assessment Field Operations Manual

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I. INTRODUCTION

Background

The Southern California Bight Pilot Project (SCBPP) was conducted in 1994 to begin addressing regional monitoring concerns. This project was the largest regional survey of environmental conditions on the mainland shelf in the Southern California Bight (SCB). It capitalized on the interest and cooperation existing in southern California and the resources available in current monitoring programs to develop an integrated and coordinated regional monitoring program that addressed the needs of the participating local, state, and federal agencies, and provided new management information. When completed, the SCBPP provided a first "snapshot" of the state of the SCB. Twelve participating agencies sampled 261 sites on the mainland shelf, which amassed a series of datasets that provided an unprecedented assessment of pollutant exposure, the status of biological resources, species diversity, and the presence of marine debris in the SCB.

Based on the initial success of the pilot program, another cooperative effort was scheduled to take place four years later. The Bight 1998 program continued the development of regional scale management information and followed the general plan of the SCBPP. Sixty-four organizations participated in the effort and the number of sites sampled grew to 416. New indicators were incorporated into the study, and the strata were expanded to include San Diego Bay, Catalina Island, the Northern Channel Islands, and historically sampled reference sites. Five years later, Bight 2003 continued to build on the cooperative interaction developed during the previous surveys. A total of 58 organizations were involved and a total of 388 sites were sampled. New strata were surveyed to include coastal estuaries, the upper continental slope (200-500 m), and the lower slope and inner basin (500-1000 m), using more parameters and new sampling methods. A fourth program, Bight 2008, took place five years later. Sixty-one organizations participated in the effort, sampling a variety of constituents at 383 sites located between Point Conception and the United States/Mexico border, including the newly added contaminants of emerging concern. The fifth survey, the 2013 Southern California Bight Regional Marine Monitoring Program (Bight'13), was comprised of 34 organizations that sampled 397 sites between Point Conception and the United States/Mexico border, including submarine canyons and marine protected areas. The Bight 2018 (Bight'18) survey continued the cooperative trend developed during the prior surveys by involving approximately 46 organizations and samples over 450 sites with the focus on fish bioaccumulation, a brackish estuaries stratum, and emerging contaminants.

The Bight 2023 (Bight'23) survey will continue the cooperative trend developed during the prior surveys by involving approximately 48 organizations that will either participate in the field collections or contribute resources and knowledge towards analyzing the samples and processing the data from over 450 sites. For this survey, some strata effort has been reduced due to cost-saving efforts and molluscan shellfish is the animal group targeted for bioaccumulation. As in the former surveys, Bight'23 will attempt to quantify the general condition of the benthos and the health of key marine resources in the region. To accomplish this goal, Bight'23 will focus on three objectives: 1) estimate the extent, magnitude, and temporal sediment quality impacts in the SCB; 2) determine the extent, magnitude, and temporal ecological changes in the SCB; and 3) determine the extent and magnitude of bioaccumulation in selected sportfishing/commercial shellfish within the SCB.

The Bight'23 Sediment Quality component of the regional survey plans to conduct summer

sampling from July through the end of September 2023. Other components of the regional survey (*e.g.*, Microbiology, Water Quality, Harmful Algal Blooms, Trash/Microplastics, Estuaries, Submerged Aquatic Vegetation) may have different sampling periods. Please see their respective work-plans for details. The purpose of this document is to provide detailed instructions on trawl and benthic field sampling methods that will be used to conduct the Sediment Quality portion of the regional survey.

II. OVERVIEW OF FIELD SURVEY

A. Sampling Period

The index period for the Bight'23 study will extend from July 1 to September 30, 2023.

B. Sampling Design

The Bight'23 study will continue to use a probability-based sampling design developed by the EPA's Environmental Monitoring & Assessment Program (EMAP) that combines the strengths of systematic and random sampling (Stevens et al. 2004). This Generalized Random Tessellated Stratified (GRTS) sampling design creates a spatially balanced random sampling of resources. Although sites were selected randomly, a systematic component was added to the selection process to minimize clustering of sample sites using a 200-meter radial exclusion zone from other randomly selected sites. Some areas had intensified sampling which used smaller hexagonal grids and adjustments were made to their assigned inclusion probabilities to prevent weighting bias. To assess temporal trends, approximately 50% of the Bight'23 samples will be new sites while 50% of the sample sites will be revisited from previous Bight surveys. See the Bight'23 Sediment Quality Assessment Workplan for further details.

Bight'23 has identified 10 different strata that will be sampled in this survey. These strata are classified as follows: inner shelf (5-30 m depth), mid shelf (30-120 m depth), outer shelf (120-200 m depth), upper slope (200-500 m depth), lower slope (500-1000 m depth), Channel Islands National Marine Sanctuary, bays, ports, marinas, and estuaries. Some freshwater estuaries were included for regulatory purposes to help participating organizations (salinity less than 27 ppt).

C. Indicators of Ecosystem Health

The primary goal of Bight'23 is to provide an assessment of the overall ecosystem condition of the SCB. To accomplish this goal, the following indicators of ecosystem health will be examined:

- Benthic - sediment characteristics, sediment contamination, infaunal assemblages, and sediment toxicity.
- Demersal fish and macroinvertebrate assemblages and gross fish abnormalities.
- Marine debris (including plastic, lumber, vegetation, glass, etc.).

III. DESCRIPTION OF FIELD TEAMS AND ACTIVITIES

A. Personnel

All field sampling will be conducted by personnel knowledgeable in safe field sampling methodologies (*e.g.*, benthic sampling, trawling, etc.). Teams of field personnel will be on each research vessel participating in the sampling effort. These groups will vary in size depending on which organization is doing the field sampling. The main requirements are that the personnel on board the vessel:

- Have the knowledge and experience necessary for working with different types of sampling devices.
- Have the knowledge and experience necessary for conducting the field collection and processing of benthic invertebrates and sediments, and trawl-caught demersal fish and megabenthic invertebrates.
- Can troubleshoot problems when they arise.

B. Chain-of-Command

The following chain-of-command is recommended to avoid confusion, identify responsible parties, and ensure that proper sampling protocols and information flow are followed by each organization:

1) The Lead Scientist will be an organization's primary contact regarding all survey and field-related matters.

2) The Boat Captain will not only be responsible for piloting the sampling vessel each day but will also have the sole authority to cease or continue sampling operations when conditions at sea are judged to be unsafe.

3) The Cruise Leader, designated prior to each sampling day, will be responsible for supervising the scientific crew and sampling operations aboard a sampling vessel. This person will have the final decision on whether to abandon or sample a station and will be responsible for assuring the quality of the data. At the end of each sampling day, this person will make sure that all field data and samples are delivered to the appropriate processing personnel in a timely manner. Cruise Leaders are not required to be the same person from field day to field day.

4) Significant changes to the established logistical plan that are outside of the jurisdiction of the Lead Scientist will be communicated to the Regional Monitoring Coordinator (Karen McLaughlin) or the Project Manager (Ken Schiff) before any change is implemented. The teams will accept technical direction from no other authority. All changes to the sampling plan that occur during the field surveys must be documented.

5) All technical matters, such as questions regarding station locations, major sampling

schedule changes, etc., will be discussed between the Regional Monitoring Coordinator and the Lead Scientist, AS SOON AS POSSIBLE, to address and resolve issues. Specific sampling (how-to) and equipment issues should be addressed by the chairs of the Field Technical Committee. The Toxicity Committee chair or the designee may request delays of field teams to accommodate overloaded laboratories and minimize holding time issues**.**

6) On the day of a field audit, the Field QA/QC Auditor and Cruise Leader will discuss any procedural and/or taxonomic issues observed during field operations. Additional concerns may be communicated to the Lead Scientist by the Lead Field QA/QC Auditor. The Lead Scientist will be expected to take the appropriate action to correct the situation as soon as possible.

C. Station Assignments

The study area of the Southern California Bight will be divided among the participating organizations according to the level of effort contributed by each. The number of stations to be sampled by each organization, with associated lab effort are summarized in Table 1. See Bight'23 Sediment Quality Assessment (SQA) Workplan for details on contributed lab effort. Maps and coordinates of the stations to be sampled by each organization are provided in Appendices A and B, respectively. Lab assignments by stations numbers are found in Appendix C.

Table 1. Number of sample sites and analyses by sample type assigned to organizations participating in the Bight'23 study, summer 2023.

Field Organization Codes	Trawl Sites	Grab Sites	Benthic Infauna	Sediment Chemistry	Sed Tox - *Eohaustorius*	Sed Tox - *Mytilus*
CLA-EMD	22	27	39	30	22	0
LACSD	25	34	20	32	15	0
OC San	24	43	41	47	10	0
City San Diego	26	33	41	65	12	0
Oxnard/ABC	19	27	19	0	0	27
NOAA/SCCWRP	0	15	15	15	0	0
RHMP	15	76	74	76	76	76
RMP (POLA/POLB)	0	22	23	23	23	23
WSP (RMP)	3	0	0	0	0	0
US Navy	0	16	16	16	16	16
OC Public Works	0	16	16	16	16	16
San Diego Co-permittees	0	8	8	8	8	8
MBC	0	7	0	0	0	0
Carlsbad Co-permittees	0	5	5	5	5	5
LA Co Public Works	0	4	4	4	4	4
City of Long Beach	0	1	1	1	1	1
CLA-Watershed	0	1	0	1	1	1
RCFC&WCD	0	1	1	1	1	1
SONGS	0	1	0	0	0	0

Unassigned	28	29	15	0	0	0
Totals	162	366	338	310	210	178

Field Organization Codes and Description

Field Organization Codes	Description of Field Organization Codes
CLA-EMD	City of Los Angeles, Environmental Monitoring Division
LACSD	Los Angeles County Sanitation Districts
OC San	Orange County Sanitation District
City of San Diego	City of San Diego, Ocean Operations
OXNARD/ABC	City of Oxnard contracting Aquatic Bioassay and Consulting
NOAA/SCCWRP	National Oceanic Atmospheric Administration partnering with Southern California Coastal Water Research Project
RHMP	Regional Harbor Monitoring Program
RMP	Greater Los Angeles and Long Beach Harbor Waters Regional Monitoring Coalition
WSP	WSP USA Environment & Infrastructure
MBC	MBC Applied Environmental Sciences
POLA/POLB	Port of Los Angeles and Port of Long Beach
RCFC&WCD	Riverside County Flood Control and Water Conservation District– Weston Solutions is contractor
San Diego Co-permittees	San Diego Watershed Group (multiple agencies) – Weston Solutions is contractor
Carlsbad Co-permittees	Carlsbad Watershed Group (multiple agencies) – Weston Solutions is contractor
OC Public Works	Orange County Public Works
LA Co Public Works	Los Angeles County Department of Public Works– Weston Solutions is contractor
CLA-Watershed	City of Los Angeles Watershed Protection District sampling on behalf of Ballona Creek Watershed Management Group (City of Los Angeles, Los Angeles County Flood Control District, Los Angeles County, City of Beverley Hills, City of Culver City, City of Inglewood, City of Santa Monica, City of West Hollywood)
City of Long Beach	City of Long Beach
US Navy	USN NIWC Pacific
SONGS	San Onofre Nuclear Generating Station

D. Equipment

All groups or organizations involved in the sampling program will provide their own research vessel, crew, Van Veen grab, otter trawl, and any other equipment necessary to complete the sampling assignment. A list of equipment used during the survey and characteristics of each vessel are provided in Appendix D and E, respectively.

Grab Sampler
Each organization should have a minimum of two modified Van Veen grab samplers (one is an emergency backup) for offshore stations. Grab specifications are given in Section 8. In addition, organizations sampling freshwater estuaries will have a minimum of two plastic corers with extension poles. Core construction information is found in Appendix L. Microplastic sampling requires two 3-inch diameter aluminum pipe cores.

Trawl Nets
Each organization will have a sufficient number of 7.6 m (headrope) trawl nets and sets of otter boards (doors) available. Net and door specifications are given in Section 9.

Mobile Phones
Mobile phones are required to facilitate communication between the Cruise Leader on the sampling vessels and land-based Bight'23 project personnel. Vessel mobile telephone numbers are listed in Appendix E.

E. Weekly Communications

Representatives from each participating organization will be required to provide SCCWRP with weekly, if not more frequent schedules, of proposed sampling activities prior to conducting operations in the field. A calendar https://bight.sccwrp.org/pages/bight-2023-field has been set up with an instruction button for schedule entry and edits (changes). This notification will include targeted sample types (sediment, trawl, etc.), and station(s) where sampling is expected to occur. The calendar is not set up for a range of dates, so give expected site visits for any given date. Up-to-date information is critical for toxicology lab sample coordination. The toxicology lab sample coordinator may contact Lead Scientists regarding delays if laboratories are overwhelmed. Field QA/QC Auditors will also use this information to schedule when they can conduct field audits for a particular organization. Prior to a QA/QC audit, the Field Auditor will contact a Lead Scientist to verify that their proposed schedule is still in place.

Each organization will at a minimum also be required to make weekly electronic submissions of success and failures at sampling sites. This information will be used to verify that each field team is accurately and completely sampling each station and tracking the overall progress of the project.

F. Important Telephone Numbers

The names and phone numbers of appropriate personnel and emergency services are listed in Section 13 and Appendix J. If an individual cannot be reached at the listed number, the caller

should contact SCCWRP, where an attempt will be made to provide an alternate means by which the individual can be reached.

IV. SAFETY

Sample collection at sea is inherently hazardous and this danger is greatly compounded in bad weather. Thus, the safety of the crew and equipment is of paramount importance throughout the project. Each person working onboard a vessel during the project should take personal responsibility for their own safety. Bight'23 organizers strongly encourage field sampling teams to closely monitor weather conditions while out sampling in the field and always secure any equipment on deck. The Lead Scientist should ensure all crew members/biologists are aware of the task at hand for the day and are comfortable using sampling equipment.

Many accidents at sea are preventable. Safety awareness by the Boat Captain and all crew members is the greatest single factor that will reduce accidents at sea. Each field crew should follow all established rules and provisions within their respective organization's safety program. Sampling should be canceled or postponed during hazardous weather conditions. The final decision shall be made by the Boat Captain, who is responsible for the safety of everyone onboard. As with any field program, the priority is the safety of the people onboard, followed by the safety of the equipment, and then the recovery of the data.

V. QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

A. Protocol Calibration/Quality Assurance Procedures

The Bight'23 survey will be conducted cooperatively by organizations which routinely monitor the marine and brackish environments according to established protocols. It is important to the success of the Bight'23 study that comparable data are collected by each organization. This Sediment Quality Assessment (SQA) Field Operations Manual will provide information on how field operations will be conducted to meet this requirement. The Lead Scientists and Boat Captains will be instructed on the field procedures to be followed during the survey and they, in turn, will instruct their field personnel on the proper procedures for the survey.

The Lead Scientist of each organization is responsible for distributing the Bight'23 SQA Field Operations Manual to all field personnel and ensuring that their staff understands and uses the protocols detailed in the manual.

B. Lead Scientist/Boat Captain Protocol Orientation Meeting

Lead Scientists and Boat Captains of all organizations participating in the survey are required to attend the protocol calibration meeting scheduled for June 21, 2023. The goals and objectives of the project will be discussed at this meeting, as will the responsibilities of the Bight'23 field personnel. Each Lead Scientist participating will be provided with a Bight'23 SQA Workplan and SQA Field Operations Manual. Participants will be instructed on field procedures. The discussion will also include instructions on proper data entry into the field computer application and onto field data forms. The meeting will emphasize decision-making procedures for determining station and/or sample acceptability, and the conditions that must be met before a station is abandoned. Lines of communication within the project and QA/QC activities occurring on the boat during the survey will also be discussed.

C. Scientific Team Training

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 SQA documents (Workplan and 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.

D. Benthic Sampling (See Section 8)

The participation of several different vessels and field sampling teams in Bight'23 requires that uniform procedures be followed in the field to ensure high quality samples and consistent data. All field personnel will be provided with and are expected to have a working knowledge of the Bight'23 SQA Field Operations Manual. The Lead Scientist of each organization will provide the necessary training to ensure their staff fully understands and uses the protocols as detailed in the manual. All participants are expected to understand and properly carry out all steps in the collection, screening, relaxation, and fixation of infaunal samples. They must also understand the techniques related to the collection and handling of sediment microplastic, chemistry and toxicity

samples.

Field audits will be conducted to ascertain an organization's field sampling capability and their adherence to standard Bight'23 protocols. These audits will be conducted by Field QA/QC Auditors. A QA/QC audit will be completed for each organization, when possible, with priorities going to those who are new to the regional survey or have undergone a significant turnover in personnel since previous surveys. Pre-survey audits are acceptable for organizations that use Bight survey protocols as their normal monitoring procedure. Field QA/QC Auditors can request additional field audits at any time and the subject organization is obligated to arrange and allow access to field crews.

The goal of the Bight'23 survey is to collect the full range of predesignated samples at all sites. The Measurement Quality Objective (MQO) of 90% which had been established for completeness for the collection of samples in earlier surveys will apply to the current effort. This completeness goal was established to derive the maximum statistical power of the sampling design and was not set at 100% in recognition that some sites will be difficult, if not impossible to sample. Nevertheless, field crews are expected to strive to collect samples at 100% of the stations.

E. Trawl Sampling (See Section 9)

Demersal fish and megabenthic invertebrate assemblage data (species identification, enumeration, biomass, and fish length) are greatly influenced by the collection methods. Therefore, strict adherence to prescribed sampling protocols are critical. Fish catches are influenced by gear type, deployment, towing speed, tow duration, and method of retrieval. All organizations collecting samples in the field must use standard nets and follow standard trawling procedures to ensure comparable samples are collected. Field personnel will be provided with and are expected to have a working knowledge of the Bight'23 SQA Field Operations Manual. The Lead Scientist of each organization will provide the necessary training to ensure their staff fully understands and uses the protocols as detailed in the manual.

Several QA/QC activities will help to ensure the quality of the trawl survey data. These include intercalibration cruises, checks of equipment, sample processing, and taxonomic identification. Trawl equipment, deployment, and sample processing protocols will be checked during audits. The Field QA/QC Auditors will ensure that the methods used are those prescribed in the SQA Field Operations Manual.

Pre-survey audits will be conducted, when possible, for those organizations who have been consistent participants in past surveys, who have adopted Bight protocols in their normal operations, and who have not undergone a significant turnover in field personnel since the last survey. These audits will permit the Field QA/AC Auditors more time to evaluate field teams with less project-related experience and re-visit as necessary.

Prior to initiating the field checks, each organization will submit complete inventories and dimensions of their field equipment to SCCWRP. That information will be forwarded to auditing teams to assist in their QA/QC evaluations on adherence to procedures and protocols outlined in the SQA Field Operations Manual. Audit data will be recorded on a Field QA/QC Checklist (Appendix I). Any significant deviations will be noted and reported to the crew and the

organization. If left uncorrected, that data could be flagged for QA/QC deficiencies.

During a field audit, the Field QA/QC Auditor will inventory equipment and ensure that an organization conducts trawling operations in the manner outlined in the manual, and that the appropriate information is recorded on data sheets (Appendix I QAQC Audit Form). The Field Auditor will make sure that: 1) the appropriate processing equipment is onboard a vessel; 2) the scales are calibrated/verified at the start of the day; 3) the net is rigged properly; 4) the trawl is deployed and retrieved properly; 5) the catch is properly processed; 6) the appropriate data are recorded; and 7) that the pressure-temperature sensor has been used to record trawl bottom time. The Lead Scientist will be notified of the field audit results so that any problems can be addressed and corrected.

Lead Bight'23 Fish and Invertebrate Taxonomists will be designated prior to the sampling period. In addition, each organization will identify a Lead fish and invertebrate taxonomists for their respective agency. These individuals must have the required expertise in field identification of trawl-caught fishes and/or invertebrates of coastal southern California in depths ranging between 5-1000 m. They will be responsible for providing accurate identifications of species collected during the survey and will complete/oversee a review of the voucher collections before they are shipped to SCCWRP.

While it is expected that the Lead Taxonomists of each organization will have a wide range of knowledge of the common trawl-caught species, it is not expected that all the people making field identifications will know every species. *It is, therefore, very important to avoid guessing when finalizing any identification*. An error made in the identification of an organism may result in an irretrievable error in the database because most of the organisms that are identified in the field are returned to the sea. If there is any question regarding the identity of a specimen, that specimen shall be returned to the laboratory for final identification. Once the final identity of any specimen has been ascertained in the organization's laboratory, that change will be made on either the trawl fish, or the invertebrate species sheets by crossing out the original name (do not erase the original name) and writing the correct name. Conversely, if it has been determined that a species cannot be identified at the organization's laboratory, the specimen will be sent to SCCWRP for further identification. Field organizations have the option to use SCAMIT or SCAITE members for help identifying animals.

Three QA/QC activities will help to ensure accurate taxonomic identification of fishes and invertebrates by providing training and intercalibration among organizations:

1) Prior to the survey, a list of recommended taxonomic identification aids will be distributed to participating organizations. Lists of trawl-caught fishes and invertebrate species from southern California will also be distributed. A reference collection of voucher specimens of species collected during former Bight surveys is available at the Natural History Museum of Los Angeles County for individuals wishing to see species likely to be encountered in Bight'23. In addition, it is recommended (but not required) that field taxonomists attend Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) and Southern California Association of Ichthyological Taxonomists and Ecologists (SCAITE) meetings, and the pre-survey information transfer meetings given at SCCWRP on

the identification of expected trawl species.

2) Lead Taxonomists from every field sampling organization will be required to participate in at least one pre-survey intercalibration cruise to ensure that identifications of commonly occurring species are standardized. Note that for Bight'23, collection permit delays canceled the intercalibration cruises.

3) Lead Taxonomists from each organization will also be required to participate in another pre-survey intercalibration exercise meant to assess the probability of taxonomic error in the field. In this exercise, a bucket of fish specimens and a bucket of invertebrate specimens will be passed among all participating organizations prior to the survey. The Lead Taxonomists will submit a list of species in the buckets but other taxonomists within their organization can aid in identification. Organizations can use all laboratory tools (*e.g.*, microscopes, taxonomic keys). The goal is to identify these trawl-caught species to the lowest taxon possible. A numbered tag will be attached to each organism so that the identifications can be checked against the correct specimens. This exercise will focus on identification errors. Correct identifications or "Return for Further Identification" (FID) are acceptable. FID indicates that the specimen would have needed outside taxonomic expertise for final identification. Organizations with more than 10-15% misidentifications (fishes and invertebrates separately) will redo the exercise with a different bucket of organisms. If an organization cannot meet this requirement on the second or third attempt, a qualified taxonomist from another organization must be on-board when trawl sampling is conducted.

F. Measurement Quality Objectives

Measurement Quality Objectives (MQOs) are defined in terms of accuracy, precision, and completeness. Acceptability criteria have been established for sediment grabs and trawl sample collections. The goal of the Bight'23 sediment grabs is to collect samples for infauna and chemistry at all designated stations. The goal of the Bight'23 trawl survey is to collect samples at all designated stations, identify all the organisms correctly, and to obtain accurate counts, measurements (for fishes), and weights on all species. However, the MQOs will be set at lower values in recognition of the realities of field sampling. Because some stations may occur on rocky bottom, the MQOs for the study completeness objective for trawl sample collection will be 90%. Of the samples collected, 100% will be processed, identified, counted, measured, and weighed. Accuracy and precision expectations for the crew performance are 90% for identification, counting, lengths, and biomass (± 0.2 kg) and 90% for anomalies.

Indicators	**Accuracy(Error)**	**Precision**	**Completeness**
Benthic Sampling			
sample collection	NA	NA	90%
Demersal fish and macroinvertebrates			
sample collection	NA	NA	90%
counting	10%	NA	90%
identification	10%	NA	90%
length	10%	NA	90%

biomass	10%	NA	90%
external anomalies	10%	NA	90%

VI. INFORMATION MANAGEMENT

A. General Requirements

A general Bight'23 Web portal or landing page has been created: https://bight.sccwrp.org/pages/bight-2023. Field portal, https://bight.sccwrp.org/pages/bight-2023-field, contains the field event planning calendar (field work and toxicology lab planning), lookup lists, documentation, Excel data templates, submission/data checker web page and data change request form. See the Bight'23 Information Management (IM) Manual for format instructions and descriptions.

A field computer should be used whenever possible to minimize transcription errors during station occupation and event (grabs, trawls) activities. Sampling organizations have the discretion to use their own field computer system. An Esri Survey123 application is available for organizations needing a field computer system. If a field computer cannot be used, all required sampling event information must be recorded on Bight'23 field data sheets and subsequently loaded into Microsoft Excel data files for submission to the Bight'23 Data Checker. Field data sheets and related activities/information must be available for at least 5 years for data checks and event inquiries.

B. Bight'23 Field Data System: ESRI Survey123 application

For those organizations not using their own computer system, SCCWRP developed an Esri Survey123 application. To get the application, request an agency name and password. You must have the free parent application (ArcGIS Survey123 field app) on your tablet, phone, or PC (device should be GPS enabled). Visit Google Play, Apple Store, Microsoft Store, or Esri web site https://www.esri.com/en-us/arcgis/products/arcgis-survey123/downloads. Visit SCCWRP's Portal to download 2 separate Survey123 applications: Bight 2023 Grab Survey and Bight 2023 Trawl Survey. The applications facilitate the collection of all the required station occupation and field sampling event information (*e.g.*, grab and trawl sampling events). The applications were designed to be used on Android tablet/phones, iPad/iPhone, and PC laptop computers. If the device does not have an internal GPS, a secondary unit is needed to manually input GPS coordinates. The app is based on intuitive questions (instruction sheet can be sent via email). Use of the Bight'23 Field Data app is optional during the survey.

Benefits of using the Esri Survey123 app:

- Runs in Android, iOS, and Windows environments.
- Employs drop-down lists or radial button selections of acceptable values in many entry fields, which reduce entry time and assures accuracy and compliance with Bight'23 data standards.
- Data is stored locally as an Esri database that links to the web portal. The data file can be exported for field organizations' internal use.
- Capable of being used as simple data entry system for information collected at sea on paper field sampling data sheets or may be used as a primary data collection tool.

C. Bight'23 Field Data Submissions

Web portal. Data submission is through SCCWRP's online data submission page. Web page: https://bight.sccwrp.org/pages/bight-2023-field The system requires that files be submitted as Microsoft Excel spreadsheets with specific tab names and field names (see table structures in the Bight'23 SQA IM Manual or instructions on the web portal). No csv files will be accepted. Specific questions regarding how-to instructions for data entry should be directed to the Field Technical Committee.

Web portal data checker. A Python-based program checks for appropriate parameter ranges, required fields, valid values from constrained look-up lists, and proper formatting/adherence to Standard Data Transfer Protocols (SDTPs) described in Bight'23 SQA IM Manual or on the web portal. Spelling, punctuation, and proper formatting are extremely important. For example, improper capital letter, additional characters (*i.e.*, spaces, underscores), character data in numerical fields, inputted values into fields constrained by a list, or omitting fields that require a value will generate an error that needs fixing. In addition, there may be QA calculations done on the data to look for outliers which generate warnings but meet IM checks.

VII. SAMPLING LOGISTICS

A. Navigation

Accurate location of sampling sites is crucial to the success of the Bight'23 survey. Station maps and coordinates (latitude and longitude) are provided in Appendices A and B. Vessel positioning will be determined by means of Wide Area Augmentation System (WAAS) or Global Positioning System (GPS). If a vessel with an integrated GPS is not available to work within the four types of inner coastal strata, using a hand-held device is an acceptable substitute.

B. Sampling Schedule

The benthic and trawl surveys may begin July 1, 2023. All field work may be completed in the order that each organization sees fit, as long as the survey is completed by September 30, 2023.

All grab samples will be collected between sunrise and sunset, except for sediment chemistry and sediment toxicity; those samples may be collected anytime throughout the 24-hour period. Otter trawl samples must be collected between one hour after sunrise and one hour before sunset.

C. Station Types

Stations located within the ten strata will be sampled during the survey. These strata are classified as follows: inner shelf (5-30 m depth), mid-shelf (30-120 m depth), outer shelf (120-200 m depth), upper slope (200-500 m depth), lower slope (500-1000 m depth), Channel Islands National Marine Sanctuary, bays, ports, marinas, and estuaries.

The project sampling station/stratum information is listed in Appendix B. If relocating a station moves the station into a different sampling stratum, the station will be abandoned and a new replacement/overdraw site within your region will be assigned. Note in the comments section of the field data sheet the reason for abandonment.

D. Site Acceptability Criteria

The location of each sampling site will be designated in advance as a set of coordinates (latitude and longitude). Upon arrival at the site, the depth will be determined by fathometer and recorded prior to sampling, as well as a validation coordinate. This will be regarded as the target depth for all subsequent sampling at the site during the survey and will be used for determining site acceptability. While all sites are single points defined by latitude and longitude, occupation within a specified distance (*i.e.*, the radius limit) of the target coordinates will be considered acceptable. This radius limit will be 100 m for all sites except those within the island strata. The radius limit at the Northern Channel Islands will be 200 m because of the known extent of rocky bottoms in the area.

Sampling may not be possible at some sites for a variety of reasons (*e.g.*, kelp beds, rocky bottom, falling outside depth range of stratum, otherwise obstructed or unapproachable, etc.) Sites may be abandoned if they fail to meet site acceptability criteria, or if samples at the site fail to meet sample acceptance criteria. The criteria and process guiding this assessment are described below and summarized as a decision tree in Figure 1 (benthic sites) and Figure 2 (trawl sites).

1) Occupy the target coordinates as closely as possible.

2) If occupation is not possible within the radius limit due to physical obstructions (*e.g.*, harbor facilities), or access prohibitions (*e.g.*, harbor security closures), or land obstruction, abandon the site and record the reason for abandonment in the field computer or on a field data sheet. Sites with temporary obstructions (*e.g.*, moored vessel) should be revisited and sampled when the area has been vacated. If the station cannot be sampled due to an extended period of occupation, note the justification on the data sheet and abandon the site.

3) For benthic sites, if occupation is possible but the target coordinates lie over unsuitable substrate or the site is physically obstructed (*e.g.*, dock, vessel, rocky reef, or kelp bed, is beyond the depth limits of the survey, is beyond the capability of a sampling vessel, etc.) as determined by visual observation and fathometer survey, attempt to find an acceptable occupation within the radius limit and record target depth. If unsuccessful, check at least one other site. If an acceptable occupation is not possible, abandon the site and record the reason for abandonment on the field computer, or on a field data sheet. If intermittent success is achieved, a minimum of nine attempts at stations <500 m is recommended before abandoning the site. The Cruise Leader can choose to continue sampling beyond the minimum limit if it is decided the effort is warranted.

4) For trawl sites, occupy the station location and record the depth before conducting a pre-trawl fathometer survey. The survey should then be conducted to determine if the site can be sampled within the radius limits. If that survey identifies unacceptable substrate or if the site is deemed otherwise unsuitable for trawling by the Cruise Leader, the site should be abandoned.

5) If an acceptable occupation is possible, proceed with sampling.

6) Sample acceptance criteria are described for benthic sampling in Section 8 and for trawling in Section 9 and are summarized in the decision tree in Figures 1 and 2.

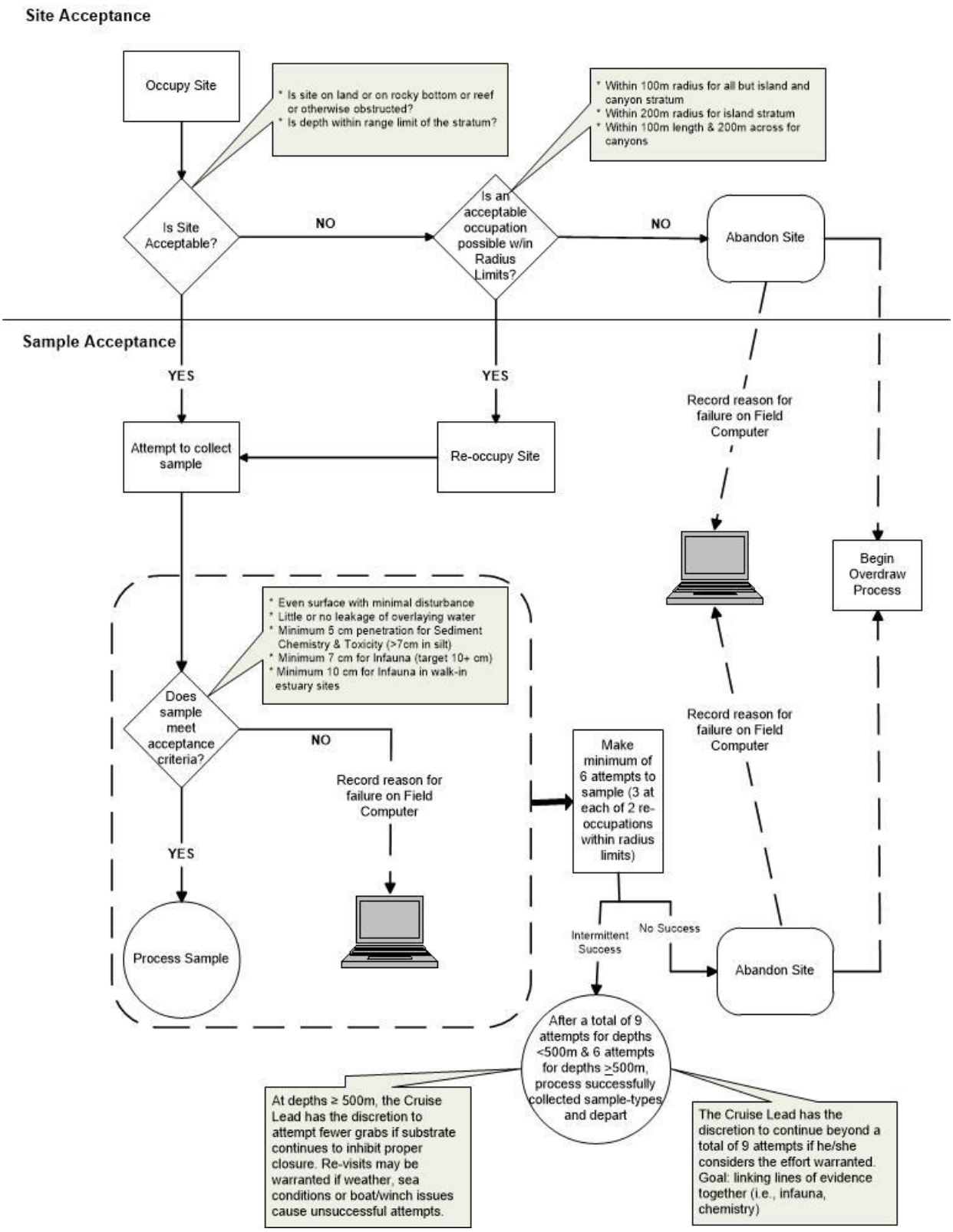

Figure 1. Benthic sampling site and sample acceptance process

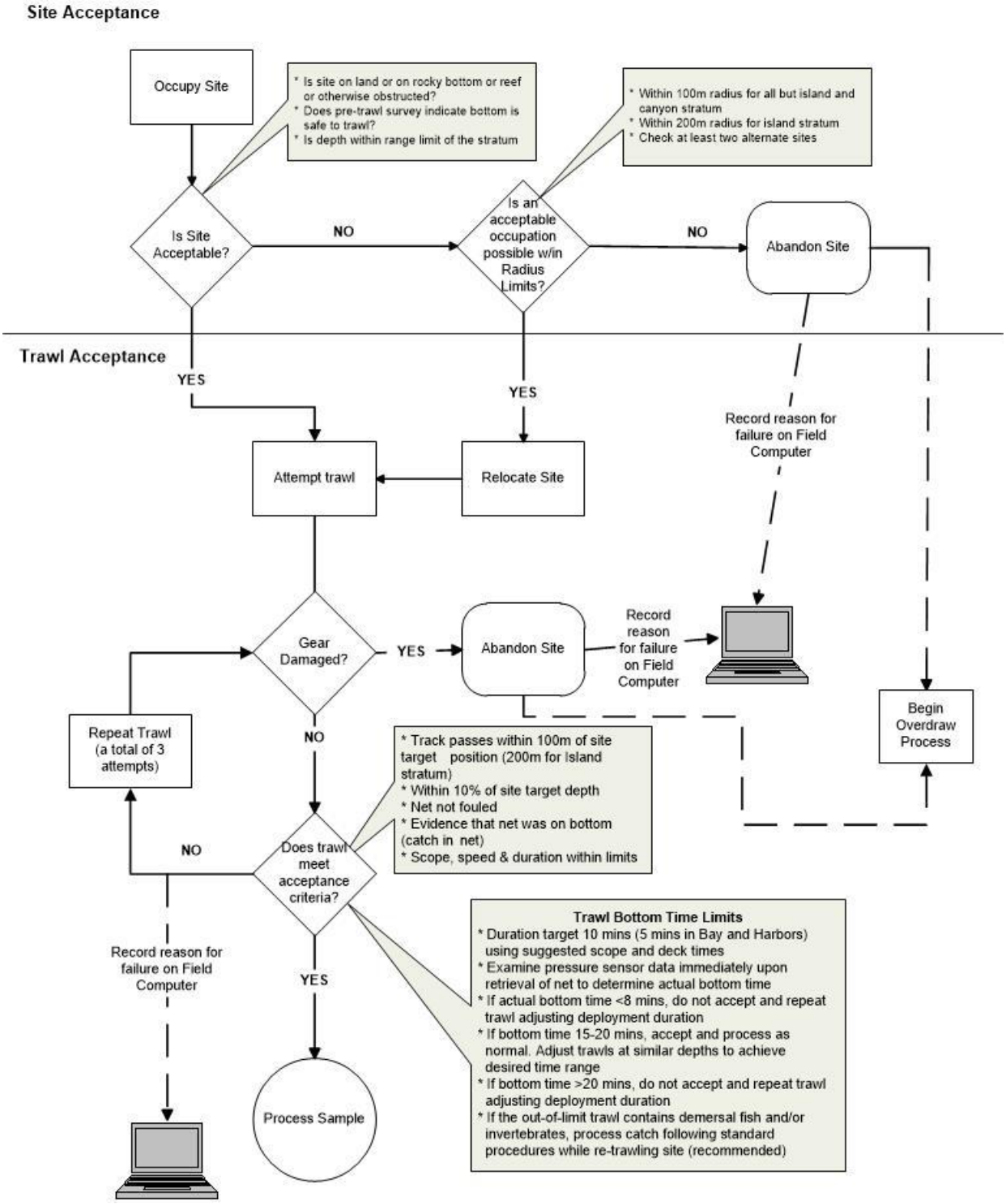

Figure 2. Trawl sampling site and sample acceptance process

E. Site Rejection Strategy

A sampling site may be rejected if any of the following occurs:

1) If the location places the site on land or in an obviously unsuitable location.

2) If the site exceeds or falls below the depth boundaries defined by the strata (*e.g.*, inner shelf 5-30 m, mid shelf 30-120 m, outer shelf 120-200 m, upper slope 200-500 m, lower slope 500-1000 m). Another depth related rejection strategy for grabs and trawls are changes of +/-10% to the established station occupation depth. Safety-related rejection strategies are depths less than 6 m in coastal ocean, 3 m in embayment, and 1 m in estuaries (main channels). The freshwater estuaries have no limit set because sites could be wadable so field crews must decide on safety concerns during sampling.

3) Estuaries have no salinity criteria. Salinity is measured near the sediment/water interface and recorded on data sheets.

4) For benthic sites <500 m, if suitable substrate cannot be found after three grabs at the nominal location, and up to three attempts each at a second and third location, the station will be abandoned. For benthic sites >500 m, a station will be abandoned after three unsuccessful attempts at two locations for a total of six attempts. Field crews have the discretion to attempt fewer grabs if substrate continues to inhibit proper closure. Field crews also have the option to attempt more grabs to complete station requirements. Adequately record the reason(s) for abandonment in the field computer, or on the field data sheet.

5) For trawl sites, if the fathometer survey identifies unsuitable substrate at three locations within the radius limit, if any equipment is lost or damaged, or if the site is deemed unsuitable by the Cruise Leader, the site will be abandoned completely. Additional rejection criteria can be found in Figure 2. Adequately record the reason(s) for abandonment in the field computer, or on the field data sheet.

F. Scientific Collecting Permits

A Specific Use permit has been submitted to the California Department of Fish and Wildlife (CDFW) but each organization can procure their own permits. Prior to collecting fish and invertebrate specimens in the field, each organization must submit a Notification of Intent to Collect for Scientific Purposes on the Scientific Collecting Permit Portal (on the permit) a minimum of 24 hours (business day only) prior to any collection activity. Submit the notices in Section 1a- Notification of Field Work or Activities on the Scientific Collecting Permit. You will need to log into the Scientific Collecting Permit Portal (SCPP) and navigate to the application. Do not select any links until you are in the application that you are notifying for. Once there go to Section 1a and click the hyperlink saying, "Add Notification Record". Then input the notification information into the portal and click "ok/save". Once the line is added click the blue submit word at the end of the line.

This form can be found at https://www.wildlife.ca.gov/Licensing/Scientific-Collecting. This

form is only to be used if the portal goes down. Any forms emailed or faxed will not be accepted unless given prior approval to use this format.

For Specific Use permits, the Principal Investigator or any listed Authorized Individuals on their permit and the permit must be onboard during sampling, and it must be presented to any CDFW warden, or personnel who request to see it. In the case of entity permits, the Principal Investigator does not need to be present, but the Authorized Individuals and permit (or reasonable facsimile) must be aboard the vessel. The phone number for the Monterey Marine Regional office is listed in the next section.

Vessels trawling at sites outside the state 3-mile limit require a federal (NOAA, National Marine Fisheries Service) letter of acknowledgement (LOA) or formal permit because of ground fish restrictions in the Southern California Bight. An LOA has been obtained and all vessels trawling in federal water must carry a copy of the LOA aboard the boat. Contact Dario Diehl (dariod@sccwrp.org) for a copy of the LOA.

G. Contact Information

It is recommended that all groups conducting fieldwork in harbors, ports, and marinas contact local security prior to attempting fieldwork in the area. Prior experience suggests that you contact the security several days prior to the work through their central numbers, then again on the day of operations, through dispatch if possible. Let them know where you will be working, and time periods, then note the name and date on which you called the security agency. If you are requested to fax in information (number may not be listed), have a copy with you in the field, and always have your scientific collecting permit – security may never have seen one before, but it does help to be able to show a permit for the activities.

In the Port of LA, call the Port Police Watch Commander each morning before starting. In the Port of Long Beach, call the Harbor Police and leave a message with the City Police. The Wharfinger and Port Pilots have been included to notify them of trawling operations and check traffic planning. It is very important in the Ports to notify the United States Coast Guard (USGS) Waterway Management of sampling plans, since the USCG is likely to be first to respond if you are reported.

It is also recommended that the USCG be informed of all nearshore sampling activity. USCG permission is needed to enter some security areas before sampling. Navy or Marine permission may also be needed.

MONTEREY

Dept. of Fish and Wildlife Marine Region 831- 649-2870

Problems with CDFW "Intent to Collect for Scientific Purposes" notification system:

Tammy Heitzenrater 831-234-0810
Tamara.Heitzenrater@wildlife.ca.gov

OXNARD/VENTURA/SANTA BARBARA

US Coast Guard

Channel Islands Coast Guard	805-985-9822		

Santa Barbara Harbor

Santa Barbara Harbor Patrol	805-564-5530		

VENTURA HARBOR

Ventura Harbor Patrol	805-642-8538		805-642-8618 0600-0200hr
VHF radio channel 16 Ventura Lifeguards	805-648-3321		

Channel Islands Harbor

Channel Islands Harbor Patrol	805-382-3007	and	805-382-3001
Emergency line:	805-382-3000		
VHF radio channel:	16, 12 and 73		
Channel Islands Coast Guard	805-985-9822		

Port Hueneme

Oxnard Harbor District	805-488-3677
Navy	805-982-4711

Mugu Lagoon

Pt. Mugu Security Dispatcher	805-989-7907

SANTA MONICA/LOS ANGELES PORT/LONG BEACH PORT/ORANGE COUNTY

USCG Waterway Management

USCG LA Region	310-521-3860	310-521-3869fax
VTS	Channel 14	
In POLA/POLB Bridge to Bridge	Channel 13	

Santa Monica Bay Area

Redondo Beach Harbor Patrol	310-318-0631
Marina Del Rey Harbor Patrol	310-823-7762
Los Angeles County Lifeguards	310-372-2166

Los Angeles Harbor/POLA

Los Angeles Port Police Watch Commander	310-732-3491
Los Angeles Port Police - general	310-732-3500
Los Angeles Wharfinger	310-732-3810
Los Angeles Port Pilots	310-732-3805
notify and monitor on channel 73	
Los Angeles City Lifeguards for Cabrillo Bch.	310-548-2909
Marine Exchange of Southern California	310-832-6411

Long Beach Harbor/POLB

POLB Wharfinger	TenantServicesOffice@polb.com
	notify prior to sampling in POLB
Long Beach Police Dept. (leave msg if no ans.)	562-570-7182 msg
LB Harbor Patrol Dispatch (On-Water)	562-283-7820
Long Beach Pilots - Field office	562-432-0664
notify and monitor on 12 and/or 74	
Long Beach Pilots - Main Office	562-435-5435
City of Long Beach Police Dispatch	562-435-6711
(San Gabriel River work notification)	

Long Beach Downtown Marina/Alamitos Bay

Long Beach Marine Patrol		
Non-emergency patrol dispatch	562-435-6711	562-570-3249fax
Administration	562-570-3245	0700-1700hr
E-Mail:	marinepatrol@longbeach.gov	

Orange County Harbors

Orange County Sheriff's Harbor Patrol Division		
Sunset / Huntington Harbor	714-840-5222	
Newport Harbor	949-723-1002	
Dana Point Harbor	949-248-2222	
Seal Beach Lifeguards	562-431-3567	562-598-8560fax
Huntington Beach Lifeguards	714-536-1454	714-536-0074fax

SAN DIEGO REGION

US Coast Guard

USCG San Diego Region	619-683-6495

SONGS Area

SONGS Security Zone extends 1 nautical mile radius. See below.
Need authorization from SD USCG Captain of the Port to enter, transit, or anchor. Only SONGS Security can initiate the request for authorization.

Pendleton Area Marine Activity Exclusion Zones

Two restricted navigation areas have been established offshore of Camp Pendleton for military training and activities. The area between the downcoast mouth of the Santa Margarita River and the upcoast edge of the Oceanside Harbor breakwater, is a restricted area that extends 1,800 m offshore. Any activity in this restricted area that may endanger underwater installments such as anchoring, fishing, or trawling is prohibited at all times. Traffic may cross the area if the vessel maintains a direct route without delay. A second restricted area occurs north of the Santa Margarita River for most of the length of Camp Pendleton. This is a military exercise area, which cautions mariners of activity between 0600 and 2400 hrs.

Oceanside Harbor

Harbor Police	760-435-4050

Mission Bay

Mission Bay Harbor Patrol	619-531-2000
Lifeguard Business Office	619-221-8899
Mission Bay Harbor Unit	619-221-8985

San Diego Bay

San Diego Bay Harbor Police	619-686-6272
Navy Base San Diego (NBSD) Patrol Operations	619-556-1442
Deputy Chief of Police	619-556-6662
Security Officer	619-556-6954

VIII. BENTHIC SAMPLING

A. Purpose

The purpose of benthic sampling is to obtain data on localized community structure of infaunal invertebrate assemblages, the surrounding sediment chemistry characteristics, and contaminant load from specific sampling sites. The pooled information is useful in determining not only the distribution, abundance, and diversity of infaunal organisms, but also whether the observed community patterns have been influenced by environmental and/or anthropogenic perturbations. Detergents currently on the market can introduce potential contaminants and toxicity to the sample. Use a minimalistic cleaning procedure (lots of ambient water, scrub brush to remove particles, final de-ionized water rinse) between sites. Use best professional judgement if sites exhibit oily residue or other potential cross-contamination issues. Follow SQO procedures (http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/777_CASQO_TechnicalManual.pdf) or established EPA procedures (https://www.epa.gov/quality/field-equipment-cleaning-and-decontamination-fec).

A few freshwater estuaries will be sampled for regulatory purposes during this survey. Benthic sediments from this stratum will continue to be collected using either a Van Veen grab, Ponar grab, or 4-inch plastic cores. All biology or infauna samples must be collected using a 4-inch core (Appendix L for construction details) and screened using a 1.0 mm sieve size. Chemistry samples can be collected using a light weight stainless-steel Petite Ponar, plastic core, or chemistry scoop. See chemistry sections for details.

B. Sampling Effort

A total of 370 benthic stations will be sampled during the survey. Table 1 and Appendices A and B provide information on the total number of stations and the parameters that will be sampled by each participating organization.

C. Sediment Samplers

Van Veen Grab. A 0.1 m^2 modified Van Veen grab will be used to collect sediment samples (optional in brackish estuaries) for physical, chemical, and infaunal analyses (Stubbs et al. 1987). This device must be custom manufactured by in-house agency shops or commercial metal fabrication shop. Previous sources included the University of Washington, Scripps Institution of Oceanography (shop), and Jon Carr (Santa Cruz). The grab may be constructed of stainless or galvanized steel. All surfaces of the grab must be clean and free of rust. Either single or tandem Van Veen grabs are acceptable.

Petite Ponar. If a Petite Ponar is used for chemistry at the **freshwater estuary** sites, it must be stainless-steel because sediment touching the sides may get sampled. It is a miniature size of a Van Veen with small surface area and maximum penetrations of 7-8 cm with little or no room to scoop sediment from retractable doors. The inner surface of this small grab must be clean, free of residual sediment, and rust free.

Plastic Push Core. A 4-inch plastic core has been designated as an alternative to the standard

Van Veen sample device for benthic infauna sampling at walk-in **freshwater estuary sites only**. It can be used for chemistry sampling at **freshwater estuary sites only except for microplastic samples (see details in section E)**. The construction SOP can be found in Appendix L. The diameter of the core is standardized to the inner diameter (ID) of the tube. Biological samples must have a penetration depth of 10 cm.

D. Salinity Measurement at Estuary Sites

Water samples should be taken at or near the bottom (near the sediment/water interface). Use a Niskin sampler, other water sampling devices, or overlying water from the grab. It is recommended that a salinity meter be used to measure salinity in Parts Per Thousand (ppt) units. A conductivity meter (uS/cm) can be used, but temperature (°C) must also be recorded, and the values converted to Practical Salinity Units (psu) through a formula in Standard Methods (1999). Allow the temperature to stabilize before recording values. Follow the steps outlined below:

1. Determine an expected reference Kcl conductivity (C) for the measured temperature (t)
   $C\ (Kcl) = d_0t^3 + d_1t^2 + d_2t + d_3$
   Where: d_0= -0.0267243, d_1= 4.6636947, d_2= 861.3027640, d_3= 29035.1640851
2. Determine the conductivity ratio from measured conductivity divided by reference C (Kcl)
   R = C (sample) / C (Kcl)
3. Determine Delta S for a reference temperature of 15°C
   $Delta\ S = ((t - 15 / (1 + 0.0162\ (t - 15))) (b_0 + b_1R^{1/2} + b_2R + b_3R^{3/2} + b_4R^2 + b_5R^{5/2})$
   Where: b_0= 0.0005, b_1= -0.0056, b_2= -0.0066, b_3= -0.0375, b_4= 0.0636, b_5= -0.0144
4. Determine Salinity for the measured temperature
   $S = a_0 + a_1R^{1/2} + a_2R + a_3R^{3/2} + a_4R^2 + a_5R^{5/2} + Delta\ S$
   Where: a_0= 0.0080, a_1= -0.1692, a_2= 25.3851, a_3= 14.0941, a_4= -7.0261, a_5= 2.7081

*Note: ppt/psu are historical unit references for salinity because calculations using a conductivity cell are unitless.

E. Special Freshwater Estuary Sampling

Site requirement is 6-inches or more of estuary water at Mean Lower Low tide. If the site is on land or has less than 6-inches of water, move to nearest main channel or deeper area but stay within 100 m of the assigned site. It is recommended that field teams do reconnaissance at the site close to MLLW, less than or equal to 0.5 ft on tide charts, and measure salinity near sediment interface. Unacceptable sites get abandoned and a new overdraw site is assigned. If the site is acceptable, field teams can revisit the site anytime afterwards to complete sampling. Note that estuary sampling is standardized to a Van Veen grab, but the field committee recognizes the logistical difficulties it entails. Infauna biological sampling in walk-in areas will accept a 4-inch PVC or aluminum push cores with minimum 10 cm penetration (Appendix L for construction SOP). Attach a pole extender to the core in intermediate water depths (Appendix L for construction SOP). It is recommended that organizations use a Van Veen in deep water. Infauna samples will be screened using a 1.0 mm sieve.

Chemistry sampling can also use the 4-inch push core, except for microplastics. Samples for microplastics must use a 3-inch aluminum push core (pre-rinsed with microplastics analysis grade

(MAG) water just before use). For general chemistry, push the core 5 cm into sediment and dump it into clean pan (e.g., aluminum, stainless steel) to remove overlying water. For microplastics, dump the contents of the aluminum push core directly into a 16 oz mason jar. At 50% of the microplastic sites, a blank must be opened and exposed to air while sediment sampling occurs. Microplastic samples must be refrigerated (do not freeze). A Petite Ponar grab can also be used for chemistry but ensure a minimum penetration of 5 cm. Collect PFAS first (metal scoop, no Teflon items such as lined lids). Additional cores for other constituents (e.g., chemistry, toxicology) should be scooped into a Teflon bag for homogenization and distribution.

F. Grab Sampling Procedures

Van Veen Grab

Prior to deployment, the grab is cocked with the safety key in place. The grab is then hoisted over the side, and the safety key is removed. The grab is lowered at up to 2 m/sec until it is approximately 5 m above the bottom, then lowered at 1 m/sec to minimize the effects of bow wave disturbance of the surface sediment. In water depths greater than 300 m, the rate of deployment may have to be reduced to <1 m/sec to avoid the grab from drifting and/or premature tripping in the water column. After bottom contact has been made (indicated by slack in the winch wire), the tension on the wire is slowly increased, causing the lever arms to close the grab. Once the grab is back on board, the top doors are opened for inspection.

While a radius limit of 100 m (200 m for island strata) has been established for site occupancy, once sampling has begun, the Cruise Leader will ensure that the vessel is maintained on station with as much precision as conditions allow. Because analytical results from separate grab samples will be used to characterize the benthic community biointegrity, contaminant load and, in many cases, toxicity of the sediment, each successive grab must be collected as close as possible to the others.

G. Priority of Grab Sampling

The priority of sampling at offshore sites are 1) infauna, 2) microplastics, 3) PFAS, 4) remaining sediment chemistry constituents, grain size and 5) sediment toxicity. Sites may not have all these sample types assigned to them. If it is impossible to obtain all assigned sample types required at a station, those samples successfully collected shall be processed and retained. The field crew has the discretion to return and complete sampling or abandon the site. Embayment sites that require both sediment chemistry and toxicity samples must collect sufficient sample for homogenization and distribution (up to 8 L). Only those sites meeting the sample acceptance criteria and sample volume requirements are designated successful.

H. Criteria for Acceptable Grab Samples

Site acceptance criteria and procedures are described in Section 7. Both site and sample acceptance criteria are summarized as a decision tree in Figure 1.

Once a site has been successfully occupied, grab sampling may still prove impossible or very difficult. Different sediment types (*e.g.*, cobble, gravel, well-sorted sands, etc.) and localities (*e.g.*, canyons, slopes, and rocky areas) may be difficult to sample. Sediments containing rocks often

create the most common problem by preventing complete closure of the grab and allowing sediment to wash out during retrieval. The randomized sampling design may cause some of the Bight'23 sampling sites to occur on these difficult sediment types or localities. Therefore, if after three consecutive unsuccessful grab attempts at a site and up to three more consecutive unsuccessful attempts at two other locations (nine total attempts within the radius limit and +/- 10% of the depth of the target site), the station should be abandoned, and the reason noted in the field computer or on a data sheet. Note: *if any grab was unsuccessful due to the result of mechanical (early closures, chain fouling, flipped grab, etc.) versus natural causes, it will not be included in the failure total and sampling should continue.*

If sampling success at a station is inconsistent, sites >500 m may be abandoned after a minimum of six attempts at two locations. In this case, only the successfully (complete) collected sample types should be processed and retained. A Cruise Leader may decide to revisit the site another day to complete sampling. The goal is to collect infauna and chemistry at a site to link lines of evidence.

These are the minimum efforts justifying site abandonment. Sampling failures due to operational error (*e.g.*, premature tripping) do not count towards this minimal effort. The Cruise Leader has the discretion to make a greater or lesser effort if he/she feels that it is warranted, or equipment safety is a concern. The reason for site abandonment must be documented in the field computer or on the field data sheets.

Upon retrieval of the grab, the acceptability of the sample must be determined. Acceptability is based upon two characteristics of the sample: sample condition and depth of penetration. Sample condition is judged using criteria for surface disturbance, leakage, canting, and washing (Figure 3).

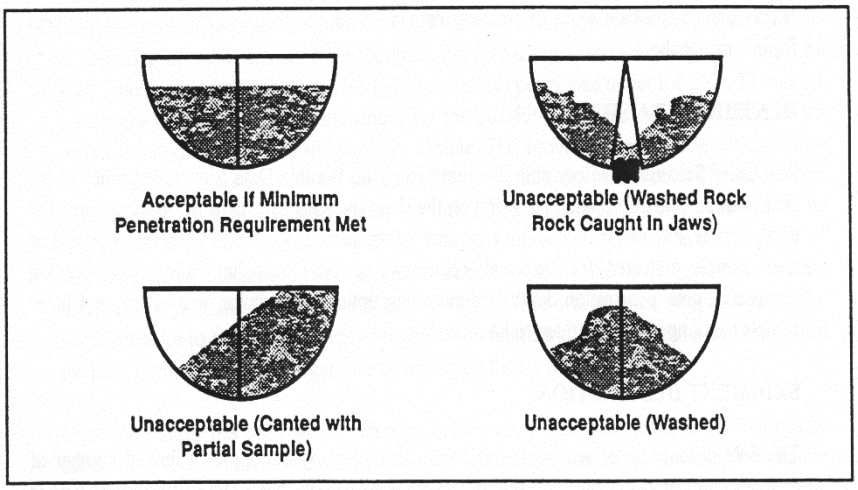

Figure 3. Examples of acceptable and unacceptable grab sample condition (from Tetra Tech 1986).

An acceptable sample condition is characterized by an even surface with minimal disturbance and

little or no leakage of the overlying water. Heavily canted samples are unacceptable. Samples with a large amount of "humping" along the midline of the grab, which indicates washing of the sample during retrieval, are also unacceptable. While some humping will be evident in samples taken from firm sediment where penetration has been poor, this can be due to the closing action of the grab and is not necessarily evidence of unacceptable washing.

If the sample condition is acceptable, the overlying water is drained off and the depth of penetration determined by insertion of a plastic (rather than metal) ruler vertically along the grab midline and measuring to the nearest 0.5 cm. Sediment penetration depth for all grabs must be at least 5 cm. Penetration depths of 7-10+ cm should be obtained in silt (fine sand to clay) and whenever possible, infaunal samples should be a minimum of 7 cm but target 10+ cm. In habitats where sediments are unusually soft (*e.g.,* some estuary muds), it may be necessary to remove the lead weights to prevent over-topping the grab.

Extra caution should be taken to drain the overlying water from the grabs for chemistry and toxicity samples. It is recommended that a siphon be employed for these grabs to avoid disturbance and loss of surface sediments. The overlying water in grabs intended for infaunal samples must be retained. Drain by slightly opening the jaws of the grab and allowing the water to run off into a tub or container for screening with the sediments (see Sample Processing below).

If both sample condition and penetration are acceptable in the first grab (*i.e.*, infauna) of offshore sites, sampling at the station will proceed with the collection of microplastic, PFAS, remaining chemistry and then sediment toxicity samples from successive grabs. At embayment sites, sufficient volume must be collected to homogenize chemistry (except microplastics and PFAS samples) and toxicity samples in a Teflon bag before distribution. **It is required that all the grabs taken at a station be of similar sediment type and depth penetration.**

I. Benthic Sampling Event Data

The Cruise Leader is responsible for collecting all the required information associated with each station occupation and each grab sampling event. While the Field Computer is the preferred method of collecting these data, paper data forms may be used (Appendix F). The required station occupation information includes:

- Station ID
- Date
- Time of day
- Agency code
- Collection Type
- Vessel name
- System used for navigation
- Weather and sea conditions
- Occupation Latitude and Longitude
- Target depth
- Salinity (at sites in the Estuary and Brackish Estuary strata)
- Station fail code (if site is abandoned)

- Comments

The required grab event information includes:

- Station ID
- Grab event number
- Gear
- Time of day for event (when grab on bottom)
- Latitude and Longitude at time of event (when grab on bottom)
- Depth of water (when grab hits bottom)
- Distance from station target location (when grab on bottom)
- Fail code (if sample fails to meet sample acceptance criteria, see Field Sheets or Information Management Plan for codes)
- Penetration
- Sediment composition (type)
- Sediment odor
- Sediment color
- Presence of shell hash (categorical: none, low 1-25%, medium 26-50%, high > 50%)
- Sample types produced from sediment grab (*e.g.*, infauna, Chem., Grain Size, Tox., Microplastic, PFAS)

J. Sediment Description

The field description of sediments is required following measurement of penetration depth. The sediment should be characterized as being cobble, course gravel, fine gravel, coarse sand, fine sand, silt/clay, shell hash or a mixed type. The presence of petroleum tar should be added to the comments. Obvious odors, such as hydrogen sulfide (the odor of rotten eggs), petroleum, humic, other odors, or a lack of noticeable odors should be recorded. General sediment colors (black, dark brown, light brown, olive green, red, other) should also be recorded.

K. Sample Processing

Benthic Infaunal Samples

After the sample description has been completed, the sediment sample intended for biological analysis is washed from the grab and screened. Raw water used to wash the samples is to be filtered in some fashion to prevent the accidental introduction of surface-water organisms. Thoroughly wash the sediment from the grab and transfer it to a sediment-washing table (screen box, etc.) for screening. An alternative sieving method for small vessels without wash water would involve semi-submerging the sieve overboard and swirling it in the water (taking care to prevent the loss of grab organisms and/or the introduction of surface water organisms) until the sediment washes away.

In any estuary strata, the necessity of sampling from small craft may not permit onboard screening of the sediment. In these cases, the samples may be screened and processed on land at a screening station temporarily established near the sampling location. To assure that the sample does not deteriorate, such "off-site" screening must be completed as soon as possible and no longer than

90 minutes after sample collection.

All the water drained from the grab and used to wash the grab must be captured and subsequently processed through screening. Typically, a tub (≥70 L capacity) is positioned under the grab. The use of a sediment-washing table is recommended, but not required. The table is useful in that it provides a flat, smooth surface over which to spread and wash the sample, thereby providing a means of gently breaking up the sediment before it runs off the end of the table into the screen box. The screening box must be equipped with a stainless-steel mesh with 1.0-mm openings. Wire diameter should be similar to that found in the U.S. Standard 1.00 mm Sieve (*i.e.*, 0.58 mm for freshwater estuaries). The surface area of the screen should be adequate to easily accept the sample without build-up. Typical surface areas used in surveys in the Bight are 1500 to 2100 cm^2. While washing the sample, control the water pressure to avoid damaging the organisms. Minimize direct application of water from the hose to the material and organisms collecting on the screen.

Once the sample has been washed through the screen, transfer the material (debris, coarse sediment, and organisms) retained on the screen to a sample container. Label the sample container with an external label containing the agency code, station name, gear type, "split number" (*i.e.*, 1 of 1, 2 of 3, etc.), collection date, and preservation method (see Appendix F for labeling example). An internal label bearing the same information is placed inside the infaunal samples. This label can be written in pencil or laser printed ink on 100% rag paper or other museum quality paper (*e.g.*, Resistall) suitable for wet labels. The sample container must have a screw-cap closure and be sufficiently large to accommodate the sample material with a headspace of at least 30% of the container volume. A sample may be split between two or more containers. However, each container must have external and internal labels (as described above) with the appropriate "split number" clearly marked. Field crews should have a broad range of sample container sizes available to them, with none less than 16 oz (0.47 L) capacity.

The sample container should be filled to approximately 50 to 70% of capacity with screened material. After the bulk of material has been transferred to the container, closely examine the screen for any organisms caught in the mesh. Gently remove any organisms with forceps, taking care to avoid damaging the organisms, and add them to the sample container. Thoroughly wash the screen box and scrub the mesh before the next sample is screened.

All infaunal samples will be treated with a relaxant solution for approximately 30 minutes prior to fixation. Either an Epsom salts ($MgSO_4$) solution or a propylene phenoxytol solution (formulations below) may be used for this purpose. Relaxant solutions may be used as the diluent water for the fixative or may be decanted after exposure and replaced with 10% buffered formalin. If it is used as diluent water, fill the sample container to 75 to 80% of its volume, close the container and invert it several times to distribute the solution. Leave the sample in the relaxant for 30 minutes. After 30 minutes, top off the container with enough sodium borate buffered formaldehyde to achieve a 10% formalin solution. Close the container, once again, and invert it several times to ensure mixing. Store the sample at room temperature for return to the laboratory.

Relaxant and fixative stock solution alternatives are as follows:

1) Epsom salts relaxant solution: 1.5 kg Epsom salts ($MgSO_4$ @ $7H_2O$) per 20

		L of freshwater.
2)	Propylene phenoxytol solution:	30 ml propylene phenoxytol to 20 L of seawater.
3)	Buffered formalin solution:	50 g sodium borate ($Na_2B_4O_7$) per liter of formalin.
4)	Buffered 10% formalin solution:	1 part buffered formalin to 9 parts fresh or salt water.

Further processing is necessary to remove formalin residue from infauna samples. After field preservation (2-10 days in formalin solution), decant sample and any liquid into a 0.5 mm or smaller sieve. Refill sample container with water, agitate, and pour into sieve. Gently wash sample in sieve to remove fine silt. Ensure that all animals are removed from the screen and placed back into the sample container. Fill the container with 70% ethanol (**do not use denatured alcohol**), place internal label inside, close the container tightly, invert container several times then store at room temperature. If your laboratory is not doing the identification, ship it to the appropriate taxonomic lab or SCCWRP (for distribution) in a leakproof ice chest/box/container. Note that shipping with a commercial shipping company may require hazmat packaging requirements.

In some instances, samples may be preserved for DNA analysis. Use of a relaxant is not recommended because it could interfere with DNA analysis. Decant any liquid from the sample through a screen with a mesh size of 1.0 mm or less. Ensure that all animals are removed from the screen and placed in the sample container. Fill the container with 95% Ethanol (ETOH), then close the container, invert it several times and store it for return to the laboratory. In laboratory, remove the old ETOH and replace with fresh 95% ETOH. **Do not use 70% ETOH for DNA specimens**. Be aware that ETOH removes most inks and archival pens are fussy to use in the field, so a No. 2 pencil is preferred for writing on internal labels.

A field organization has the discretion to take an additional infauna sample for DNA analysis by the Natural History Museum of Los Angeles County (in collaboration with the Smithsonian). The museum still has very poor DNA coverage for infauna invertebrates. The museum can provide 90% ethanol for collecting. Note that 90% ethanol is only recommended for short-term storage. It's best to use 95% or greater ETOH. If specimens are small, ideally 3-5 individuals of any species will elucidate the diversity at a specific locality (*i.e.*, stations). For species complexes and troublesome taxa, specimens from multiple localities are extremely useful for quickly discerning relevant distinguishing morphological characters. If specimens are large, specimen photo-documentation (needs to be associated with collection data/specimen/lot numbers) and a preserved piece of tissue will suffice. **The taxonomic labs will need to sort and identify the animals**. Small specimens should be double-vialed (inner vial contains specimens, outer vial contains label data, shell vials stoppered with only 100% cotton -- as specified in the benthic lab manual). The museum will be happy to provide glassware and cotton for the "final" inner vial storage containers. The museum will save and return outer containers or vials originating from the taxonomic laboratories upon request. The museum only accepts completely identified animals. The taxonomic identification laboratories or associated sampling organizations can contact the museum directly or use SCCWRP as a pickup and dropoff location for museum supplies and transfers. The museum will need a copy of CDFW field collection

permit. Museum contacts are Dean Pentcheff (pentcheff@gmail.com) or Regina Wetzer (rwetzer@gmail.com).

L. Sediment Chemistry

General Sediment Chemistry Samples from Offshore Sites

Following collection of benthic infauna, the next grab(s) will be taken for microplastics. Note that a daily group photo, if sampling microplastics, of field personnel is requested to validate that colored fibers in the sample did not come from their clothing. Use a stainless-steel scoop that has been pre-rinsed with MAG water (i.e., 1 µm filtered distilled water) immediately before collecting the sediment. Take the **top 5 cm** of sediment and fill a 16 oz mason jar completely (100%). Wiping off excess sediment from the threads of the mason jar with gloved fingers or cellulose materials (e.g., Kim wipes, paper towel) before sealing the container is acceptable for microplastics. At 50% of the microplastic sites, a blank must be opened and exposed to air while sediment sampling occurs. Microplastic samples must be refrigerated (do not freeze). Both sample and field blank jars should be closed as soon as possible after sampling to mitigate contamination.

If the other side of the grab is still available and undisturbed for sediment sampling, take the **top 2 cm** for PFAS using a pre-rinsed stainless-steel scoop (alcohol then DI/MAG water), otherwise an additional grab is needed. Prior to PFAS sampling, remove any nearby Teflon related coatings/products (*e.g.*, Teflon, Kynar, Neoflon, Tefzel, Hostaflon) before scooping sediment. See Table 2 below for precautions and note that PFAS also requires blanks at 50% of the sites and a single equipment blank per agency sampling for PFAS prior to the first sample. Use new nitrile gloves for every PFAS sample.

Table 2. Field precautions for PFAS sample collection (CSWRCB 2020)

Personal care products to avoid (if possible)	Cosmetics, moisturizers, perfumes, creams, insect repellant, sunscreen (wash hands and wear nitrile gloves if used)
Acceptable clothing	Cotton clothing, cotton lab coat (not necessary in the field)
Clothing to Avoid	Water-repellent treatment (*e.g.*, Gore-Tex, wax coatings, rain gear)
Acceptable Personal Protection Equip.	Powderless nitrile gloves, no latex gloves
Acceptable Label equipment	Pencil, ballpoint pen, fine and ultra-fine tipped sharpie **Important:** if labeling before opening bottle, change gloves after labeling bottle, otherwise label after sampling.
Labeling equipment to avoid	Thick tipped sharpies or markers, sticky notes, waterproof paper
Containers	Pre-labeled HDPE with Teflon-free caps (provided by SCCWRP)
Scoop	Stainless steel, avoid anything with Teflon-related coatings

Scoop cleaning	Wash scoop with soap and water, rinse with methanol or ethanol, and a final rinse with DI or MAG water before use. Can be stored in ashed heavy-duty aluminum foil (provided by SCCWRP) between sites for PFAS sampling only. PFAS-free pure water already opened for that collection event to make field blanks can also be used for rinsing.
A required Equipment (scoop) Blank	Prior to collecting the first sample, pour PFAS-free pure water over the interior of the pre-cleaned scoop and into an empty pre-labeled HDPE sample bottle (both bottles and PFAS-free pure water supplied by SCCWRP). Close lid then label as PFAS equipment blank with date. Only one equipment blank is needed per collection organization.
Field blanks to assess boat/crew contamination	At 50% of the sites: SCCWRP supplies all pre-labeled bottles and PFAS-free pure water supply. If field blanks are not pre-filled, fill a HPDE sample bottle with pure water supply to 80% full. Place this open bottle near where PFAS sample is collected. Open actual sample bottle at start of sample collection. Close actual sample bottle after sample collection. Pour pure water from open blank bottle into pre-labeled PFAS field blank for that site after sample collection is done. Write time & date on PFAS field blank. Use new pure water supply and bottles for each field blank.

Following PFAS sampling, additional grabs may be necessary to meet the sample volume requirements of the remaining chemistry samples. The sediment from each grab will be distributed evenly among the remaining individual sample containers. These sediment samples will be collected using the top **2 cm** of the undisturbed surface material **at the embayment and inner shelf** sites. Sediment will be collected using a stainless-steel scoop (a plastic scoop is acceptable for TOC and grain size samples). Scoops will be washed with seawater and rinsed with de-ionized (DI) water between stations. Use of a new scoop with each sample is also acceptable. Sediment in contact with or within 1 cm of the metal sides of the grab should be avoided to prevent sample contamination. Wearing Nitrile powder-free gloves during sediment sampling is highly recommended.

Embayment sampling. Following collection of benthic infauna with a Van Veen grab, the next series of grabs with the Van Veen will be taken for both sediment chemistry (*e.g.*, microplastic, PFAS remaining constituents) and toxicology. More than one grab will be necessary to meet the sample volume requirements of this sample type. The sediment from each grab will be collected from the top **5 cm** of the undisturbed surface material **at the inner coastal stations** (bays, harbors, marinas, and estuaries). Sediment will be collected from the Van Veen using a stainless-steel scoop. In-between sites, scoops will be washed with seawater to remove residual sediment and triple rinsed with DI or MAG water between stations (PFAS requires an additional rinse with alcohol and DI rinse). Use of a new scoop with each sample is also acceptable if pre-cleaned. Sediment in contact with or within 1 cm of the metal sides of the grab should be avoided to prevent sample contamination. Depending on site analysis, the total minimum volume may be 8 liters of sediment (2L for chemistry, 3L for amphipod test, 3L for mussel test). If samples contain excessive shell hash or other debris, additional sample volume is recommended. Carefully remove

large pieces of debris (*e.g.*, eelgrass, trash, rocks, shells) without touching the sediment. Wearing Nitrile powder-free gloves during sediment sampling is highly recommended.

Sediment sampling order is similar to offshore: 1) microplastics (pre-rinse scoop with MAG water before use), 2) PFAS (pre-rinse scoop with alcohol and DI/ MAG water before use), 3) remaining chemistry constituents, and 4) toxicology. Using a stainless-steel scoop, fill a 16 oz mason jar completely (100%) with sediment. Both the jar and the stainless-steel scoop should be triple rinsed with MAG water immediately prior to sample collection. Next, fill the PFAS container 80% full (close lid and label both sample and blank before working on next step). Finally, scoop all remaining sediment into a single Teflon bag placed within a pre-labeled food-grade polypropylene bag, lining a 3 to 5-gallon bucket. Teflon bags can be found online from many vendors (for example: https://fluorolab.com/product/pfa-pail-liners/?attribute_description=5+Gallon+Pail+Liner). The double lining provides extra support and protection from contamination should there be accidental tearing of the inner bag. Massage, knead, and squeeze the bag for at least 3-5 minutes with your hands while holding the top of the bag closed in a twisted fashion (move material around to homogenize the sediment), taking care to not tear the bag or squeeze sediment out of the top of the bags. A two-person team may be needed. Homogenization should result in a uniform color and texture throughout. In the unlikely event that the inner Teflon bag tears before chemistry and toxicity samples are taken, a new bag and additional grabs are necessary to start the process again.

Once sediment is fully homogenized, use a stainless-steel scoop to transfer the sediment to the remaining chemistry sample jars, 80% full. No proportioning is necessary for chemistry jars. If chemistry samples are to be frozen, leave enough headspace for expansion. The remaining sediment is for toxicity testing. If two toxicology labs are processing the sediment, fill an additional Teflon bag with half the remaining sediment (3 L) and then place the Teflon bag within a pre-labeled food-grade polypropylene bag, or use three HDPE 1-liter sample containers, for mussel testing (field team's choice). Zip-tie the inner bag closed, then zip-tie the outer pre-labeled bag. A waterproof label should also be securely attached to the zip tie in addition to the labelling on the outer plastic bag itself. Place the zip-tied Teflon bag in a third outer polypropylene or Zip Lock bag for extra protection (optional), and place directly on ice in a cooler. The toxicological samples cannot be frozen. If Teflon bag tears after chemistry samples are taken, but retained in the outer plastic bags, sediment is acceptable for toxicology. Place an additional bag over the contents for extra protection.

Freshwater estuary sampling (for permit purposes) follows the same compositing procedure outlined for estuaries except the sampling equipment may differ. If a Van Veen is used, follow the procedure outlined above.

If a Petite Ponar is used, sediment touching the side of the grab is used. Ensure the grab is free of residual sediment in the laboratory by scrubbing the inside with soap and water using a brush, then thoroughly rinsing with tap water, followed by DI water and placing grab in a plastic bag to prevent contamination. In the field, in-between stations, scrub the inside of the grab with a brush to remove residual sediment and thoroughly rinse with ambient seawater. On site, rinse grab with ambient seawater before use. Take the grab sample and dump the contents into a clean tray or container. An aluminum tray is recommended because sediment has aluminum concentrations in the percent range and highly unlikely to add significant contamination to the sample. Next choice

of tray would be stainless steel. Clean the tray following the same procedure outlined for the Petite Ponar. An alternative for microplastic sampling is to use a 3-inch aluminum pipe as a push core (see details below) inside the grab but the rounded bottom may prevent a 5 cm penetration. A completely full Ponar grab has approximately 7-8 cm of sediment. Pour off overlying water from tray. Scoop the top 5 cm of sediment from the tray following the same order outlined above: 1) microplastics (pre-rinse scoop with MAG water before use), 2) PFAS (pre-rinse scoop with alcohol and DI/ MAG water before use), 3) remaining chemistry constituents, and 4) toxicology into a Teflon-lined bucket. Repeat the process until the required sediment volume is obtained for the site. Follow the homogenization procedure outlined for embayments to distribute samples for chemistry and toxicology.

If a plastic push core is used, sediment touching the side of the core is used. Note that microplastic samples requires an aluminum 3-inch pipe as a push core (contact Leah Thornton Hampton at leahth@sccwrp.org for details). Ensure the core is thoroughly cleaned in the laboratory after construction. All metal, plastic and rubber items including cores, scoops and trays should be washed in the laboratory with hot soap and water, rinsed with tap water, rinsed with DI water, and bagged for the field (except metal push core). In the field, in-between stations, scrub the inside of the core with a brush to remove residual sediment and thoroughly rinse with ambient seawater. On site, rinse push core with ambient seawater before use. The 3-inch core for microplastics requires rinsing with MAG water just before use. For microplastic sampling, push the core to the 5-cm mark and dump it directly into the mason jar. For general chemistry, push the core to the 5-cm mark and dump the contents into a clean tray (pour off overlying water from tray). Scoop the top 5 cm of sediment from the tray following the same order outlined above: 1) PFAS, 2) remaining chemistry constituents, and 3) toxicology into a Teflon-lined bucket. Repeat the process until the required sediment volume is obtained for the site. Follow the homogenization procedure outlined for embayments to distribute samples for chemistry and toxicology.

If the site is shallow enough to wade into the water, a stainless-steel scoop can be used directly for general chemistry (microplastics require a 3-inch aluminum core with contents dumped directly into a 16 oz mason jar). Ensure the sediment being scooped is undisturbed by wading action or footprints. Follow the cleaning procedures outlined for scoops and cores. Pour off any residual overlying water if necessary. Scoop the top 5 cm of sediment following the same order outlined above: 1) microplastics (pre-rinse scoop with MAG water before use), 2) PFAS, 3) remaining chemistry constituents, and 4) toxicology into a Teflon-lined bucket. Repeat the process until the required sediment volume is obtained for the site. Follow the homogenization procedure outlined for embayments to distribute samples for chemistry and toxicology. Note that flowing water can remove the flocculant organic layer.

The following container types, samples sizes, and storage requirements will be used with the analytical laboratory supplying all sample containers for all parameters except for microplastics and PFAS (see Appendix G for summary sediment chemistry guide).

1) **Sediment Grain Size** – Approximately 100 g of sediment material will be collected at each station. Using a stainless-steel or plastic scoop, fill a 4-oz (125 mL) plastic container 80% full of sediment. Do not overfill, take care to leave an air space at the top. Samples should be stored at approximately 4 °C by placing them on wet ice or in a refrigerator until transported to the laboratory. **Do not**

freeze these samples. They should be delivered to the analytical laboratory within a week of sampling.

2) **Total Organic Carbon/Nitrogen** – Approximately 200 g of sediment material will be collected at each station. Using a stainless-steel scoop, fill an 8-oz (~250 mL) amber glass container (with a Teflon-lined lid) 80% full. Do not overfill, take care to leave an air space at the top. Frozen sediment expands and can easily break glass or lids. Samples should be stored at <4 °C by placing them on wet ice or in a refrigerator but must be frozen within 24 hours. If frozen, they should be transported to the laboratory within a week; if not, they should be delivered to the analytical laboratory within 24 hours.

3) **Trace Metals** – Approximately 200 g of surface sediment will be collected at each station. Using a stainless-steel or plastic scoop, fill an 8-oz (~250 mL) amber glass container (with a Teflon-lined lid) 80% full. Do not overfill, take care to leave an air space at the top. Frozen sediment expands and can easily break glass or lids. Samples should be stored at <4 °C by placing them on wet ice or in a refrigerator but must be frozen within 24 hours. If frozen, they should be transported to the laboratory within a week; if not, they should be delivered to the analytical laboratory within 24 hours.

4) **Trace Organics (CHCs, PCBs, PAHs, PBDEs, Pyrethroids, Neonicotinoids, Tire Wear compounds)** – Approximately 2 x 200 g of sediment material will be collected at each station. Using a stainless-steel scoop, fill two 8-oz (~250 mL) amber glass containers (with a Teflon-lined lid) 80% full. Do not overfill, take care to leave an air space at the top. Frozen sediment expands and can easily break glass or lids. Field organizations have the discretion to fill extra sample containers according to their analytical laboratory specifications. Samples should be stored at <4 °C by placing them on wet ice or in a refrigerator but must be frozen within 24 hours. If frozen, they should be delivered to the laboratory within a week. If not frozen, they should be delivered to the analytical laboratory within 24 hours. Note: the minimum required is 2 x 125 mL (4 oz) containers 80% full but does not account for potential laboratory analysis error.

5) **PFAS** – Using a stainless-steel scoop (take equipment blank, as described in PFAS table above, prior to taking first PFAS sample), collect approximately 100 g of sediment at selected embayment and inner shelf stations (163 total sites). Field blanks are assigned to 50% of sites. If a field blank is assigned, follow the procedure described in Table 2 above. Fill an 8-oz (~250 mL) HPDE container provided by SCCWRP 80% full of sediment. Do not overfill, take care to leave an air space at the top. Frozen sediment expands and can easily break glass or lids. Samples should be stored at <4 °C by placing them on wet ice or in a refrigerator but must be frozen within 24 hours. If frozen, they should be delivered to the laboratory within a week. If not frozen, they should be delivered to the analytical laboratory within 24 hours. Precaution: avoid any product that may contain fluoropolymers touching the sediment and use a PFAS field blank at designated sites (see Table 2 for PFAS precautions).

6) **Microplastics** – These samples will only be collected at selected embayments and the inner shelf stations (30 total for each stratum). Field blanks are assigned to 50% of sites. If a field blank is assigned, open the field blank jar first, and place the jar as close as reasonably possible to the working area. Using a stainless-steel scoop pre-rinsed with MAG water (provided by SCCWRP), completely fill a 16-oz (~470 mL) mason jar glass container (with a silicone-lined lid), provided by SCCWRP, with sediment. Once the sample jar has been filled with sediment, close both the sample and field blank jar completely. Samples should be stored at 4 °C by placing them on wet ice or in a refrigerator until transported to the laboratory. **Do not freeze these samples**. They should be delivered to SCCWRP within a week of sampling, if possible.

7) **Toxicology** – Using a stainless-steel or plastic scoop, approximately 6 L of sediment material will be collected at embayment and 3 L of sediment will be collected at select shelf stations. The embayment sample should be placed into a single Teflon bag placed within a pre-labeled food-grade polypropylene bag, lining a 3 to 5-gallon bucket. Teflon bags can be found online from many vendors (for example: https://fluorolab.com/product/pfa-pail-liners/?attribute_description=5+Gallon+Pail+Liner). Offshore shelf stations may use multiple plastic containers to hold the sediment. Samples should be stored at 4 °C by placing them on wet ice or in a refrigerator until transported to the laboratory. **Do not freeze these samples**. They should be delivered to the analytical laboratory or SCCWRP within 72 hours.

If any samples need to be transported to another organization for processing, they should be packed appropriately (blue ice or dry ice) and shipped to SCCWRP via overnight express, or a local carrier. Check with carrier for shipment restrictions.

Labeling of sample containers will be the responsibility of the field sampling crew. The following minimum information will be required on each sample label: 1) station number; 2) sampling date; 3) agency code; and 4) parameter.

Samples that will be analyzed by the organization conducting the field collection will be transferred to their laboratory by the field crew. Unless specifically instructed, samples to be analyzed by other laboratories will generally be transported to SCCWRP for later distribution. It is recommended that SCCWRP (Alle Lie, 714-755-3213 or Darrin Greenstein, 714-755-3224) be contacted prior to delivery of samples so that arrangements can be made to transfer custody. A **completed chain of custody form** must accompany all shipments of samples. If samples are shipped by carrier, a copy of the chain of custody form should be emailed to SCCWRP (Alle Lie, allel@sccwrp.org or Darrin Greenstein, darring@sccwrp.org) for tracking purposes.

M. Toxicology

General Toxicology Requirements

Three liters of sediment per species, 6 L total for two species testing (*e.g.*, *Eohaustorius*, *Mytilus*), are required for toxicology testing. A minimum of 2.5 L per species (5.0 L total) will satisfy the sampling requirement if insufficient sediment is available. In the field, each labeled toxicology container should be refrigerated or placed on wet ice. **Do not freeze these samples.** Samples to be analyzed by the organization conducting the field collection will be transferred to their laboratory by the field crew. Samples to be analyzed by other laboratories will be transported to SCCWRP for later distribution. Contact SCCWRP (Alle Lie, 714-755-3213 or Darrin Greenstein, 714-755-3224) prior to shipment so arrangements can be made to accommodate laboratory schedules. A **completed chain of custody form** must accompany all shipments of samples. It is recommended that a copy of all chain of custody forms be emailed to SCCWRP (Alle Lie, allel@sccwrp.org or Darrin Greenstein, darring@sccwrp.org) for tracking purposes.

The recommended samples holding time in the field is no more than three days before transport to the designated toxicity laboratories. The inter-laboratory transport time should not exceed 24 hours. The minimum labeling information required on each sample: 1) station number; 2) sampling date; 3) agency code; 4) parameter; and 5) split container number (if needed). A waterproof label should also be securely attached to the zip tie closing a bag, in addition to the labelling on the outer plastic bag itself.

At the very minimum, the sampling scoop will be washed with sample water and rinsed with DI water between stations**.** Use of a new scoop with each sample is also acceptable. Sediment within 1 cm of the metal sides of the grab will be avoided to prevent sample contamination. Field sampling crews will provide sample containers.

Offshore strata sampling. Following the collection of benthic infauna, microplastic, PFAS and remaining sediment chemistry samples in the offshore strata (inner-, mid-, outer-shelf), grabs will be taken for sediment toxicity analysis. Sediment samples will be collected by scooping the top 2 cm of the undisturbed surface material. Multiple grabs may be necessary to meet the sample volume requirements for toxicology (5-6 L). Field crews have the option to fill one Teflon bag or multiple plastic containers. If using multiple containers, the sediment from each grab will be distributed evenly among the individual sample containers. Sediments will not be homogenized in the field for offshore sites located on the inner, mid, and outer shelf.

Embayment strata sampling. Following the collection of benthic infauna, microplastic and PFAS samples, sediment grabs will be taken for combined toxicity and remaining chemistry analysis. Sediment samples will be collected by scooping the top 5 cm of the undisturbed surface material. Multiple grabs may be necessary to meet the sample volume requirements (7-8 L). Field crews will fill one Teflon bag. Sediment in contact with or within 1 cm of the metal sides of the Van Veen grab are to be avoided unless a Petite Ponar or push core is used in the field. Sediment must be homogenized in the field before distribution to remaining chemistry containers.

Homogenization. Line a 3 to 5-gallon bucket with a single Teflon bag placed within an outer pre-labeled food-grade polypropylene bag. The double lining provides extra support and protection from contamination should there be accidental tearing of the inner bag. Scoop the sediment directly into the bucket. The outside of the bucket should have a mark indicating the fill level (6 or 8 L). Carefully remove large pieces of debris (*e.g.*, eelgrass, trash, rocks, shells) without touching the sediment with your gloved hand. Knot or zip tie both bags sequentially, inner bag first than outer bag. Knead and squeeze the bag with your hands, moving material around to homogenize the sediment, taking care not to tear the bags or squeeze sediment out of

the top of the bags. Homogenization should result in a uniform color and texture throughout. After homogenization and sample distribution, secure a waterproof label to the zip-tie closing the Teflon bag. In addition, use a Sharpie to label the outer plastic bag itself. A third outer polypropylene bag can be used for extra protection (optional). The toxicity samples can be placed directly on ice in a cooler.

Special Circumstances. If two different toxicology labs are testing the sediment, use two Teflon bags and fill with half of the toxicity sample (3 L each) or three HDPE 1-liter sample containers (depending on stratum). Use a stainless steel or plastic scoop to transfer sediment. Zip-tie the inner bag closed and attach a waterproof label, then zip-tie the outer pre-labeled bag. A third outer polypropylene bag can be used for extra protection (optional). The toxicity samples can be placed directly on ice in a cooler.

N. Special Studies

Special Studies

Microplastics and PFAS sampling are considered special studies. See Section L for details.

IX. TRAWL SAMPLING

A. Purpose

The purpose of trawl sampling is to obtain data on the distribution, abundance, biomass, diversity, and disease prevalence of demersal fish and invertebrate assemblages. Historically, it has been used to collect fish and invertebrates for tissue contaminant analysis in previous regional surveys. This information is useful in characterizing possible anthropogenic effects on demersal fish and invertebrate populations. Mearns and Allen (1978) provide a comprehensive description of how small otter trawls should be designed and used for conducting biological surveys in coastal waters.

B. Sampling Effort

A total of 150 trawling stations are targeted during the survey (Table 1, Appendix A). Information regarding trawl station locations and the corresponding strata/location are listed in Appendix B.

C. Otter Trawl Specifications

A semi-balloon otter trawl (Figure 4) will be used to collect epibenthic invertebrates and demersal fishes. Net dimensions are as follows: 7.6-m (25 ft) headrope; 8.8-m (29 ft) footrope; 3.8-cm (1.5 in) body mesh; and a 1.3-cm (0.5 in) cod-end mesh. This net will have 22.9-m (75 ft) long bridles made of 1.0-1.6 cm (3/8 to 5/8 in) diameter rope (*e.g.*, Samson braid). Typical otter boards (doors) will have a width of 76 cm (30 in), height of 50 cm (20 in), and a suggested weight of 16 kg (35 lb) (Figure 5). Slight deviations (< 10%) from the dimensions are acceptable. The recommended door chains should be 5 mm (3/16 in) in diameter and should have the following numbers of links: front top -- 12; front bottom -- 11; back top -- 17; back bottom -- 16. The actual specifications of how any trawl door is set up may depend on the manufacturer of the otter trawl, but the user of the equipment should be sure to follow the factory recommended set-up procedures to ensure that the net fishes appropriately in the field.

The Bight'23 survey will require two additions to the trawl specifications: 1) non-crushable floats are required for any nets used to trawl deeper than 200 m; and 2) pressure-temperature (PT) sensors (capable of withstanding 500 m depths) will be attached to one of the trawl doors to measure water temperature, depth, and time of the individual trawls. Data collected by these sensors will be downloaded to a computer so that data regarding bottom time and depth of the trawls can be monitored in the field and analyzed after the survey has been completed. Time synchronizing between multiple computers can be problematic, so record the time offset between field data tablets/computers and computers used to download PT data in the datasheet comments field. Data is to be submitted to SCCWRP for post-survey validation checks.

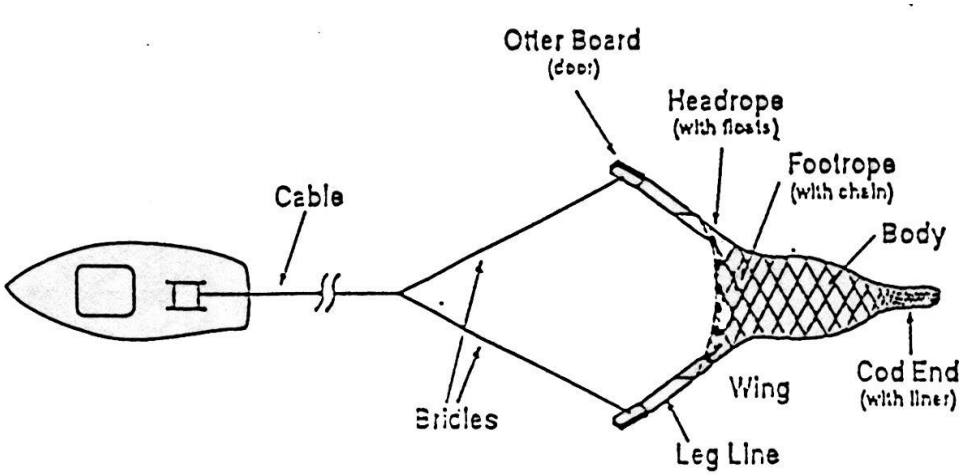

Figure 4. Semi-**balloon otter trawl recommended for marine receiving-water monitoring programs in southern California (modified from Mearns and Allen, 1978)**

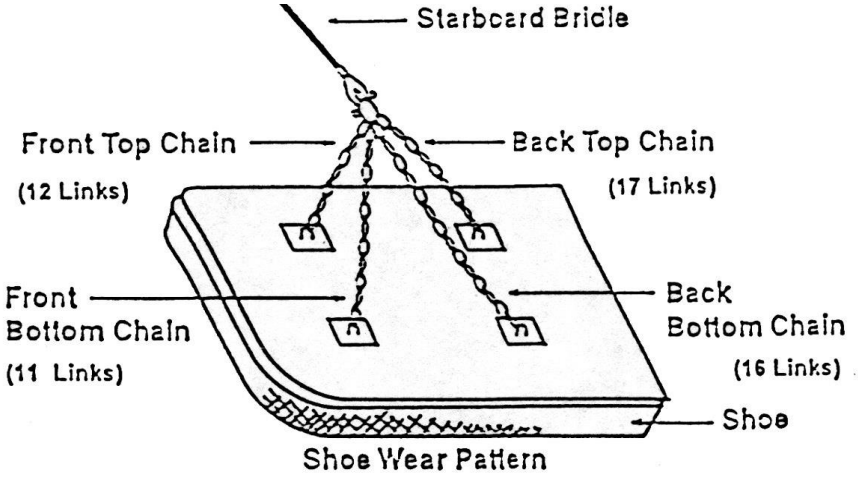

Figure 5. **View of an otter board of a semi-balloon otter trawl with recommended numbers of chain (5 mm or 3/16 in. diameter) links (modified from Mearns and Allen, 1978)**

D. Trawl Data Flow and Responsibilities

The collection of trawl data (identifications, measurements, etc.) is largely a field activity for which there is little opportunity to clarify or correct errors. Therefore, it is important that the field personnel appreciate the ultimate fate of the data records they are creating and assure that their field records support subsequent steps in the data creation process. For example, specimens collected as vouchers or as FID specimens, must be labeled under the same name as recorded on the field data sheet. This allows these specimens to be unambiguously associated with the data records for purposes of data QC or revision.

In addition, each organization conducting trawling must complete all stages of sample analysis (lab IDs, voucher confirmation, data sheet revisions, etc.) prior to submitting data and voucher specimens to the project for further review. The flow of data from the trawl to final data set and the parties responsible for completion of each stage is summarized in Figure 2.

E. Trawl Data Log

If for any reason the Field Computer stops functioning, the field crew will be responsible for keeping a manual trawl data log (Appendix F). The information recorded in the log includes water depth, length of the tow-wire used, times and coordinates (latitude and longitude) for start of the trawl and the end of the trawl (beginning of trawl retrieval). Similar information for when the net was deployed (net over) and when the net was retrieved (net on deck) may also be recorded. Any anomalous conditions, such as rocky substrate, debris in the catch, and/or a torn net should also be recorded in the log.

F. Net Preparation

The trawl components should be properly prepared prior to trawling so that the trawl can be deployed in an orderly and safe manner upon arrival at a station. Nets should be inspected for holes prior to deployment and repaired as needed. The net should be laid out and stacked on the stern of the vessel in the same configuration that it will be deployed: cod-end to the stern, floats up, and footrope down. The trawl net should be checked to make sure that the cod-end is tied correctly, the doors should be connected properly to the leg lines, and the bridles should be securely fastened to the doors and to the tow wire.

G. Station Occupation

Every effort should be taken to ensure that any trawl track passes the station coordinates at no greater than 100 m, and that the trawl course varies no more than +/-10% of the target depth (Figure 2). The trawl track can be plotted prior to sampling so that a successive series of waypoint locations along the track can be obtained. These coordinates can then be entered into the navigation system and then retrieved at the time of sampling to ensure that the vessel maintains its course along the trawl track.

H. Pre-Trawl Survey

After recording the depth at the assigned station, a pre-trawl survey of the trawl course will be conducted to determine site acceptability and whether uncharted features such as reefs, wrecks, etc., could obstruct the trawl and potentially damage equipment. Trawl gear can be lost if it becomes snagged on obstructions and replacement of nets can be costly. The trawl track should be evaluated by the Cruise Leader/Boat Captain using a fathometer and following the expected course along the isobath.

If the first run indicates that a particular site is unacceptable, another survey will be conducted within 100 m of the original location and within +/-10% of the original depth. If this attempt is unsuccessful, a third attempt will be conducted at a different location using the same protocols (100 m of the original location, and +/-10% of original depth). The site will be abandoned after

three unsuccessful attempts (Figure 2).

I. Trawling

Trawls will be towed along, rather than across, isobaths. While the vessel is underway the net and doors are placed in the water. It is important that the floats skim the surface and that the net is not entangled (*e.g.*, crossed leg lines, bunched or hooked portions of the net) prior to paying out the bridles. This small step could mean the difference between a successful or unsuccessful trawl. The bridles should be paid out by personnel on either side of the net, to avoid becoming entangled in the rigging during deployment.

Use of the proper scope (*i.e.*, length of marine grade wire paid out versus the water depth) is important for successful trawls. After the net touches the bottom, a sufficient length of towing wire should be paid out to ensure that the net is pulled from a horizontal rather than a vertical position. Insufficient scope will prevent the net from consistently fishing the bottom and will result in a no-catch, or a short-catch situation. In general, the required scope declines with increasing depth because the additional weight of the wire enhances the horizontal component of the towing forces (Table 3, Appendix H).

Table 3. Recommended scope and length of wire for trawling and estimated times for trawl performance at different depths in the Southern California Bight (expanded table in Appendix H).

Station Depth (m)	Depth/Wire Ratio or Scope[1]	Wire (m)	Winch[2] Time (min)	Initial Net[3] Depth (m)	Minutes To Bot Lag[4]	Minutes Off Bot Lag[5]	10 Min Trawl Est Deck Time (min)
50	5.0	252	6.12	50.7	-0.05	2.20	7.75
100	4.1	410	9.97	82.5	1.33	2.91	8.42
150	3.6	545	13.25	109.6	3.06	3.62	9.44
200	3.3	668	16.22	134.2	4.99	4.33	10.67
250	3.1	781	18.97	157.0	7.06	5.04	12.02
300	3.0	888	21.56	178.4	9.23	5.75	13.48
350	2.8	989	24.03	198.8	11.47	6.46	15.02
400	2.7	1,086	26.39	218.4	13.78	7.17	16.62
450	2.6	1,180	28.67	237.2	16.15	7.87	18.27
500	2.5	1,271	30.87	255.5	18.56	8.58	19.97

[1] Power function was 16.139219 * (Station Depth $^{-0.297449384}$) based on method protocol.
[2] Average agency winch rate was 41.16 m/min.
[3] Average descent rate was 8.3 m/min. Average lag on bottom decent rate changed +1.6 times.
[4] Used: (Station Depth – Wire Depth) / (Avg Descent Rate * Avg Change Rate Factor).
[5] Used: regression formula: 1.4903252151 + (0.0141874591*Station Depth)) based on Lag Off vs. Depth data.

These scopes are for 1.0 cm (0.38 in) wire. These scopes will have to be adjusted accordingly when using a different diameter of wire. Variability can occur with boat equipment (*e.g.*, winch speed, engine speed). The table is meant as a guide to Boat Captains trawling. Use the PT sensor information as a tool for subsequent trawls.

Trawling is conducted at a speed-over-ground of 1.0 m/sec (1.5 to 2.0 kt) and the net is generally towed for 10 minutes (see Table 3 for modifications), measured on deck from start of trawl to end of trawl (*i.e.*, lock down of winch to start of retrieval). *All vessels will maintain speed while retrieving the net*. In confined areas (*e.g.*, bays and harbors), the trawl duration may be reduced

to 5 minutes, a distance over ground of 225-300 m, or a working range of 4-7.5 minutes. While 10 minutes on the bottom is the nominal target time for each trawl, a working range of 8-15 minutes (determined by the PT sensor) is acceptable. Upon completion of each trawl the PT sensor data will be downloaded immediately to determine the actual on-bottom duration. If the bottom time is less than 8 minutes or greater than 20 minutes, the trawl is repeated. If the bottom time falls between 15-20 minutes, crews must adjust subsequent deployment durations, as necessary, to fall as close to10 minutes as possible. If there are demersal fishes and invertebrates in trawls falling under 8 minutes or greater than 20 minutes, the catch can be processed (field crew's discretion) while the station is being re-trawled. An error code is provided for the data sheets to indicate that the data are from a failed trawl, outside the on-bottom time limits, and additional comments should indicate why a re-trawl was needed. This allows rare and unusual species to be documented while not compromising the study design.

All PT sensor information will be retained electronically and submitted with the other data types at the end of the project.

J. Criteria for Accepting a Trawl

At the end of the prescribed trawl time, the net is retrieved and brought onboard the vessel. The cod-end is then opened, and the catch deposited into a tub or holding tank. The catch is subsequently released to the scientific crew for processing. If the trawl is retrieved with little or no catch in the cod-end, its acceptability will be evaluated according to whether the trawl was conducted properly. The criteria used to evaluate the success of any trawl include making sure that proper depth, scope, speed, and distance (or duration) were maintained, whether the net was fouled (net tangled), and whether the catch shows evidence that it was on the bottom (*e.g.*, rocks, benthic invertebrates, benthic fishes) (Figure 2). If any trawl procedures were not followed, if the net was fouled or torn (the tear must be sufficient to allow escapement), or if there was no evidence of contact with the bottom (PT sensor), the trawl will be considered unacceptable, and the site will be re-trawled. When evaluating the situation to decide whether to abandon or re-trawl a station, the Cruise Leader should keep in mind that the goal is to collect the best sample possible.

If a retrieved net has been irreparably torn during a trawl, the station will be abandoned. If the trawl hangs up on the bottom, the site can be resampled or abandoned at the discretion of the Cruise Leader. If re-trawling that station proves unsuccessful after another two attempts, the site will be abandoned (Figure 2).

K. Special Case: High Density Species Incidence

If at the end of the prescribed trawl time, the net is so full of one species (*e.g.*, Pelagic Red Crab *Grimothea planipes*, Heart Urchins *Briopsis/Brisaster*) that it cannot be brought onboard normally or the species is falling out of the net on retrieval, the site may be abandoned temporarily. These occurrences are generalized to certain areas and depths. These species can move, so revisiting the site several weeks later may have different results. Field organizations revisiting these sites may want to test the area with a 1-minute trawl. The Cruise Leader has the discretion to abandon the site if abundances remain significant from a 1-minute trawl. Field organizations worried that new sites within the same general area could experience high density abundances may use a 1-minute test trawl for evaluation purposes. If high densities are present,

the site can be temporarily abandoned. The protocol is to quantify a standard 10-minute trawl. One-minute evaluation trawls are not to be quantified for Bight'23. A Cruise Leader has the discretion to work-up the trawl but must qualify the event as a failed trawl. The site may be abandoned if logistical problems prevent the boat from revisiting the site.

To process these high-density catches, follow the standard procedures listed in the subsequent sections. An optional procedure can be used for invertebrate species. It was specifically designed for Pelagic Red Crabs. At the beginning of the day obtain the weight of a wet empty trawl net (net tare weight). When a high-density trawl is obtained record the weight of the total catch (total net and catch weight) and subtract the net tare weight then record the result as the catch weight in the comments section of the trawl invertebrate data sheet. Sort through the entire catch and place the high-density species into multiple bins or buckets for weighing, counting, and anomaly quantification. Using the aliquot datasheet, weigh out 1 kg of high-density invertebrates (minus the tare) and count the number of individuals comprising the weight. Record the numbers on the aliquot datasheet (*e.g.*, 1kg = X#). Batch weigh any remaining (not high-density species) invertebrates, fishes, and debris separately and record on the aliquot datasheet. Subtract the weights of the remaining invertebrates/fishes/debris from the catch weight and multiply that weight (*i.e.*, the weight of the high-density species) by number of individuals comprising 1 kg of the high-density species. Begin processing the debris, fishes, and remaining invertebrates as listed below.

L. Sample Processing

Sorting

The trawl catch will be sorted on deck into containers. The catch may initially be rough sorted into major categories (*e.g.*, urchins, shrimp, other invertebrates, flatfishes, rockfishes, other fishes). The categories used are not important, but it is more efficient to sort into rough categories before identifying organisms to species. Trawl debris should also be sorted into containers for processing. Objects, including organisms, less than 1 cm in largest dimension, should not be included for quantification.

Trawl Debris

Debris, anthropogenic or otherwise, collected during any trawl will be quantified by recording the specific types of material and their quantities on the Trawl Debris Form (Appendix F). If possible, debris should be quantified by direct enumeration and recorded on the form. Additional information can be added to comments. Photographs are not required but interesting debris images can be sent to Leah Thornton Hampton (leahth@sccwrp.org).

Identification

The goal is to provide species-level identifications for all fishes and invertebrates captured in the trawl. Most, if not all, of the trawl-caught organisms should be identifiable to species in the field using the recommended taxonomic keys and field guides. Species of fishes and invertebrates that cannot be reliably identified to species in the field should be returned to the laboratory for further identification. In these instances, it is better that the field crew recognize their taxonomic limitations, record "FID" (further identification required) on the field sheet and include descriptions or photographs of any attributes that may later aid in the identification of that specimen.

Under no circumstances should an organism be discarded if the identity is in question.

When the "FID" organisms have finally been identified, the correct identity of the species should be recorded on the original data sheet. If the laboratory identity differs from that recorded in the field, the original name should be crossed out with a single line only; do not erase the original name. If a specimen cannot be identified by the sampling organization, it will be sent to SCCWRP or brought to SCAMIT/SCAITE meetings for help with identifications.

Although all fish and invertebrates collected during Bight'23 should be identified to the lowest possible taxon (either in the field or in the laboratory), only certain trawl-caught animals meeting very specific criteria will need to be identified to that level. There are likely to be infauna and pelagic species that will be taken incidentally in the trawl catch. These need not be processed or documented but noted in the comments for consistency among the field organizations. Only epibenthic invertebrates and fish greater than 1 cm in the largest dimension must be recorded on the datasheet. Fouling colonial and pelagic invertebrates will not need to be enumerated but noted in the comments. Recently extruded juvenile fish (*e.g.*, from live bearing Sea Perch) or shark egg sacs will not be recorded separately from the adults but weighed together with adults for a final species weight (put juvenile counts in comment section). Signs of a recently extruded juvenile include fins appearing red or bloody. Common Cymothoidae fish parasites will be recorded on the trawl invertebrate datasheet as present and given the name "Cymothoidae". Cruise Leaders have the discretion to keep separate records of animals for organizational database purposes. Post-survey data analysis will identify all species which do not meet the epibenthic invertebrate and demersal fishes definition and flag the data in the final database records. These data will be excluded in the final report but remain in the final database records.

A recommended list of field guides and taxonomic aids for identifying fishes and invertebrates will be distributed to participating organizations prior to the survey. The most basic and comprehensive guides for fish are Miller and Lea's Guide to the Coastal Marine Fishes of California (Love and Passarelli 2020), Kells et al. (2016), Lamb and Edgell (2010), Eschmeyer (1998), and Eschmeyer et al. (1983). Allen (1977) provides information for identifying juvenile rockfishes (*Sebastes* spp.), while Orr et al. (2000) and Love et al. (2002) provide keys to larger rockfishes. Kramer et al. (1995) provides information for identifying flatfishes. Generally, there are no widely comprehensive guides to the epibenthic invertebrates.

Either common or scientific names of fishes may be used in the field, however, in the case of invertebrates, only scientific names are permissible. Use standard common and scientific names of fishes and scientific names of invertebrates given in a list of expected or trawl-caught species of fishes and invertebrates in southern California that have been distributed to organizations prior to the survey. For species not in these lists, use only standard common and scientific names of fishes given in Page et al. (2013), and scientific names of invertebrates from the SCAMIT (2023) edition 14 list of benthic macro- and mega-invertebrates. Remember, data submissions must have current scientific names.

For every species caught, each organization will provide at least one representative of that species to the Bight'23 voucher collection (see Voucher Collection).

Each organization should have a kit containing a variety of tools which will aid in field identification. The kit should include forceps (small with sharp points and large with blunt points), a hand lens, dividers or calipers, dissecting needles, scalpels with scalpel blades, probes, and plastic rulers (marked in millimeters).

Diversity Index Exclude Column

The fish and invertebrate datasheets include a "diversity index exclude" column. A "Yes" or check response represents the taxonomist's recommendation that the taxon should be excluded from counts of the number of taxa reported in the sample. It usually only pertains to organisms not identified to species-level (*e.g.*, class/order/family/genus). Three conditions must co-exist for the reported taxon to be excluded: (1) identification is not to species-level; (2) the reported taxon is represented in the sample by other members of its same taxon group identified to a lower level (*e.g.*, species); (3) the taxonomist cannot determine if the reported taxon is distinct from other members of same taxon group identified in the sample. It is necessary that the taxonomists make this evaluation during sample analysis (i.e., by annotation of the field sheet). It cannot be effectively applied after sample analysis as there is no way of determining later whether the third criterion for use was met. **Example**: The final identification of a specimen is "Virgulariidae". There is not enough information for the taxonomist to determine whether the specimen might be "Virgularia agassizii", which was also found in the same sample. The "Virgulariidae" record is given an Exclude = "Yes" on the datasheet.

Length Measurement

All fish species captured in the hauls will be measured using measuring boards, a meter stick, or a tape measure for very large specimens. Lengths of invertebrate species captured in the hauls will not be measured. A measuring board typically consists of either a flat or trough shaped board with a part of a meter stick running down the middle. A smaller board (cross board) is attached across the zero-end of the meter stick. Centimeter size-classes can be marked along the side of the measuring board with the number of the size class marked next to the appropriate centimeter. Measuring boards should be checked periodically for accuracy (+/-1 mm).

When measuring a fish, the head should be pushed gently against the cross member at the zero-end of the measuring board. Standard length in bony fishes is obtained by measuring from the anterior tip of the head to the posterior end of the caudal peduncle, located slightly anterior of the externally visible origin of the caudal fin rays. Bending the tail laterally upwards and noting the point of sharp flexure can most closely approximate where standard length is measured (Figure 6). Total length will be measured for all cartilaginous fishes and some bony fishes (*e.g.*, eel-like fish). Wingspan will be measured in addition to total length for stingrays and whip-tailed rays because the tips of their tails are frequently broken off (Figure 7).

The length of all fish specimens will be reported in size classes of 1 cm intervals (Mearns and Allen 1978). The first centimeter size class (size class number 1) extends from >0 to 1.0 cm; size class 2 extends from >1.0 to 2.0 cm, and so forth (Figure 8). For example, a fish measuring 7.2 cm is recorded as an 8 cm size class fish.

All species will be recorded on either the Demersal Fish Identification datasheet or the Epibenthic Invertebrate Identification datasheet (Appendix F). If using a field app to record data, ensure a hardcopy is available in case of power failure. For fish species with 10 or fewer individuals, each

size class measurement will be recorded on the Demersal Fish Identification Form (Appendix F), separated by commas. For species with more than 10 individuals, the species identifications and totals are listed on the data sheet, but the individual sizes are tallied on a separate Demersal Fish Size-Class Form (Appendix F).

An attempt should be made to size-class all fish. For the rare occasions when size classing is not possible (*e.g.*, a huge catch of a single species), a subsample of at least 250 individuals should be measured. This subsample should contain size classes which are proportionally distributed to represent the overall catch for that species (see Appendix F for more details). When this occurs, the reason should be noted on the data sheet. All anomalies must be individually noted by their size class.

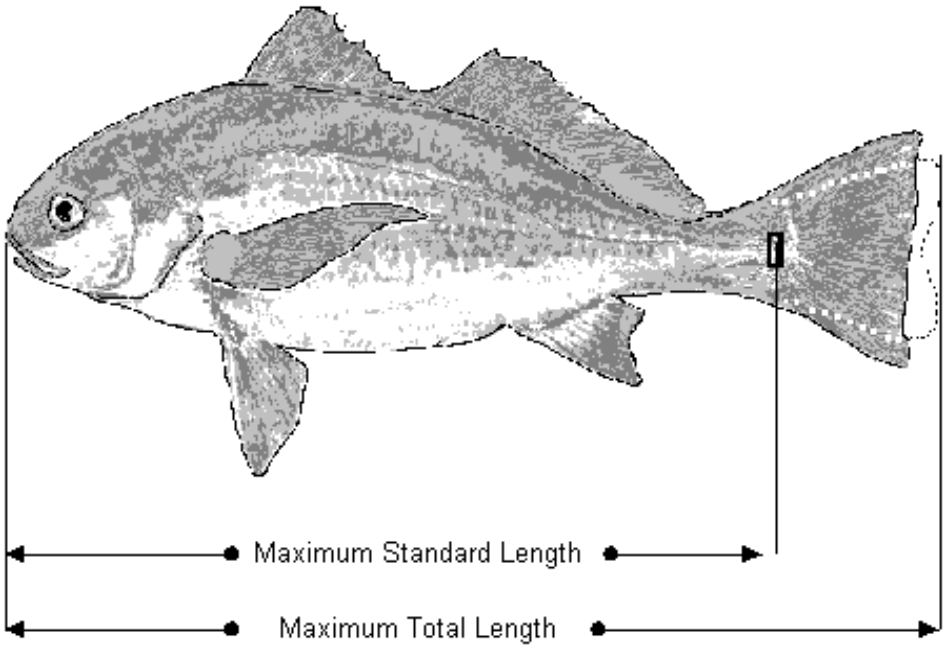

Figure 6. Endpoints for standard length (SL) and total length (TL) for bony fish.

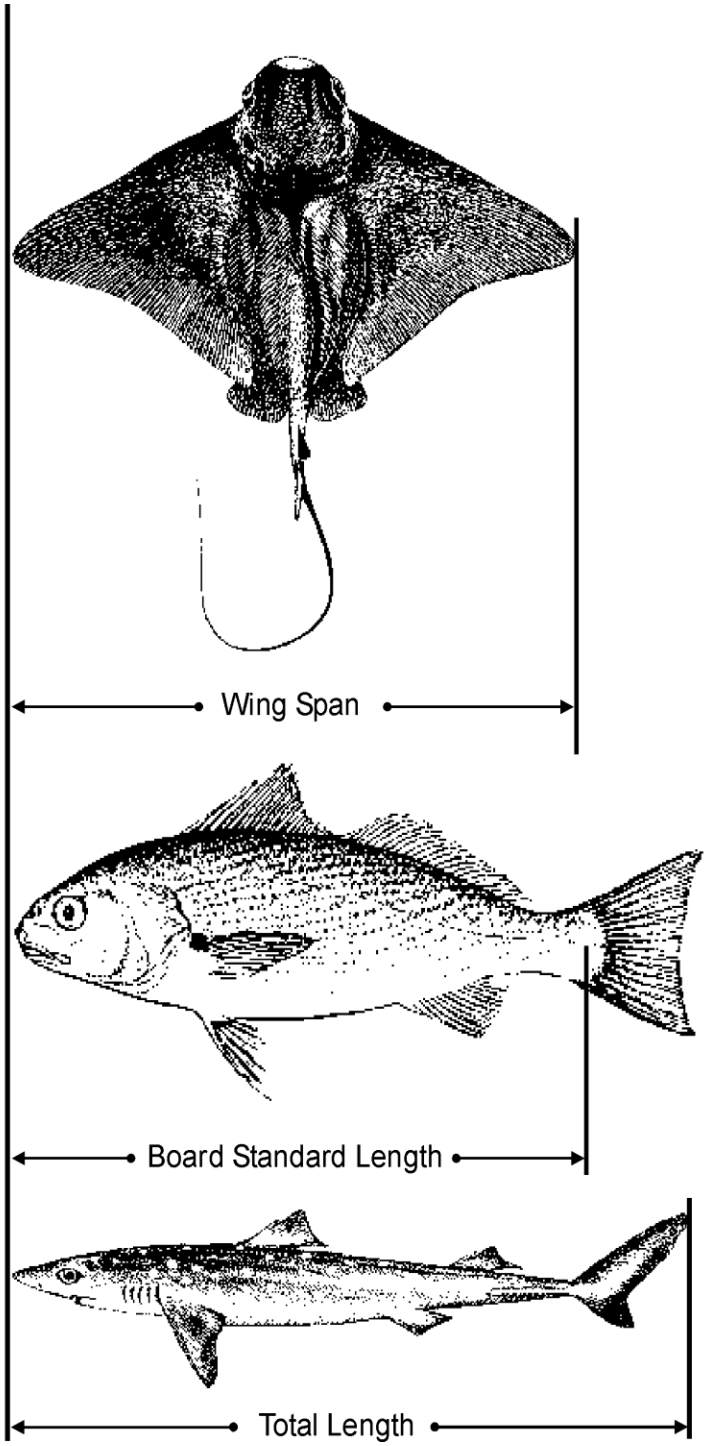

Figure 7. Comparison of board standard length (BSL) endpoints for boney fishes to wingspan (WS) and total length endpoints for cartilaginous fishes.

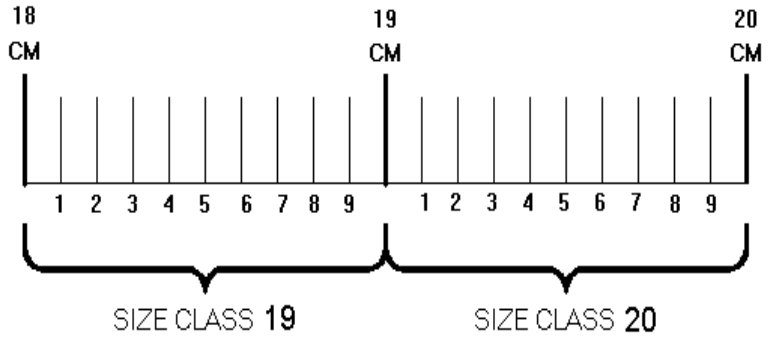

Figure 8. Relationship of centimeter size classes to millimeter values using centimeter and millimeter marks on a meter stick where size class 20 is defined as 19.1 to 20.0 mm.

Weighing

Weight data collected from fish and invertebrate species will be used to estimate the total biomass of the catch and for each species where practical. Each organization should have a range of spring scales capable of weighing up to the nearest 0.1 kg. Field crews have the discretion to use finer scales. The scales should be calibrated/verified at the start of each trawling day using a standard set of at least two weights which cover the low and high ranges of the scale. Weighing will be done using a pre-weighed tare bucket, or another suitable container (*e.g.*, plastic net bags). If a tare bucket is used, the bottom should have many holes drilled through it to allow any excess liquid to drain off before the weight is recorded. Tare buckets should be washed periodically to remove the accumulated slime.

The total biomass of each species will be measured on a spring scale. Individuals of a species with a biomass greater than 0.1 kg will be recorded to the nearest 0.1 kg. The tare container weight will be subtracted from the gross weight (species group plus tare container) to give the net weight of the species in the catch. Tare and gross weight can be recorded on the data sheet but are not required. Small species weighing less than 0.1 kg will be recorded as <0.1 kg or weighed to the 0.00 level at the discretion of the field crew. An alternative is to weigh all <0.1 kg in a composite bucket for fish or invertebrates. It is difficult to estimate catch biomass when large number of species in a trawl net are <0.1 kg. These composite weights will assist in a better calculation of total biomass for the catch.

Large organisms may be weighed individually. Individual weights of smaller specimens may also be collected using a range of scales capable of weighing to the nearest 0.1 g.

Enumeration

Fishes and invertebrates are normally enumerated after identification. The total number of each fish and invertebrate species should be recorded on their respective identification form. When catches of single fish exceed 10 individuals, those counts will also be recorded on a Demersal Fish Size-Class Form. If a particularly abundant species (250+) is encountered, the aliquot method of enumeration can be employed (at the discretion of the Cruise Leader).

Aliquots

A generalized aliquot method is commonly used to subsample large catches of fish and

invertebrate species. Begin by selecting a representative subsample of the catch by counting a minimum of 250 specimens from the catch and weighing the subsample to the nearest 0.1 kg. Next, weigh the remaining specimens and then divide that weight by the aliquot weight. Multiply that by the number of individuals in the aliquot to arrive at an estimate of the total number of individuals.

An alternative method for invertebrates can also be used. Add an unknown number of animals to a bucket until a weight of 1 kg is reached. Determine the number of animals it took to achieve the 1 kg weight. Weigh the remaining specimens, and then divide that weight by the aliquot weight. Multiply that weight by the number of individuals in the aliquot to arrive at an estimate of the total number of individuals.

The aliquot method has some inherent biases that the field crew must guard against.

1) The size class distribution of the individuals in the subsample should be representative of the specimens from which the aliquot was taken. Very large or small individuals could bias the weight so they should be enumerated separately.
2) Choose a spring scale where the weights fall within the mid to upper range of the spring scale being used. This prevents the inherent inaccuracy of the spring scale at the low end from being multiplied throughout the entire biomass calculation.
3) **Do not overlook anomalies** when processing aliquots. The number of anomalies should be recorded in the aliquot comments section of the data sheet and transcribed to the station species list. For fishes, include size class information. **This anomaly information needs to be included with the data submittal**.

Examination for Gross Pathology

During the identification and measurement procedures, all fishes and invertebrates will be examined for gross pathology. This entails a scan of an individual organism for obvious anomalies/parasites and noting the type of pathology (by abbreviation) next to the length of organisms (for fish) during measurement on the appropriate data sheet. The following anomalies will be noted for fish:

1) fin and tail erosion
2) tumors
3) leeches (Hirudinea)
4) monogeneans
5) other external parasites (*e.g.*, copepods, isopods)
6) eye parasites (*i.e., Phrixocephalus cincinnatus)*
7) color anomalies (ambicoloration, albinism) (Mearns and Haaker 1973)
8) skeletal deformities (Valentine 1975)
9) lesions
10) other anomalies

For fishes, anomalies will be noted next to their associated length measure or tally on the Trawl Fish Species datasheet or Size Class datasheet (Appendix F) and described in the comments section. Fin erosion can be found on the dorsal, anal, and caudal fins of flatfishes, and on the lower caudal fin and pelvic fins of bilaterally symmetrical fishes. Tail erosion occurs on the top

and bottom of the caudal fin or along the entire posterior caudal fin of bilaterally symmetrical fishes. Tumors can be smooth and rounded (angioepithelial nodule) or furrowed (epidermal papilloma). Leeches are small worm-like animals that often occur on the body of some elasmobranchs and bony fishes. Monogeneans look like scales that are moving. Externally obvious copepod parasites occur on the eye, fins, gills or body of fishes. Ambicoloration is often found on the blind side of flatfish (Figure 9). Skeletal deformities include crooked backs, snub noses, or bent fin rays. Lesions include sores that do not appear to be caused by net damage, often black in color. Note that common Cymothoidae gill parasites are not to be marked as a parasite if seen on a fish.

During the data submittal process, anomalies are recorded differently into the database. A separate record should be used for fishes of the same species and size class with and without anomalies. For example, if five *Citharichthys sordidus* of size class 10 were collected at a given site and only one had an eye parasite, then two records would be needed. One record would record four *C. sordidus* of size class 10 with no anomalies, and the other would record one *C. sordidus* of size class 10 with an eye parasite (see Bight'23 Information Management Plan for more detailed information and anomaly codes pertaining to multiply occurrences on an individual).

For invertebrates, anomalies will be counted and noted in the Epibenthic Invertebrate Identification Form (Appendix F). Invertebrate anomalies are largely restricted to external parasites and include the following: surface-dwelling parasites; copepod parasites; other large, surface-dwelling molluscan, crustacean (barnacles), or turbellarian parasites; burn-spot disease (on decapods); echinoderm wasting disease (on asteroids and echinoids). Copepod parasites on the gills, which are hidden from external view and generally too small for field identification, are excluded from the anomaly category. In cases where decapods are infested with parasitic barnacles, the presence is recorded as an anomaly. Although the body of the parasitic barnacle is primarily internal, it is reflected in an external brood sac visible on the body surface. The presence of species using the exoskeleton of decapods as substrate for growth is not considered parasitic. Burn-spot disease in decapods should be counted as one anomaly per infected member of the catch, not by counting individual burn-spots on each carapace. Similarly, in echinoderm wasting disease as seen in asteroids and echinoids, each infected echinoderm should be counted as one anomaly.

Remember to associate an anomaly incidence with an individual, not an entire size class grouping or an entire group of identified species.

Retain representative examples of fishes and invertebrates exhibiting each new instance of disease or parasite. These vouchers (photo or specimen) should be submitted to SCCWRP.

Note that ectoparasites and endoparasites are common in fish but field crews have neither the time nor the experience to carefully examine each fish. Thus, only a tiny fraction of the parasites are recorded based on this superficial inspection.

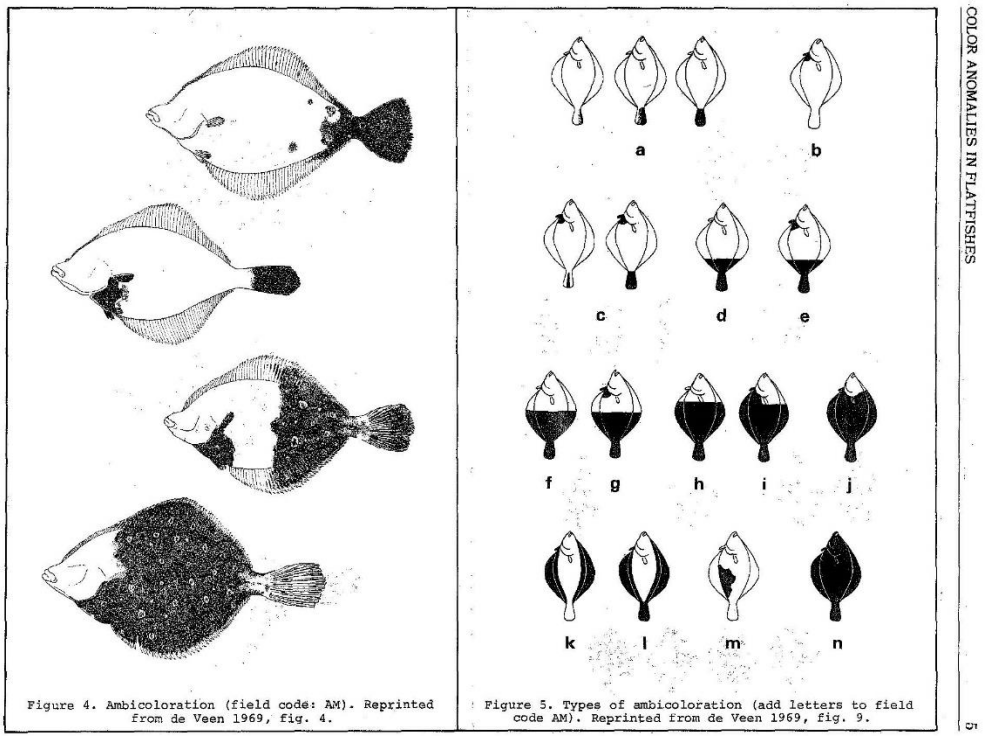

Figure 9. Examples of ambicoloration on flatfishes (Mearns and Haaker 1973)

Process Stage Monitoring

Accidental omissions can occasionally be made if a bucket of organisms is not processed. One method to avoid this problem is attaching a colored rubber tag (made of a square with a slit in one side) to the handle of each bucket to indicate a stage of processing. For instance, different tags can represent that the bucket is ready for identification, measurement, weighing, preservation, or discarding. As the bucket progresses to the next stage, the current tag can be pulled off and a new tag can be added. This procedure is not necessary for small catches but may be helpful when catches are large. Another method uses tags with commonly caught species names that can be temporarily attached to buckets to facilitate sorting and processing. The field crew has discretion to use whatever agency-specific method they choose to stop accidental omissions.

Safe Handling of Organisms

Field personnel are likely to encounter a variety of organisms that are potentially harmful. California Scorpionfish (*Scorpaena guttata*) have venomous fin spines that can cause severe pain. This species should be handled with leather gloves and/or pliers. Hot water should be applied to any puncture wound inflicted by this fish; heat is useful in breaking down the protein in the venom.

Several species of rockfishes and the Spotted Ratfish (*Hydrolagus colliei*) also have mildly venomous spines which can cause a burning sensation. The Round Stingray (*Urobatis halleri*), the California Butterfly Ray (*Gymnura marmorata*), and the Bat Ray (*Myliobatis californica*) all have venomous spines on their tails. The wound should be immersed in hot water to break down the protein in the venom.

The Pacific Electric Ray (*Tetronarce californica*) can emit a very strong electric shock. If you must handle this species, wear rubber gloves and hold it by the tail. **Do not grasp the disk with both hands!**

Pacific Angel Shark (*Squatina californica*), Pacific Spiny Dogfish (*Squalus suckleyii*), Spotted Ratfish, Midshipman (*Porichthys* spp.), and California Halibut (*Paralichthys californicus*) are some of the encountered fishes with sharp teeth that can result in painful bites if they are not handled properly.

Care must also be taken in handling the Blue Leg Mantis Shrimp (*Hemisquilla californiensis*). This species is capable of severely cutting a person with its raptorial appendages. Care should also be taken in handling any of the large crabs and octopus.

Preservation of Specimens

Voucher specimens, DNA specimens/samples (optional), incompletely identified fish and invertebrate specimens, and those with diseases that require further examination should be transported to the laboratory. Fish and invertebrate specimens may be preserved or documented for QC or identification purposes in one of four ways:

1) fixing in buffered formalin-seawater.
2) 95% ethanol (ETOH) for **DNA specimens only**; Do not use denatured or 70% ETOH.
3) freezing.
4) photographing.

Most specimens should be fixed in buffered formalin-seawater UNLESS (1) they are destined for DNA barcoding or (2) are absolutely too large for preservation in the field.

The preferred method for preserving small specimens is to fix them in 10% buffered formalin-seawater. Buffered formalin is made by mixing 50 g $Na_2B_4O_7$ (sodium borate) per liter of formaldehyde or 5 g per liter of 10% formalin. The body cavities of fish greater than 6 cm in length should be slit with a scalpel on the right (for most bilaterally symmetrical fish), the blind side (for flatfish), or ventral side (for dorsoventrally flattened fish, such as rays) before the specimen is placed in formalin. The slit allows the preservative to enter the body cavity and preserve the internal organs. **Note that by convention, bilaterally symmetrical fish are photographed or drawn with their heads facing left and dissections or gut cavity incisions are conducted only on the right side of the fish.**

1) Fishes and invertebrates will be placed in plastic bags or plastic jars and fixed in 10% buffered formalin-seawater. Fishes should be inserted tail-first into jars so that they can be removed easily without destroying the fin rays or spines.

2) Fishes should remain in formalin for no more than a week before being transferred to a freshwater bath. It is recommended that fish specimens soak in freshwater for at least two days. The water should be replaced at least once during that period. The fish should then be transferred to a solution of 70% ethanol for long-term preservation.

3) Trawl-caught invertebrates will also be fixed in 10% buffered formalin-seawater, rinsed with water after 2-10 days, and then preserved in 70% ethanol.

4) Freezing is acceptable to help with color pattern identification and euthanasia. If needed, large specimens can be placed in plastic bags and frozen on dry ice if excessively large quantities of formalin would be required to fix the specimen in the field. These can then be thawed and fixed in the laboratory with a 10% buffered formalin solution. If possible, large specimens with tumors, fin erosion, or lesions should be photographed then the section with the anomaly should be fixed in the field with formalin rather than frozen. **Do not freeze specimens that can otherwise be preserved in the field in formalin-seawater.**

5) Small invertebrates (*e.g.*, nudibranchs) may be kept cold in seawater and returned alive to the lab for identification. Color photographs of these specimens are strongly recommended.

Photography of recently caught specimens can be useful in documenting color patterns that can be used in subsequent field identifications. It is recommended that the specimen should be photo documented whenever possible. Very large specimens of fish and invertebrates can be officially photo-vouchered in the field. Photo-vouchers of very common species with easily identifiable morphological structures are acceptable. The photograph should show the overall appearance of the specimen, and additional photos must be taken to verify important taxonomic features. If characters necessary for the identification of a species cannot be seen in the photograph, preserve it because the photograph will not be accepted as a voucher. Colorful fishes may also be photographed in addition to providing a preserved specimen to aid in identification of the voucher. Photographs of unidentified rockfishes, in particular juveniles, should be taken as soon as possible after capture because their color, which is an important taxonomic character, fades or changes during preservation.

Bilaterally symmetrical fishes and dorsoventrally flattened fishes (skates, rays) should be photographed facing left. Flatfish should be photographed with the eyed side up. The left-eyed species should be photographed facing to the left and the right-eyed species should face to the right (**Note: To prevent upside-down photos, t**he gill cover slit should be oriented towards the bottom profile of the body). If an anomaly or important character occurs on the opposite side of the recommended profile, additional photos should <u>also</u> be taken of the afflicted side. All specimens should be photographed on a light background with a ruler alongside. Labeling the photo with date, station number, and species in large bold letters is recommended but image metadata can be submitted with the photo. Notes should be made of character states that can aid in identification (*e.g.*, counts of fin rays, gill rakers, and scales).

Specimens preserved for further identification must be noted on the field data sheet. Note whether the organism is fixed (formalin or ethanol), frozen, or photographed. A photograph log should be kept during the survey, documenting the species name, the frame or image number, the date, and the station location of each photograph. Voucher specimens will not be submitted to SCCWRP until they have been transferred to alcohol, numbered, and an associated inventory list presented.

Species preservation and voucher collection is a QA/QC activity to ensure data quality and

comparability across all participating field organizations. Historically, photos have been of poor quality or lack important taxonomically identifiable structures. Review photos in the field to verify quality and morphological structures.

M. Voucher Collection

Participating organizations will provide at least one representative of each unique species collected by their field crew during the survey for the Bight'23 voucher collection. This collection will document and verify trawl diversity and the types of diseases or anomalies found in the examinations for gross pathology. Voucher specimens should be preserved in an appropriate manner and include a label with scientific name, collection date, site name, site location, and depth (Appendix F). It represents the final QAQC check for taxonomic identification. Field crews are responsible for creating, maintaining, and checking a species list for specimens collected as vouchers. These specimens are to remain with the Bight'23 collection and cannot be used for their own organizations collection.

The Bight'23 voucher collection of trawl organisms will be temporarily housed at SCCWRP. Submit an electronic voucher inventory list with the specimens on an Excel spreadsheet (*i.e.*, Organization code, Specimen Number, Scientific Name, Common Name, Station ID, Collection Date, Collection Depth, and Preservation Method). Clearly number the outside of the voucher containers so it matches the inventory list. The invertebrate collection and selected rare/unusual fishes will later be transferred to the Natural History Museum of Los Angeles County. The collection will be taxonomically validated by members of SCAMIT (invertebrates) and SCAITE (fish). The Bight program encourages new and existing participants to continue developing an organizational voucher collection for their future needs if accessing museum collections is not a good alternative. Fishes not transferred to the museum will be returned to the collecting organization for disposal.

N. DNA Barcoding Specimens

Collecting specimens for DNA barcoding is optional and at the discretion of field crews and their organizations. If more than one specimen of a newly encountered species is taken, a second specimen (tissue clips are acceptable substitutes) can be retained for future DNA analysis. If possible, the museum is interested in small multiples of invertebrate specimens from multiple locations. Each of these specimens/samples will be preserved in 95% ethanol (not denatured ethanol or isopropyl alcohol). The museum can provide 90% ethanol upon request for collecting specimens. Note that 90% ethanol is only recommended for short-term storage. For large specimens, or if only one individual of a species is collected, the whole specimen will be photo-vouchered (needs associated collection data/scientific name) or retained for the voucher collection and a snip of a fin/tissue will be retained in 95% ethanol. Priority should be with whole animals for DNA analysis because of potential mucus contamination from other trawl-caught species. Store DNA samples individually or in a bucket of 95% ethanol and away from formalinized voucher specimens. Upon returning to the laboratory, transfer specimens to fresh 95% ethanol. DNA specimens will be transferred to SCCWRP in clean glass jars or bucket with fresh 95% ethanol. Separate and label specimens by station and scientific name (see Appendix F for examples of inside and outside labels) so animals can be tracked back to its voucher counterpart and database record. Distinguish DNA specimens with a color dot on the outside of the container

for post-survey voucher validation with coded numbering (*e.g.*, D-1, DNA-1, etc.). For invertebrates, the taxonomic laboratories or associated sampling organizations can contact the museum directly or use SCCWRP as a pickup and dropoff location for museum supplies and transfers. The museum will need a copy of the CDFW field collection permit. Museum contacts for invertebrates are Dean Pentcheff (pentcheff@gmail.com) or Regina Wetzer (rwetzer@gmail.com).

At present, the museum still has poor DNA coverage for many invertebrates. If specimens are small, ideally 3-5 individuals of any species will elucidate the diversity at a specific locality (*i.e.*, stations). For species complexes and troublesome taxa, specimens from multiple localities are extremely useful for quickly discerning relevant distinguishing morphological characters. If specimens are large, specimen photo-documentation (needs associated collection data/scientific name) and a preserved tissue will suffice. For fish, the museum is only interested in new, rare, or unusual specimens.

O. FID Specimens

Specimens requiring further identification should be reexamined in the lab by the same organization and the data corrected as appropriate on the field data sheet. Do not submit FID specimens to SCCWRP unless the identifications cannot be reliably resolved in-house by staff taxonomists. Any unresolved FIDs SCCWRP receives will be identified at the time when vouchers are validated. FID data will be returned to the responsible organization so the data sheets can be revised, and the database submissions corrected.

P. Quality Assurance/Quality Control Procedures

In addition to the pre-survey QA protocols, the following QC measures will check the accuracy of taxonomic identifications and counts made during the survey:

1) Measurement Quality Objectives (MQO) for trawl-caught organisms are as follows:

   Identification- 90%,
   Enumeration- 90%
   Length- 90%
   Biomass- 90%
   Gross pathology- 90%

2) External QA/QC field audits of each field group will be conducted during Bight'23 to ensure that trawling is being carried out per project protocols and that the specimens are being processed properly. Taxonomic identifications will be checked during at least one visit to each vessel by QA/QC Field Auditors. They will observe species identifications by each organization in the field and record the data on a Taxonomy QA/QC Data Sheet (Appendix I). Their duties include rechecking the identifications of at least 25% of the species collected during the day and noting any problems with the identification of pathologies. An auditor may ask that a species gets retained, re-measured and re-weighed for QAQC purposes. The Lead Scientist will be informed of any problems and the field

personnel will be instructed regarding the appropriate identifications as needed. Each vessel will be expected to have appropriate taxonomic identification aids during the survey. The trawl committee may recommend that data from organizations that fail their external audit be flagged in the database for possible exclusion from the Bight'23 Trawl report.

3) The Cruise Leader for the field team will perform QC field audits on a minimum of 10% of their assigned trawl sites. For example, if 21 sites are assigned then 3 QC audits are performed or if 4 sites are assigned then 1 QC audit is performed. The audit is performed on fellow team members conducting trawling operations. The Cruise Leader will predetermine the QC stations. Per QC audit, two species of fish (one bilaterally symmetrical and the other a flatfish) and invertebrates will be internally audited. Whenever possible, the species selected for auditing should have a minimum of 10 individuals (greater is recommended). After normal processing, the crew will retain these species. The Cruise Leader (or designee) will reprocess the same specimens with the results recorded on a QA/QC data sheet (Appendix I) and then compare with the original results. If obvious discrepancies occur, the Cruise Leader is responsible for re-training and oversight as the specimens are reprocessed, in addition to oversight at subsequent trawl sites. Species selected for QC processing should change throughout the project. If low abundances of invertebrate and fish (<10 individuals) occur, QC audits can run into subsequent trawl sites until complete. The Cruise Leader has the option to QC process invertebrate abundances between 5-10 individuals if subsequent trawl sites still produce low invertebrate counts.

4) Taxonomic QC voucher checks. A voucher specimen of each species collected by each organization (preserved and photo-vouchered) will be submitted to SCCWRP (see Voucher Collection above). The identification of these specimens will be checked by qualified taxonomists (*i.e.*, members of SCAMIT, SCAITE) following the survey to further ensure that identifications were made correctly. Anomalies will also be verified. Errors will be corrected in the data.

5) A digital copy of all field organizations' internal QC data sheets are to be emailed to SCCWRP (Dario Diehl, dariod@sccwrp.org). They will be summarized and reported to the steering committee and included in the final trawl report.

Lead Scientists, Cruise Leaders, and Lead Taxonomists are responsible for training their staff on methods described within this SQA Field Operations Manual. A check-list of internal QA/QC activities (*e.g.*, fishboard accuracy check, scale calibration, oversight of measuring and weighing techniques, anomaly checks, datasheet review, etc.) is recommended.

Q. Special Studies

None

X. LABELING AND SHIPPING OF SAMPLES AND FIELD DATA SHEETS

A. Sample Labels/Tracking

Each sample will be identified and tracked by the station, parameter, date sampled, and split number if required. Individual log numbers may be used at the discretion of the sampling organization. Sample log numbers will be handled by SCCWRP for the samples shipped to SCCWRP that are not run by the organization that collected them in the field.

B. Labels

Labels will be printed by the organization responsible for field sampling prior to the survey and will include, at a minimum, the station number, parameter, date, and split (*i.e.*, 1 of 1, 2 of 3, etc.). Dates will be reported as day/month/year. External labels should be affixed with clear postal tape to the outside of the container. Internal labels for biological samples must us archival paper. Use 100% cotton rag (*e.g.*, Resistall, available from University Products) which can be both laser printed and written on with No. 2 pencil. These labels are put directly into the container with its specimen(s). Ethanol removes most inks and archival pens are fussy to use in the field – hence No. 2 pencil is preferred. Plasticized label paper is not suitable for wet collections of any kind.

C. Field Data Sheets

If a field computer data system is not being used during any part of the Bight'23 sampling, data sheets and cruise logs will be retained by the sampling organization up to 5 years following completed sampling. Ensure all species identifications are complete on the trawl data sheets. Species identified in the laboratory must be added to these data sheets and verified within the laboratory.

Upon completion of all laboratory identifications, the good quality hardcopies of original field data sheets, photographs, and collection permit are to be retained by the sampling organization. Submit all field data electronically to the SCCWRP web portal (data checker). Submit good quality PDFs of all field data to SCCWRP as soon as the data sheets have completed internal QA/QC review by sampling organizations. Ensure all handwritten comments from pencil are visible and clear in the PDF or hardcopy. SCCWRP may request the originals if sampling organizations submit poor PDF copies or ask for additional electronic copies which clearly highlight problematic text.

D. Shipping of Samples

All benthic infauna, sediment chemistry, and toxicity samples not analyzed by the field sampling organization's laboratory will be shipped or delivered to SCCWRP within the prescribed holding time. All shipping of samples will be the responsibility of the field sampling organizations. See Appendix K for detailed SCCWRP shipping information. Check regulations for shipping hazardous materials.

Voucher collections will be taken or shipped to SCCWRP after an organization has completed proper specimen preservation, transfers to specimen jars, internal taxonomic identification, and inventory list.

E. Chain of Custody Forms

Chain of custody forms (field organizations own form or Appendix F) are to be filled out detailing the transfer of samples from the vessel crew to the laboratory, or to delivery personnel. A form is to be filled out for each set of samples that will be transferred to a specific location. The sample and container type should be included on the form to identify the samples being transferred. This form is to be signed by the crew member transferring the samples and the laboratory staff member receiving them. A copy of the form is to be kept and the original form with signatures will accompany the samples. If samples are shipped by carrier, a copy of the chain of custody form is to be sent to SCCWRP for tracking purposes.

XI. CONTINGENCY PLANS

A. Purpose

Any field program can be affected by factors outside the control of the sampling crews. Weather, equipment failure, errors in designating station locations, and accidents can all prevent the field crews from obtaining samples at one or more stations. Contingency plans made in advance of the survey can greatly facilitate decision-making in the field. It is the responsibility of the Cruise Leader to make most of these decisions in the field, based on the protocol described below. If there is any question regarding which protocol to follow, the Field Coordinator (Dario Diehl) should be notified immediately.

B. Adverse Weather Conditions

If the weather conditions deteriorate during any sampling day, it is ultimately the responsibility of the Boat Captain to determine if the conditions are sufficiently bad to prevent further sampling. The Cruise Leader in consultation with the Boat Captain should evaluate all alternatives, such as sampling in more protected areas or returning to the prescribed schedule when the weather improves. Every attempt should be made to avoid wasting the entire day. However, **the safety of the crew is priority number one.**

C. Station Inaccessibility

Stations can be inaccessible because 1) they were incorrectly positioned on land, 2) located in water too shallow for the boat, or 3) they cannot be sampled for unforeseen circumstances. If it cannot be sampled, the sampling site will be moved to a location within 100 m horizontal distance from the original site, staying within +/-10% of the depth of the original site. If it still cannot be sampled, the station will be abandoned. For most Bight'23 strata (shelf, slope, Northern Channel Islands), no station should be sampled in less than 6 m or more than 1000 m. In bays and harbors, the safety margin is 3 m. In estuaries, 1 m is the safety margin using shallow draft vessels. Estuary samples should only be collected within subtidal portions of the channel. In freshwater estuaries with potential wadable sites, it is the judgement of the field team as to safety and accessibility of the site.

D. Lost Gear

Lost gear can potentially have a significant effect on the sampling program. Equipment can be expensive, and replacements may not be obtained in a timely manner. Crews should take every precaution against the loss of gear by properly tightening shackles and other connectors.

If important gear is lost, notify the Boat Captain immediately, so he can record the position using the vessel's navigation system. If possible, deploy a buoy at that exact location so relocation is made easier. Attempt to recover the equipment for a reasonable amount of time. If unsuccessful, use spare equipment (when available) or continue sampling without that particular equipment. Notify the Regional Monitoring Coordinator as soon as possible when equipment is lost.

XII. WASTE DISPOSAL

Proper disposal of all waste is an important component of field activities. At no time will any waste be disposed of improperly. The proper methods of waste disposal are outlined below:

A. Routine Garbage

Regular garbage (paper towels, paper cups, etc.) is placed in trash containers on board the boats. It can then be disposed of on land in public receptacles or recycled.

B. Detergent Washes

Biodegradable detergents are not to be used for routine cleaning of any sampling equipment during Bight'23. They are not as effective as laboratory detergents with lower pH. Limit detergent disposal at sea on an as-needed basis or use ambient seawater.

C. Chemicals

Acetone, formalin, and other hazardous materials should be disposed of by following all appropriate hazardous materials regulations. They should never be disposed of at sea.

D. Fish Waste

After each trawl catch has been processed completely, the remaining catch should be returned to the sea. Use discretion when discarding the catch. For sampling conducted nearshore or in bays and harbors, return only live fish and invertebrates to the area where trawling occurred. All remaining fish should be disposed offshore. Under no circumstances should fish be given to the public.

XIII. BIGHT'23 PROGRAM ORGANIZATION

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XIV. LITERATURE CITED

Allen, M. J. 1977. Southern California trawl-caught juvenile rockfishes (Preliminary). Southern California Coastal Water Research Project, El Segundo, CA. Proc. Taxonomic Standardization Program 5 (4): 25-32.

CSWRCB (California State Water Resources Control Board). 2020. Per- and polyfluorinated substances (PFAS) sampling guidelines for non-drinking water. Sacramento, CA. 23pp.

Eschmeyer, W. N. 1998. Catalog of fishes. California Academy of Sciences. San Francisco, CA. 2905 pp.

Eschmeyer, W. N., E. S. Herald, H. Hammann, and R. T. Peterson. 1983. A Field Guide to Pacific Coast Fishes of North America. Houghton Mifflin Co., Boston, MA. 336 pp.

Kells, V., L. A. Rocha, and L. G. Allen. 2016. A field guide to coastal fishes from Alaska to California. John Hopkins University Press, Baltimore, Maryland.

Kramer, D. E., W. H. Barss, B. C. Paust, and B. E. Bracken. 1995. Guide to northeast Pacific flatfishes. University of Alaska, Fairbanks, Alaska Sea Grant College Program, Fairbanks, AK. 104 pp.

Lamb, A., and P. Edgell. 2010. Coastal fishes of the Pacific Northwest. Harbour Publishing, Madeira Park, British Columbia.

Love, M. S., and J. K. Passarelli. 2020. Miller and Lea's guide to the coastal marine fishes of California, 2nd ed. Davis: UC Agriculture and Natural Resources Publication 3556.

Love, M. S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the Northeast Pacific. University of California Press. Berkeley, CA. 404 p.

Mearns, A. J., and M. J. Allen. 1978. Use of small otter trawls in coastal biological surveys. U. S. Environ. Prot. Agcy., Environ. Res. Lab., Corvallis, OR. EPA-600/3-78-083. 33 pp.

Mearns, A. J., and P. L. Haaker. 1973. Identifying and coding color anomalies in flatfishes. S. Calif. Coastal Water Res. Proj., El Segundo, CA. TM 200. 6 pp.

Orr, J. W., M. A. Brown, and D. C. Baker. 2000. Guide to rockfishes (Scorpaenidae) of the genera *Sebastes, Sebastolobus*, and *Adelosebastes* of the Northeast Pacific Ocean. Second edition. NOAA Technical Memorandum NMFS-AFSC-117. 47 p.

Page, L. M., H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, N. E. Mandrak, R. L. Mayden, and J. S. Nelson. 2013. Common and scientific names of fishes from the United States, Canada, and Mexico, 7th edition. American Fisheries Society, Special Publication 34. Bethesda, Maryland. 384 pp.

SCAMIT (Southern California Association of Marine Invertebrate Taxonomists). 2023. A taxonomic listing of benthic macro- and megainvertebrates from infaunal and epibenthic monitoring and research programs in the Southern California Bight. Edition 14. Prepared by Southern California Association of Marine Invertebrate Taxonomists and the Natural History Museum of Los Angeles County, Research & Collections, 900 Exposition Boulevard, Los Angeles, CA 9000.

Stevens, Don L. Jr., and A. R. Olsen, 2004. Spatially Balanced Sampling of Natural Resources. Journal of the American Statistical Association March 2004 vol 99 # 465, Theory and Methods, pp.262-278.

Stubbs, H. H., D. W. Diehl, and G. P. Hershelman. 1987. A Van Veen grab sampling method. Southern California Coastal Water Research Project, Long Beach, CA. Tech. Rep. 276. 4 pp.

Tetra Tech. 1986. Quality Assurance and Quality Control for 301(h) Monitoring Programs: Guidance on field and laboratory methods. Final report prepared for U. S. Environ. Prot. Agency, MOD/OMEP. Contract No. 68-01-6938.

Valentine, D. W. 1975. Skeletal anomalies in marine teleosts. Pp. 695–718 in: W.E. Ribelin and G. Megaki (Eds.). The Pathology of Fishes. Wisconsin Press, Madison.

APPENDICES

APPENDIX A

BIGHT'23 STATION LOCATION MAPS

APPENDIX B

BIGHT'23 FIELD SAMPLING ORGANIZATIONS

AND STATION DRAW INFORMATION

APPENDIX C

BIGHT'23 SAMPLE PROCESSING

ANALYTICAL LABORATORIES

APPENDIX D

BIGHT'23 SAMPLING EQUIPMENT

APPENDIX E

BIGHT'23 VESSEL SPECIFICATIONS

APPENDIX F

BIGHT'23 FIELD DATA FORMS

APPENDIX G

BIGHT'23 SEDIMENT SAMPLING GUIDE

APPENDIX H

BIGHT'23 TRAWL WIRE SCOPE GUIDE

APPENDIX I

BIGHT'23 QA/QC AUDIT FORMS

APPENDIX J

BIGHT'23 ORGANIZATION CONTACTS

APPENDIX K

BIGHT'23 SHIPPING INFORMATION