



Eelgrass (*Zostera marina*) Bed Sampling

Standard Operating Procedure, v. 1.0, Southwest Alaska Monitoring Network

Natural Resource Report NPS/SWAN/NRR—2016/1174



ON THE COVER

Eelgrass, Hogan Bay, Prince William Sound, Alaska
Photograph courtesy of Mandy Lindeberg, NOAA

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Revision History Log

All edits and amendments made to this document since its inception should be recorded in the table below. Users of this protocol should promptly notify the project leader of the marine nearshore monitoring program of recommended edits or changes. The project leader will review and incorporate suggested changes as necessary, record these changes in the revision history log, and modify the date and version number on the title page of this document to reflect these changes.

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1. Background and Objectives

Eelgrass (*Zostera marina*) is the dominant seagrass in protected waters of the Gulf of Alaska and is broadly distributed in sheltered embayments, especially in habitats dominated by soft sediments where they often form “beds” or relatively monotypic stands that can cover much of the shallow (0 to 5 m depth) subtidal zone (McRoy 1968, 1970). Eelgrass is an important “living habitat” that serves as a nutrient filter, provides shelter for fish and a variety of invertebrates, and provides physical substrate for invertebrates and algae (Phillips 1974, 1984; Thayer and Phillips 1977; Jewett et al. 1999; Dean et al. 2000; Bostrom et al. 2006). Eelgrass is a major primary producer in the marine nearshore (McConnaughey and McRoy 1979) and because it is located in shallow water, is susceptible to oil spills and other human disturbances (Short and Wiley-Eschevaria 1996, Dean et al. 1998, Duarte 2002, Larkum et al. 2006, Short et al. 2006). Eelgrass is especially susceptible to dredging, anchor scars, and events that reduce light penetration into the water column such as runoff (increased turbidity) or nutrient addition (Walker et al. 1989, Oleson 1996, Hauxwell et al. 2003, Neckles et al. 2005, Terrados et al. 2006).

The purpose of monitoring is to assess changes in the extent of eelgrass over time; specifically, changes in the cover and relative abundance of eelgrass. The sampling is designed to examine smaller spatial- (within beds of approximately 10,000 m²) and temporal-scale (several year) changes within eelgrass beds. These results are to be complemented by aerial imagery that examines changes in the distribution of eelgrass over the entire shore of each park on a less frequent basis (approximately once every 10 to 12 years; Harper and Morris 2004). Sampling will be conducted in eelgrass habitats within the Katmai (KATM) and Kenai Fjords (KEFJ), and Prince William Sound (PWS; Figure 1).

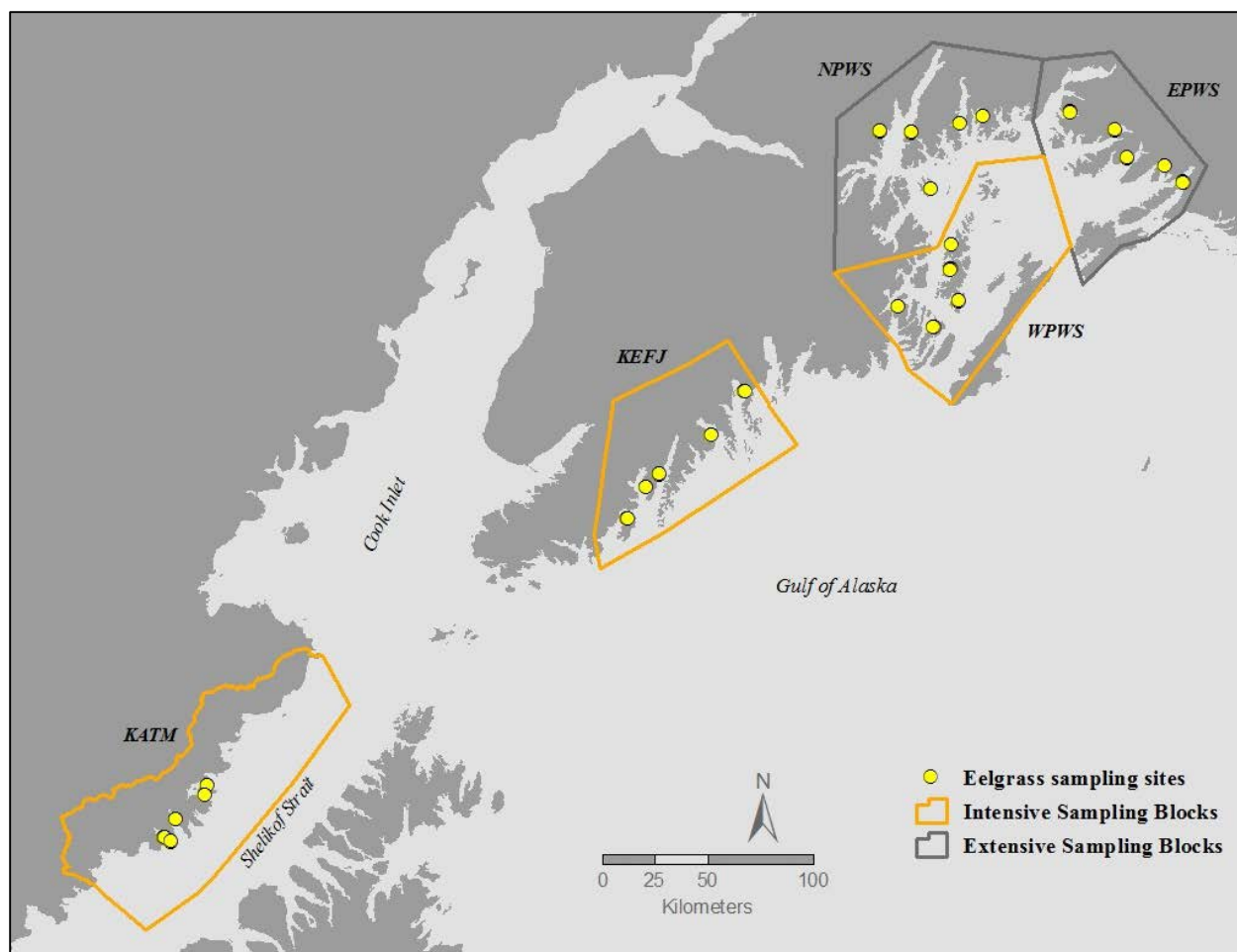


Figure 1. Areas for sampling within KATM, KEFJ, and PWS.

2. Sampling Design

2.1. Rationale and Overview

Changes in relative abundance of eelgrass will be examined by measuring the area covered by eelgrass at selected sites where eelgrass has been observed in the past. Sampling will be conducted using a digital fathometer and underwater video. A total of 25 sites are to be sampled, 5 each in Katmai National Park (KATM), Kenai Fjords National Park, (KEFJ), Western PWS (WPWS), Northern Prince William Sound (NPWS), and Eastern Prince William Sound (EPWS). Sites are to be sampled yearly at KATM, KEFJ, and WPWS and every other year at NPWS and EPWS. Sampling sites are at eelgrass beds in close proximity to sites selected for sampling of invertebrates on sand/gravel beaches and identified in aerial shorezone mapping surveys (Harper and Morris 2004) or observed during previous field sampling. The surveys will provide data on the relative abundance of eelgrass associated with sampled shoreline segments approximately 50 to 200 m in length.

Maps of the distribution of eelgrass at each site will be made using presence/absence data obtained using a digital fathometer (Lowrance HDS-5, Lowrance Inc. Tulsa OK, or similar) linked to a GPS (Sabol et al. 2002). Ground truth for the digital fathometer recordings will be obtained using an underwater video (Splash Cam Deep Blue Pro Color Video, Ocean Systems, Everett WA, or similar; Norris et al. 1997).

We examined the possible use of other well-known methods for monitoring eelgrass including remote sensing via satellite or airplane (Ackleson and Klemas 1987; Ward et al. 1997, 2004; Su et al. 2006) surface-based sidescan or multiscan sonar (Montefalcone et al. 2013), surface-based videography using a towed camera (Schultz 2008), and direct observation by divers within marked quadrats or transects (Heidelbaugh and Nelson 1996; Dean et al. 2000, Short et al., 2006). We chose not to use these methods largely because of cost or logistical constraints (e.g. limited weather windows for routine aerial or satellite imagery, cost and time required for aerial imaging from a plane or diver based surveys). Preliminary surveys indicated that we could obtain relatively precise estimates of cover by eelgrass using the sonar and underwater videography at minimal costs. Past studies of various eelgrass mapping methods (at the scale of concern) have also found these methods to be cost effective (Sabol et al. 2002, Precision Identification 2002, Stevens et al. 2008). These data will be supplemented by less frequent, larger scale mapping of eelgrass beds in the region using aerial imaging (Harper and Morris 2004).

2.2. Metrics

At each site, we will measure the percent cover of eelgrass within prescribed areas.

2.3. Sampling at Each Site

Eelgrass cover will be estimated at five sites in KATM, five sites in KEFJ, and 15 sites in PWS. The areas selected for sampling represent approximately 200-m long segments of shoreline where eelgrass has been observed in past (Harper and Morris 2004 and personal observation). Selected sites are eelgrass beds with clearly defined geographic boundaries (e.g., within a small embayment) that were closest to soft sediment sampling sites. The soft sediment sites were those close to selected sheltered rocky sampling sites chosen using a generalized random tessellation stratified

(GRTS) sampling scheme (Stevens and Olsen 2004). This design provides a random yet spatially balanced distribution of sites within each park. Sites were selected using S-Draw, a windows-based GRTS sampling software program developed by McDonald (2005; the user's guide, *GRTS for the Average Joe: A GRTS Sampler for Windows*) for downloading the program go to: <http://www.west-inc.com/computer.php>).

In the initial years of sampling, visits will be made annually to each site in KATM, KEFJ, and WPWS and bi-annually at NPWS and EPWS.

Sampling is to be conducted during spring tide series from late May through early July. Sampling at this time helps to ensure that eelgrass is near its annual peak in coverage, but not heavily fouled with epizoics that can occur later in summer. Heavy fouling by hydroids, mussels (*Musculus* spp.) and algae (primarily *Cladophora* spp.) can weigh down eelgrass blades and make proper identification from sonar images difficult. Sampling at each site is to be conducted near times of high water so that the sampling vessel can navigate at the nearshore limit of eelgrass distribution.

The sampling goal is to detect a 50% decrease of cover by eelgrass within a five year period. Trends over time at each site as well as time by location interactions will be examined (see Protocol Narrative section 4.2). At present, there is insufficient information on the extent of variation between sites and times to conduct appropriate power analyses. As with other metrics, it is recommended that power analyses be conducted after the initial five years of sampling and sampling effort be adjusted accordingly to maximize power and sampling efficiency.

3. Field Methods

At each site, we will sample eelgrass within a prescribed area of approximately 10,000 m². The shape of the eelgrass bed sampling area will vary by site, but will generally be bounded by an approximate 50 to 200-m long segment of shoreline over which eelgrass is observed and will extend offshore to a distance approximately 15 m beyond the last observed eelgrass.

The percent cover of eelgrass within this area will be estimated by determining the presence or absence of eelgrass using digital sonar (Lowrance HDS-5, Lowrance Inc., Tulsa, Oklahoma, or similar) along a series of evenly spaced transects running perpendicular to the shore that are spaced approximately 10 to 20 m apart. Instructions for operation of the Lowrance HDS-5 digital fathometer and GPS are given in full in the GPSMap 400/500 Series Owner's Manual that is available for download at Lowrance.com; these are also summarized in Appendix A. Procedures for conducting the sonar survey at each site are as follows:

On the morning prior to the first survey of a cruise, power the Sonar unit and let sit on the deck so that the GPS can acquire satellites. At or near high tide, take a small vessel with GPS, digital fathometer, and underwater video camera to the site. On the initial survey, conduct a preliminary reconnaissance survey to determine the offshore extent of the eelgrass bed. Place buoys offshore of the left and right boundaries of shoreline transect, at a distance of approximately 15 m offshore of the furthest offshore extent of eelgrass. Note the coordinates of these buoys using a GPS. After the initial survey, buoys will be placed at these same locations so the same area can be surveyed each year. Coordinates for corner buoys at each site are given in Appendix B.

Place 3 additional buoys at approximate evenly spaced intervals between the corner buoys along the inshore and offshore boundaries of the sampling grid defined by the corner buoys (Figure 2); these are to be used as navigation aids. Next, conduct a preliminary survey to “calibrate” observers of the hydroacoustic images. Select a minimum of 15 locations with varying hydroacoustic images (indicating no vegetation, sparse vegetation, or high cover) and drop a camera to confirm the type and density of eelgrass present. Fathometer traces in areas of no or dense vegetation are generally easily distinguished, but there are often more subtle differences between areas with eelgrass vs. kelps. Eelgrass produces a trace characterized by vertical striations, while kelps generally produce a more rounded, lower profile hydroacoustic return (Figure 3). Also, note that hydroacoustic traces of very sparse eelgrass are often more subtle, but can be distinguished from bare substrate or other algae with some practice.

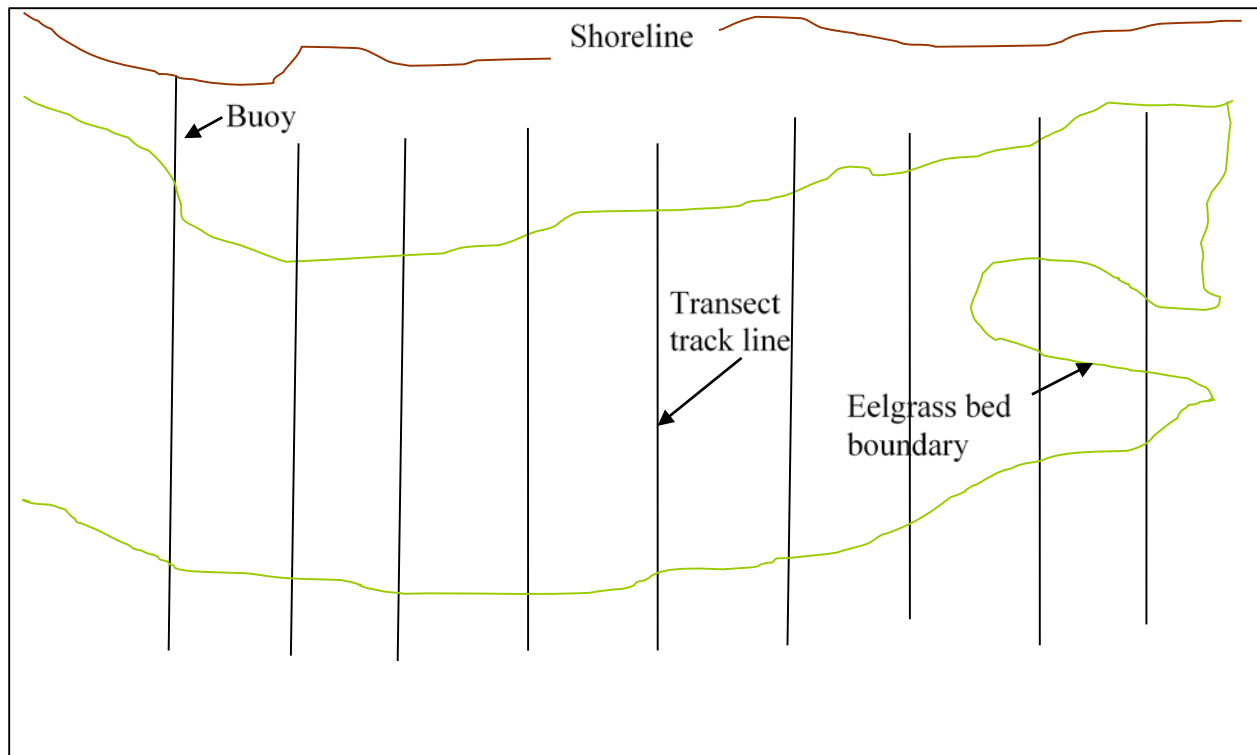


Figure 2. Diagram showing example layout of buoys and hydroacoustic track lines used to estimate abundance of eelgrass.

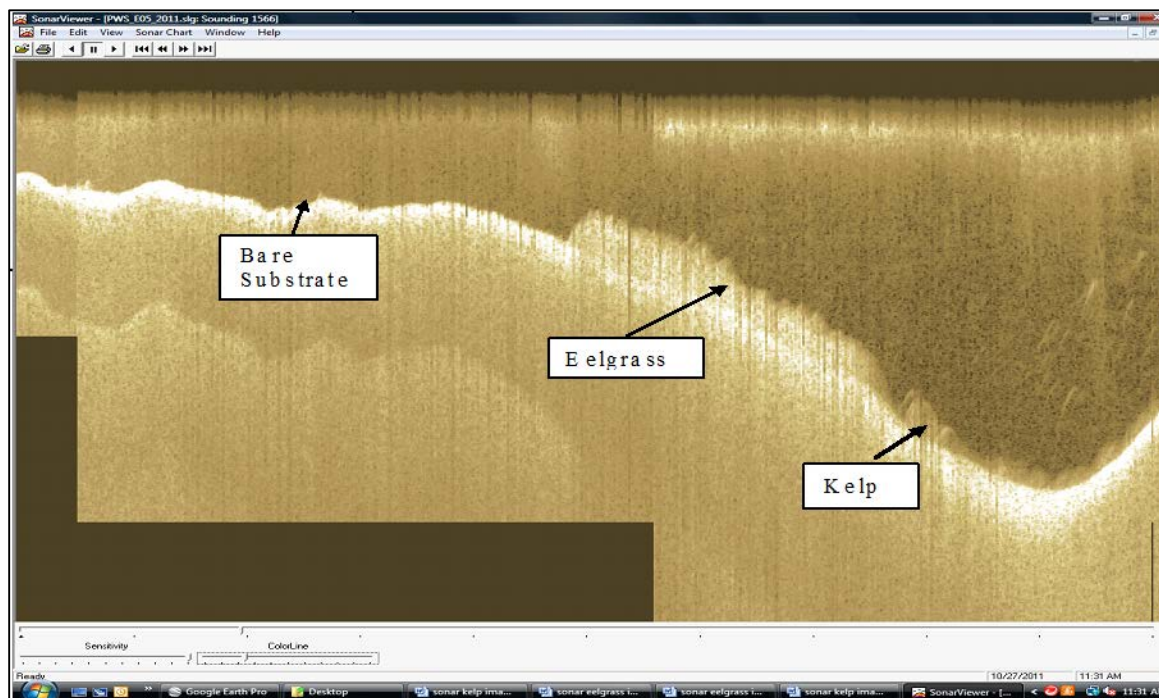


Figure 3. Example sonar record showing typical traces characteristic of bare substrate, eelgrass, and understory kelps.

Once the observers are confident with their ability to discern eelgrass on the fathometer, conduct a hydroacoustic survey along 9 onshore/offshore transects within the grid. Note the start time of the survey on the survey data sheet (Appendix C) as this is not recorded in the outputs from the sonar record. The transect lines are generally to be run from inshore to offshore, from buoy to buoy, and at midpoints between buoys (Figure 4). Drive the boat at a slow, constant speed and record the sonar data and coordinates in the Lowrance (or equivalent) sonar and GPS. Continue the transect until the inshore buoy is reached or the water is too shallow to continue. Proceed to the start of the next trackline and drive the boat to a point approximately 20 m beyond the offshore boundary (as defined by a line between the two offshore buoys). Continue this process until the right boundary is reached. Stop recording and SAVE THE SONAR RECORD TO THE SD CARD. Save with a file name that includes the site number and date (EG... AKP_B10_EI_01_2Jun2014). Review the record to make sure it is in good order (decipherable sonar record and correct coordinates).



Figure 4. Example plot of sonar transects. The yellow line indicates the boundary of the prescribed sampling area at this site; red dots indicate sonar soundings where no eelgrass was observed; and green dots indicated sonar soundings where eelgrass was found.

After completion of the hydroacoustic survey, conduct a “ground truth” survey. Set up and power an underwater video camera (DropCAM or equivalent). Re-run the 9 transects and at 5 locations (approximately evenly space) along each transect line, bring the boat to a near stop and note the presence or absence of eelgrass using the sonar. Then have an independent observer note presence or absence of eelgrass at the same location using the dropped video camera. Make sure that the camera is dropped directly over the sonar transducer. Record these observations on a data sheet (Appendix C). At the end of the survey stop recording and save the sonar record onto the SD card. Rename the sonar file (E.G. AKP_B10_EI_01_2Jun2014_GT).

4. Field Season Preparation and Equipment Set

Prior to each field season, the following tasks are to be performed:

- Review the master field schedule and prepare a list of tasks to be performed and set the field schedule
- Review personnel requirements, train personnel as needed, and make personnel assignments
- Arrange for vessel charters
- Prepare an itinerary and emergency contact list
- Arrange for travel of personnel to the departure site
- Prepare smaller boats (inflatable and/or other skiffs) for use
- Review sampling procedures
- Gather equipment and supplies including:
 - Laptop computer with data entry forms, databases, standard operating procedures, and needed software loaded
 - Underwater video and accessories (memory sticks, cables for downloading images to a computer)
 - Sonar and GPS with SD card
 - Transducer and equipment for mounting the transducer to a small inflatable vessel
 - Battery (12-volt marine battery) for powering the fathometer/GPS
 - Buoys for marking transects
 - Sheet with corner buoy positions
 - Eelgrass data sheets

Ensure that electronics have fresh batteries and are in good working order.

5. Post-collection Sample and Data Processing

After each field day, the following tasks are to be completed:

- Download files from the SD card in the sonar unit onto a Toughbook computer. Store these and provide additional documentation as needed. Backup all sonar and video files.
- Check and replace batteries in electronic equipment, as needed.
- Provide a summary of activities and observations for the day including any problems, suggestions for modifications in procedures, and unusual occurrences or observations.
- Prepare field sheets and equipment for the following day's use.

After each field trip or cruise, the following are to be completed:

- Produce a summary of the cruise based on summaries of daily activities and observations.

After each field season, the following are to be done:

- Clean and check all electronic equipment and field gear for needed repair and store appropriately.
- Make repairs or obtain replacements for damaged or lost equipment or supplies.
- Produce a field season summary report based on daily and cruise reports. This should be completed within one week of completion of the seasons.

6. Data Handling, Analyses, and Reporting

6.1. Sonar Data Analysis

Steps in the analysis of the sonar data are as follows:

- Download the Sonar Viewer software available from Lowrance.com.
- Open the sonar file (file with SLG or SL2 extension) into Sonar Viewer software.
- Output the chart data as a comma delimited data file that contains the geographic coordinates, times, depths, and sounding number. Note that the times are offsets from the start time of the survey, and the geographic coordinates are given in terms of Mercator coordinates. Convert these latitude and longitude to decimal degrees using the following formulae:

$$\text{Decimal degree latitude} = (2 * \text{ATAN}[\text{EXP}(\text{Mercator Latitude}/6356752.3142)] - 1.570796) * 57.2957795130823$$

$$\text{Decimal degree longitude} = (\text{Mercator Longitude}/6356752.3142) * 57.2957795130823$$

- View the sonar chart using the Sonar Viewer software. Note the sounding number where boundaries of patches of eelgrass are observed. Use these data to enter a new column (eelgrass present or not) in the output file that contains sounding numbers and coordinates.
- Create two separate files, one with coordinates with eelgrass present and one with coordinates for sounding where no eelgrass was observed. Import the latitudes and longitudes

from each sounding into Goggle Earth Pro or similar GIS software and plot these coordinates (Figure 4, above). Also import and plot the positions of the corner buoys that define the sampling area.

6.2. Metadata

See Protocol Narrative, section 4.0.

6.3. Data Entry, Verification, Editing, and Archival

Procedures for entry, verification, editing, and archival of the data are to be as described in the data management plan.

6.4. Data Analysis and Reporting

See Protocol Narrative, section 4.0 for a general discussion.

6.5. Routine Data Summaries and Analyses

Annually compute the percent cover of eelgrass within each site and compute the percentage of false negative or false positive sonar observations based on “ground truth” surveys.

6.6. Reporting Schedule

Summary reports should be produced annually. More comprehensive reports should be produced after the first five years of sampling and every four years thereafter.

6.7. Report Format

Reports should include plots of means of each metric of interest vs. time and vs. location. A process for determining what additional analyses may be appropriate for inclusion in comprehensive reports and suggested formats for these, are presented in the Nearshore Protocol Narrative (Dean et al. 2014).

Reports will conform to specific guidelines set by the NPS Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/NRPM/index.cfm>). Reports will include maps, graphs, figures, and other visuals to facilitate comprehension of findings.

6.8 Long-term Trend Analysis

Procedures for long-term trend analyses are presented in the Protocol Narrative (Dean et al. 2014).

7. Personnel Requirements and Training

7.1. Roles and Responsibilities

The roles and responsibilities of personnel are described here as responsibilities regarding the overall project, particular cruises, or particular field sampling teams at a given site. A single person may fill several of these roles. For example, a project leader may also serve as a cruise leader and field team leader or field assistant. The roles of these persons are as follows:

Project Leader – Organizes the schedule and personnel assignments, takes part in field sampling, oversees all activities, is responsible for preparation of reports.

Cruise Leader – Organizes daily schedules, makes sure all daily and cruise reports are completed, takes part in sampling, and reviews all data collected on a given cruise.

Field Team Leader – Is responsible for on-site activities on a daily basis and for the review and entry of all data collected by the crew.

Field Assistant - Assists in site selection and data collection at a site.

7.2. Qualifications

Project Leader – Five or more years' experience in similar projects and background in project management, nearshore marine ecological field studies, data analysis, and report preparation.

Cruise Leader – Experience in nearshore marine ecological field studies and leading field teams, expertise in sampling and taxonomy of marine algae and invertebrates.

Field Team Leader – Expertise in sampling and marine algae and invertebrate taxonomy.

Field Assistant – Competent boat handler and field crew member with ability to identify common marine algae and invertebrates.

7.3. Training Procedures

At least one crew member is to be trained and show proficiency in small-boat handling and the specific procedures for sampling outlined in this standard operating procedure. All field team members should be accompanied by personnel that have carried out sampling under this procedure in the past and must demonstrate proficiency by independently conducting site set up and duplicating observations of an experienced sampler. All personnel must be current with applicable safety training.

8. Operational Considerations

8.1. Personnel Requirements

A minimum of two crew members are required to conduct surveys in each region.

8.2. Annual Workload and Field Schedule

Field surveys are to be conducted in the summer of each year (see Protocol Narrative). It is anticipated that field sampling will require a crew of two people working approximately four hours per site. Approximately one person-month's time will be required for field preparation, coordination, data entry, and data analysis.

8.3. Facility and Equipment Needs

A charter vessel that accommodates at least six field crew members will be required. The vessel will be equipped with a skiff; a digital depth finder, GPS, and underwater video camera are required.

8.4. Start-up Costs and Budget Considerations

There are no startup costs associated with this SOP; the annual budget is estimated at \$12,000.

9. Procedures for Revising the Protocol

All edits and amendments made to this SOP should be recorded in the revision history log table at the beginning of this document. Users of this protocol should promptly notify the project leader of the marine nearshore monitoring program of recommended edits or changes. The project leader will review and incorporate suggested changes as necessary, record these changes in the revision history log, and modify the date and version number on the title page of this document to reflect these changes.

It is anticipated that following at least five years of annual data collection it will be important to evaluate, in terms of power and sensitivity, the ability of the sampling design to detect change in the data derived from sea otter foraging observations. Following such analyses it may be appropriate to consider revising sampling design or data collection protocols.

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Appendix A. Lowrance HDS-5 Sonar and GPS Operation Summary

Prior to survey - Sonar set up

POWER

Accept - **ENTER**

Simulator - **ENTER**

MENU

Settings to be as follows:

Range Auto 30 m

Frequency 200kHz - scroll and change if necessary

Ping speed set to 15

Stop sonar not highlighted

scroll and change if necessary

EXIT

MENU MENU

Highlight Sonar

ENTER

Setting should be as follows:

Network sonar not highlighted

Noise rejection low

Scroll speed normal

Fishing mode "shallow water"

scroll and change if necessary

EXIT EXIT

Prior to survey - Entering corner buoy names and coordinates routes

POWER

Accept - **ENTER**

Simulator - **ENTER**

PAGE

RIGHT ARROW - scroll to waypoints, routes, trails

ENTER

Highlight a waypoint

ENTER

Scroll to waypoint number **ENTER**

Edit the waypoint name to eelgrass site number, year, corner buoy number, e.g.

"PWS_B8_E01_2011_1"

OK

Scroll to Coordinate **ENTER**

Use arrow keys to change coordinates

ENTER

Survey - Setting corner buoys

POWER

Accept - **ENTER**

PAGES

Scroll to Waypoints, routes, trails - **ENTER**

Highlight waypoint of interest - **MENU**

Scroll to GoTo - **ENTER**

Navigation chart screen will appear

Survey - Logging sonar data

PAGES

Scroll to Sonar page – **ENTER**

Scroll through options to “no split screen” - **ENTER**

MENU

Scroll to Log sonar - **ENTER**

Highlight filename - Edit file name site number and date, e.g. PWS_B8_E01_4Jun2011

Scroll to Save to - **ENTER**

Scroll to Memory Card 1 - **ENTER**

Scroll to record – **ENTER**

Survey - At completion of survey

MENU

Scroll to Log sonar- **ENTER**

Scroll to Stop - **ENTER**

To review sonar files

Scroll to Waypoints, routes, trails and cursor down to files - **ENTER**

Scroll to memory card - **ENTER**

Scroll to sonar log file “slg” of choice - **ENTER**

Appendix B. Coordinates (Albers, WGS 84) for Corner Buoys at Eelgrass Beds

Region	Site Number	Site Name	Latitude	Longitude
WPWS	PWS_B8_EI-01	Hogan Bay	60.205402	-147.763855
	PWS_B8_EI_01	Hogan Bay	60.206753	-147.763657
	PWS_B8_EI-01	Hogan Bay	60.205467	-147.762253
	PWS_B8_EI-01	Hogan Bay	60.206894	-147.762711
	PWS_B8_EI-04	Johnson Bay	60.342731	-147.809891
	PWS_B8_EI-04	Johnson Bay	60.342529	-147.807648
	PWS_B8_EI-04	Johnson Bay	60.342262	-147.809723
	PWS_B8_EI-04	Johnson Bay	60.341839	-147.808167
	PWS_B8_EI-05	Herring Bay	60.444042	-147.782959
	PWS_B8_EI-05	Herring Bay	60.444897	-147.785461
	PWS_B8_EI-05	Herring Bay	60.444939	-147.783905
	PWS_B8_EI-05	Herring Bay	60.443837	-147.785267
	PWS_B8_EI-02	Iktua Bay	60.105892	-147.995346
	PWS_B8_EI-02	Iktua Bay	60.106251	-147.999100
	PWS_B8_EI-02	Iktua Bay	60.105427	-147.995682
	PWS_B8_EI-02	Iktua Bay	60.105492	-147.999649
	PWS_B8_EI-03	Whale Bay	60.206070	-148.289825
	PWS_B8_EI-03	Whale Bay	60.206097	-148.290634
	PWS_B8_EI-03	Whale Bay	60.205120	-148.290527
	PWS_B8_EI-03	Whale Bay	60.205120	-148.290192
EPWS	PWS_B9_EE_01	Galena Bay	60.952701	-146.639448
	PWS_B9_EE_01	Galena Bay	60.953459	-146.636895
	PWS_B9_EE_01	Galena Bay	60.953004	-146.635277
	PWS_B9_EE_01	Galena Bay	60.952028	-146.638543
	PWS_B9_EE_02	Port Fidalgo	60.854051	-146.272834
	PWS_B9_EE_02	Port Fidalgo	60.853026	-146.270694
	PWS_B9_EE_02	Port Fidalgo	60.854852	-146.269667
	PWS_B9_EE_02	Port Fidalgo	60.855470	-146.271134
	PWS_B9_EE_03	Olsen Bay	60.731214	-146.189815
	PWS_B9_EE_03	Olsen Bay	60.730958	-146.188715
	PWS_B9_EE_03	Olsen Bay	60.731816	-146.188376
	PWS_B9_EE_03	Olsen Bay	60.732106	-146.189619
	PWS_B9_EE_04	Simpson Bay	60.682279	-145.877302
	PWS_B9_EE_04	Simpson Bay	60.682117	-145.876938
	PWS_B9_EE_04	Simpson Bay	60.681359	-145.878265
	PWS_B9_EE_04	Simpson Bay	60.681623	-145.878824
	PWS_B9_EE_05	Observation Island	60.601642	-145.733728
	PWS_B9_EE_05	Observation Island	60.602186	-145.732587

Region	Site Number	Site Name	Latitude	Longitude
EPWS (<i>continued</i>)	PWS_B9_EE_05	Observation Island	60.601586	-145.731380
	PWS_B9_EE_05	Observation Island	60.601114	-145.732051
NPWS	PWS_B7_EE_01	Cedar Bay	60.975355	-147.402340
	PWS_B7_EE_01	Cedar Bay	60.974974	-147.402400
	PWS_B7_EE_01	Cedar Bay	60.974948	-147.399908
	PWS_B7_EE_01	Cedar Bay	60.975337	-147.399667
	PWS_B7_EE_02	Esther Passage	60.934343	-148.035943
	PWS_B7_EE_02	Esther Passage	60.934058	-148.034392
	PWS_B7_EE_02	Esther Passage	60.933017	-148.035091
	PWS_B7_EE_02	Esther Passage	60.933352	-148.036502
	PWS_B7_EE_03	Bettles Bay	60.949479	-148.317125
	PWS_B7_EE_03	Bettles Bay	60.949006	-148.315554
	PWS_B7_EE_03	Bettles Bay	60.950242	-148.314679
	PWS_B7_EE_03	Bettles Bay	60.951005	-148.315513
	PWS_B7_EE_04	Perry Island	60.689781	-147.912623
	PWS_B7_EE_04	Perry Island	60.689605	-147.911290
	PWS_B7_EE_04	Perry Island	60.689872	-147.910831
	PWS_B7_EE_04	Perry Island	60.690660	-147.911386
	PWS_B7_EE_05	Unakwik Inlet	60.952889	-147.610648
	PWS_B7_EE_05	Unakwik Inlet	60.953130	-147.611997
	PWS_B7_EE_05	Unakwik Inlet	60.954427	-147.610717
	PWS_B7_EE_05	Unakwik Inlet	60.954157	-147.609350
KATM	AKP_B10_EI_01	Kukak Bay	58.302751	-154.193774
	AKP_B10_EI_01	Kukak Bay	58.302911	-154.195102
	AKP_B10_EI_01	Kukak Bay	58.303667	-154.192286
	AKP_B10_EI_01	Kukak Bay	58.304258	-154.194332
	AKP_B10_EI_02	Kafli Bay	58.262818	-154.208808
	AKP_B10_EI_02	Kafli Bay	58.263529	-154.208472
	AKP_B10_EI_02	Kafli Bay	58.262935	-154.210828
	AKP_B10_EI_02	Kafli Bay	58.263701	-154.210689
	AKP_B10_EI_03	Kinak Bay	58.158119	-154.440895
	AKP_B10_EI_03	Kinak Bay	58.158101	-154.442080
	AKP_B10_EI_03	Kinak Bay	58.159290	-154.440258
	AKP_B10_EI_03	Kinak Bay	58.159406	-154.441134
	AKP_B10_EI_04	Amalik Bay	58.082087	-154.535146
	AKP_B10_EI_04	Amalik Bay	58.081977	-154.533744
	AKP_B10_EI_04	Amalik Bay	58.083045	-154.533058
	AKP_B10_EI_04	Amalik Bay	58.083090	-154.534046
	AKP_B10_EI_05	Takli Island	58.063171	-154.479851
	AKP_B10_EI_05	Takli Island	58.063197	-154.480873
	AKP_B10_EI_05	Takli Island	58.065787	-154.481884
	AKP_B10_EI_05	Takli Island	58.065741	-154.481361

Region	Site Number	Site Name	Latitude	Longitude
KEFJ	KEP_B5_EI_01	Aialik Bay	59.898310	-149.642669
	KEP_B5_EI_01	Aialik Bay	59.898670	-149.644718
	KEP_B5_EI_01	Aialik Bay	59.899147	-149.643943
	KEP_B5_EI_01	Aialik Bay	59.898643	-149.641799
	KEP_B5_EI_02	McCarty Fjord	59.568433	-150.403231
	KEP_B5_EI_02	McCarty Fjord	59.568622	-150.404334
	KEP_B5_EI_02	McCarty Fjord	59.569660	-150.402212
	KEP_B5_EI_02	McCarty Fjord	59.570010	-150.403480
	KEP_B5_EI_03	Nuka Bay	59.518573	-150.522455
	KEP_B5_EI_03	Nuka Bay	59.519213	-150.520919
	KEP_B5_EI_03	Nuka Bay	59.519490	-150.524626
	KEP_B5_EI_03	Nuka Bay	59.520237	-150.523654
	KEP_B5_EI_04	Nuka Passage	59.390309	-150.689214
	KEP_B5_EI_04	Nuka Passage	59.390686	-150.691392
	KEP_B5_EI_04	Nuka Passage	59.391287	-150.687336
	KEP_B5_EI_04	Nuka Passage	59.391625	-150.690727
	KEP_B5_EI_05	Harris Bay	59.722148	-149.948418
	KEP_B5_EI_05	Harris Bay	59.722657	-149.949109
	KEP_B5_EI_05	Harris Bay	59.722827	-149.945773
	KEP_B5_EI_05	Harris Bay	59.723273	-149.946796

Appendix C. Data Sheets

Sonar Survey Data Sheet

Sonar File Name example: AKP_B10_EI_01_6Jun2014.sl2

Video File Name example: AKP_B10_EI_01_vid_6Jun2014.mp4

For Sonar or videos done as part of the ground truth effort, add “GT” to the file name

If multiple surveys are conducted, add “a” or “b” to the end of file name

[illegible]

Ground Truth Data Sheet

Site name_____ Date_____ Observers_____

E = eelgrass present, N = no eelgrass present

[illegible]

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 953/132108, March 2016

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