Project Instructions

Date Submitted: June 24, 2016

Platform: NOAA Ship *Reuben Lasker*

Project Number: RL-16-04 (OMAO), 1606RL (SWFSC)

Project Title: Summer 2016 California Current Ecosystem Survey (CCES2016), Fisheries Resources Division

Project Dates: June 28, 2016 to September 22 2016

Prepared by: _____ Dated: June 24, 2016
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Approved by: _____ Dated: 6/24/16
Gerard DiNardo, Ph.D.
Fisheries Resources Director, SWFSC

Approved by: _____ Dated: 6/24/16
Francisco E. Werner, Ph.D.
Science and Research Director, SWFSC

Approved by: _____ Digitally signed by PARKER.BRIAN.W.1076514042 Date: 2016.06.28 08:37:06 -07'00' Dated: June 28, 2016
Commander Brian W. Parker, NOAA
Commanding Officer, Marine Operations Center - Pacific

I. Overview

A. Brief Summary and Project Period

The Summer 2016 California Current Ecosystem Survey, hereafter CCES2016, will assess the biomasses, distributions, and biological compositions of sardine, anchovy, hake, and other Coastal Pelagic Species (CPS) populations in U.S. and Canadian waters off the Pacific coast. The survey period is June 28, 2016 through September 22, 2016.

B. Days at Sea (DAS)

Of the 78 days at sea (DAS) scheduled for this project, 0 DAS are funded by an OMAO allocation, 78 DAS are funded by a Line Office allocation and 0 DAS are Program Funded, and 0 DAS are Other Agency funded. This project is estimated to exhibit a High Operational Tempo.

C. Operating Area

CCES2016 will potentially span the west coasts of the U.S. and west Vancouver Island, Canada, from approximately latitude 32.8°N (San Diego) to approximately latitude 50.8°N (north end of Vancouver Island, Canada) (**Appendix 1**, **Fig.1**). Eastern and western extents will ordinarily range from the 30-m isobath or as close to shore as is safely navigable, to either the 1000 fathom isobath or a point 35 nm west of the inshore waypoint, whichever is farther offshore.

D. Summary of Objectives

The primary goal of the survey is to estimate the biomasses, distributions, and biological compositions of populations of CPS and hake using data from an integrated acoustic and trawl survey. Also, a small portion of the survey will be devoted to deploying, testing and evaluating acoustic (EK80s, ME70, MS70, and M3) and optical (stereo and HD-video cameras) instrumentation, including the deploying of a remotely operated vehicle (ROV) and HARP/WBAT moorings. The CCES2016 will:

I.D.1. Monitor the following CPS listed in the Pacific Fisheries Management Council Fisheries Management Plan (PFMC, 2011): Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), Pacific Mackerel (*Scomber japonicus*), and Jack Mackerel (*Trachurus symmetricus*). The SWFSC is also interested in all species of euphausiids, various salmon species and market squid populations found in the U.S. EEZ off the west coast.

I.D.2. Continue to monitor the populations of Ecosystem Component Species (ECS; PFMC, 2011), in particular Pacific Herring (*Clupea pallasii*), and other forage species such as Pacific hake (*Merluccius productus*).

I.D.3. Continuously sample multi-frequency acoustic backscatter data using the ship's Simrad EK60 echosounders, to estimate the distribution and abundances of the CPS assemblage, and euphausiids.

I.D.4. Validate the relationship between the backscattered signals from narrow-band EK60 and wide-band EK80 echosounders. Elaborate on the use of wide-band backscattering spectra to remotely identify animal species and their sizes, and improve the precision and accuracy of the biomass estimates.

I.D.5. Continuously sample multi-frequency acoustic backscatter data using the ship's Simrad ME70 multibeam echosounder system, synchronized and configured to not interfere with the EK60s and EK80s.

I.D.6. Intermittently sample multi-frequency acoustic backscatter data using Simrad SX90 scanning- and MS70 imaging-sonar systems. These data will be used to estimate the distributions and behavior of the CPS assemblage.

I.D.7. Conduct, during Leg II, daytime trawling to estimate the abundances of salmon species in pre-determined or ad hoc stations.

I.D.8. Conduct, during nighttime, i.e., between sunset and sunrise, up to 5 surface trawls to collect specimens of CPS and other organisms. These data will be used to classify CPS backscatter to species and their size distributions.

I.D.9. Image fish using a portable X-radiograph machine for the purpose of target strength modeling and estimation.

I.D.10. Collect a variety of other acoustic, biological, and oceanographic samples relevant to CPS and hake distributions. These data are vital for the surveys and assessments of hake and CPS.

I.D.11. Continuously sample sea-surface temperature, salinity, and chlorophyll-a using the ship's thermosalinograph and fluorometer. These data will be used to estimate the physical oceanographic habitats for selected target species.

I.D.12. Continuously sample air temperature, barometric pressure, and wind speed and direction using the ship's integrated weather station.

I.D.13. Continuously sample ichthyo- and zooplankton using the Continuous Underway Fish Egg Sampler (CUFES).

I.D.14. Sample profiles of temperature and salinity using a combination of an underway conductivity-temperature-depth (UCTD) system during the day or a standard CTD system with water-sampling rosette and other instruments at nighttime stations, as time allows.

I.D.15. Sample plankton using a CalBOBL (CalCOFI Bongo Oblique) net tow at prescribed stations. These data will be used to estimate the distributions and abundances of ichthyoplankton and zooplankton species.

I.D.16. Optically verify CPS backscatter while underway and conducting acoustic transects, using a cast stereo camera system.

I.D.17. Optically observe fish behavior inside nighttime trawls using cameras and lights mounted inside the net.

I.D.18. Sample profiles of currents using the RDI/Teledyne Acoustic Doppler Current Profiler (ADCP), only when conducting station work (which include side stations). The ADCP will be secured during daytime transiting due to interference with the EK60/80. It is requested that the ship's survey technician be responsible for ADCP operations

I.D.19. Monitor ambient sounds using the ship's hull-mounted hydrophones, recorded using scientist's instruments.

I.D.20. Test and evaluate the dynamic positioning system and train operators.

I.D.21. Calibrate the ROV-USBL and evaluate its performance navigating over a known-length pipeline.

I.D.22. Test the ROV stereo cameras and M3 multibeam sonar.

I.D.23. Monitor the Diel Vertical Migration (DVM) of the Deep Scattering Layer (DSL) in a depth > 1500 m.

I.D.24. Identify DSL species that migrate and those that remain at depth, using the ROV, M3, and cameras.I.D.25. Acoustically survey the Del Mar Steeples site using the EK80s and ME70.

I.D.26. Evaluate the ranges that acoustic targets may be resolved from the seabed using the EK80s.

I.D.27. Characterize DVM and avoidance behaviors of rockfishes using the ROV, M3 and cameras.

I.D.28. Characterize seabed bathymetry and classes acoustically, and optically validate seabed classes.

I.D.29. Acoustic Sampling in the vicinity of the Endurance Array (http://oceanobservatories.org/wp-content/uploads/2011/04/Endurance-Array-Map_2013_04-17_ver_0-02.jpg) for calibration of bottom mounted echosounders.

E. Participating Institutions:

- NOAA/NMFS/SWFSC, 8901 La Jolla Shores Drive, La Jolla, CA 92037
- NOAA/NMFS/SWFSC, 110 Shaffer Rd, Santa Cruz, CA 95060

F. Personnel/Science Party: name, title, gender, affiliation, and nationality

Dockside Calibration in San Diego

Name (Last, First)	Title	Date Embark	Date Disembark	Gender	Affiliation	Nationality
Renfree, Josiah	Acoustician	June 24, 2016	June 24, 2016	M	SWFSC	US
Sessions, Steve	Acoustician	June 24, 2016	June 24, 2016	M	SWFSC	US
Stierhoff, Kevin	Acoustician	June 24, 2016	June 24, 2016	M	SWFSC	US
Demer, Louis	Acoustician	June 24, 2016	June 24, 2016	M	SWFSC Volunteer	US
Demer, David	Project Leader	June 24, 2016	June 24, 2016	M	SWFSC	US
Zwolinski, Juan	Acoustician	June 24, 2016	June 24, 2016	M	SWFSC	Portugal

Leg I

Name (Last, First)	Title	Date Embark	Date Disembark	Gender	Affiliation	Nationality
Stierhoff, Kevin	Acoustician	June 28, 2016	July 4, 2016	M	SWFSC	US
Stacey, Brett	Biologist	June 27, 2016	July 4, 2016	M	UCSC	US
Demer, Louis	Acoustician	June 28, 2016	July 12, 2016	M	SWFSC Volunteer	US
Sessions, Steve	Acoustician	July 4, 2016	July 12, 2016	M	SWFSC	US
Mau, Scott	Acoustician	July 12, 2016	July 22, 2016	M	SWFSC	US
Manion, Sue	Fishery Biologist	June 28, 2016	July 22, 2016	F	SWFSC	US
Griffith, Dave	Fishery Biologist/ Chief Scientist	June 28, 2016	July 22, 2016	M	SWFSC	US
Freire, Anne	Fishery Biologist	July 4, 2016	July 22, 2016	F	SWFSC	US
Gilmore, Kelsey	Fishery Biologist	July 4, 2016	July 22, 2016	F	SWFSC	US

Macewicz, Bev	Fishery Biologist	July 4, 2016	July 22, 2016	F	SWFSC	US
Osborn, Nicolas	Fishery Biologist	July 4, 2016	July 22, 2016	M	SWFSC Volunteer	US

Leg II

Name (Last, First)	**Title**	**Date Embark**	**Date Disembark**	**Gender**	**Affiliation**	**Nationality**
Murfin, David	Acoustician	July 25, 2016	August 11, 2016	M	SWFSC	US
Manion, Sue	Fishery Biologist/Chief Scientist	July 25, 2016	August 11, 2016	F	SWFSC	US
Thompson, Andrew	Fishery Biologist	July 25, 2016	August 11, 2016	M	SWFSC	US
Watson, William	Fishery Biologist	July 25, 2016	August 11, 2016	M	SWFSC	US
Craig, Matt	Fishery Biologist	July 25, 2016	August 11, 2016	M	SWFSC	US
Hinton, Kristen	Fishery Biologist	July 25, 2016	August 11, 2016	F	SWFSC Volunteer	US
Fournier, Thais	Fishery Biologist	July 25, 2016	August 11, 2016	F	SWFSC Volunteer	US
Wells, Brian	Fishery Biologist	July 25, 2016	August 11, 2016	M	SWFSC	US

Leg III

Name (Last, First)	**Title**	**Date Embark**	**Date Disembark**	**Gender**	**Affiliation**	**Nationality**
Cutter, George	Acoustician/ Chief Scientist	August 15, 2016	September 2, 2016	M	SWFSC	US
Palance, Danial	Acoustician	August 15, 2016	September 2, 2016	M	SWFSC/ NOAA Corps	US
Hays, Amy	Fishery Biologist	August 15, 2016	September 2, 2016	F	SWFSC	US
DiNardo, Jordan	Fishery Biologist	August 15, 2016	September 2, 2016	F	SWFSC Volunteer	US
Winnacott, Blair	Fishery Biologist	August 15, 2016	September 2, 2016	M	SWFSC Volunteer	US

Bowlin, Noelle	Fishery Biologist	August 15, 2016	September 2, 2016	F	SWFSC	US
Gardner, Emily	Fishery Biologist	August 15, 2016	September 2, 2016	F	SWFSC	US
Mohammad Sedarat	Fishery Biologist	August 15, 2016	September 2, 2016	M	SWFSC	US

Leg IV

Name (Last, First)	**Title**	**Date Embark**	**Date Disembark**	**Gender**	**Affiliation**	**Nationality**
Zwolinski, Juan	Acoustician/Chief Scientist	September 6, 2016	September 17, 2016	M	SWFSC	Portugal
Griffith, Dave	Fishery Biologist	September 6, 2016	September 17, 2016	M	SWFSC	US
Overcash, Bryan	Fishery Biologist	September 6, 2016	September 17, 2016	M	SWFSC	US
Macewicz, Bev	Fishery Biologist	September 6, 2016	September 17, 2016	F	SWFSC	US
Charter, Sherri	Fishery Biologist	September 6, 2016	September 17, 2016	F	SWFSC	US
Winter, Deb	Fishery Biologist	September 6, 2016	September 17, 2016	F	SWFSC Volunteer	US
Arthur-Mcghee, Nancy	Fishery Biologist	September 6, 2016	September 17, 2016	F	SWFSC Volunteer	US

Leg V

Name (Last, First)	**Title**	**Date Embark**	**Date Disembark**	**Gender**	**Affiliation**	**Nationality**
Demer, David	Acoustician/Chief Scientist	September 19, 2016	September 22, 2016	M	SWFSC	US
Cutter, Randy	Acoustician	September 19, 2016	September 22, 2016	M	SWFSC	US
Renfree, Josiah	Acoustician	September 19, 2016	September 22, 2016	M	SWFSC	US
Stierhoff, Kevin	ROV specialist	September 19, 2016	September 22, 2016	M	SWFSC	US
Murfin,	ROV specialist	Septembe	September	M	SWFSC	US

David		r 19, 2016	22, 2016			
Mau, Scott	ROV specialist	Septembe r 19, 2016	September 22, 2016	M	SWFSC	US
Condiotty, Jeff	Vendor	Septembe r 19, 2016	September 22, 2016	M	KUTI	US
Korneliussen , Rolf	Acoustician	Septembe r 19, 2016	September 22, 2016	M	IMR	Norway
Macaulay, Gavin	Acoustician	Septembe r 19, 2016	September 22, 2016	M	IMR	Norway
Berger, Laurent	Acoustician	Septembe r 19, 2016	September 22, 2016	M	IFREME R	France
Briony Hutton	Vendor	Septembe r 19, 2016	September 22, 2016	F	Echoview	Australia

Note, if approved by the Chief Scientist, Project Leader and the CO, personnel transfers via a small craft may occur during any or all of the project legs. There are two small craft transfers currently scheduled. These will occur during the afternoon, at Neah Bay, on July 4th, between the transit and the beginning of Leg 1, and the second on July 12th, roughly mid-way through Leg 1.

G. Administrative

i. Points of Contact:

David Demer, Project Lead, 8901 La Jolla Shores Drive, La Jolla, CA 92037, (858) 546-5603, david.demer@noaa.gov

Alternate: Juan Zwolinski, 8901 La Jolla Shores Drive, La Jolla, CA 92037, (858) 546-5654, juan.zwolinski@noaa.gov

ii. Diplomatic Clearances: This project involves Marine Scientific Research in waters under the jurisdiction of Canada. Diplomatic clearance has been requested.

iii. Licenses and Permits: This project will be conducted under the Scientific Research Permits (U.S.) issued by:

- Scientific Research Permit from NOAA Fisheries West Coast Region
- California DFW Permit on 02 April, 2015 (expires April 2018) NOAA-SWFSC-FRD-Cisco Werner (SC-12372)
- Letter of Authorization (LOA) for the CA Current: 80 FR 58982. The LOA valid from October 30, 2015 through October 29, 2020
- ESA consult (eulachon, salmon, sea turtles): WCR ESA consultation 2015-2455

- Oregon Scientific Taking Permit # 20332 issued to Dr. Gerard DiNardo (SWFSC FRD Division Director) from March 22, 2016 through December 31, 2016
- ESA sec. 10 SR permit 19320 issued to Dr. Steve Lindley, (SWFSC FED Director) Dec. 1, 2015 to Oct. 29, 2020
- Canadian Authorization (request F2016-024/IDR-1482) issued June 17, 2016 for *Reuben Lasker* to undertake marine scientific research July 3-15, 2016.
- Washington State Scientific Permit (SWFSC FRD Director) to operate within State waters has been requested. *Fishing operations within 3 nm miles off the Washington coast will only occur upon Permit's issuance.*

II. Operations

A. Project Itinerary

The CCES2016 will be conducted during June 28, through September 22, 2016, aboard NOAA Ship *Reuben Lasker*. The survey will provide essential data for multiple CPS stock assessments

The project will start in San Diego, California. The ship will then transit to the northernmost transect off Vancouver Island to begin the survey.

Staging and de-staging

Initial staging will be in San Diego, CA on approximately June 22-27, 2016 and final de-staging will be in San Diego on September 23-25, 2016. Intermediate staging might occur in San Diego between Legs III and IV, to remove the EK80s, and between Legs IV and V in San Diego, to install the EK80s and the ROV.

Leg	Mission	Days	Date start	Date end
Staging	Staging in San Diego, CA	2	6/23/2016	6/24/2016
Calibration	Calibration of EK60s and EK80s in San Diego	1	6/24/2016	6/24/2016
Transit	Transit from San Diego, CA to Neah Bay, WA	7	6/28/2016	7/04/2016
I	Acoustic sampling of transects 1 to 38, plus 2 weather days. Exchange of personnel will occur in Neah Bay on July 4th and July 12th.	18	7/05/2015	7/22/2016

Leg	Mission	Days	Date start	Date end
Inport	Newport, OR	2	7/23/2016	7/24/2016
II	Acoustic sampling of transects 39 to 86, plus 2 weather days*	18	7/25/2016	8/11/2016
Inport	San Francisco, CA	3	8/12/2016	8/14/2016
III	Acoustic sampling of transects 87 to 112, plus 2 weather days*	19	8/15/2016	9/2/2016
Inport	San Diego, Remove EK80s	3	9/03/2016	9/05/2016
IV	Acoustic sampling of transects 112 to 116, plus repeated sampling of near-shore transects off Southern California, as time permits*	12	9/06/2016	9/17/2015
Short Inport	San Diego, Load EK80s and install ROV	1	9/18/2015	9/18/2015
V	Buoy deployment at 43 Fathom Bank (FTFB), and ROV and acoustic sampling at FTFB and Del Mar Steeples – See Appendix 5	4	9/19/2015	9/22/2015
De-staging	San Diego, CA	1	9/24/2015	9/24/2015

* The transects covered in each leg correspond to those of the compulsory cruise track presented in Appendix 1. The adaptive survey design for this survey might result in more transects being sampled off the West Coast, resulting in departures from above schedule. Please refer to Appendix 1 for more details.

B. Operations to be conducted

The following list of survey priorities includes detailed descriptions of the planned activities. Daytime priorities: EK60 and EK80 acoustic transects, mid-water trawls targeting salmon and CPS (during leg II), and UCTD. Nighttime priorities: CTD profiles and plankton samples, surface trawls targeting CPS maximally spread in regions of abundance echoes.

The ship's echosounders and Doppler velocity log (DVL) should be secured as much as possible. When their use is necessary, the crew shall inform the Chief Scientist of any use of the vessel's sounders or DVL. They interfere with the signals received on the EK60s and EK80s.

1. Acoustic data collection

   Acoustic equipment and calibration

   The echosounder calibrations and collections of EK60 and EK80 data take priority over all other daytime operations.

   Calibration of the Simrad EK60/80 echosounders will be performed at the beginning of the project (requiring 6-8 hours, potentially up to 12). Attempts will be made to conduct the acoustic calibration while the ship is dockside on Friday June 24, 2016 or Monday June 27, 2016. It is requested that the transducer faces of every transducer are cleaned of all barnacles or any other bio-fouling that will potentially hinder the calibration operations and degrade echosounder data, within one week prior to the calibration. Immediately prior to calibration, a CTD will be cast to obtain measures of temperature and salinity versus depth, to calculate mean sound speeds and absorption coefficients. The centerboard will remain in the retracted position. Three motorized down-riggers, two on one side of the vessel and one on the other, will be used to swing a 38.1 mm diameter tungsten carbide sphere beneath the centerboard-mounted transducers.

   Throughout the project, acoustic backscatter data will be collected with EK60s operating at discrete 18, 38, 70, 120, 200 and 333 kHz, and at a continuous band between 38 and 200 kHz using the EK80 The .raw files will be telemetered continuously, as collected, to the SWFSC via a Matlab script, secure ftp, and the ship's VSAT. The protocol for data transfers meets NOAA IT security requirements. The split-beam transducers are mounted on the ship's retractable centerboard. During the survey, the centerboard will be extended to intermediate depth, which extends the transducers to ~7.2 m below the surface, to reduce the unsampled region near the sea surface. Any changes to the centerboard depth will be reported to the Chief Scientist and recorded in the SCS.

   Throughout the project, the ME70 multibeam system, configured to collect data to 350 m, will be operated synchronously with the EK60/80

echosounders. Acoustic sampling using MS70 and SX90 might occur at the discretion of the acoustician in any part of survey.
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An EK60/80 Adaptive Logging program (EAL) will be run continuously to detect the seabed depth and optimize the transmit interval and logging range while avoiding aliased seabed echoes (“false bottoms”). The EAL will provide a pseudo seabed depth telegram to the ship’s K-Sync, to adaptively adjust the transmit intervals of the EK60/80 echosounders, the ME70, and the ADCP.

A “Z-MUX” multiplexer system will periodically measure the impedances of each of the EK60/80 transducers, ambient noise as measured by the EK60/80 echosounders, and the concomitant environmental conditions collected by the SCS.

Three-dimensional imaging software, “Simrad TD50”, will be loaded on a PC in the acoustics lab for real-time viewing of water column and seabed backscatter. This beta version software will be evaluated for bugs, refinements, and its utility for visualizing aggregations of fish and zooplankton, and their behaviors and associations with seabed habitat.

The vessel's Simrad ES60 depth sounder and Doppler current meter (or comparable) may be used minimally at the discretion of the Commanding Officer, but will normally remain off while underway. The ship shall inform the Chief Scientist of any use of the vessel's sounders, as it interferes with the signals received on the EK60/80 and ME70 echosounders that will be used continuously. The ER60/80 display on the bridge must be a video replicate of the ER60/80 running in the Acoustics Lab. A second instance of the ER60/80 will conflict with the EAL (EK60/80 Adaptive Logging program) and cause the EAL, ER60/80, and ME70 to crash.

A plate with a sound speed sensor and a pan-tilt-zoom camera has been attached to the retractable centerboard. These instruments will be used to monitor the sound speed, temperature, and pressure at the transducer faces to improve calibration accuracy, and to observe the presence and behaviors of epi-pelagic animals, respectively. Data from the sound speed sensor will be input to the SCS and also logged with the Z-MUX software.

SX90 and MS70 might be operated *ad hoc* at any time of day, under the direction of the acoustician.

To complement the acoustic sampling, aerial surveying might occur concurrently in transects off Washington and Oregon, during legs I or II. The acoustician will maintain regular email contact with the fishing industry-pilots in order to inform them of Lasker's location and schedule.

Survey design

The survey will start in the North end of Vancouver Island with parallel transects, spaced at 10 or 20 nm and oriented east-west north of Point Conception, and northeast-southwest in the SCB (**Appendix 1**, **Fig. 1**). Acoustic transects will be run only during the daytime (approximately 12 to 14.5 hours per day). Vessel speed may vary between 8 and 10 kts on compulsory and adaptive transects, and up to 12 kts on when transiting between transects. If CPS are detected acoustically at the western end of a transect, that transect will be extended farther west until the ship reaches the end of the aggregations, plus an additional 0.5 nm. In such cases, the next transect south will also be extended west by the same amount. In the unlikely event of having many transects extended to the point of compromising the completion of survey at the planned time, provisions will be made by the project leaders to adapt the remaining portion of the survey, either by removing transects or increasing their spacing. Planned waypoints defining the transect lines (listed in **Appendix 1**, **Tables 1 and 2**) were provided to the ship in .CSV format.

Acoustic sampling along transects will be done predominantly between sunrise and sunset. It is requested that the Officer on Deck (OOD) note the locations and times when the acoustic data collection starts and stops each day. After the last trawl of each night or 30 minutes prior to sunrise, the ship will return to the exact location where the acoustic sampling stopped the previous day, and resume acoustic sampling. Relaxing of this rule might be approved by the Chief Scientist.

The transit between San Diego to Neah Bay will approximately track the 100 m isobath, and will be used to test the performance of scientific acoustic equipment. All requirements for acoustic data collection describe above should be met. Additionally, Brett Stacy from the University of California – Santa Cruz will perform periodic collections of surface water using the outflow of the ship's thermosalinograph for analysis of phytoplankton.

2. Biological data collection

Biological data are important to provide information about fish and plankton species for interpreting acoustic data. Nighttime sampling will in general be completed in time for the ship to be back on the acoustic transect at sunrise. If decided by the Chief Scientist, CPS fishing might be extended to the point that the return to the acoustic transect might occur past sunrise. On Leg II, day-time trawls will also occur during the morning, typically before 9 am.

Night- and daytime trawl sampling

Both night- and daytime trawling will be conducted with a Nordic 264 surface trawl. This trawl has been modified with a marine mammal excluder device (MMED) designed to expel marine mammals and other large animals (e.g., turtles, sharks) before they are swept to the rear of the net. The MMED consists of a rigid aluminum grid in the intermediate section forward of the codend. The trawl will be fitted with cameras and lights to observe animal behaviors and assess the performance of the MMED. Each nighttime trawl, as many as time allows, will be fished at the discretion of the CPS fishing Field Party Chief (FPC) for 45 minutes at a towing speed of approximately 3.5 – 4.5 kts. Reducing trawling time to 30 minutes might occur at the discretion of the FPC. Trawl locations will be selected each day by the acoustician and FPC and authorized by the OPS Officer. Trawl spacing will be determined based on the acoustic backscatter observed during daytime, and other factors. The first trawl will be done approximately between 0.5 and 1 hours after sunset.

In an attempt keep the footrope from sinking too deep during deployment, it is requested that prior to the tom weights being deployed, the ship's speed be increased to 3.0 – 3.5 knots.

Processing of the catch will be done according to the SWFSC sampling protocol. The catch will be weighed and subsampled, if necessary. Each morning during Leg II, before 0900h, one trawl will be performed at convenient locations to estimate salmon abundance. The trawling procedure will be identical to those of the night. The locations for salmon trawls will be defined the previous night.

For all trawling operations, protected species watches (e.g. marine mammals and turtles) are now a standard part of conducting fisheries research activities, particularly those that use gear (e.g., long-

lines and mid-water trawls) known to interact with protected species or that we believe have a reasonable likelihood of doing so in the future.

30 minute protected species watch (Monitoring prior to deploying trawl gear)

Protected species watches (visual observation) will be initiated by a designated scientist/s no less than 30 minutes prior to deployment of gear for sampling in order to determine if any protected species are near the proposed trawl set location. This watch can occur during transit leading up to arrival at the sampling station. Upon arrival at a sampling station trawl operations shall be conducted immediately except when it is necessary to conduct a bongo plankton tow or CTD deployment prior to deploying trawl gear. Protected species watches will be conducted using any binocular or monocular sighting instrument, with a means to estimate distance to protected species during daytime. During nighttime operations, visual observation shall be conducted using the naked eye and available vessel lighting.

Move-on rule

If marine mammals, sea turtles or other protected species are sighted within 1 nm of the planned set location prior to setting the gear, the vessel will transit to a different section of the sampling area to maintain a minimum distance of 1 nm between the set location and estimated location of sighted protected species. If, after moving on, marine mammals or sea turtles remain within the 1 nm exclusion zone, the CS or watch leader may decide to move again or to skip the station, but in any case may not set while a marine mammal or sea turtle is in the 1 nm exclusion radius.

Monitoring during trawl deployment, fishing and retrieval

In addition to the 30 minute protected species watch, visual monitoring efforts for protected species are required throughout the entire period of time that trawl gear is in the water. These watches will occur from deployment through gear retrieval and will be conducted by the watch leader, Chief Scientist (CS), or other designated scientists. If marine mammals or sea turtles are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take will be determined by the professional judgment of the CS, watch leader and other experienced crew as necessary. This judgment will be based on his/her past experience operating gears around marine mammals and SWFSC training sessions that will facilitate dissemination of Chief Scientist expertise that is used

operating in these situations (e.g., factors that contribute to marine mammal gear interactions and those that aid in successfully avoiding these events). These professional judgment decisions will be recorded in the provided visual monitoring watch logs. If trawling efforts have been suspended due to the presence of marine mammals trawl operations may only resume when sighted protected species are estimated to be at least 1 nm away from the trawl set location.

Data collection for visual watches
The visual monitoring watches (from 30 min prior to set through gear retrieval) and any data gathered during these watches will be recorded in the watch logs provided for each survey and in the SCS.

Marine mammal excluder devices (MMED)
At all times Nordic 264 trawl nets must be fitted with marine mammal excluder devices to allow marine mammals caught during trawling operations an opportunity to escape.

Acoustic deterrent devices
Pingers must be deployed during all trawl operations and on all types of trawl nets. Two to four pingers will be placed along the footrope and/or headrope and will be tested regularly to ensure they are operating properly.

Other standard trawl survey protocols. The gear will be emptied as quickly as possible upon retrieval in order to determine whether or not protected species are present. Care will be taken when emptying the trawl to avoid damage to protected species that may be caught in the gear but are not visible during retrieval.

Reporting, Data Collection and Handling Procedures for Protected Species
All protected species (marine mammals, sea turtles, seabirds and fish) lethal and non-lethal interactions with fisheries research gear will be reported to Krista Catelani via the Incidental Take Authorization account: SWFSC.ITA@noaa.gov. These interactions will be immediately relayed to the SWFSC Director and recorded in the Protected Species Incidental Take Database within 48 hours of the event.

In addition, for take of marine mammals and sea turtles, the CS or watch leader will call Krista Catelani immediately at 707-293-3563 (cell) or 858-546-7166 (work) to provide a detailed report of the event. Catch of eulachon and salmon will only be reported to SWFSC.ITA@noaa.gov at the conclusion of every survey day; no call is necessary. Appropriate communications on all authorized takes will occur in a timely manner to allow Krista Catelani to report the event to the PSIT in the required 48 hours.

Protected Species Handling

In general, following a "common sense" approach to handling protected species will present the best chance of minimizing injury to the animal and of decreasing risks to scientists, officers and crew. There are inherent safety concerns associated with handling/disentangling protected species, so using good judgment and ensuring human safety is paramount. SWFSC researchers should refer to PSIT-004.01, *SWFSC Marine Mammal Handling Guidelines*, and the Pacific Islands Region's *Identification, Handling and Release of Protected Species* (PSIT-005.01), and SWFSC's marine mammal and sea turtle sampling protocol (PSIT-002.01) for more specific guidance on protected species handling and sampling (e.g., species identification, safe removal of fishing gear, etc.).

For all marine mammal and sea turtle incidental interactions, SWFSC researchers will record interaction information using the Protected Species Incidental Take Form and the Marine Mammal and Sea Turtle Biological Sampling form. For any incidental takes of protected fish species (salmon and eulachon) SWFSC researchers will fill out the Protected Fish Specimen Data form.

Protected Species Sampling and Data Collection

Under the incidental take authorization SWFSC scientists are authorized and encouraged to collect samples from protected species incidentally captured or killed during fisheries research activities. For sampling, follow guidelines in SWFSCs *Detailed Sampling Protocol for Marine Mammal and Sea Turtle Incidental Takes* and fill out the Marine Mammal and Sea Turtle Biological Sampling form.

Standard tow durations have been reduced to 45 min or less at targeted depth, excluding deployment and retrieval time, to reduce the likelihood of attracting and incidentally taking protected species. These short tow durations decrease the opportunity for curious marine mammals to find the

vessel and investigate. The resulting tow distances are typically 1 to 2 nm, depending on the survey and trawl speed. Additionally, short tow times reduce the likelihood that captured sea turtles would drown.

Vessel speeds are restricted on research projects in part to reduce the risk of ship strikes with marine mammals. Transit speeds vary from 8-12 knots, but average 10 knots. The vessel's speed during active sampling is typically 3.5-4.5 knots due to sampling design. Thus, these much slower speeds essentially eliminate the risk of ship strikes.

Night plankton sampling

CalBOBL (CalCOFI Bongo Oblique): standard oblique plankton tow with 300 meters of wire out, depth permitting, using paired 0.505 mm mesh nets with 71 cm diameter openings. The technical requirements for this tow are: Descent wire rate of 50 meters per minute and an ascent wire rate of 20 meters per minute. All tows with ascending wire angles lower than 38° or higher than 51° in the final 100 meters of wire will be repeated. Additionally, a 45° wire angle should be closely maintained during the ascent and descent of the net frame. The port side sample will be preserved in buffered ethanol at every station. The CalBOBL tows will be performed at night, before or in between trawling operations, in conjunction with a CTD cast using Lasker's CTD rosette.

Please have the ST record "bongo deployed" and "bongo recovered" for SCS.

Pairovet net: will be fished from 70 meters to the surface (depth permitting) using paired 25 cm diameter 150 μm mesh nets at all stations. The technical requirements for Pairovet tows are: Descent rate of 70 meters per minute, a pause at terminal depth time of 10 seconds, and an ascent rate of 70 meters per minute. All tows with wire angles exceeding 15° during the ascent will be repeated.

Please have the ST record Pairovet deployed and Pairovet recovered for SCS.

3. Physical oceanographic data collection

Thermosalinograph and meteorological sensors

The ship will provide and maintain a thermosalinograph (TSG), which is calibrated and in working order, for continuous measurement of surface water temperature and salinity. A backup unit (calibrated and in working order) will also be provided by the vessel and remain aboard during the

project. The Scientific Computing System (SCS) will serve as the main data collection system. TSG and SCS data will be recorded continuously during the survey. These data will be logged to the ship's computers, and copied to media hard disk drive (HDD) that we provide. The ship's station and position information (MOA log) will also be copied to this HDD. During the pre-project meeting, we will specify what to include in the MOA and how the bridge and survey departments wish to number stations and transects

ADCP

Sample profiles of currents using the RDI/Teledyne Acoustic Doppler Current Profiler (ADCP), only when conducting station work (which include side stations). The ADCP will be secured during daytime transiting due to interference with the EK60/80. It is requested that the ship's survey technician be responsible for ADCP operations.

Underway CTD deployments:

The UCTD will be deployed during the day along acoustic transects at selected locations (**Appendix 3**), or as deemed necessary by the Chief Scientist or Acoustician and authorized by the Officer on Deck. The underway CTD requires a vessel speed of approximately 10 kts. The underway winch will be mounted on the ship's stern. The ship's personnel is needed to assist with the operation and maintenance of this equipment. The acoustician will provide a deployment duration time to the ST on duty. During the transit to Neah Bay, UCTD casts will be performed at 7:00, 11:00, 15:00, 19:00 PST. At the discretion of the acoustician or Chief Scientist, and upon approval with the OOD and Survey tech, UCTD casts during the transit could be replaced for CTD rosette deployments.

CTD rosette deployments

The ship's CTD rosette will be cast during crepuscular periods or at night in conjunction with CalBOBL and Pairovet tows, at the discretion of the Chief Scientist. Additional daytime CTD cast might be scheduled as necessary. The ship's Survey Tech is needed to assist with the operation and maintenance of this equipment.

CUFES

The egg pump will be mounted inside the ship's hull drawing water from a depth of three meters. The pump will run continuously between stations to sample any pelagic fish eggs. Approximately 640 liters/minute is sent

through a concentrator which filters all material larger than 505 µm. The sieved material is then collected and identified. All fish eggs are identified to lowest taxa, counted and entered into the data acquisition software. Each sample entry is coupled with sea surface temperature, geographical position, wind speed and direction, date and time, and surface salinity. Sampling intervals will vary in length, depending on the number of fish eggs seen, from five to 30 minutes. It is requested that prior to departure on June 28 that the CUFES intake be cleared from all marine growth.

4. Acoustic data Collection in the vicinity of bottom-mounted transducer off the Coast of Washington and Oregon will be done for at least 1 hour in each of the three locations indicated in Appendix 4. When approaching the locations (Figure 4.1). Lasker will brake transect, transit to the nearest waypoint of the square pattern prescribed in Table 4.1 and loop around the square pattern for 1 hour. Sampling in these locations will be limited to EK60 and EK80s. All restrictions and conditions for acoustic sampling described above are applicable.

5. Acoustic and Optical sampling, and equipment deployment during Leg V
   This survey leg is devoted to testing acoustic (EK80s, ME70, MS70, and M3) and optical (stereo and HD-video cameras) instrumentation, using on-board, moored and a ROV-mounted sensors (ROV), in order to observe mesopelagic and demersal fishes and their habitats. Due to the specialized nature of this leg, details on its procedures are explained in the detail on Appendix 5.

C. Dive Plan
   All dives are to be conducted in accordance with the requirements and regulations of the NOAA Diving Program (http://www.ndc.noaa.gov/dr.html) and require the approval of the ship's Commanding Officer. At least 1 dive will be necessary to clean the transducers of EK60, EK60, ME70 and MS70 and SX90, and the intake of the CUFES pump.
D. Applicable Restrictions
   Conditions which preclude normal operations: If sea conditions and vessel ride deteriorate to a point where the quality of collected acoustic data is compromised, the vessel may need to break from running acoustic transects and seek shelter until conditions improve enough for satisfactory collection of acoustic data.

III. Equipment

A. Equipment and Capabilities provided by the ship (itemized)

	Item Name	Notes
1	CTD (main unit plus spare), rosette, carousel, 6 water sampling bottles, computer/deck unit, hydrographic winch	
2	ADCP computer/deck unit	
3	Underway sensors (SCS) and computer/deck unit	
4	Trawl winch, net mensuration (e.g., Simrad third wire)	
5	Ship's computer network (at least 4 static IP addresses on SH)	
6	Centerboard-mounted transducers	
7	Spaces needed: Fish Processing Lab, Chem Lab, Dry Lab, Hydro Lab, Constant Environment Room, and Preservation Alcove	
8	Email, telephones, intercom system, handheld radios	
9	VHF Radios with NOAA F-Channels	
10	Simrad EK60: 18-, 38-, 70-, 120-, and 200-kHz GPTs	
11	Simrad ME70 Multibeam echosounder system	
12	Simrad MS70 Multibeam sonar system	
13	Simrad SX90 Fish finding sonar	
14	FS70 third-wire trawl sounder	
15	Applanix POS MV position and attitude sensor system	
16	Internal CUFES pump and concentrator	
17	Large, medium, and small Marel fish lab scales and calibration weights	
18	Three-pole 30 Amp breaker on the Chem Lab for powering the ROV	
19	Forward cable pass-through between Chem Lab and side-sampling station for	

	ROV cabling	
20	Access to the Centerboard with service platform during the September 18 inport	Necessary to install USBL transceiver and remove camera/SVP
21	ET support to run VGA over CAT5 cables for displaying ROV navigation on the bridge	VGA-over-CAT5 Hardware to be provided by SWFSC

B. Equipment and Capabilities provided by SWFSC (itemized)

	Item Name	**Itemized; total weight**
1	Computers	5 laptops; 25 lb
2	External hard drives	(8) 4-TB USB 3.0 HDDs, 8 lb
3	Software	Software media, NA
4	Trawl gear	1 midwater NORDIC 264 nets; 2000 lb
		2 sets of 3.0 m X Lite trawl doors; 2400 lb
		Trawl rigging; 1000 lb
5	UCTD/SC	Cast CTD and Stereo-Camera system (SWFSC/AST) and associated hardware and spares; 100 lb
6	CalBOBL	2 71 cm frames, nets, supplies; 50 lb
7	Pairovet	1 frame and nets; 50 kb
8	Fish processing miscellaneous	Fish baskets, bins, trays, dissection supplies; 100 lb
9	ROV	(1) 600 lb
10	ROV Tether and reel	(1) 3000 lb
11	ROV Fish totes	(2) 500 lb
12	ROV Control console	(1) 200 lb
13	ROV Clump weights	(2) 500 lb
14	Assorted jars, scintillation vials, etc	(many) 500 lb

15	Dissecting Microscope	(1) 50 lb
16	Motion compensated scales	(2) 100 lb
17	Trawl-Camera systems	(2) 60 lb
18	Underway CTD	2 probes, 1 winch; 80 lb
19	Biology Fish totes	(~8) 800 lb

IV. Hazardous Materials

A. Policy and Compliance

The Chief Scientist is responsible for complying with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it). By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all hazardous materials by name and the anticipated quantity brought aboard, MSDS and appropriate neutralizing agents, buffers, or absorbents in amounts adequate to address spills of a size equal to the amount of chemical brought aboard, and a chemical hygiene plan. Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

- Per FEC 07, the scientific party will include with their project instructions and provide to the CO of the respective ship 60 to 90 days before departure:
- A list of hazardous materials by name and anticipated quantity
- Include a chemical spill plan the addresses all of the chemicals the program is bringing aboard. This shall include:
- Procedures on how the spilled chemicals will be contained and cleaned up.
- A complete inventory (including volumes/amounts) of the chemical spill supplies and equipment brought aboard by the program. This must be sufficient to clean and neutralize all of the chemicals brought aboard by the program.
- A list of the trained personnel who will be accompanying the project and the training they have completed.

Common Name of Material	**Qty**	**Notes**	**Trained Individual**	**Spill control**
Ethanol (95%)	2 x 5 gallons	5-gallon carboys, stored in chem lab	Dave Griffith Sue Manion Amy Hays	E
Formaldehyde solution (37%)	5 gallons	No waste, stored in preservation alcove fume hood	Dave Griffith Sue Manion Amy Hays	F

Common Name of Material	Qty	Notes	Trained Individual	Spill control
Buffered formalin (10%)	40 gallons (in 4 oz. and 8 oz. jars)	Stored in wet lab, no waste	Dave Griffith Sue Manion Amy Hays	F
Sodium borate powder	500 gr	Stored in chem lab	Dave Griffith Sue Manion Amy Hays	D
Ethyl alcohol (95%)	40 liters (in 20 ml vials)	Stored in chem lab, no waste	Dave Griffith Sue Manion Amy Hays	F
Tris buffer	500 ml	Stored in chem lab	Dave Griffith Sue Manion Amy Hays	D

B. Spill Control

F: Formalin/Formaldehyde

- Ventilate area of leak or spill. Remove all sources of ignition.
- Wear appropriate personal protective equipment.
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible.
- Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e.g., vermiculite, dry sand, earth), and place in a chemical waste container.
- Do not use combustible materials, such as sawdust.

E: Ethanol

- Ventilate area of leak or spill. Remove all sources of ignition.
- Wear appropriate personal protective equipment.
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible.
- Use non-sparking tools and equipment. Absorb spill with inert material, then place in suitable container.

D: Powdered and granular chemicals

- Wear appropriate protective equipment and clothing during clean-up. Keep upwind. Keep out of low areas.
- Sweep up dry chemical and place in a doubled zip lock bag.
- If contact with water occurs, use proper neutralizing agent prior to cleanup.
- Store in sealed container to be returned and disposed by SWFSC.

Inventory of Spill Kit supplies

Product Name	Amount	Chemicals it is useful against	Amount it can clean up
Spill-X-FP	12 lbs	formalin/formaldehyde	13.6 gallons
absorbent pads	10	formalin/ethanol/Tris buffer	10x its weight
Formaldehyde Eater	5 gallons	Formaldehyde	10 gallons

Upon embarkation and prior to loading hazardous materials aboard the vessel, the scientific party will provide to the CO or their designee:

- An inventory list showing actual amount of hazardous material brought aboard
- An MSDS for each material
- Confirmation that neutralizing agents and spill equipment were brought aboard and are sufficient to contain and clean up all of the hazardous material brought aboard by the program.

Upon departure from the ship, scientific parties will provide the CO or their designee an inventory of hazardous material indicating all materials have been used or removed from the vessel. The CO's designee will maintain a log to track scientific party hazardous materials. MSDS will be made available to the ship's complement, in compliance with Hazard Communication Laws.

Scientific parties are expected to manage and respond to spills of scientific hazardous materials. Overboard discharge of scientific chemicals is not permitted during projects aboard NOAA ships.

B. Radioactive Isotopes

The Chief Scientist is responsible for complying with OMAO 0701-10 Radioactive Material aboard NOAA Ships. Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

At least three months in advance of a domestic project and eight months in advance of a foreign project start date the shall submit required documentation to MOC-CO, including:

1. NOAA Form 57-07-02, Request to Use Radioactive Material aboard a NOAA Ship
2. Draft Project Instructions
3. Nuclear Regulatory Commission (NRC) Materials License (NRC Form 374) or a state license for each state the ship will operate in with RAM on board the ship.

4. Report of Proposed Activities in Non-Agreement States, Areas of Exclusive Federal Jurisdiction, or Offshore Waters (NRC Form 241), if only state license(s) are submitted).
5. MSDS
6. Experiment or usage protocols, including spill cleanup procedures.

Scientific parties will follow responsibilities as outlined in the procedure, including requirements for storage and use, routine wipe tests, signage, and material disposal as outline in OMAO 0701-10.

All radioisotope work will be conducted by NRC or State licensed investigators only, and copies of these licenses shall be provided per OMAO 0701-10 at least three months prior to the start date of domestic projects and eight months in advance of foreign project start dates.

C. Inventory (itemized) of Radioactive Materials

Common Name Radioactive Material	**Concentration**	**Amount**	**Notes**
None			

V. Additional Projects

A. Supplementary ("Piggyback") Projects
B. NOAA Fleet Ancillary Projects

VI. Disposition of Data and Reports

Disposition of data gathered aboard NOAA ships will conform to NAO 216-101 *Ocean Data Acquisitions* and NAO 212-15 *Management of Environmental Data and Information.* To guide the implementation of these NAOs, NOAA's Environmental Data Management Committee (EDMC) provides the *NOAA Data Documentation Procedural Directive* (data documentation) and *NOAA Data Management Planning Procedural Directive* (preparation of Data Management Plans). OMAO is developing procedures and allocating resources to manage OMAO data and Programs are encouraged to do the same for their Project data.

A. Data Classifications: *Under Development*

i. OMAO Data

ii. Program Data

B. Responsibilities: *Under Development*

VII. Meetings, Vessel Familiarization, and Project Evaluations

A. Pre-Project Meeting: The Chief Scientist and Commanding Officer will conduct a meeting of pertinent members of the scientific party and ship's crew to discuss required equipment, planned operations, concerns, and establish mitigation strategies for all concerns. This meeting shall be conducted before the beginning of the project with sufficient time to allow for preparation of the ship and project personnel. The ship's Operations Officer usually is delegated to assist the Chief Scientist in arranging this meeting.

B. Vessel Familiarization Meeting: The Commanding Officer is responsible for ensuring scientific personnel are familiarized with applicable sections of the standing orders and vessel protocols, e.g., meals, watches, etiquette, drills, etc. A vessel familiarization meeting shall be conducted in the first 24 hours of the project's start and is normally presented by the ship's Operations Officer.

C. Post-Project Meeting: The Commanding Officer is responsible for conducted a meeting no earlier than 24 hrs before or 7 days after the completion of a project to discuss the overall success and short comings of the project. Concerns regarding safety, efficiency, and suggestions for future improvements shall be discussed and mitigations for future projects will be documented for future use. This meeting shall be attended by the ship's officers, applicable crew, the Chief Scientist, and members of the scientific party and is normally arranged by the Operations Officer and Chief Scientist.

D. Project Evaluation Report

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Chief Scientist. The form is available at https://sites.google.com/a/noaa.gov/omao-intranet-dev/operations/marine/customer-satisfaction-survey and provides a "Submit" button at the end of the form. It is also located at https://docs.google.com/a/noaa.gov/forms/d/1a5hCCkgIwaSII4DmrHPudAehQ9HqhRqY3J_FXqbJp9g/viewform. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the ships, specific concerns and praises are followed up on while not divulging the identity of the evaluator.

VIII. Miscellaneous

A. Meals and Berthing

The ship will provide meals for the scientists listed above. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the project, and ending two hours after the termination of the project. Since the watch schedule is

split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least seven days prior to the project.

Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the Chief Scientist. The Chief Scientist and Commanding Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current make-up of the ship's complement. The Chief Scientist is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The Chief Scientist is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the project and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The Chief Scientist will ensure that all non NOAA or non Federal scientists aboard also have proper orders. It is the responsibility of the Chief Scientist to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 17, 2000 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts

The NOAA Health Services Questionnaire (NHSQ, NF 57-10-01 (3-14)) must be completed in advance by each participating scientist. The NHSQ can be obtained from the Chief Scientist or the NOAA website http://www.corporateservices.noaa.gov/noaaforms/eforms/nf57-10-01.pdf.

All NHSQs submitted after March 1, 2014 must be accompanied by NOAA Form (NF) 57-10-02 - Tuberculosis Screening Document in compliance with OMAO Policy 1008 (Tuberculosis Protection Program).

The completed forms should be sent to the Regional Director of Health Services at the applicable Marine Operations Center. The NHSQ and Tuberculosis Screening Document should reach the Health Services Office no later than 4 weeks prior to the start of the project to allow time for the participant to obtain and submit additional information should health services require it, before clearance to sail can be granted. Please contact

MOC Health Services with any questions regarding eligibility or completion of either form. Ensure to fully complete each form and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

The participant can mail, fax, or email the forms to the contact information below. Participants should take precautions to protect their Personally Identifiable Information (PII) and medical information and ensure all correspondence adheres to DOC guidance (http://ocio.os.doc.gov/ITPolicyandPrograms/IT_Privacy/PROD01_008240).

The only secure email process approved by NOAA is Accellion Secure File Transfer which requires the sender to setup an account. Accellion's Web Users Guide is a valuable aid in using this service, however to reduce cost the DOC contract doesn't provide for automatically issuing full functioning accounts. To receive access to a "Send Tab", after your Accellion account has been established send an email from the associated email account to accellionAlerts@doc.gov requesting access to the "Send Tab" function. They will notify you via email usually within 1 business day of your approval. The 'Send Tab" function will be accessible for 30 days.

Contact information:

Regional Director of Health Services
Marine Operations Center – Pacific
2002 SE Marine Science Dr.
Newport, OR 97365
Telephone 541-867-8822
Fax 541-867-8856
Email MOP.Health-Services@noaa.gov

Prior to departure, the Chief Scientist must provide an electronic listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: contact name, address, relationship to member, and telephone number.

C. Shipboard Safety

Hard hats are required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. Hard hats and work vests will be provided by the ship when required.

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. At the discretion of the ship CO, safety shoes (i.e. steel or composite toe protection) may be required to participate in any work dealing with suspended loads, including CTD deployment and recovery. The ship does not provide safety-toed shoes/boots. The ship's Operations Officer should be consulted by the Chief Scientist to ensure members of the scientific party report aboard with the proper attire.

D. Communications

A progress report on operations prepared by the Chief Scientist may be relayed to the program office. Sometimes it is necessary for the Chief Scientist to communicate with another vessel, aircraft, or shore facility. Through various means of communications, the ship can usually accommodate the Chief Scientist. Special radio voice communications requirements should be listed in the project instructions. The ship's primary means of communication with the Marine Operations Center is via email and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth at 128kbs is shared by all vessels staff and the science team at no charge. Increased bandwidth in 30 day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required and it must be arranged through the ship's Commanding Officer at least 30 days in advance.

E. IT Security

Any computer that will be hooked into the ship's network must comply with the *OMAO Fleet IT Security Policy* 1.1 (November 4, 2005) prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

(1) Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.
(2) Installation of the latest critical operating system security patches.
(3) No external public Internet Service Provider (ISP) connections.

Completion of the above requirements prior to boarding the ship is required.

Non-NOAA personnel using the ship's computers or connecting their own computers to the ship's network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo (http://deemedexports.noaa.gov). National Marine Fisheries Service personnel will use the Foreign National Registration System (FNRS) to submit requests for access to NOAA facilities and ships. The Departmental Sponsor/NOAA (DSN) is responsible for obtaining clearances and export licenses and for providing escorts required by the NAO. DSNs should consult with their designated Line Office Deemed Export point of contact to assist with the process.

Full compliance with NAO 207-12 is required.

Responsibilities of the Chief Scientist:

1. Provide the Commanding Officer with the email generated by the Servicing Security Office granting approval for the foreign national guest's visit. (For

NMFS-sponsored guests, this email will be transmitted by FNRS.) This email will identify the guest's DSN and will serve as evidence that the requirements of NAO 207-12 have been complied with.

2. Escorts – The Chief Scientist is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer.
3. Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the Servicing Security Office.
4. Export Control - Ensure that approved controls are in place for any technologies that are subject to Export Administration Regulations (EAR).

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Responsibilities of the Commanding Officer:

1. Ensure only those foreign nationals with DOC/OSY clearance are granted access.
2. Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written approval from the Director of the Office of Marine and Aviation Operations and compliance with export and sanction regulations.
3. Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.
4. Ensure receipt from the Chief Scientist or the DSN of the FNRS or Servicing Security Office email granting approval for the foreign national guest's visit.
5. Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.
6. Export Control - 8 weeks in advance of the project, provide the Chief Scientist with a current inventory of OMAO controlled technology onboard the vessel and a copy of the vessel Technology Access Control Plan (TACP). Also notify the Chief Scientist of any OMAO-sponsored foreign nationals that will be onboard while program equipment is aboard so that the Chief Scientist can take steps to prevent unlicensed export of Program controlled technology. The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.
7. Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the Servicing Security Office.

Responsibilities of the Foreign National Sponsor:

1. Export Control - The foreign national's sponsor is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.
2. The DSN of the foreign national shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen and a NOAA or DOC employee. According to DOC/OSY, this requirement cannot be altered.
3. Ensure completion and submission of Appendix C (Certification of Conditions and Responsibilities for a Foreign National

Appendix 1 – Survey Design

The proposed survey design attempts to make optimal use of the available survey time by allocating *a priori* higher effort in regions of highest interest: Washington and Oregon, San Francisco and Monterey regions, and the Southern California Bight (Figure 1). In these regions transects are placed every 10 nm for maximum resolution and precision. Outside these regions, transects are placed every 20 nm to achieve a balance between precision and time savings. Together, they form the "compulsory survey pattern".

Within the areas of the compulsory pattern on which transects are spaced by 20 nm, additional transects might be added upon the observation of CPS. These transects are called adaptive transects because they will result in adapting the survey design *on-the-fly*. Adaptive transects might be added according to the following protocol:

1. If CPS are observed during a compulsory transect, an adaptive transect will be added 10 nm to the north. The ship will then transit to the transect 20 nm south to resume sampling on the next adaptive transect, followed by a compulsory transect and one last adaptive transect. This scheme guarantees that when adaptive sampling is initiated, there is a minimum of 3 adaptive transect added to the compulsory pattern to comprise a stratum.
2. If CPS eggs or adults are encountered on the last compulsory transect of the adaptive event, continue adding adaptive transects to the compulsory pattern. Revert to the compulsory sampling pattern once CPS are absent from a compulsory transect.
3. Resume adaptive sampling once CPS eggs or adults are found.

The adaptive sampling scheme presented here results in larger uncertainty about the progress of the survey in relationship to a fixed survey design. For planning purposes, two examples are considered. The first one corresponds to the completion of survey using only the compulsory transects (Figure 1.2), and the second one corresponds to completing the survey using all adaptive and compulsive patterns (Figure 1.3). These two extreme scenarios allow to visualize the range of transects executed during each of the survey legs. In case the entire survey pattern is completed before September 17, Lasker will resample transects on the Southern California Bight where the presence of CPS has been detected. The collection of these data will be used to reduce uncertainty of the estimates of biomass and demographics, and to study the habitat and behavior of the CPS species. If requested by the Chief Scientist and approved by the Commanding Officer, daytime trawl operations might be performed.

Figure 1.1 Requested transect locations for the 2016 California Current Ecosystem survey, displaying compulsory and adaptive transects. The compulsory transects constitute the core of the survey. The extreme points for each set of transects are provided in Tables 1 and 2.

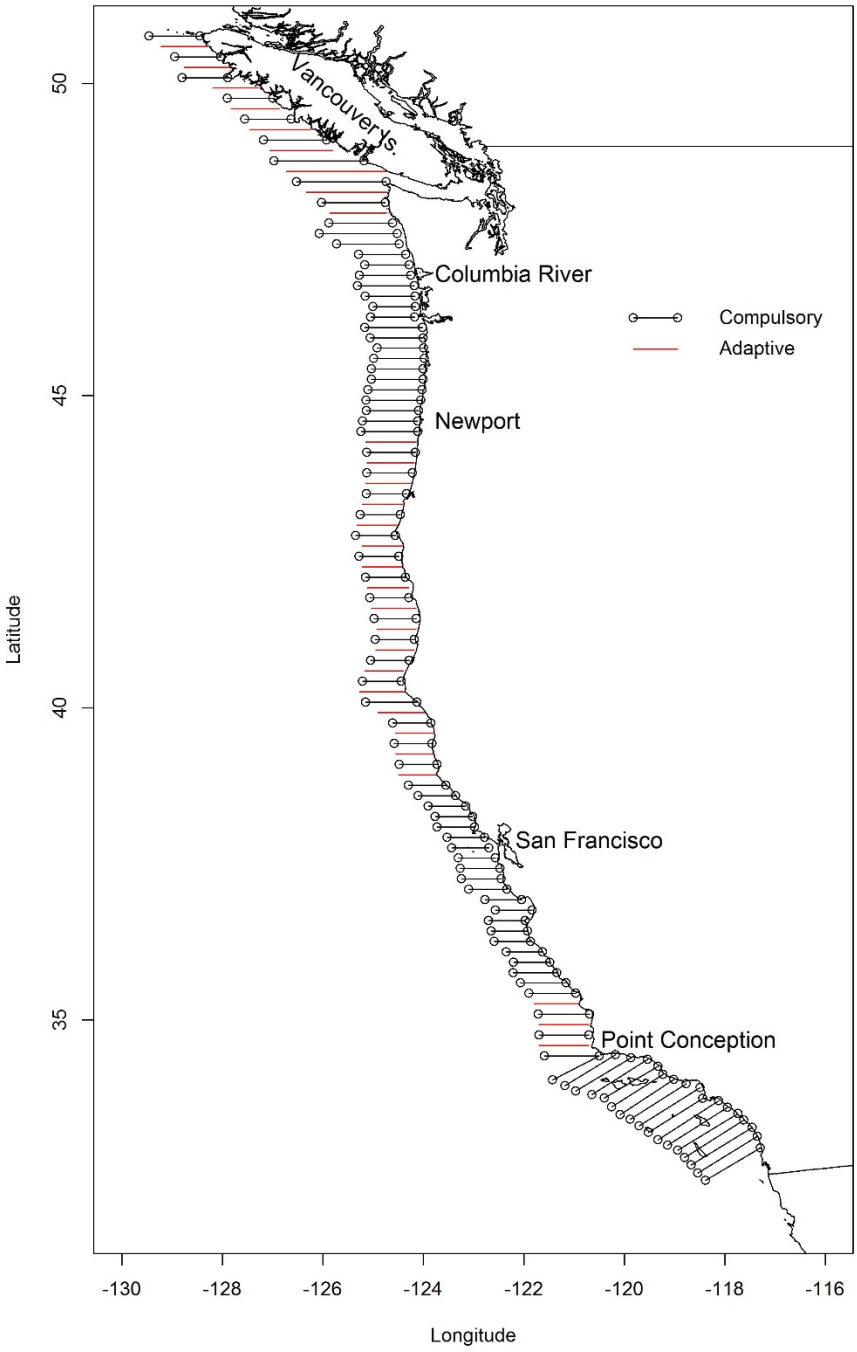


Figure 1.2 Projected survey track in the event that no adaptive transects are added to the compulsory pattern. The different colors represent the expected transects sampled during each leg.

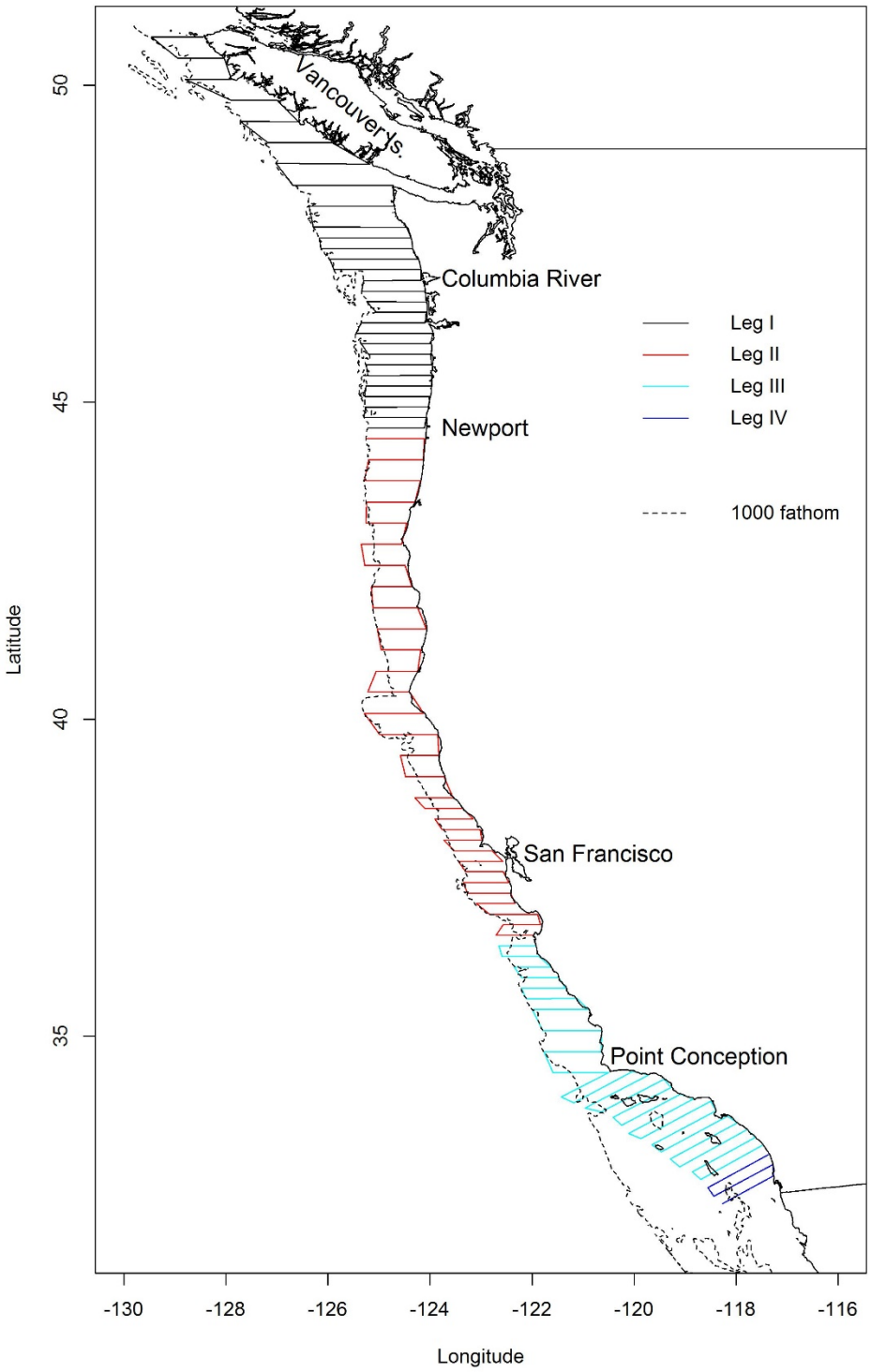


Figure 1.3 Projected survey track in the event that all adaptive transects are added to the compulsory pattern. The different colors represent the expected transects sampled during each leg.

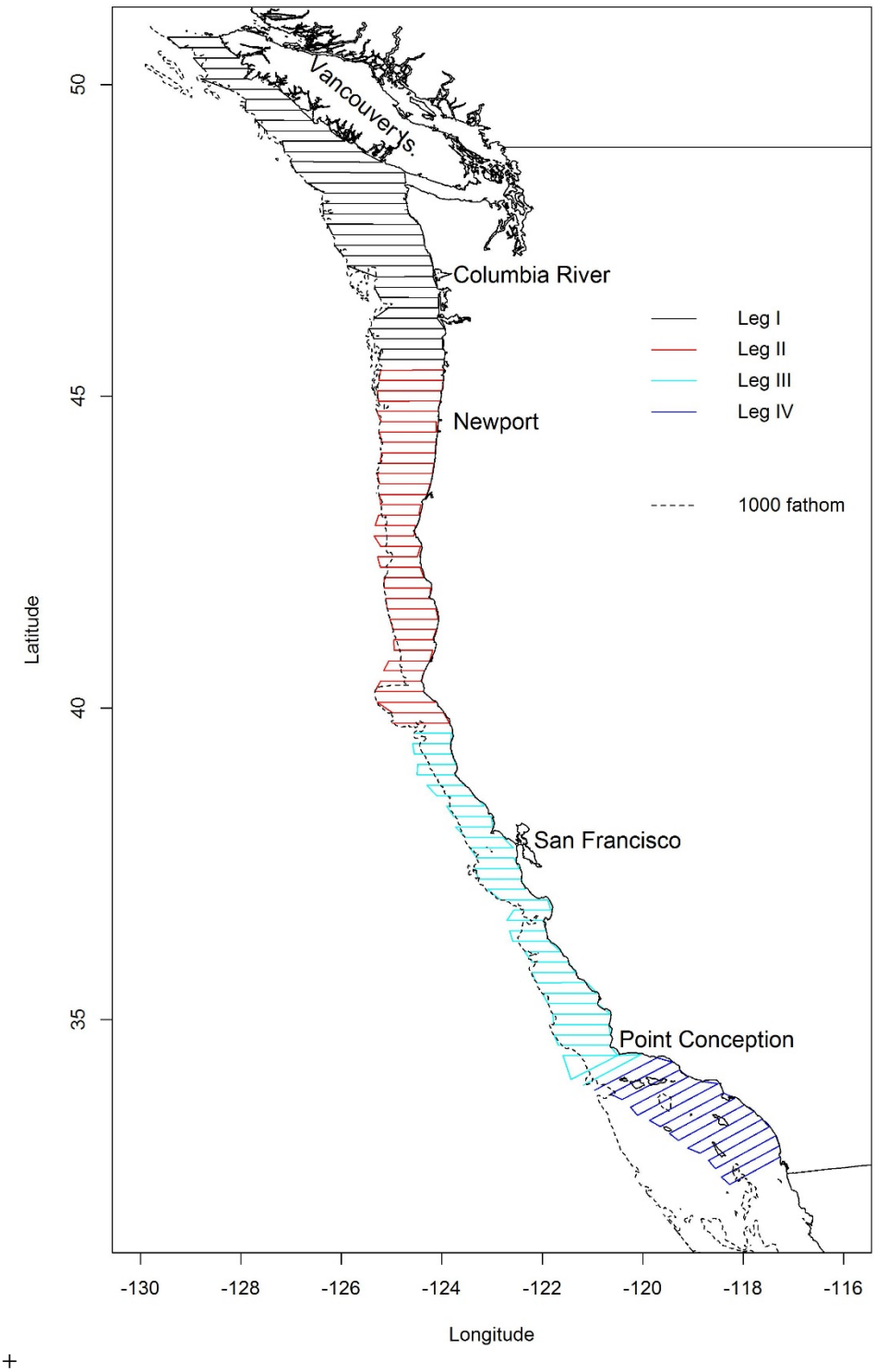


Table 1.1 – Table with coordinates of compulsory transects indicated in black in Figure 1.1. Transects are numerated sequentially from north to south from 1 to 116. Adaptive transects are shown separately in Table 1.2.

long	lat	transect
-128.449	50.76083	1
-129.462	50.76083	1
-128.948	50.4275	3
-128.032	50.4275	3
-127.893	50.09417	5
-128.803	50.09417	5
-127.899	49.76083	7
-126.996	49.76083	7
-126.576	49.4252	9
-127.717	49.4306	9
-127.177	49.09417	11
-125.925	49.09417	11
-125.184	48.75657	13
-127.019	48.76736	13
-126.688	48.42226	15
-124.72	48.42226	15
-124.712	48.09333	17
-126.371	48.09333	17
-126.288	47.76441	19
-124.46	47.75902	19
-124.374	47.59186	20
-126.173	47.59186	20
-126.141	47.4247	21
-124.342	47.4247	21
-124.245	47.25754	22
-125.968	47.25754	22
-125.885	47.09577	23
-124.18	47.09577	23
-124.18	46.92322	24
-125.302	46.91783	24
-125.338	46.75067	25
-124.097	46.75067	25

-124.072	46.58352	26
-125.241	46.58891	26
-125.058	46.42175	27
-124.072	46.42175	27
-124.097	46.25459	28
-125.349	46.25459	28
-125.446	46.08743	29
-123.946	46.08743	29
-123.989	45.92567	30
-125.353	45.92567	30
-125.215	45.75821	31
-123.989	45.75821	31
-123.963	45.58795	32
-125.249	45.58795	32
-125.215	45.41569	33
-123.959	45.42047	33
-123.973	45.25778	34
-125.258	45.25299	34
-125.282	45.09029	35
-123.997	45.09029	35
-124.038	44.9276	36
-125.266	44.92281	36
-125.299	44.76012	37
-124.071	44.76012	37
-124.113	44.59417	38
-125.212	44.59417	38
-125.24	44.4275	39
-124.115	44.4275	39
-124.134	44.0902	41
-125.204	44.0902	41
-125.286	43.76187	43
-124.189	43.76187	43
-124.295	43.42575	45
-125.243	43.42575	45
-125.259	43.09417	47
-124.46	43.09417	47
-124.555	42.76083	49
-125.35	42.76083	49
-125.28	42.4275	51

-124.49	42.4275	51
-124.36	42.09417	53
-125.146	42.09417	53
-125.118	41.75911	55
-124.239	41.75911	55
-124.071	41.42298	57
-125.032	41.42298	57
-124.958	41.09417	59
-124.184	41.09417	59
-124.245	40.75777	61
-125.055	40.75777	61
-125.22	40.43004	63
-124.407	40.43004	63
-124.127	40.09286	65
-125.289	40.09286	65
-124.99	39.75883	67
-123.847	39.75883	67
-123.829	39.4275	69
-124.584	39.4275	69
-124.478	39.09417	71
-123.727	39.09417	71
-123.55	38.76083	73
-124.298	38.76083	73
-124.107	38.59417	74
-123.361	38.59417	74
-123.16	38.4275	75
-123.905	38.4275	75
-123.763	38.26083	76
-123.02	38.26083	76
-122.983	38.09417	77
-123.724	38.09417	77
-123.528	37.9275	78
-122.784	37.9275	78
-122.571	37.75964	79
-123.439	37.75964	79
-123.303	37.59417	80
-122.567	37.59417	80
-122.456	37.42635	81
-123.351	37.42635	81

-123.267	37.2577	82
-122.418	37.2577	82
-122.337	37.09417	83
-123.097	37.09417	83
-122.83	36.92442	84
-121.887	36.92442	84
-121.835	36.76083	85
-122.564	36.76083	85
-122.701	36.59417	86
-121.975	36.59417	86
-121.926	36.4275	87
-122.651	36.4275	87
-122.588	36.26083	88
-121.865	36.26083	88
-121.63	36.09417	89
-122.352	36.09417	89
-122.204	35.9275	90
-121.484	35.9275	90
-121.339	35.76083	91
-122.216	35.76083	91
-122.109	35.59003	92
-121.116	35.59474	92
-120.897	35.4254	93
-121.994	35.4254	93
-121.785	35.08672	95
-120.638	35.08672	95
-120.641	34.75746	97
-121.764	34.75746	97
-121.587	34.4275	99
-120.499	34.4275	99
-120.499	34.4275	100
-121.427	34.04449	100
-121.18	33.95181	101
-120.027	34.44667	101
-119.711	34.38831	102
-120.961	33.87011	102
-120.645	33.80709	103
-119.413	34.32295	103
-119.273	34.19224	104

-120.408	33.72072	104
-120.246	33.59701	105
-119.093	34.08486	105
-118.834	34.0125	106
-120.101	33.46863	106
-119.867	33.38459	107
-118.495	33.97282	107
-118.391	33.82576	108
-119.651	33.28889	108
-119.468	33.17685	109
-118.163	33.7394	109
-117.972	33.63202	110
-119.289	33.06247	110
-119.106	32.94343	111
-117.783	33.52932	111
-117.619	33.40794	112
-118.857	32.86173	112
-118.689	32.74268	113
-117.479	33.27955	113
-117.351	33.14183	114
-118.553	32.61197	114
-118.437	32.47658	115
-117.275	32.98077	115
-117.269	32.7987	116
-118.267	32.35987	116

Table 1.2 – Table with coordinates of adaptive transects indicated in red in Figure 1.1. Transects are numerated sequentially from north to south from 1 to 116. Compulsory transects are shown separately in Table 1.1.

long	lat	transect
-128.303	50.59417	2
-129.222	50.59417	2
-127.853	50.26083	4
-128.765	50.26083	4
-128.242	49.92668	6
-127.256	49.92668	6

-126.803	49.59236	8
-127.918	49.59236	8
-127.49	49.25805	10
-126.22	49.25805	10
-125.59	48.92373	12
-127.137	48.92373	12
-126.9	48.59481	14
-124.745	48.58941	14
-124.729	48.26083	16
-126.333	48.26083	16
-124.658	47.92617	18
-126.36	47.92617	18
-124.117	44.26246	40
-125.204	44.26246	40
-125.223	43.9275	42
-124.16	43.9275	42
-124.236	43.59848	44
-125.24	43.59848	44
-124.418	43.26083	46
-125.219	43.26083	46
-124.529	42.9275	48
-125.325	42.9275	48
-124.426	42.59417	50
-125.218	42.59417	50
-124.437	42.26083	52
-125.225	42.26083	52
-125.151	41.92717	54
-124.229	41.92717	54
-124.12	41.59104	56
-125.085	41.59104	56
-124.973	41.25958	58
-124.11	41.26425	58
-124.179	40.9275	60
-124.951	40.9275	60
-125.161	40.59705	62
-124.348	40.59705	62
-124.371	40.26303	64
-125.332	40.26303	64
-124.98	39.92585	66

-123.969	39.92585	66
-123.8	39.59417	68
-124.557	39.59417	68
-123.799	39.26083	70
-124.553	39.26083	70
-123.745	38.9275	72
-124.495	38.9275	72
-121.886	35.26547	94
-120.911	35.26077	94
-120.67	34.92209	96
-121.775	34.92209	96
-121.681	34.59282	98
-120.663	34.59282	98

Appendix 2: Intentionally left Blank

Appendix 3 - Underway CTD locations

Underway CTD (UCTD) casts will be primarily performed along the east-west transects in pre-determined locations (Table 3.1). During the transit to Neah Bay, UCTD casts will be performed at 7:00, 11:00, 15:00, 19:00 PST. If requested by Chief Scientist or Acoustician and approved by the Officer on Deck, UCTD casts can be performed *ad hoc* during any part of the survey.

Table 3.1 – Coordinates UCTD casts to be performed on compulsory transects. Refer to Table 1.1 for transect names.

UCTD	long	lat	transect
1	-128.649	50.76083	1
2	-129.118	50.76083	1
3	-128.934	50.4275	3
4	-128.478	50.4275	3
5	-128.025	50.41009	3
6	-128.11	50.09417	5
7	-128.484	50.09417	5
8	-127.892	49.76083	7
9	-127.41	49.76083	7
10	-126.973	49.73731	7
11	-126.885	49.4275	9
12	-127.357	49.4275	9
13	-127.17	49.09417	11
14	-126.552	49.09417	11
15	-125.906	49.08556	11
16	-125.722	48.76083	13
17	-126.422	48.76083	13
18	-126.679	48.4275	15
19	-125.697	48.4275	15
20	-124.797	48.4212	15
21	-125.12	48.09417	17
22	-125.811	48.09417	17
23	-126.277	47.76083	19
24	-125.361	47.76083	19
25	-124.509	47.76083	19
26	-124.899	47.59417	20
27	-125.684	47.59417	20
28	-126.052	47.4275	21
29	-125.19	47.4275	21
30	-124.367	47.4275	21
31	-124.728	47.26083	22

32	-125.434	47.26083	22
33	-125.884	47.09417	23
34	-125.035	47.09417	23
35	-124.211	47.09417	23
36	-124.465	46.9275	24
37	-124.93	46.9275	24
38	-125.3	46.76083	25
39	-124.692	46.76083	25
40	-124.134	46.74981	25
41	-124.28	46.59417	26
42	-124.867	46.58148	26
43	-125.053	46.4275	27
44	-124.533	46.4275	27
45	-124.071	46.40933	27
46	-124.32	46.26083	28
47	-124.871	46.26083	28
48	-125.406	46.09417	29
49	-124.709	46.09417	29
50	-123.976	46.08415	29
51	-124.258	45.9275	30
52	-124.907	45.9275	30
53	-125.166	45.76083	31
54	-124.563	45.76083	31
55	-123.988	45.76083	31
56	-124.204	45.59417	32
57	-124.854	45.59417	32
58	-125.15	45.4275	33
59	-124.536	45.4275	33
60	-124.016	45.4185	33
61	-124.282	45.26083	34
62	-124.861	45.26083	34
63	-125.174	45.09417	35
64	-124.578	45.0895	35
65	-124.034	45.08567	35
66	-124.324	44.9275	36
67	-124.932	44.9275	36
68	-125.286	44.76083	37
69	-124.672	44.76083	37
70	-124.088	44.75667	37
71	-124.396	44.59417	38
72	-124.94	44.59417	38

73	-125.184	44.4275	39
74	-124.674	44.4275	39
75	-124.117	44.40854	39
76	-124.378	44.09417	41
77	-124.908	44.09417	41
78	-125.091	43.76083	43
79	-124.669	43.76083	43
80	-124.207	43.76083	43
81	-124.519	43.42575	45
82	-124.959	43.42575	45
83	-125.243	43.09241	47
84	-124.831	43.09241	47
85	-124.497	43.09241	47
86	-124.677	42.75908	49
87	-125.02	42.75908	49
88	-125.269	42.42575	51
89	-124.821	42.42575	51
90	-124.482	42.40639	51
91	-124.592	42.09241	53
92	-124.892	42.09241	53
93	-125.055	41.76487	55
94	-124.634	41.75908	55
95	-124.27	41.75908	55
96	-124.408	41.42575	57
97	-124.749	41.42575	57
98	-124.939	41.09241	59
99	-124.542	41.09241	59
100	-124.188	41.06864	59
101	-124.485	40.75908	61
102	-124.785	40.75908	61
103	-125.14	40.42575	63
104	-124.607	40.42575	63
105	-124.421	40.42575	63
106	-124.394	40.09241	65
107	-124.818	40.09241	65
108	-124.894	39.75908	67
109	-124.403	39.75908	67
110	-123.844	39.73191	67
111	-123.955	39.42575	69
112	-124.251	39.42575	69
113	-124.414	39.09241	71

114	-124.065	39.09241	71
115	-123.778	39.09241	71
116	-123.667	38.75908	73
117	-123.984	38.75908	73
118	-124.076	38.59241	74
119	-123.75	38.59241	74
120	-123.408	38.59241	74
121	-123.276	38.42575	75
122	-123.64	38.42575	75
123	-123.661	38.25908	76
124	-123.355	38.25908	76
125	-123.017	38.24697	76
126	-123.111	38.09241	77
127	-123.421	38.09241	77
128	-123.46	37.92575	78
129	-123.141	37.92575	78
130	-122.815	37.92575	78
131	-122.824	37.75908	79
132	-123.116	37.75908	79
133	-123.205	37.59241	80
134	-122.898	37.59241	80
135	-122.555	37.59241	80
136	-122.674	37.42575	81
137	-123.063	37.42575	81
138	-123.189	37.25908	82
139	-122.787	37.25908	82
140	-122.442	37.25908	82
141	-122.603	37.09241	83
142	-122.93	37.09241	83
143	-122.661	36.92575	84
144	-122.196	36.92575	84
145	-121.899	36.92575	84
146	-122.022	36.75908	85
147	-122.398	36.75908	85
148	-122.669	36.59241	86
149	-122.303	36.59241	86
150	-122.007	36.59241	86
151	-122.088	36.42575	87
152	-122.37	36.42575	87
153	-122.541	36.25908	88
154	-122.137	36.25908	88

155	-121.848	36.25908	88
156	-121.779	36.09241	89
157	-122.06	36.09241	89
158	-122.168	35.92951	90
159	-121.851	35.9275	90
160	-121.518	35.9275	90
161	-121.608	35.76083	91
162	-121.94	35.76083	91
163	-121.902	35.59417	92
164	-121.483	35.59417	92
165	-121.153	35.59417	92
166	-121.056	35.4275	93
167	-121.539	35.4275	93
168	-121.705	35.09417	95
169	-121.13	35.09417	95
170	-120.66	35.09417	95
171	-120.897	34.76083	97
172	-121.495	34.76083	97
173	-121.564	34.4275	99
174	-121.02	34.4275	99
175	-120.509	34.4275	99
176	-120.775	34.314	100
177	-121.107	34.17514	100
178	-121.073	33.99797	101
179	-120.508	34.23978	101
180	-120.061	34.43131	101
181	-119.926	34.29963	102
182	-120.296	34.14641	102
183	-120.436	33.89502	103
184	-119.856	34.13683	103
185	-119.465	34.29963	103
186	-119.499	34.10331	104
187	-119.915	33.92854	104
188	-120.004	33.7011	105
189	-119.486	33.92136	105
190	-119.149	34.06022	105
191	-119.141	33.87826	106
192	-119.649	33.6604	106
193	-119.732	33.44014	107
194	-119.216	33.66279	107
195	-118.486	33.96206	107

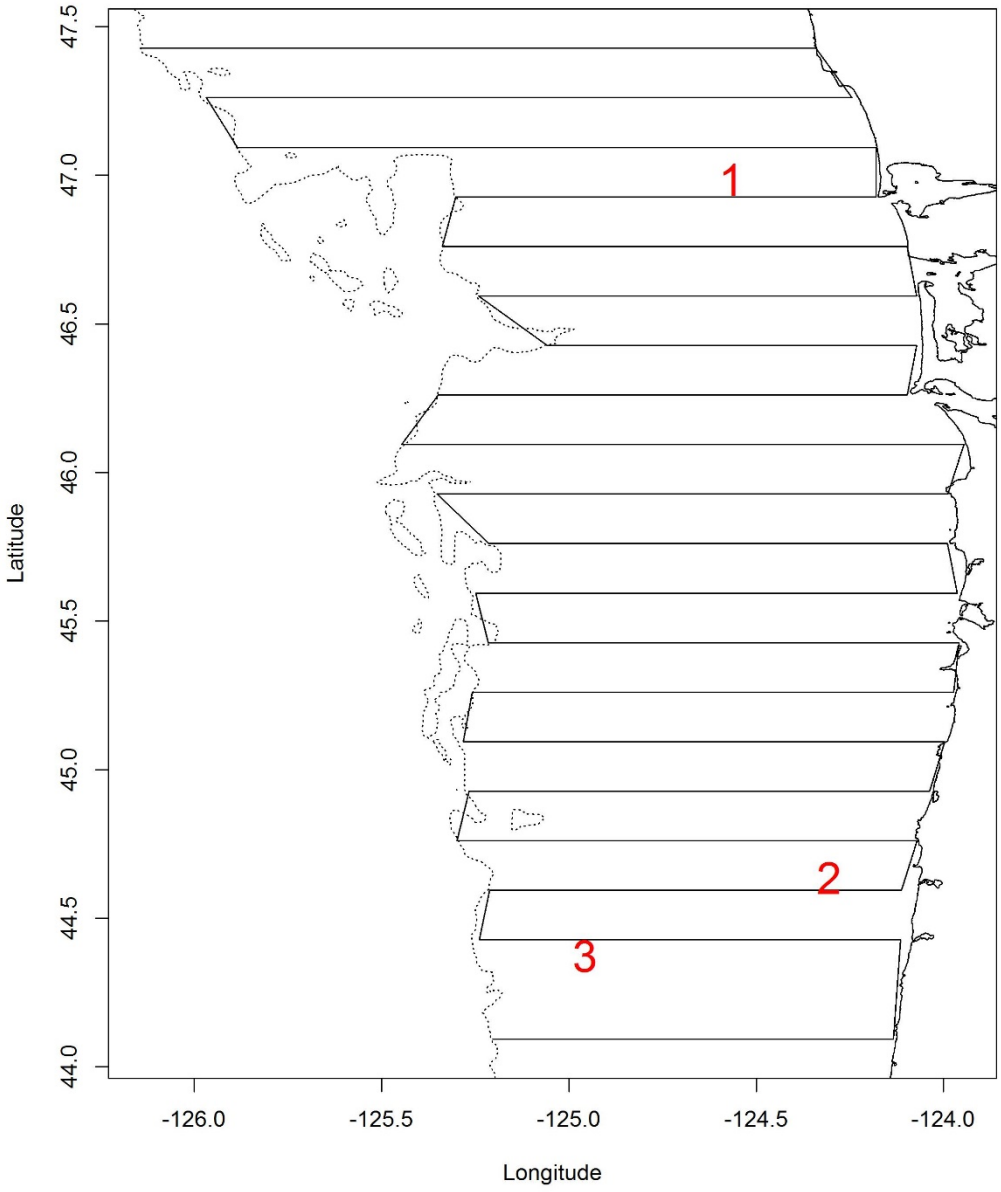
196	-118.652	33.71546	108
197	-119.162	33.4976	108
198	-119.222	33.28452	109
199	-118.717	33.49999	109
200	-118.144	33.72743	109
201	-118.263	33.50717	110
202	-118.758	33.2941	110
203	-118.792	33.08341	111
204	-118.336	33.28212	111
205	-117.859	33.4952	111
206	-117.984	33.24861	112
207	-118.38	33.06905	112
208	-118.629	32.76739	113
209	-118.048	33.02595	113
210	-117.461	33.25818	113
211	-117.645	33.00919	114
212	-118.201	32.76739	114
213	-118.375	32.50643	115
214	-117.836	32.73626	115
215	-117.36	32.94695	115
216	-117.569	32.66444	116
217	-117.95	32.49685	116

Appendix 4

Table 4.1 Waypoints to be connected on a square pattern in order to circumscribe a selections of bottom-mounted transducers belonging to the Endurance array (http://oceanobservatories.org/wp-content/uploads/2011/04/Endurance-Array-Map_2013_04-17_ver_0-02.jpg). The location of the transducers in relation to acoustic transects can be seen in Figure 4.1.

	Transducer 1		Transducer 2		Transducer 3	
waypoints	Long	Lat	Long	Lat	Long	Lat
1	-124.5727	46.98168	-124.3118	44.63291	-124.9628	44.36962
2	-124.5727	46.99066	-124.3118	44.64191	-124.9628	44.37864
3	-124.5597	46.99066	-124.2994	44.64191	-124.9503	44.37864
4	-124.5597	46.98168	-124.2994	44.63291	-124.9503	44.36962

Figure 4.1 Location of a subset of moorings of the Endurance array in relation to acoustic transects. If time allows, Lasker will break transect and navigate along the way points circumscribing each of the three moorings (Table 4.1) for 1 hour.



Appendix 5 – Details for leg V

This survey leg is devoted to testing and evaluation of acoustic (EK80s, ME70, MS70, and M3) and optical (stereo and HD-video cameras) instrumentation, and a remotely operated vehicle (ROV), with observations of mesopelagic and demersal fishes and their habitats. Participants are from the US, Norway, and France. The activities will be defined somewhat ad-hoc, depending on the lessons learned and any obstacles encountered, but with the following provisional objectives and schedule.

Objectives

- Conduct experiments with EK80s, ME70, and MS70.
- Test and evaluate the dynamic positioning system and train operators.
- Calibrate the ROV-USBL and evaluate its performance relative to a known-length pipeline.
- Test the ROV stereo cameras and M3 multibeam sonar.
- Deploy mooring with vertical array of sensors (HARPs, WBATs, CTDs) at 32.99 N, 117.41 W.
- Monitor the Diel Vertical Migration (DVM) of the Deep Scattering Layer (DSL) using EK80s.
- Identify migrating and non-migrating DSL species using the ROV, M3, and cameras.
- Acoustically survey Del Mar (DM) and Forty-Three Fathom Bank (FTFB) with EK80s, ME70.
- Evaluate the ranges that acoustic targets may be resolved from the seabed using the EK80s.
- Characterize DVM and avoidance behaviors of rockfishes using the ROV, M3, and cameras.
- Characterize and validate seabed bathymetry and classes acoustically and optically.

Sunday 18 Sep
Load EK80s, ROV, and install USBL transponder on centerboard.

Monday 19 Sep
0900 Depart SD Bay and transit to site DSL-B (32.99 N, 117.41 W)
1100 Deploy HARP/WBAT mooring in 600 m depth.
Deploy UCTD to obtain sound speed profile.
1200-1600 Test and evaluate dynamic positioning (DP) and train operators; Calibrate the ROV-USBL.
1600-1700 Conduct experiments with EK80s, ME70, and MS70.
1700 Hold position near vertical array with DP; record the DSL DVM using EK80s and ME70.
Deploy UCTD to obtain sound speed profile.
1800 Run DP technician via RHIB to the SIO pier.

1900-2200 ROV dive to identify migrating and non-migrating species.
Deploy UCTD to obtain sound speed profile.
Maintain position with DP while recording DSL DVM overnight.
Conduct experiments with EK80s, ME70, and MS70.

Tuesday 20 Sep
0430-0730 ROV dive on DSL to identify migrating and non-migrating species.
Deploy UCTD to obtain sound speed profile.
Conduct experiments with EK80s, ME70, and MS70.
1800-2000 ROV dive on Deep Scattering Layer to identify migrating and non-migrating species.
2000-2200 Shallow and deep ROV dive to identify species near the surface and ~ 400 m deep.
Deploy UCTD to obtain sound speed profile.
Maintain position with DP overnight while recording the DSL DVM.

Wednesday 21 Sep
0900 Transit to Del Mar site and survey transects using EK80s and ME70.
Note: The ST should use Hypack to prepare survey lines for the navigator to follow, and to provide real-time coverage maps.
Deploy UCTD to obtain sound speed profile.
1400 Retrieve WBAT lander using acoustic release; download data; service instrument, and redeploy lander.
1500-1700 ROV dive on rockfishes and their seabed habitat using ROV-M3 and stereo cameras.
Deploy array of vertical targets near the Del Mar mooring and lander.
Deploy UCTD to obtain sound speed profile.
1700 Use DP and split-beam acoustics to hold position exactly over the vertical-target array.
1700-1900 ROV dive on rockfishes and their seabed habitat using ROV-M3 and stereo cameras.
Deploy UCTD to obtain sound speed profile.
1900 Hold position over the array overnight with DP while monitoring with EK80s and ME70.

Thursday 22 Sep
0500-0700 Stationary-ROV observations of rockfishes using ROV-M3 and stereo cameras.
Deploy UCTD to obtain sound speed profile.
0800 Recover the vertical array.
0900 Transit to Forty-Three Fathom Bank (FTFB) and survey transects using EK80s and ME70.
Note: The ST should use Hypack to prepare survey lines for the navigator to follow, and to provide real-time coverage maps.
1400 Retrieve WBAT lander using acoustic release; download data; service instrument, and redeploy lander.
Deploy UCTD to obtain sound speed profile.
1700 To pier