Arctic Whale Ecology Study (ARCWEST)/Chukchi Acoustics, Oceanography, and Zooplankton Study-extension (CHAOZ-X) 2014 Cruise Plan

DATES: 4 AUGUST - 18 SEPTEMBER 2014

Vessel TBD

I. Cruise Overview

Cruise Title – ARCWEST/CHAOZ-X 2014

Cruise Dates: 4 August – 18 September 2014

Departure – Dutch Harbor, AK – 4 August

Arrival – Dutch Harbor, AK – 18 September

Operating Area – Bering, Chukchi, and Beaufort Seas

A. Summary of Objectives

There are four objectives for the ARCWEST study:

1. Estimate the spatial and temporal use patterns of the Chukchi Sea by endangered bowhead, fin and humpback whales as well as gray, minke and beluga whales.
2. Assess population structure and stocks of origin of these animals via genetic analysis of tissue biopsy samples and as appropriate, individual photo identification records.
3. Evaluate ecological relationships for the species, including physical and biological oceanography.
4. Conduct physical and biological oceanographic sampling to further understand the transport and advection of krill and nutrients from the northern Bering Sea through the Bering Strait and to the Barrow Canyon.

And six objectives for the CHAOZ-X study:

1. Refocus the passive acoustic and biophysical monitoring begun under the study "COMIDA: Factors Affecting the Distribution and Relative Abundance of Endangered Whales" from the initial lease areas to Hanna Shoal.
2. Describe patterns of current flow, hydrography, ice thickness, light penetration, and concentrations of nutrients, chlorophyll, and large crustacean zooplankton around the Shoal.
3. Assess the spatial and temporal distribution of marine mammals in the region of Hanna Shoal.
4. Evaluate the extent to which variability in environmental conditions such as sea ice, oceanic currents, water temperature and salinity, and prey abundance influence whale distribution and relative abundance.
5. Develop a quantitative description of the Chukchi Sea's noise budget, as contributed by biotic and abiotic sound sources, and continuous, time-varying metrics of acoustic habitat loss for a suite of arctic marine mammal species.
6. Continue development of a near-real-time passive acoustic monitoring system that can be used as an impact mitigation tool.

These findings will be useful for formulating designs of mitigation for human activities in the region. In particular, these data will be used to support National Environmental Policy Act analysis and documentation for Chukchi Lease Sales, Draft Proposed Programs, and monitoring, as well as ESA consultations, Marine Mammal Protection Act permitting, and preparation of Biological Evaluations and Biological Opinions. The main components of both studies include satellite tagging, biopsy sampling, passive acoustic recorder and oceanographic instrument deployments, as well as biophysical (CTD and plankton tow) sampling stations. In addition, a passive acoustic survey (using sonobuoys) will be undertaken throughout the survey, and a visual observation survey will be undertaken in the Chukchi Sea.

B. Operating Area

The primary operating area will be within the northern Bering Sea, the Chukchi Sea, and the western Beaufort Sea, and transiting to and from these areas. Primary mooring locations (biophysical and passive acoustic clusters) will be on Hanna shoal as well as off Icy Cape, Wainwright, and Peard Bay (Figure 1). Other mooring locations can be seen in Figure 2. CTD and Tucker tow transects will occur on three separate lines perpendicular to the coast, one line parallel to the coast through Hanna Shoal, and also along a 'box' near the Barrow Arch (Peard Bay) (Figure 3). Five additional lines will be sampled with shiptime from a NOAA-funded study (green dots, Figure 3). Pacific Marine Environmental Laboratory's (PMEL's) oceanographic moorings and four additional passive acoustic moorings will be deployed along the 70 m and 50 m isobaths in the Bering Sea (Figure 2).

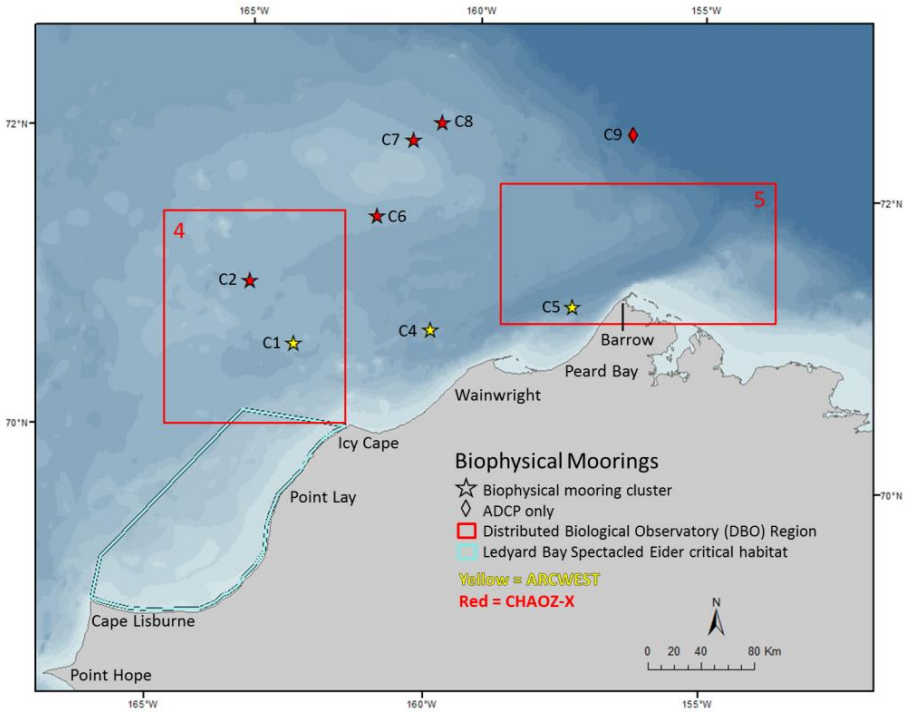

Figure 1. Planned passive acoustic moorings (top panel) and biophysical mooring clusters to be retrieved and/or deployed during the 2014 ARCWEST/CHAOZ-X cruise. Yellow symbols indicate ARCWEST moorings. Red symbols indicate CHAOZ-X moorings.

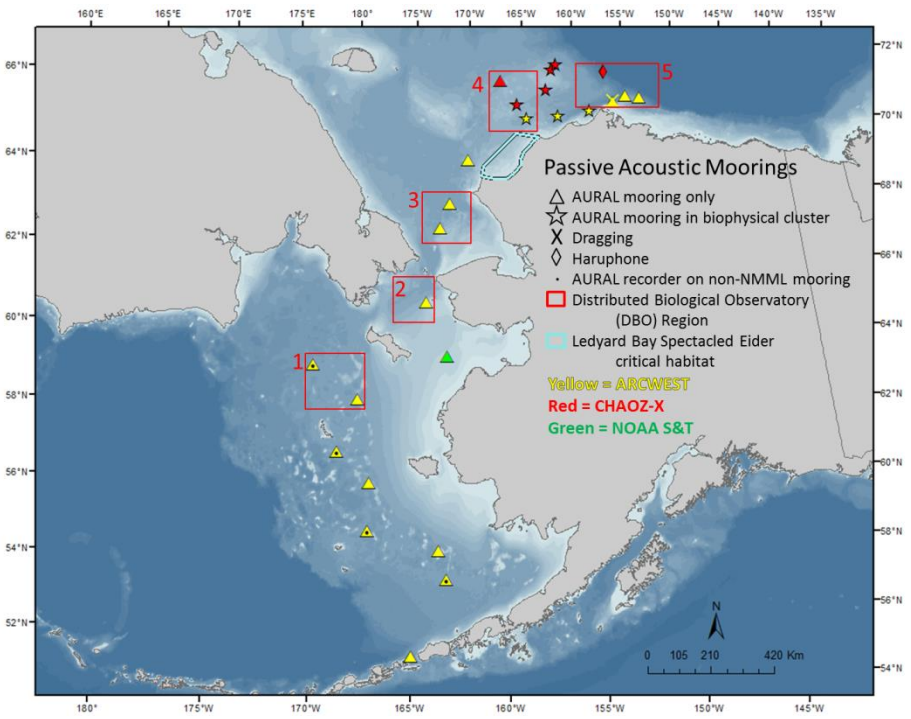

Figure 2. Planned passive acoustic moorings (top panel) and biophysical mooring clusters to be retrieved and/or deployed during the 2014 ARCWEST/CHAOZ-X cruise. Yellow symbols indicate ARCWEST moorings. Red symbols indicate CHAOZ-X moorings

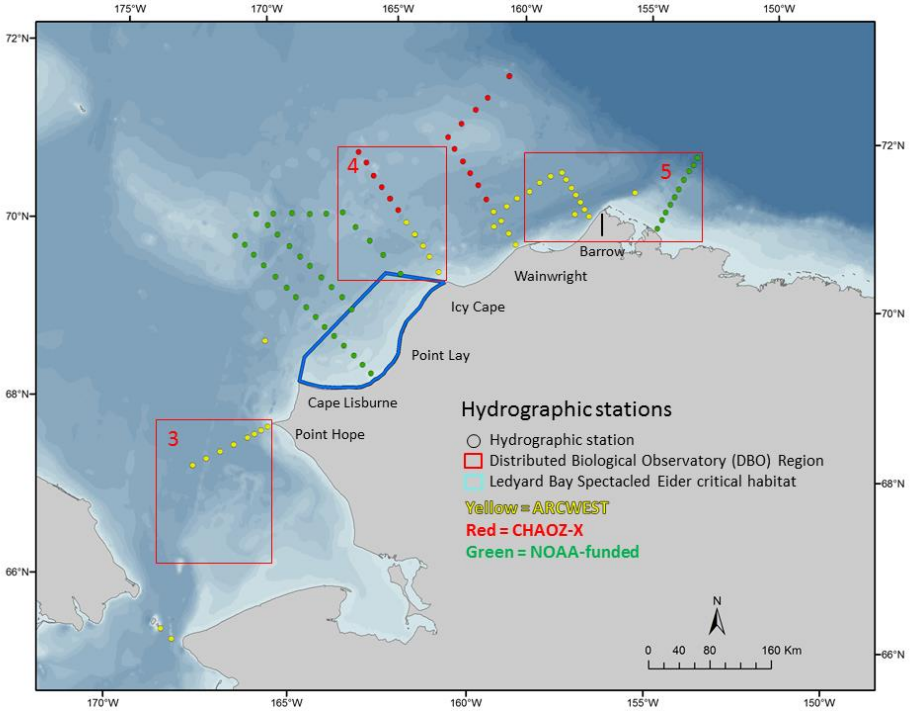

Figure 3. Planned biophysical stations to be sampled during the 2014 ARCWEST/CHAOZ-X cruise. Yellow symbols indicate ARCWEST stations. Red symbols indicate CHAOZ-X stations. Green symbols indicated NOAA-funded stations.

The locations for deploying satellite transmitters on gray, humpback, and fin whales will be the northern Bering Sea and southern Chukchi Sea. Photographic identification data and biopsy samples of cetacean sightings will also be collected during satellite tagging operations.

Sonobuoys will be deployed every three hours throughout the cruise. Visual observations will occur during the tagging leg in the northern Bering Sea and Chukchi Sea and during transit to and from stations and mooring locations in the Chukchi Sea.

C. Participating Institutions

The primary participating institutions for this cruise will be the National Marine Mammal Laboratory (NMML), Resource Assessment and Conservation Engineering (RACE), and the Pacific Marine Environmental Laboratory (PMEL) as well as researchers from the U.S. Fish and Wildlife Service, University of Alaska Fairbanks, and Northeast Fisheries Science Center.

D. Personnel

The Chief Scientist for the cruise will be Dr. Catherine Berchok, who will also be leading the Acoustics component. Sigrid Salo will lead the Oceanographic component on behalf of Dr. Phyllis Stabeno. Adam Spear, on behalf of Dr. Jeffrey Napp, will take the lead on the Zooplankton component. Dr. Amy Kennedy will lead the satellite tagging component on behalf of Dr. Alex Zerbini and act as the small boat officer. Brenda Rone will lead the visual operations component also on behalf of Dr. Alex Zerbini. There will also be a person working independently on seabird observations depending on berthing space available. All personnel sailing on ARCWEST/CHAOZ-X 2014 are listed in Table 1. There will be no more than thirteen (13) scientists on board at any given time. Personnel may need to be modified prior to the cruise due to extenuating circumstances.

E. Administrative

<u>Scientific Operations</u>

Primary point of contact for this cruise is Nancy Friday: Nancy.Friday@noaa.gov, 206-526-6266.

Required clearances: these consist of the following: (i) medical history and emergency info form submitted to captain by all scientific personnel; (ii) foreign clearance for all non-US citizens (listed by nationality on Table 1); (iii) research permits to conduct the work (all scientific operations with marine mammals will be conducted under NMFS permit number 14245 issued to NMML with the Senior Mammal Observer identified as the Co-Investigator); and (iv) certification of all small boat operators in accordance with current NOAA requirements for coxswains. It is the Chief Scientist's responsibility to ensure that all clearances are obtained prior to the cruise.

Table 1. Personnel

Position	Name	Nationality	Institution	Leg
Chief Scientist Lead Acoustics	Catherine Berchok	United States	NMML/AFSC	1, 2, 3, 4
Lead Oceanography	Sigrid Salo (on behalf of Stabeno)	United States	PMEL	3, 4
Lead Zooplankton	Adam Spear (on behalf of Napp)	United States	RACE/AFSC	3
Lead Visual Operations Senior Mammal Observer	Brenda Rone (on behalf of Zerbini)	United States	NMML/AFSC	2
Lead Satellite Tagging Mammal Observer Small Boat Officer	Amy Kennedy (on behalf of Zerbini)	United States	NMML/AFSC	2
Acoustician	Jessica Crance	United States	NMML/AFSC	1, 2, 3, 4
Acoustician	Stephanie Grassia	United States	NMML/AFSC	1, 2, 3, 4
Acoustician	Eliza Ives	United States	NMML/AFSC	1, 2, 3, 4
Mammal Observer/Acoustician	Alexandra Ulmke	United States	NMML/AFSC	2, 3
Mammal Observer	Jennifer Gatzke	United States	NOAA/NEFSC	2
Mammal Observer	Ernesto Vázquez Morquecho	Mexico	Independent Contractor	2
Mammal Observer	Carol Fairfield (tentative)	United States	BOEM	2, 3
Oceanography	TBD	United States	PMEL	3
Oceanography	William Floering	United States	PMEL	4
Zoo- & Ichthyoplankton	Lisa Eisner	United States	RACE/AFSC	3
Zoo- & Ichthyoplankton	Daniel Langis	United States	RACE/AFSC	3
Seabird Observer	TBD	United States	U.S. Fish and Wildlife Service	1, 2, 3, 4
Independent Oceanographer	Dan Naber	United States	Univ. Alaska Fairbanks	4

II. Operations

A. Data to Be Collected

Data to be collected on this cruise include the following: passive acoustic data obtained from long-term acoustic recorder arrays; passive acoustic recordings of species detected on sonobuoy deployments; oceanographic measurements including water temperature, salinity, dissolved nitrate concentration, chlorophyll fluorescence, turbidity, and dissolved oxygen concentration; drifter locations; zooplankton and ichthyoplankton net and acoustic samples; euphausiid stable isotope and fatty acid signatures; data associated with satellite tracking of individual animals, including dive data; date, time and location of all recorded sightings of marine mammals and seabirds as well as group characteristics; photographic data for individual identification; and data associated with biopsy sampling of individual animals.

B. Staging Plan and Cruise Plan

The staging plan for the cruise will be as follows (all dates and times are approximate):

2 August: Eight (8) personnel arrive in Dutch Harbor, AK. Most necessary equipment loading and set-up will have been conducted prior to the vessel's arrival in Dutch Harbor. Any remaining equipment will be loaded on 3 or 4 August.
4 August: Vessel departs Dutch Harbor. Passive acoustic survey conducted and seven (7) Bering Sea moorings retrieved and deployed during transit.
9 August: In-port at Nome, AK. Six (6) additional personnel board the vessel, three (3) disembark.
10-23 August: Operations deploying satellite tags on individual whales will be conducted in the Chukchi Sea and northern Bering Sea. Acoustic surveys, visual surveys, photo-identification, and biopsy sampling will also be conducted.
23 August: Arrive in Nome, AK. Six (6) additional personnel board the vessel, four (4) disembark.
24 August – 12 September: Operations retrieving and deploying 43 passive acoustic and/or oceanographic moorings, oceanographic and plankton sampling including CTDs and net tows, passive acoustic surveys, and visual surveys will be conducted in the Chukchi Sea.
13 September: In-port at Nome, AK. One (1) additional personnel board the vessel, six (6) disembark.
13 - 18 September: Vessel transits to Dutch Harbor, AK. Remaining six (6) Bering Sea moorings retrieved and deployed along transit. Passive acoustic survey conducted.
18 September: Vessel arrives in Dutch Harbor, AK. The remaining eight (8) scientists disembark.

Acoustic surveys will be conducted every three hours along the cruise track. Visual surveys will be conducted during the tagging leg in the northern Bering Sea and Chukchi Sea, during the acoustic/oceanographic leg in the Chukchi Sea, and opportunistically throughout the cruise (dependent on personnel schedule).

The cruise plan is to deploy a total of 56 moorings (26 passive acoustic, 25 oceanographic, and 5 passive acoustic/oceanographic), 43 of which will be in the primary working area (21 passive acoustic, 21 oceanographic, 1 passive acoustic/oceanographic), as well as collect various oceanographic measurements. A biophysical transect off Point Hope and across Barrow Canyon as part of the International Distributed Biological Observatory (DBO) initiative will also be conducted. In addition to the mooring and oceanographic work, if time allows, the vessel will drag for 1 acoustic mooring that lost its flotation in 2009 (but is still responding). Satellite tagging operations will deploy up to 16 satellite tags on gray, humpback, and fin whales. Further details of mooring, oceanographic, satellite tagging, and dragging operations are given below.

C. Mooring Deployments

During the 2014 ARCWEST/CHAOZ-X cruise we will deploy and/or retrieve passive acoustic moorings, biophysical moorings, and combination biophysical/passive acoustic moorings. Biophysical moorings will be deployed in clusters consisting of three moorings: 1) "ice mooring" with an ASL upward-looking ice profiler and an RCM9 current meter (that also measures temperature, oxygen, and either salinity or turbidity), 2) a "bio mooring" with either a 300 or 600 KHz RDI ADCP and a linked set of instruments (Seacat, eco-fluorometer, PAR sensor, ISUS nitrate meter), and 3) an upward looking TAPS-6NG (Tracor Acoustic Profiling System, Next Generation) instrument to measure zooplankton bio-volume and size distribution. The TAPS-6NG mooring will be located at all sites except for the easternmost Hanna Shoal cluster and was built specifically to detect and quantify euphausiids. These moorings will collect various

oceanographic measurements, including temperature, pressure, depth, salinity, conductivity, and fluorescence.

The passive acoustic recorders will run on a duty cycle of 80 minutes on every 5 hours, at a sampling rate of 16 kHz, for an entire year (365 days). This duty cycle staggers the recording loop so that the recording period advances by one hour each day. This overall pattern repeats every six days, producing a large sample size for all time periods equally.

For ARCWEST, fifteen passive acoustic, nine biophysical in three clusters of three, and four Bering Sea combination biophysical/passive acoustic moorings will be deployed. These will all be turnarounds (retrieve and deploy in the same place). The four combination moorings are funded by another project, but the passive acoustic recorders on them are funded by ARCWEST. The Bering Sea combination moorings are PMEL's oceanographic moorings in combination with a passive acoustic instrument.

For CHAOZ-X, nine passive acoustic, twelve biophysical moorings in four clusters of three, and one combination mooring will be deployed. These include five AURALs, and one Haruphone recorder. One of the AURALs and the Haruphone are new deployments for 2014, the rest are turnarounds. For the biophysical moorings, there are 4 new deployments and 8 turnarounds. The combination mooring is a new deployment for 2014 and includes an RDI ADCP and a linked set of biophysical instruments and the Haruphone.

The remaining moorings are funded by other projects, two passive acoustic and four biophysical moorings, and the four combination moorings mentioned above for ARCWEST (moorings funded by other project, AURALs funded by ARCWEST). Additional ship time was funded by these other projects for these turnarounds.

D. Hydrography and Zooplankton Net Tows

At each mooring site, and along the transect between moorings and other selected stations in the northern part of the Bering Sea and in the Chukchi Sea, hydrographic data (temperature, conductivity, nutrients, chlorophyll, and oxygen) and zooplankton will be collected (Figure 2). All hydrographic casts include high-resolution vertical profiling of water properties (including temperature, salinity, chlorophyll fluorescence, PAR, dissolved O_2) to within 4 m of the bottom using a Seabird 911Plus CTD with dual temperature, conductivity and oxygen sensors. Oxygen samples will be titrated on board to ensure quality of data from the CTD oxygen sensors. Nutrient and chlorophyll samples will be collected onboard and frozen for analysis at a later date at the NOAA laboratories in Seattle.

Samples for mesozooplankton and micronekton will be collected with a 1 m^2 Tucker Sled which allows us to collect samples right next to the bottom (and does a better job of capturing larger prey such as euphausiids). The mesh size for the Tucker nets will be 0.500 mm, and the two primary nets will have 25 cm diameter Clarke-Bumpus net frames inside them with 0.150 mm mesh to capture small zooplankton. The net samples will also contain ichthyoplankton (fish larvae) that will be identified and enumerated as part of the study. All processing of the samples will be done after the completion of the cruise.

In addition, Tucker Sled tows will be conducted on an ad hoc basis to obtain samples of euphausiids for stable isotope and fatty acid signatures. The majority of these will be accomplished at night during the initial whale tagging period, but will also occur during other times on a not–to-interfere basis (e.g. in the Beaufort when not dragging). Organisms will be sorted and either dried (stable isotopes) or quickly frozen at – 80 °C (fatty acids).

E. Satellite Tagging Operations.

Fourteen days will be dedicated to deploying up to 16 deep implantable satellite tags on gray, humpback, and fin whales in the northern Bering and southern Chukchi Seas. Eight of the tags are SPOT5 (location only) transmitters, and eight are MK-10A (location, light, temperature, and depth) transmitters. All tags are made by Wildlife Computers (Redmond, WA).

F. Dragging Operations

In an attempt to recover one of the moorings lost in 2009, a hydraulic winch, cable, and modified scallop dredge will be used to drag the bottom for a couple of hours to attempt recovery of the mooring as we transit over the area where it was lost. All dragging operations will be time and weather permitting, and conducted at the discretion of the Captain and Chief Scientist.

G. Underway Operations (Visual and Acoustic Monitoring)

As noted above, during transit to and from the working area and during non-mooring operations, passive acoustic monitoring and visual searches will be conducted. Directional sonobuoys will be deployed from the vessel and used to obtain cross-bearings to individual vocalizing whales. Visual surveys will be conducted during daylight operational hours, weather permitting, during the tagging leg in the northern Bering Sea and Chukchi Sea and during the acoustic/oceanographic leg in the Chukchi Sea.

H. Small Boat Operations

We will be bringing two of NMML's rigid hulled inflatable boats on this cruise to use during marine mammal tagging operations. All small boat operations, including moving the small boats on deck and/or launching, must be approved by the captain and small boat officer in advance. The captain and small boat officer will create a launching protocol before tagging operations begin. The launching protocol will be discussed and practiced by all parties involved several times prior to any small boat launch. Launching of the small boat will be subject to weather conditions and undertaken only at the discretion of the Captain and small boat officer. During launch and retrieval, all appropriate safety procedures shall be maintained.

The small boat crew shall consist of no more than 4 people during tagging operations: the small boat officer/tagger/biopsier, a qualified coxswain, a photographer, and a tagging assistant/data recorder. Each of these crew members will also be members of the scientific party. During satellite tagging operations, the "primary" small boat will be deployed in the presence of whales at the discretion of the Chief Scientist and Captain. The role of the "primary" small boat during tagging operations will be to approach a target animal and maneuver into position to obtain photographs and biopsy samples, and to deploy satellite transmitters. A second "stand-by" boat may be launched during tagging operations at the discretion of the small boat officer and Chief Scientist. The "stand-by" boat will serve as a safety and follow-up vessel to the "primary" boat; they may be asked to assist in locating animals or obtaining opportunistic photos of marine mammals, but their primary function will be to assist the tagging vessel when needed, and be alert in the event of an emergency. The most senior boat operator available will coxswain the "stand-by" vessel, and may be accompanied by up to two qualified crew members for assistance. The small boat officer and coxswain will have the final say in the operation of the small boats, but as long as he/she feels that safety is not compromised, will take direction from the lead scientist in the "primary" vessel.

The following people have completed the required NOAA small boat certifications and training, qualifying them as either coxswains (cox), or qualified crew, during this cruise:

Amy Kennedy (cox)
Brenda Rone (cox)
Catherine Berchok (cox)
Crance (crew/cox)
Grassia (crew/cox)

The small boat may also be used to ferry scientists and/or equipment to and from the vessel, as necessary. Shuttling operations will be at the discretion of the Captain and small boat officer. A coxswain and one qualified crew member, plus scientific passengers, will be on board during these operations; the passengers will not participate in the small boat operations unless instructed by the small boat officer.

Safety checks/status reports will be performed by VHF radio every hour, during which each small boat coxswain will provide current location and activity information to the vessel bridge. Small boat operations will be conducted within half a mile of the ship at all times. A Loss of Communication plan will be developed at the start of the cruise with the Captain.

I. De-Staging Plan

Prior to disembarking, scientists will ensure that all staterooms and lab spaces are cleaned. All equipment will be packed, stored, and secured on the vessel for its return to Seattle. Offloading of the vessel will occur in Seattle, WA at the NOAA Sand Point Pier.

III. Facilities

A. Equipment and Capabilities Provided by Ship

Suitable deck space for preparing, assembling, and deploying moorings, preparing and deploying oceanographic equipment, and for installation and operation of three winches.
A-frame on the stern of the ship with a load capacity of at least 2 tons.
Space on deck for placing a scientific van (10’ x 24’).
Weather-proof, heated wheelhouse with room for an acoustic recording station inside the wheelhouse.
An outside area suitable for observational work at a height above the water line of at least 15 feet.
Room for a visual observation station inside the wheelhouse or in another interior portion of the ship.
Room for four (4) feet of dry bench space with an AC outlet to be used for computer work and satellite tag assembly.
Electronic navigational and communication equipment in compliance with industry safety standards.
Capability for loading and off-loading the scientific party and a 25-foot RHIB with outboard motor (~3000 lbs) to and from the water.
Deck or crane-accessible outdoor space for storage.
Supply of 220 VAC (20 amp circuit) electrical service to the scientific van.
Secure and easily accessible rail cleats to securely tie a RHIB alongside the vessel.
A watertight 55-gallon drum with a rotary hand pump for gasoline for the RHIBs.
Dry storage areas, readily accessible, providing a minimum of 400 cubic feet for stowage.
A minimum of 10 cubic feet of freezer space for specimens.
Freshwater and seawater (non-firehose) deck hose

An enclosed, weather-proof, temperature controlled area where two lab benches (one 3'x6', one 4'x2') can be installed.
Approximately 6' x 3' of deck space near the saltwater hose
Capability to install one hydraulic winch and one electrohydraulic winch and to secure a back-up electrohydraulic winch on deck.
Capability of installing one standard VHF antenna and one yagi antenna in the crow's nest.
Knuckle crane capable of lifting up to 2 tons while fully extended.
Crane capable of towing a Tucker sled.
Potable fresh water supply.
Two washers and two clothes dryers.
Muffler on ship must be in compliance with the operational standards specified by the manufacturer.
Arctic-type survival suits.
Category I 406 MHz EPIRB (Emergency Position Indicating Radio Beacon).
Up-to-date emergency trauma first aid kit.

B. Equipment and Capabilities Provided by Scientists

3 Laptop computers for acoustic work
2 Acoustic interfaces
3 VHF receivers
8 Sonobuoy crates
26 Acoustic recorders
10 + 26 Acoustic releases
10 + 8 Mooring floats
2 Deck sets
1 CTD (with its frame and Niskin bottles), dual sensors
1 CTD (with no frame and no Niskin bottles), dual sensors
2 CTD deck units
2 CTD PARs
2 CTD fluorometers
2 CTD dissolved oxygen sensors
1 AFSC Electrohydraulic winch
1 PMEL Electrohydraulic winch
1 Tucker sled plankton net
2 PMEL FastCATs
2 PDIMs
2 Deck units for FastCAT
1 Hook and cables for dragging
1 Hydraulic winch
16 Satellite tags
2 Satellite tag delivery carriers (delivery rockets)
2 Satellite tag delivery systems (ARTS)
2 Compressed air tanks and associated equipment for deployment of tags
2 25-power (Big Eye) binoculars
2 Aluminum adjusting stands
2 Nikon Nikon DSLR cameras
2 Nikon fixed 300 mm f/4 AF-S lens
2 Nikon 80-200mm 2.8 lens

1 Scientific van (10’ x 24’)
1 -80 deg C Ultracold Freezer
1 -40 deg C freezer
2 Laptop computers for collecting survey data
2 Satellite phones (including PMELs)
1 Laptop computer for e-mail communication
3 Zooplankton Laptops/Desktops
AFSC Zoopl Misc. Electronic testing equipment
5 TAPS-6NG moored instruments (including floats)
1 Zeiss Stemi- Dissecting Microscope
5 Ice profilers
9 ECO-fluorometers
4 ISUS
2 ISUS, UAF
1 SUNA
16 Microcats
10 RCM9s
11 Seacats
6 Seacat PARs
10 Temp sensors
1 R/V Radar RHIB with 150 hp Yamaha 4 stroke outboard engine
1 R/V EJ RHIB with 115 hp Yamaha 4 stroke outboard engine
2 crates Mooring chain parts
57anchors

IV. Data and Reports

A. Data Responsibilities

At the end of the field work, the Chief Scientist and project coordinator will submit a cruise data summary to BOEM and to the Project Leaders.

B. Pre- and Post-Cruise Meetings

These shall be arranged at the discretion of the Captain and Chief Scientist.

C. Ship Operation Evaluation Report

After the cruise, a Ship Operation Evaluation form is to be completed by the Chief Scientist with suggestions for improvements to future operations aboard this vessel.

V. Miscellaneous

A. Scientific Berthing

A list of all scientific personnel is given above. Specific personnel berthing arrangements will be determined in coordination with the vessel once the vessel contract is awarded.

B. Medical Forms and Emergency Contacts

All scientific personnel shall have completed and submitted all required medical forms three weeks prior to sailing. A list of emergency contacts for scientific staff will be provided to the Captain prior to the cruise.

C. Shipboard Safety

All scientific staff shall be briefed on shipboard safety procedures and their compliance with these will be monitored by the Captain and the Chief Scientist. Safety drills (person overboard, fire, abandon ship) will be conducted within two days of each leg change.

D. Communications

There will be one satellite phone on board the vessel for limited use. One email will be sent daily to a land based contact at NMML giving our current status and position and a summary of the previous day's activities. Additional emails will be sent/received sparingly at the Chief Scientist's discretion. PMEL's Iridium: 8816-315-33586

Communications between the bridge, deck, small boat, visual observers and acousticians will be by VHF radio.