SEMI-ANNUAL PERFORMANCE REPORT

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Amount of Grant: $344,843

Project Title: Acoustic Monitoring of Beluga Whales and Noise in Cook Inlet

Grantee: Alaska Department of Fish & Game

Award Period: From 1 October 2007 through 30 September 2010

Period Covered by this Report: 1 October 2007 through 31 March 2008

Prepared by: Robert J. Small

Summary of Progress and Expenditures to Date

Work Accomplishments

This project was initially designed in two phases, the first of which was to be conducted during this reporting period. The first phase of this project had two primary objectives:

1. Record and analyze ambient noise levels from both 'natural' and anthropogenic sources in Cook Inlet, by deploying acoustic instruments on idle drilling platforms.

2. Design and test the performance of acoustic recording instruments moored in Puget Sound, Washington, in locations with substantial currents and tides.

The purpose of the first objective was to obtain some acoustic data from Cook Inlet without the numerous challenges associated with deploying acoustic instruments in the open water with severe currents. The purpose of the second objective was to deploy acoustic instruments on moorings in areas with severe currents, yet with much easier access to the instruments to monitor and evaluate their performance and make necessary modifications to improve performance.

Based on several discussions with representatives of Chevron, the decision was made not to deploy the acoustic instruments ('EAR' – Ecological Acoustic Recorder; see last page of this report) on idle drilling platforms. This decision was based on the relatively extensive amount of effort required to secure the EAR to the platform far enough below the mean low tide height, which would have included the use of scuba divers. Further, Chevron representatives informed us of successful deployment and retrieval of similar

types of instruments using bottom-mounted moorings. These bottom-mounted moorings would require less effort to deploy and also represent the type of mooring we will consider for the longer term deployments planned for the second phase of this project. By the time the decision was made not to pursue deployments on idle drilling platforms (late October), the environmental conditions in Cook Inlet precluded any field work.

The second objective of the first phase of this project was based on establishing a collaborative relationship with the National Ocean Service (NOS). Specifically, collaboration with NOS was sought to provide the opportunity for Jennifer Ewald to attach EARs to existing mooring packages that belonged to the NOS and then test those moorings in Puget Sound during a scheduled NOS field project. However, the NOS field project was cancelled, and thus the opportunity to test the EARs and mooring packages was no longer available.

With the knowledge that the Alaska SeaLife Center (ASLC) and Hubbs SeaWorld had received NMFS funding for acoustics projects on Cook Inlet belugas, a teleconference was held in November to discuss and explore possible collaboration. The work proposed by Hubbs SeaWorld represents a more fine-scaled approach with different objectives than that of either ADF&G or ASLC, and the later two entities found substantial common ground in research objectives. Thus, ADF&G and ASLC agreed to work cooperatively in developing a revised approach for the initial testing of the EARs in Cook Inlet during the spring of 2008.

In January, scientists from ADF&G, ASLC, Hawaii Institute of Marine Biology, NMFS, University of Washington, North Gulf Oceanic Society, and the Prince William Sound Science Center met at the Alaska Marine Science Symposium in Anchorage to discuss research objectives and the planning for initial testing of EARs in Cook Inlet; see attached meeting agenda and summary. ADF&G and ASLC agreed to work cooperatively on the initial testing of the EARs in late May 2008. During February and March additional discussions took place to plan for the specific equipment required for the initial testing, in addition to reserving a vessel needed for those tests.

The primary objective of the initial testing will be to assess the range of the EAR, due to concerns about how noise from strong currents could mask the detection of beluga calls, as well as how sediment suspended in the water column could potentially reduce sound propagation. Either previously recorded beluga calls or a noise signal with known sound levels in the general frequency of beluga calls will be emitted via a transducer and amplifier to test EAR performance. Tests will be done in several locations and under different tidal stages. Additional tests will explore how the strumming of lines in fast currents may produce sound that could mask the detection of beluga calls.

If the results of the initial tests in May indicate the EARs are recording sounds as expected and without substantial interference from currents or line strumming, the next step will be to deploy three (3) EARs on moorings in late July. The moorings will be placed in locations where belugas are known to concentrate during the summer; i.e., Knik Arm and Chickaloon Bay. The NMML will be conducting an aerial survey of belugas in early August and will be able to provide information on when belugas were sighted within the expected range of the EARs. Presuming belugas will be vocalizing during a portion of the time they are within the range of the EARs, knowledge of beluga presence will aide in assessing the performance of the EARs.

Contact will be maintained with Chevron during spring and summer 2008 because they (1) have expressed continued interest in the project, (2) will be conducting field tests to determine areas of relatively low current and bottom sedimentation for their purposes, and (3) have expressed a willingness to provide vessel support for possible future EAR deployments. Additionally, contact with other entities conducting research on belugas in Cook Inlet will be sought and maintained.

Jennifer Ewald accepted a position with the Prince William Sound Science Center in the fall of 2007.

The amount of total expenditures during this reporting period was minimal (~$3,000), representing some salary costs for co-PI Robert Small.

ACOUSTIC STUDIES IN COOK INLET - 22 JANUARY 2008
DRAFT approach to discussions

1. What CAN be achieved by using acoustic devices in Cook Inlet?

Expected outcome of discussion: Increased understanding of (1) the acoustic data that can, and can not, be collected in Cook Inlet and (2) the factors that need to be considered to optimize the collection of those acoustic data.

What will the EARs hear? - What acoustic data do we believe is possible to collect in Cook Inlet?

- Spatial scale: How far away will an EAR be able to detect and record noise? What factors will influence that distance? How does the distance vary depending on the type of noise; i.e., belugas and killer whales, ambient environmental noise, anthropogenic noises
- Temporal scale: What is the maximum possible deployment period? What type of duty-cycling is possible? Memory capacity, power.

What should we do to get the most out of our EARs? - Logistical and technical considerations for EAR deployments in Cook Inlet

- Environmental: Tides, Currents, Sedimentation, Ice
- Geographic Location: How will we determine which regions of CI provide the greatest potential for successful deployment and retrieval?
- Mooring configuration: Housing for EAR; flotation; release mechanism; additional data gathering instruments to measure currents and oceanographic parameters? Will these devices influence collection of acoustic data by EARs?
- Where did my EAR go? Mooring to sea floor, placement in the water column.

2. What do we WANT to achieve by using acoustic devices in Cook Inlet?

Expected outcome of discussion: Clear understanding of (1) research objectives and hypotheses and (2) how the research provides information needed for management and conservation of CI belugas.

What are we going to do and why? - Research objectives & hypotheses, information needs for management and conservation

- Changes in seasonal distribution of Cook Inlet belugas
- Occurrence of killer whales in Cook Inlet
- Estimate ambient noise levels
- Estimate anthropogenic noise levels (and sources?)
- Measure oceanographic parameters associated with beluga presence
- Others?

3. How are we going to collect the acoustic data we want?

Expected outcome of discussion: (1) Experimental design for obtaining desired acoustic data and (2) approach to the analysis and interpretation of those acoustic data.

Conduct 'pilot studies' prior to implementing full research program?

- Test EAR performance in controlled (i.e., ASLC?) cold water conditions?
- Short duration deployments to ensure EARs will be recovered at selected sites?
- Short duration deployments to test mooring configurations?
- Short duration deployments to test data collection by EARs? What's the optimal sampling scheme?
- Coordinate with aerial survey?
- Experimental design: how many, where, and for what duration?

Experimental design of full research program

- Where will EARs be deployed? Upper inlet, mid inlet, lower inlet?
- Deployment duration
- Replicate deployments at the same sites vs. deployments at new sites

Data are like garbage – you should know what you are doing to do with it before you collect it: Data analysis and interpretation

- Who will analyze and interpret the data?
- Consistency of data analysis and interpretation among projects

4. Miscellaneous

- Craig Matkin – insights on killer whale acoustics relative to our interests; i.e., range
- What can be learned from similar acoustic studies under similar environmental conditions?
- Are there other type of acoustic devices that should be considered?
- Logistical support – Potential vessel and diver support from Chevron; Conoco Phillips?

BELUGA WHALE ACOUSTICS STUDIES IN COOK INLET
Draft Summary of 22 January meeting in Anchorage

[*Note - Agenda & approach to discussions attached*]

In attendance: Shannon Atkinson, Catherine Berchok, Doug DeMaster, Jennifer Ewald, Barbara Mahoney, Craig Matkin, Sue Moore, Bob Small, Jim Wilder

1. Craig Matkin presented information relative to killer whales in Cook Inlet and insights on examining predation by killer whales on belugas in CI:

- Very little is known about KW in CI.
- Transients and residents KW can be easily separated by dialect.
- Learning more about killer whale predation on belugas will require spending lots of time following belugas.
- KW move in and out of CI, perhaps not as likely to go into the upper inlet.
- Craig will be conducting his vessel-based KW research in CI during the mid (and perhaps late) summer season.
- It was noted that Paul Wade would be deploying both a PAL and an EAR near the Barrens, and those deployments could potentially provide acoustics data on KW.
- Jennifer mentioned additional research being conducted in the lower inlet, with a NOAA vessel being used (Hydro-paluza?).

2. Discussions regarding EARs:

Performance

- Whit indicated that detection range is very difficult to predict, as it is based on numerous factors, including depth, bottom contour, noise, and the type of sound targeted for detection. General agreement that range will likely be ~1 km, maybe up to a few kms.
- Validation of detection range could be explored through aerial surveys, ground or vessel observations, etc.
- Shallowest deployments of EARs to date have been ~30 meters.
- Dan suggested that the acoustic signals may vary through time, and asked about the feasibility of using recorded belugas calls to test EARs; i.e. are the EARs recording what we want them to record?
- Support was expressed to test EAR performance in cold water, ASLC could take lead and conduct test at the Chiswell Islands.
- Dan suggested we explore the use of simulated beluga calls to test performance.
- Dan expressed interest in exploring the probability of detecting beluga sounds when belugas are sighted visually, which could potentially be done in cooperation with Brent Stewart's project.

Miscellaneous

- Determine when EARs should arrive in Alaska with sufficient time for any necessary testing, integration into moorings, etc: Once date determined inform Marc and Whit such that they have plenty of lead time for production.
- ADF&G needs to establish a contract with Whit & Marc for EARs.

Mooring Configuration:

- Jennifer has the lead, will work with Catherine and David Leech (Univ. of AK).
- Catherine suggested we explore the potential of using towed arrays.

Acoustic sampling design:

- Dan has the lead.
- Parameters to consider will include the number of EARs, spatial dispersion of EARs, deployment duration, duty-cycling, etc.
- The idea of deploying 2 'paired' EARs was mentioned as a means to test performance.

Pilot study:

- Group supported the idea of a pilot study to test both (1) feasibility/viability of deploying and retrieving EARs in CI, and (2) EAR performance.
- Suggested approach is for two deployments, one in upper CI for which Jennifer will take the lead on determining a specific location, and a second deployment in the mid-inlet area for which Bob will take the lead on determining a specific location in cooperation with personnel from Chevron that have been involved in previous deployments of a similar nature.
- Deployment period would be very short during the pilot studies.

Near-term activities:

- In early March Jennifer will attend the ONR/MTS Buoy Workshop to make a presentation and discuss the technical issues associated with determining mooring configuration with other experts.
- Dan and Jennifer will meet in late February-early March to discuss mooring configuration and the experimental design for acoustic sampling.

MISC.

- Review the results of acoustics work conducted by LGL; i.e., what was learned that can be applied to our studies? Mike Williams may have insights.

- Cara Hotchkins has data through work with Greenridge - Blackwell report. Can results provide pertinent information on ambient noise and beluga calls for our projects?
- Army Corps has recently obtained information on depth/bathymetry in CI. Do we need such data, and if so, can we obtain it from the Corps?
- For our deployments – will need to stay out of shipping lanes
- ASLC & ADF&G reconfirmed agreement on study objectives and are committed to cooperatively conducting the project.
- Jennifer worked in CI during 2002-2005, 02-03 in the upper inlet
- Bob will contact Chevron and discuss their potential in-kind support for vessels and divers; similar contact will be made with Conoco Phillips
- Brent Stewart's project - comments included the likely involvement of at least one EAR, with the objective of determining if beluga calls are recorded when belugas are sighted visually. Will need to maintain contact and discussion with Brent to collaborate to the extent possible.

Ecological Acoustic Recorder (EAR)

Points of Contact: Marc O. Lammers, Hawaii Institute of Marine Biology (HIMB), lammers@hawaii.edu (808-375-0010) and Kevin Wong, NOAA Fisheries Coral Reef Ecosystem Division (CRED), Kevin.Wong@noaa.gov (808-983-3733).

The EAR is a digital, low power system that records ambient sounds up to 30 kHz on a programmable schedule, but can also respond to transient acoustic events that meet specific criteria, such as vessels passing nearby. There are two types of EAR: a shallow-water (0 - 36 m) version that is diver-deployed and a deep-water version that is rated to a depth of 500 m (Fig. 1). The deep EAR is recovered by activating an acoustic release that allows the unit to float back to the surface. The shallow-water EAR can be deployed for a year or longer, depending on the number of batteries included and the recording schedule. The deep EAR can be deployed for up to 6 months at a time.

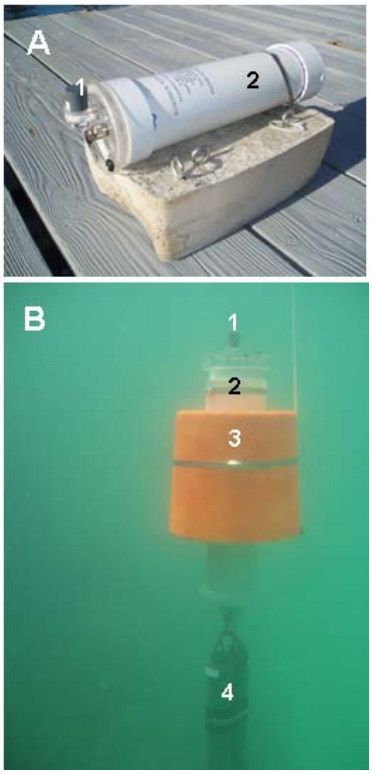

Figure 1 – (A) A shallow EAR showing (1) the hydrophone and (2) housing attached to a concrete anchor. (B) A deep EAR showing (1) the hydrophone, (2) aluminum housing, (3) syntactic foam collar, and (4) two acoustic releases.

The system is based on a Persistor CF2 microprocessor and a 16-bit analog to digital converter that records the ambient sound field and stores the recordings on an onboard 120 Gb disk. Recording sessions are initiated in one of three ways: on a software-regulated schedule, on a start trigger tuned to vessel-generated acoustic energy, and/or on a trigger tuned to sounds produced by cetaceans.

To date, the EAR has been used to record long-term acoustic patterns on coral reefs, monitor vessel traffic in marine reserves, track the occurrence of cetaceans in an area, and establish the acoustic signaling behavior of bottom fish.

Working with the EAR:

There are three ways to work with the EAR: as a Data Solicitor, as an Instrument Leaser, or as a Project Collaborator. The cost will depend on the use agreement, the number of units required, the type of unit(s) (shallow vs. deep), and the duration of use. The three use categories are summarized as follows:

Data Solicitor (DS) – Individuals or agencies interested only in a data product with no need or desire to interface directly with the EAR hardware or raw data. EAR units are deployed at specified sites for a specified duration and a CRED-authored report is produced following the deployment period summarizing the results. Cost range $8,000 - $15,000. DS is also responsible for any deployment costs beyond shipping from/to Hawaii.

Instrument Leaser (IL) – Individuals or agencies desiring to work with the EAR hardware and capable of data analysis without further assistance from HIMB/CRED. EAR units are leased by the user on a monthly or yearly basis and are returned upon completion of the contract. Cost range: $4,000 - $8,500 + lease of topside unit for acoustic releases for deep EARs ($300/deployment/recovery). IL is responsible for shipping costs from/to Hawaii and deployment costs.

Project Collaborator (PC) – Individuals or agencies interested in entering into a collaborative agreement with HIMB/CRED. The PC pays for hardware costs and HIMB/CRED absorb the labor costs of building the EAR unit(s). The data are shared and presentations/publications are authored jointly. EAR units are returned to HIMB/CRED at the end of the collaboration. Cost range: $2,500 - $7,500. PC is responsible for shipping costs from/to Hawaii and deployment costs.