Appendix A

Acoustic monitoring for the presence of beluga whales in Cook Inlet, Alaska

Marc O. Lammers

and

Whitlow W.L. Au

Hawaii Institute of Marine Biology
46-007 Lilipuna Rd.
Kaneohe, HI 96744

Cook Inlet beluga whales (*Delphinapterus leucas*) are listed as an endangered sub-population and are being impacted by a variety of anthropogenic activities, including coastal development, oil and gas exploration, shipping and military activities. Their population has declined from an estimated 635 animals in 1995 to 375 in 2007. As a result, there is an urgent need for data that will help regulatory agencies such as the National Oceanic and Atmospheric Administration (NOAA) and Alaska's Department of Fish and Game (ADFG) implement effective management and recovery plans. Among the principal types of information needed are: quantifiable measures of seasonal presence in the Inlet, temporal and spatial patterns of habitat preference and the occurrence of animals in areas impacted or considered for industrial development.

To address these information needs, a research partnership was formed in 2007 between the Alaska SeaLife Center/University of Alaska Fairbanks (UAF), ADFG and the Hawaii Institute of Marine Biology (HIMB) in order to apply an acoustic monitoring strategy to study the occurrence of beluga whales in Cook Inlet. This approach is based on the use of Ecological Acoustic Recorders (EARs), digital, low power systems that record ambient sounds at frequencies up to 30 kHz on a recording schedule (Lammers et al, 2008). Three EARs were field-tested in Cook Inlet in the summer of 2008. The objectives were to test two different deployment strategies in Cook Inlet's notoriously challenging waters and to determine whether the EARs would 'hear' belugas and therefore serve as an appropriate monitoring tool. One deployment scenario involved placing the EAR in a custom-built 'submarine' structure in an attempt to provide hydrodynamic water flow around the recorder. This method was used with one unit, subsequently called the 'Jumbo EAR' (Fig.1). The other two units were deployed the way EARs are typically deployed, with a syntactic foam collar and two burn-wire acoustic releases. These were termed 'conventional' EARs (Fig. 2). Two of the units (the Jumbo and a conventional EAR) were deployed in the vicinity of Fire Island and the third (a conventional EAR) was placed in the vicinity of Port McKenzie between 7/24/08 and 8/15/08 (22 days).

Only the two conventional EARs were successfully recovered. Communications could be established with the Jumbo EAR's acoustic releases, but the unit could not be successfully called to the surface. Multiple attempts were made on different days, but the effort was abandoned after it was concluded that the unit had lost buoyancy. It is hypothesized that the submarine structure became filled with sediment, thereby compromising the unit's ability to float to the surface.

The two EARs that were recovered recorded successfully during the entire deployment period. Nearly 10,000 recordings were made by each EAR. These recordings were processed using semi-automated algorithms that calculate the total acoustic energy and scan for the presence of tonal signals, which are indicative of the presence of beluga calls.

The detection of beluga calls in the recordings was made difficult by the considerable amount of vessel noise present at both deployment locations, but especially at Port McKenzie. Vessel noise confounds the detection algorithm and results in a high rate of false positive candidate detections. Manual examination of nearly 1000 recordings flagged as candidate detections revealed that belugas occurred on four occasions at the EAR near Fire Island and once at Port McKenzie (Fig. 3 & 4). One 'event' (on 7/29) lasted nearly two and a half hours.

The results of the preliminary effort indicate that a) the conventional approach to EAR deployment does appear to be feasible in Cook Inlet, and b) the EAR does detect the presence of belugas. In this regard, the effort was successful, despite the loss of one of the units. The results also reveal that anthropogenic noise poses a challenge for hearing belugas. Continuing efforts will factor this lesson into plans for selecting future monitoring locations. Efforts will also be undertaken to improve detection algorithms so they are more robust to the effects of vessel noise.

Lammers, M.O., Brainard, R.E. and Au, W.W.L., Mooney, T.A. and Wong K. (2008). An Ecological Acoustic Recorder (EAR) for long-term monitoring of biological and anthropogenic sounds on coral reefs and other marine habitats. *J. Acoust. Soc. Am.* 123: 1720-1728

Appendix A

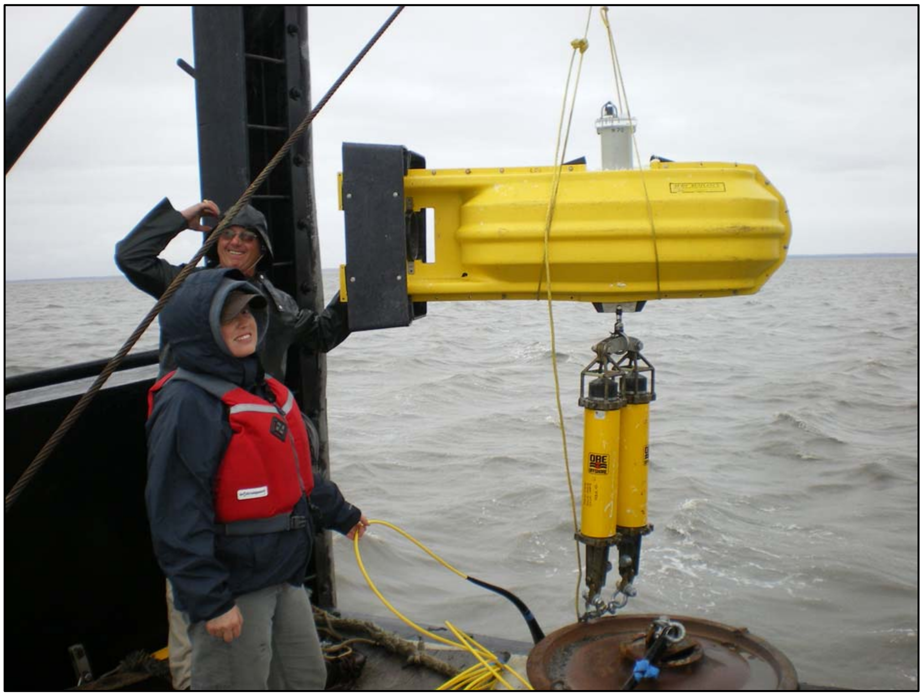

Figure 1 – 'Jumbo EAR' with submarine structure and acoustic releases

Figure 2 – Conventional EARs with syntactic foam float and acoustic releases

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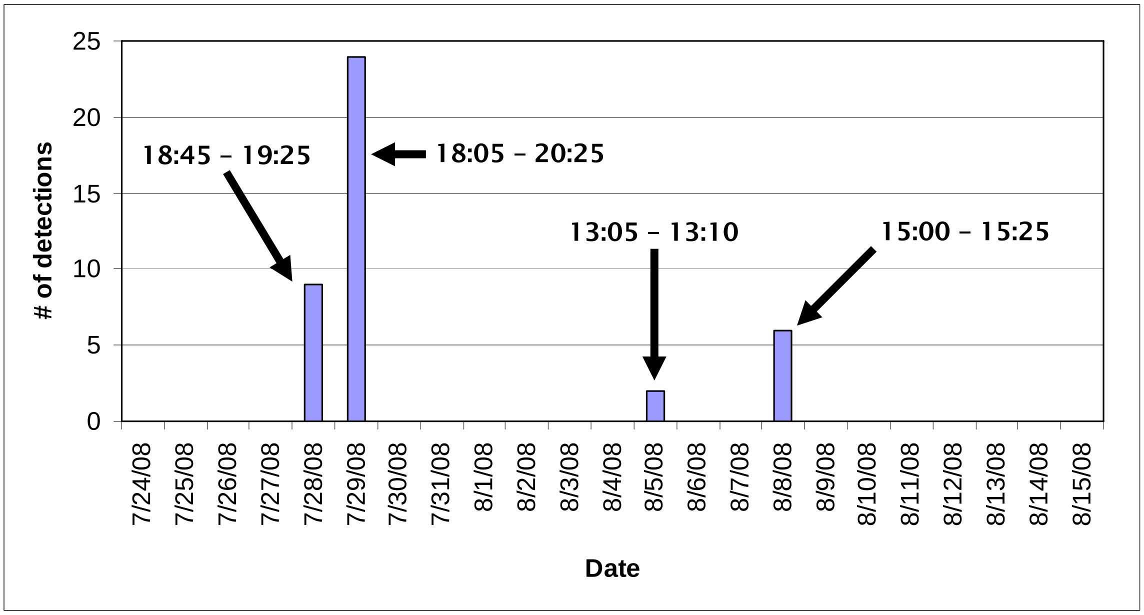

Figure 3 – Detections of beluga whale calls by day on the recovered EAR at the Fire Island deployment location. The time of day is indicated when beluga calls were heard.

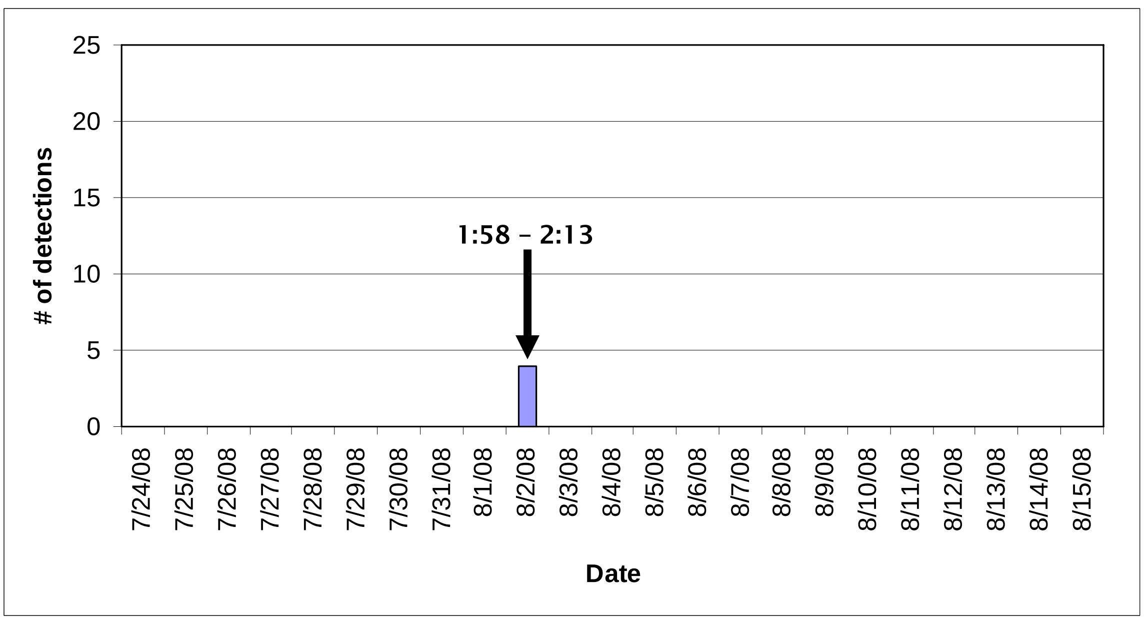

Figure 4 - Detections of beluga whale calls by day on the recovered EAR at the Port McKenzie deployment location. The time of day is indicated when beluga calls were heard.