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Acoustic monitoring of belugas in Eagle River, Cook Inlet

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BACKGROUND

Due to the endangered status of Cook Inlet belugas (*Delphinapterus leucas*), there is a requirement to monitor their presence in the coastal portion of the Joint Base Elmendorf Richardson (U.S. Army and U.S. Air Force) in Knik Arm, upper Cook Inlet. In particular, due to proposed live firing into the Eagle River flats impact area (Fig. 1), both the Eagle River and Eagle Bay are areas of conservation concern for the military.

OBJECTIVE

We conducted a pilot study from May to November 2011 to continuously monitor (24/7) the acoustic presence of belugas at four different locations in Eagle River, covering the last 2.3 river miles of the river upstream from its mouth in Eagle Bay. (Fig. 1).

METHODS

Echolocation loggers (C-POD v1, Chelonia Ltd.) were installed in four monitoring stations in the lower part of the river bank. The instruments were attached to a line fixed with one screw anchor and two 40 lbs chunks of railway above and below the C-POD to maintain the position of the instrument in high current conditions (Fig. 2 & 3).

C-PODs continuously scanned the band 40-160 kHz to log detections of beluga echolocation and multiple features of detected clicks for validation.

Monitoring stations were visited approximately every 2 weeks to check the status of the line and service the instruments.

Beluga detections reported by the C-POD software were manually validated and the percentage of days sampled by each C-POD that had at least one minute of beluga echolocation detection, termed percentage of detected positive days (%DPD), were calculated for all four stations.

RESULTS

None of the 4 c-pods were lost, although some could not detect whales when they became buried by sediment for several days. A total of 168 days were sampled from May 25th till November 7th 2011, and belugas were detected on 37 of those days at one or more stations.

The lowest %DPDs were at the two upstream locations (ER3 = 5.1%, ER4 = 4.3%) and the highest at ER2 (30.4%) (Fig. 4). The %DPD of ER1 (14.9%) was about half that of ER2, probably because the instrument was buried in sediment during part of the peak period of beluga presence.

In order to estimate how many times belugas visited the river, how much time they spent in the river during each visit, and how far up they traveled in each visit, we defined “beluga acoustic encounter” as a group of echolocation detections bound on either side by a detection-free time period of at least 1 hour and 12 minutes (95 percentile of time between consecutive detections for all the detections).

Belugas were first detected on August 5th and then consistently detected until November 3rd when monitoring ended (Fig. 5). Encounters lasted as much as 3h 59 min. There were no statistical differences in the duration of encounters between locations ($F_{(3,74)} = 1.6$, $p = 0.2$); however, average values for encounter durations were smaller for ER 3 and ER4 (Fig. 6).

Beluga visits were concentrated in the area covered by the first 2 stations, 34% traveled to ER1, 57% traveled to ER2. However some belugas travelled up to ER 3 (15%) and ER4 (6%) (Fig. 7).



Figure 1: Eagle River and its surrounding flats with the locations of the C-POD monitoring stations, covering the last 2.3 river miles of Eagle River.



Figure 2: C. Garner installing an echolocation logger in the river bank at low tide.



Figure 3: Echolocation logger installed in the river bank at low tide.

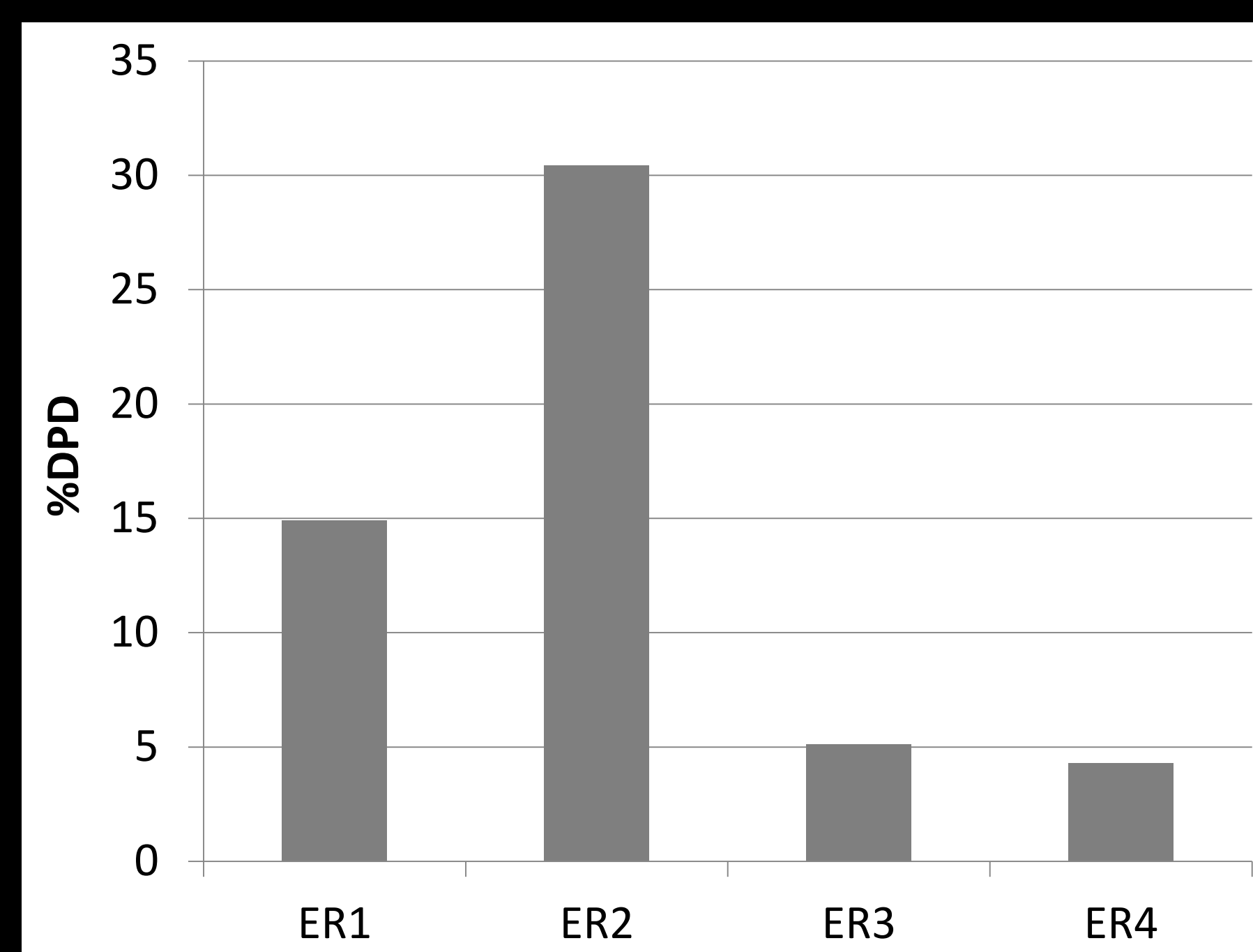


Figure 4: %DPD for each river station.

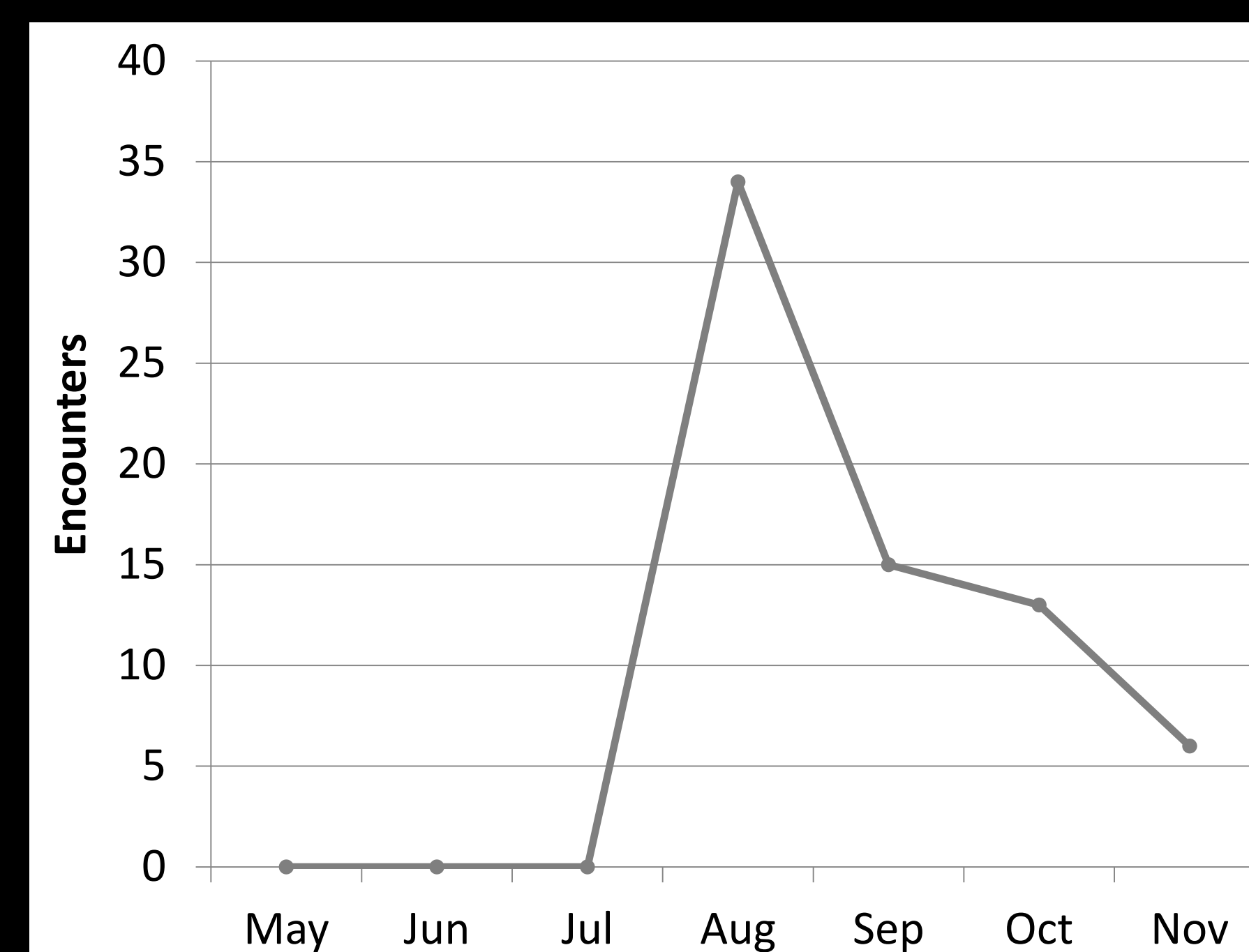


Figure 5: Total number of beluga encounters per month.

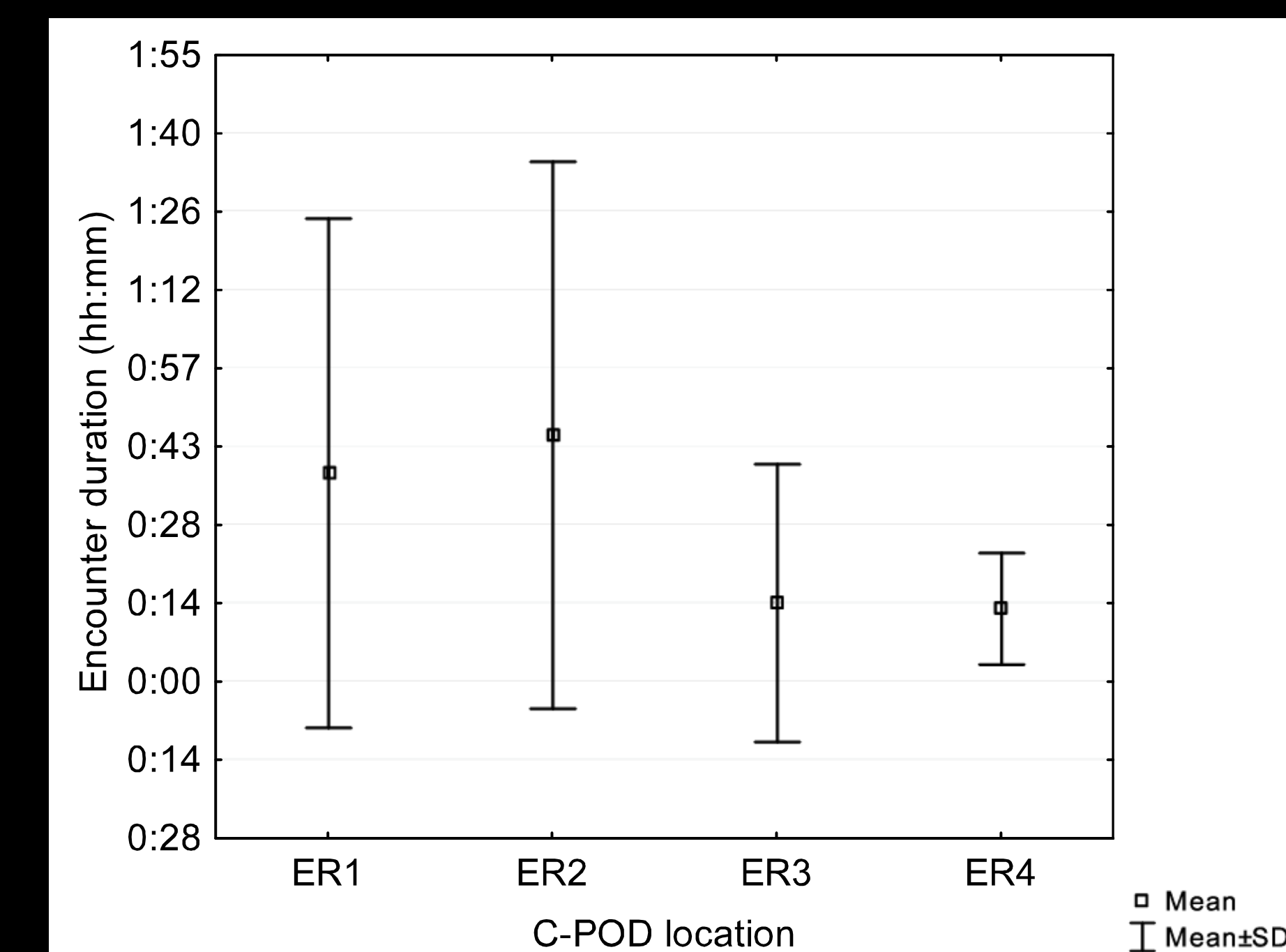


Figure 6: Beluga encounter duration for each river station.

DISCUSSION

This pilot study demonstrated the feasibility of acoustically monitoring the presence of belugas in Eagle River. Beluga visits occurred in a specific period, from early August until November, when the instruments were retrieved. Belugas probably visited the river later in the year, but this pilot study was not designed to continue sampling in the presence of ice. Figure 4 suggests that beluga presence after November was probably low. These results are in accordance with current knowledge based on visual observations.

Belugas concentrate their time in the river to the lower section of the monitored area, in particular ER2, and the upper limit of the area of concentration is somewhere between ER2 and ER3. However, when belugas travel further upstream, they spend the same amount of time per encounter in the upper section of the monitored area. Therefore, a smaller proportion of encounters in ER3 and ER4 than in ER 1 and ER2 do not necessarily mean that these areas are of less interest to the whales. This might indicate that their visit time (and therefore encounter time) is constrained by the duration of highest tide height, more than by their motivation to stay in these locations of the river.

On average, belugas took between 8 to 28 minutes to travel between monitoring locations (Fig. 8). Swimming speeds were estimated to be from 0.5 to 2.1 meters/second based on the distance between locations and the time difference between consecutive encounters. These are generally higher than the average of 0.78 ± 0.67 meters/second calculated from satellite telemetry data in Cook Inlet belugas (NMFS unpublished data), which can be explained by the effect of the river's downstream current.

The loss of data collection when c-pods were buried was the most challenging problem, however, even with substantial data gaps throughout the sampling period, results provide a detailed description of beluga presence, time spent in the river and movements within the river.

The hypothesis that belugas echolocate almost continuously when navigating through the river is supported by these results. Considering the limited detection range of narrowband ultrasonic signals such as echolocation click trains and the fact that every time belugas passed a monitored station these were detected (based on consistent consecutive detections between stations), we assume that silent periods are rare. Thus, monitoring echolocation signals proves to be an efficient method to detect the presence of belugas in Eagle River, and probably as well in many other regions of upper Cook Inlet.

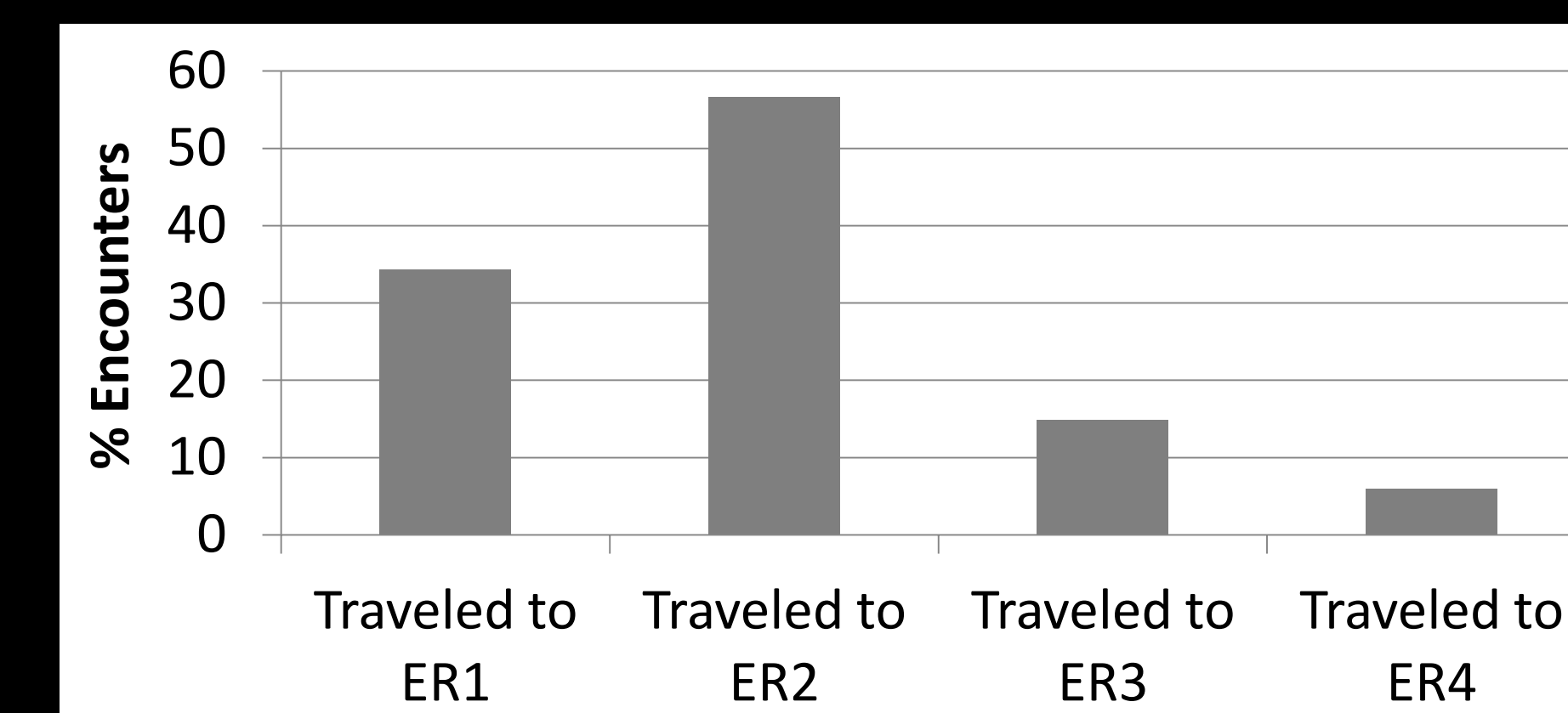


Figure 7: Percentage of encounters based on how far upstream belugas traveled in the river.

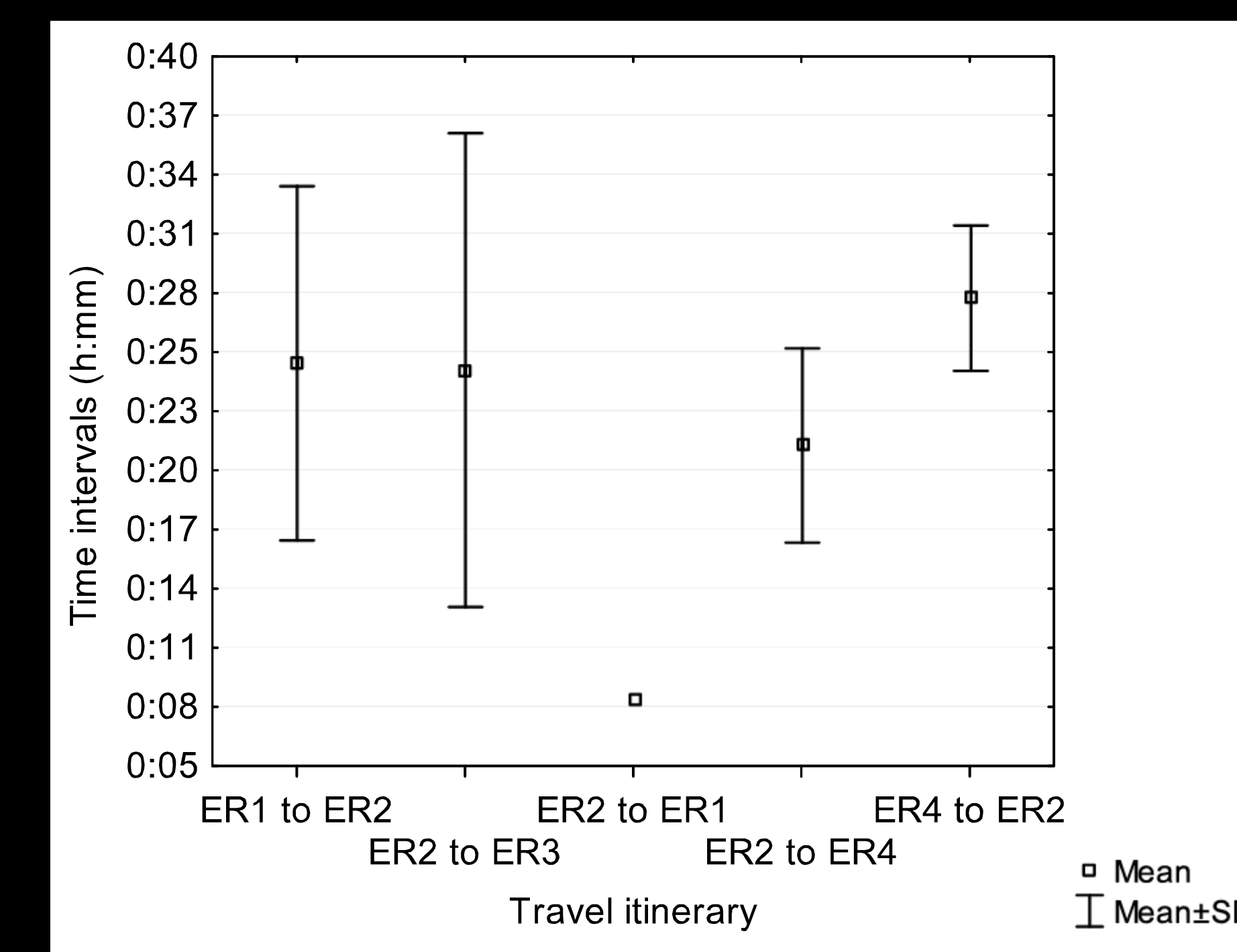


Figure 8: Time intervals that belugas took to travel from one station to another in the river; the number of samples for each pair of locations is at the top of the figure.

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