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

Cooperators: Scientific staff from the NMFS, Alaska SeaLife Center, & Hawaii Institute of Marine Biology

Award Period: From 1 October 2007 through 30 September 2010

Period Covered by this Report: 1 April 2009 through 30 September 2009

Prepared by: Robert J. Small

Summary of Progress and Expenditures to Date

Fieldwork Accomplishments

During this reporting period substantial fieldwork was conducted, with a primary focus on the deployment, recovery, and redeployment of moorings designed for the passive acoustic monitoring (PAM) of beluga whales in Cook Inlet. Acoustic moorings were deployed at 10 sites throughout Cook Inlet (Figure 1). Specifically, 3 moorings were deployed in Knik Arm, (Eagle Bay), 3 in the upper inlet (Cairn Point, Fire Island, and Beluga River), 2 in the mid inlet (MacArthur River & Kenai River), and 2 in the lower inlet (Kachemak Bay & Tuxedni Bay) during 2 field trips on 4-6 June and 30 June-1 July.

EARs were deployed at each of the 10 moorings locations during the first trip to each site. However, only one C-POD was obtained from the vendor by May, and that C-POD was deployed at the Fire Island site in early June. The additional C-PODs were delivered to Alaska in June, and 4 were subsequently deployed in the lower and mid inlet June 30-July 1, and 3 more were deployed in the upper inlet July 6-7. C-PODs were not deployed at the two Eagle Bay sites because when the Eagle Bay-North mooring was located it did not surface following the release command being sent to the acoustic release. During the course of the summer, the presence of the mooring at the site was confirmed by signals sent from the acoustic release; however, several attempts failed to recover the mooring. The Eagle Bay-South mooring barely reached the waters surface during the July 6-7 field trip, due to substantial vegetative material that had accumulated on the mooring line

(Figure 2). Following the failure to recover the Eagle Bay-North mooring, and the near failure of recovery of the Eagle Bay-South mooring, the decision was made to not redeploy moorings at the two sites in Eagle Bay. A summary of mooring deployment, recovery, and re-deployment by date and location is shown in Table 1.

An EAR and C-POD were deployed at the mouth of the Eagle River on July 6-7, yet the mooring configuration was different than the other 9 moorings. Specifically, due to water depths no more than 10 feet at low tide, the EAR, C-POD, and acoustic release were placed closely together in a wooden housing (Figure 3). The length of the mooring line between the release and the anchor was ~5 feet. This mooring was recovered during the September 28-30 field trip, yet was not re-deployed at Eagle River because the mooring would likely be damaged or lost due to contact with ice during the over-winter period. The mooring was deployed at the Eagle Bay–South site where sufficient depth should preclude contact with ice.

The 4 moorings in the lower and mid inlet (MacArthur River, Kenai River, Kachemak Bay, & Tuxedni Bay) will be recovered during the fall of 2009 and re-deployed for the overwinter period.

Preliminary Data Analyses and Results

As of 30 September 2009, belugas were detected at the 5 locations in upper CI in which moorings were recovered; i.e., Beluga River, Fire Island, Cairn Point, Eagle River, and Eagle Bay - South. The focus of the preliminary analyses was on the data from the Beluga River site. This site was chosen because of the high concentration of belugas observed during previous aerial surveys in June, and thus the expectation that belugas would be detected regularly during June (Figure 4). The EAR recorded belugas throughout the ~6 week period of 7 July – 24 August, with whistles, calls (burst pulses), and clicks all being recorded at the lower frequencies (0-15 kHz) of the EAR; see Figure 5. The C-POD detected a peak in echolocation clicks over the 10-day period of 7-17 July (Figure 6); the EAR also recorded a similar peak during this period. On a diurnal basis, the frequency of clicks peaked during the 6-hour period of ~1200-1600 hrs (Figure 7).

An interesting and intriguing result was the detection of 'click trains' by the C-POD that had "terminal buzzes", which are an acoustic behavior exclusive to feeding behavior. Specifically, the click rate variation over ~10 seconds in Figure 8 is indicative of a 'feeding click train' from the Beluga River mooring.

Overall, these preliminary results from the 5 moorings recovered during this reporting period indicate diverse acoustic behaviors of beluga whales can be detected in Cook Inlet. Further, in general, the preliminary results indicate the following:

1. Passive acoustic monitoring detected diverse acoustic behaviors of Cook Inlet belugas (CIB), and recordings from upcoming year-round deployments should increase our understanding of seasonal distribution patterns.
2. Click trains indicative of feeding behavior suggest acoustic monitoring can provide information on which areas may represent important habitats for CIB.
3. The use of both EARs & C-PODs can provide insights on the spatial and temporal differences in CIB acoustic behavior (calls vs. echolocation), including relationships with ambient and anthropogenic noise levels.
4. Visual observations from other studies will be compared with acoustic recordings for differences in detection rates and, potentially, observed CIB behaviors (e.g., feeding) with distinct acoustic patterns.

Future Plans

The moorings will remain deployed throughout the upcoming over-winter period and recovered late spring 2010. Because the attempts to recover two moorings (Eagle River North and Cairn Point) were unsuccessful, likely due to an accumulation of vegetative debris, alternative mooring designs will be further explored for spring-summer 2010 deployments.

Data analysis of all data received to date will be pursued through the next reporting period.

Manolo Castellote will begin an NRC post-doc at the National Marine Mammal Laboratory (NOAA Fisheries), and this study will represent a substantial portion of his studies. In particular, he will take the lead on analysis of the data collected by the C-PODS.

Coordination and Collaboration

Several other acoustic studies in Cook Inlet, most involving belugas, are being conducted and we continue to coordinate and collaborate with these projects. In particular, once we have completed additional data analysis we will begin to compare acoustic and visual detections of beluga whales at the same sites.

Project Costs

The large majority of project funds have been expended, primarily on equipment for the moorings and the contract to have the data analyzed by the University of Hawaii.

MOORING#	*LOCATION*	*JUNE 4-6*	*JUNE 30-JULY 1*	*JULY 6-7*
1	Kenai River		EAR & C-POD Deployed	
2	Kachemak Bay		EAR & C-POD Deployed	
3	Tuxedni Bay		EAR & C-POD Deployed	
4	MacArthur River		EAR, M-cat, & C-POD Deployed	
5	Beluga River	EAR & M-cat Deployed		EAR & Micro-cat Recovered; EAR, C-POD, Micro-cat Re-Deployed
6	Cairn Point	EAR Deployed		EAR Recovered; EAR & C-POD Re-Deployed
7	Fire Island	EAR & C-POD Deployed		EAR & C-POD Recovered; EAR & C-POD Re-Deployed
8	Eagle Bay - North	EAR Deployed		Mooring Not Recovered
9	Eagle Bay - South	EAR Deployed		EAR Recovered, but not Re-Deployed
10	Eagle River			EAR & C-POD Deployed

MOORING#	*LOCATION*	*AUGUST 24-25*	*SEPTEMBER 28-30*
1	Kenai River		
2	Kachemak Bay		
3	Tuxedni Bay		
4	MacArthur River		
5	Beluga River	EAR, C-POD, & Micro-cat Recovered; EAR, C-POD, Micro-cat Re-Deployed	EAR, C-POD, & Micro-cat Recovered; EAR, C-POD, Micro-cat Re-Deployed
6	Cairn Point	EAR & C-POD Recovered; EAR & C-POD Re-Deployed	Mooring Not Recovered; New EAR & C-POD Deployed
7	Fire Island	EAR & C-POD Recovered; EAR & C-POD Re-Deployed	EAR & C-POD Recovered; EAR & C-POD Re-Deployed
8	Eagle Bay - North		
9	Eagle Bay - South		EAR & C-POD Deployed
10	Eagle River		EAR & C-POD Recovered; but not Re-Deployed

Table 1. A summary of acoustic mooring deployment, recovery, and re-deployment by location and date in Cook Inlet, 2009.

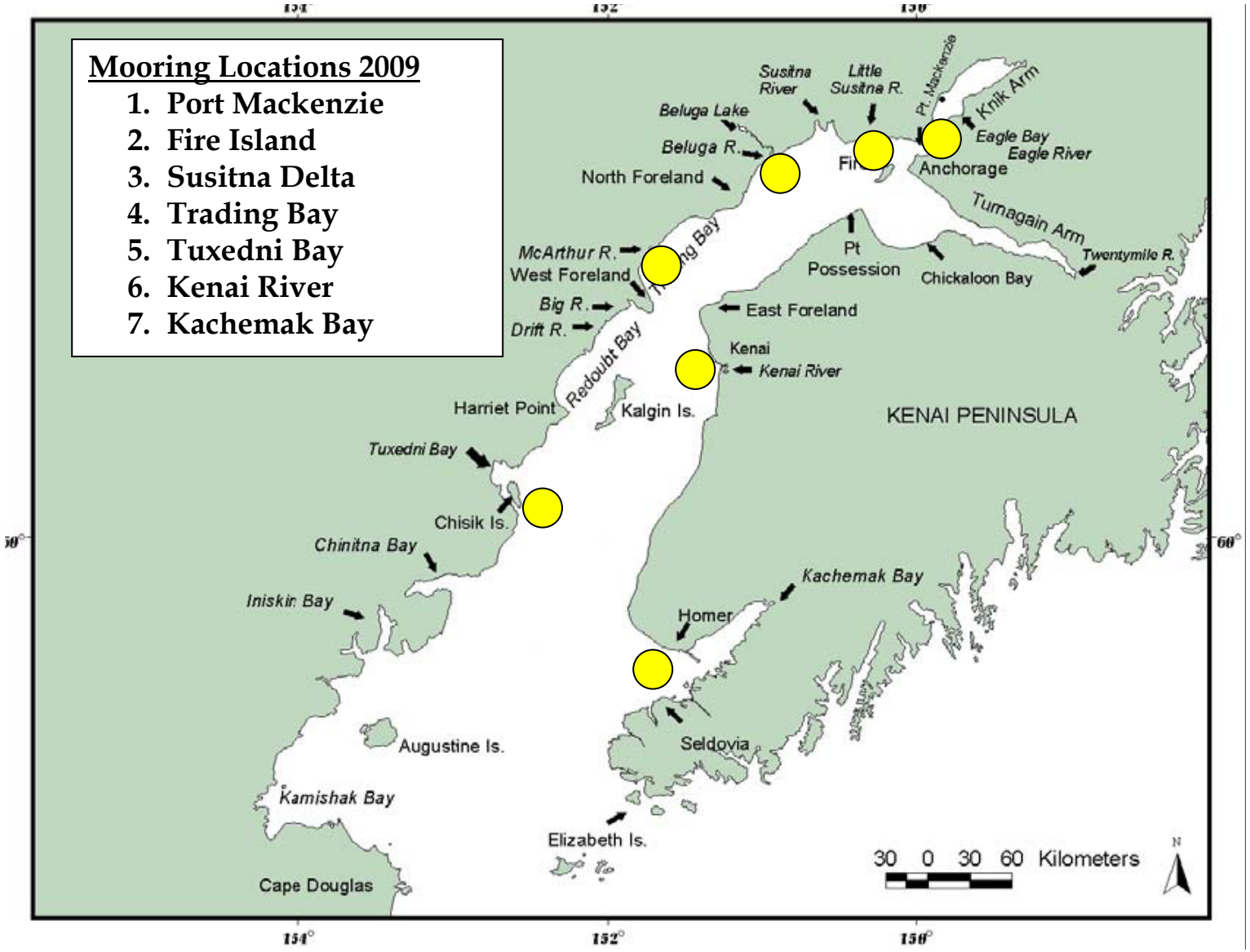

Figure 1. Map of Cook Inlet, Alaska, showing the location of 7 of 10 acoustic moorings deployed during the summer of 2009 to monitor the presence of beluga whales; three additional moorings (not shown) were deployed in Knik Arm.

Figure 2. Vegetative debris on the mooring line between the acoustic release (yellow) and EAR (grey) on the Eagle River – South mooring.

Figure 3. The acoustic mooring design used at the Eagle River location, with the C-POD (grey tube), EAR (inside the orange syntactic foam collar), and acoustic release (under the C-POD) held close together by a wooden frame. The white mooring line (top, left of center) attaches the acoustic equipment to the railroad track used as an anchor.

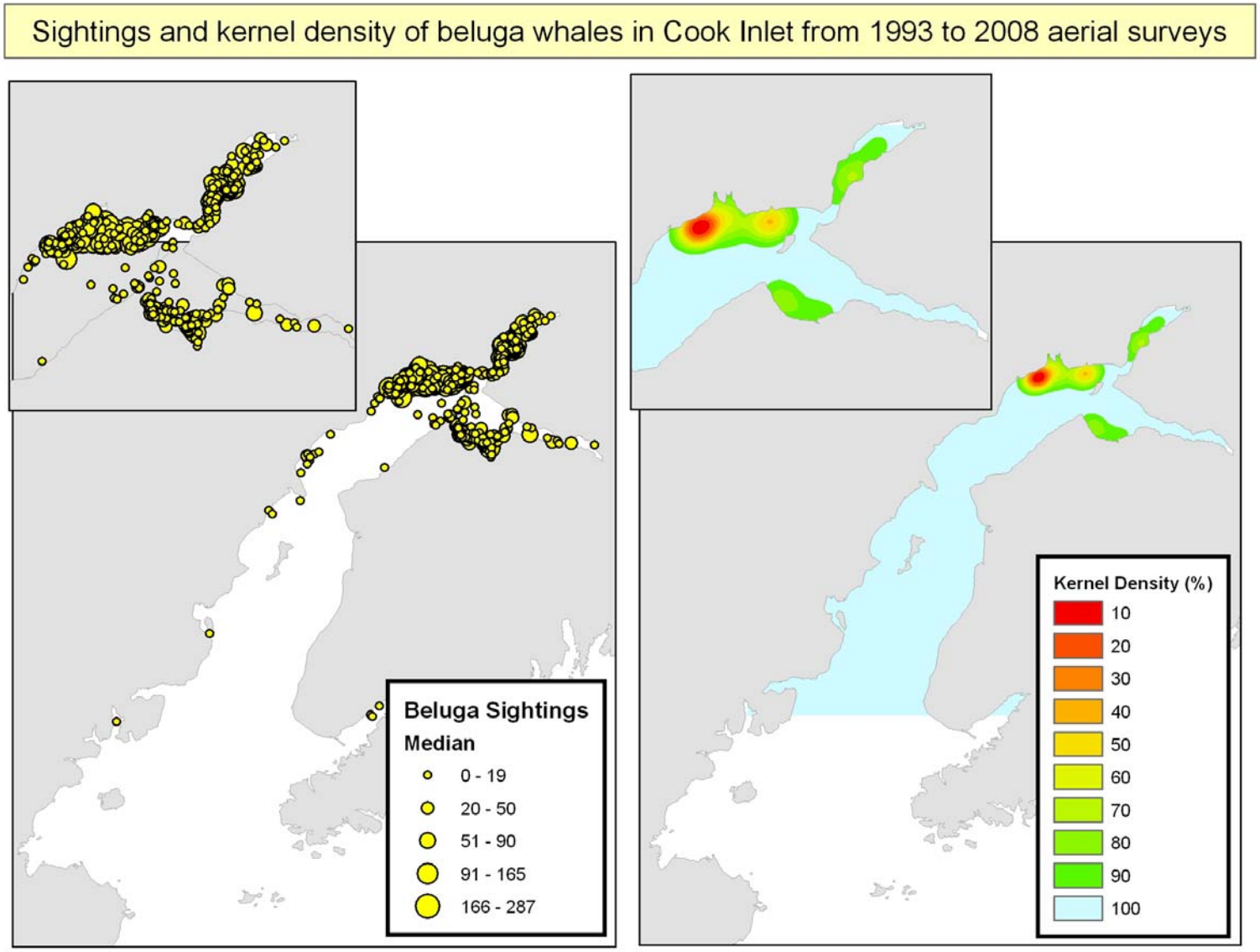

Figure 4. Sightings of beluga whales seen in Cook Inlet, Alaska, 1993-2008 during June aerial surveys; NMFS unpublished data. The darker red and orange area represents the highest concentration of beluga observations, which is near the location of the Beluga River acoustic mooring.

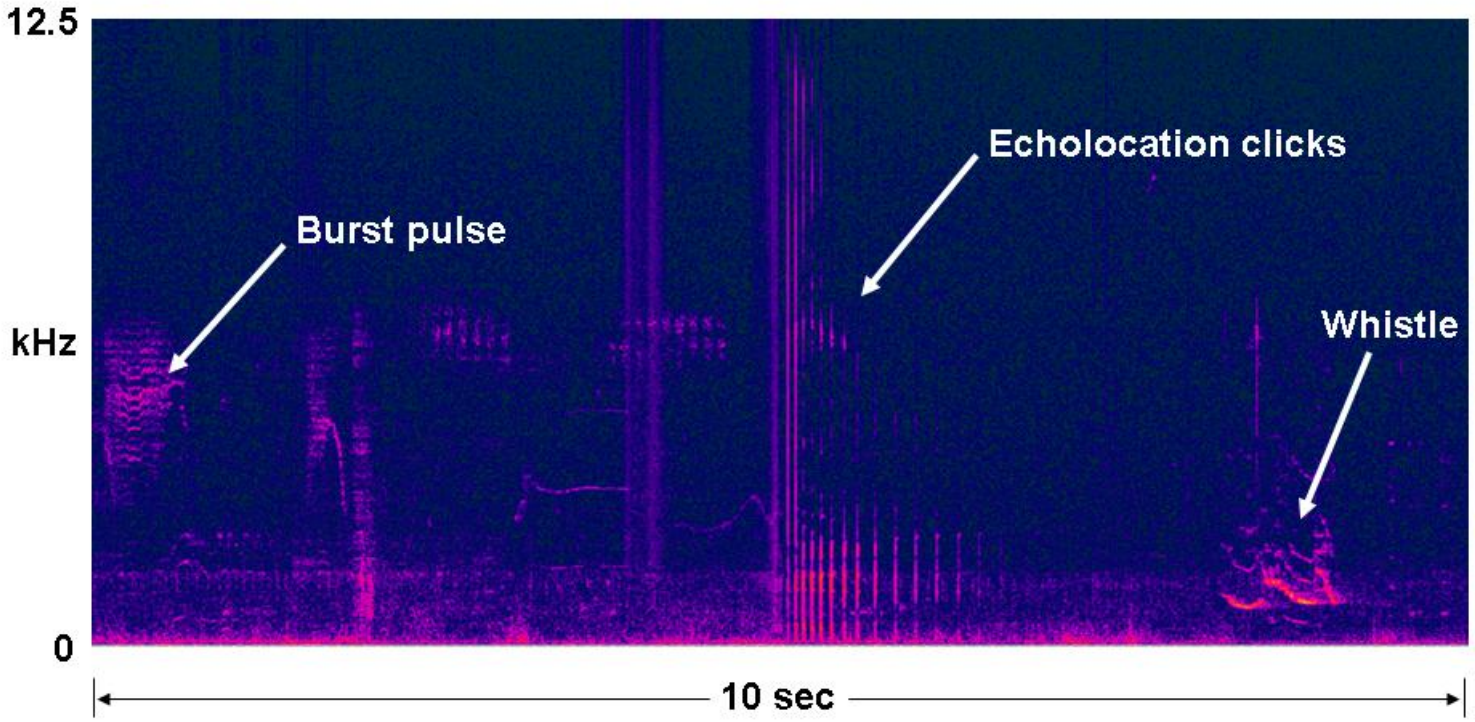

Figure 5. Spectrogram from the Beluga River EAR showing the low frequency recordings of the diverse acoustic behavior of beluga whales.

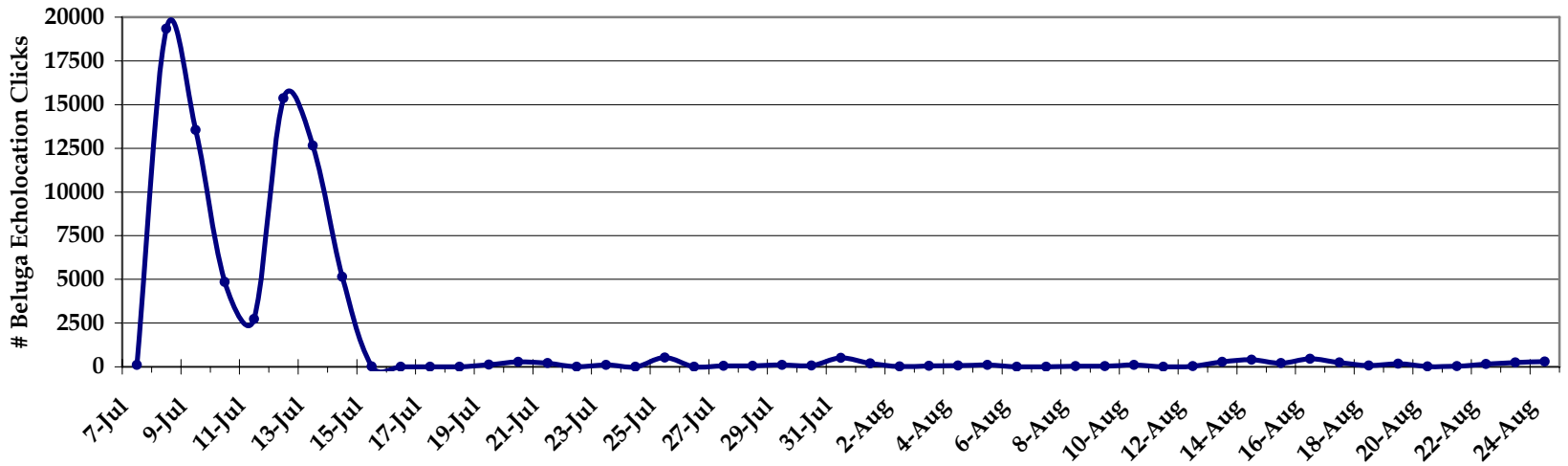

Figure 6. The number of echolocation clicks detected daily by the C-POD at Beluga River, Cook Inlet, from 7 July to 24 August 2009.

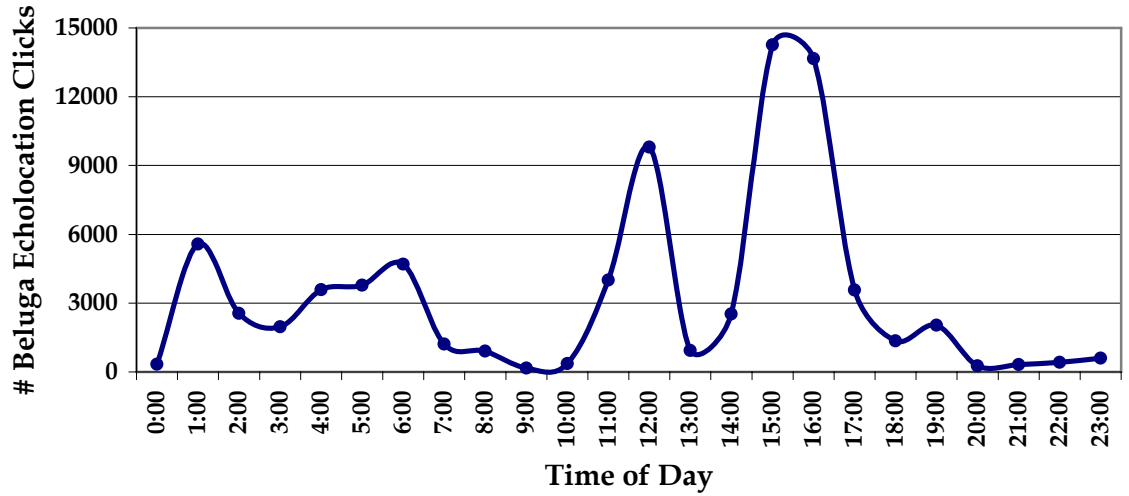

Figure 7. The diurnal pattern of the number of echolocation clicks detected by the C-POD at Beluga River, Cook Inlet, from 7 July to 24 August 2009.

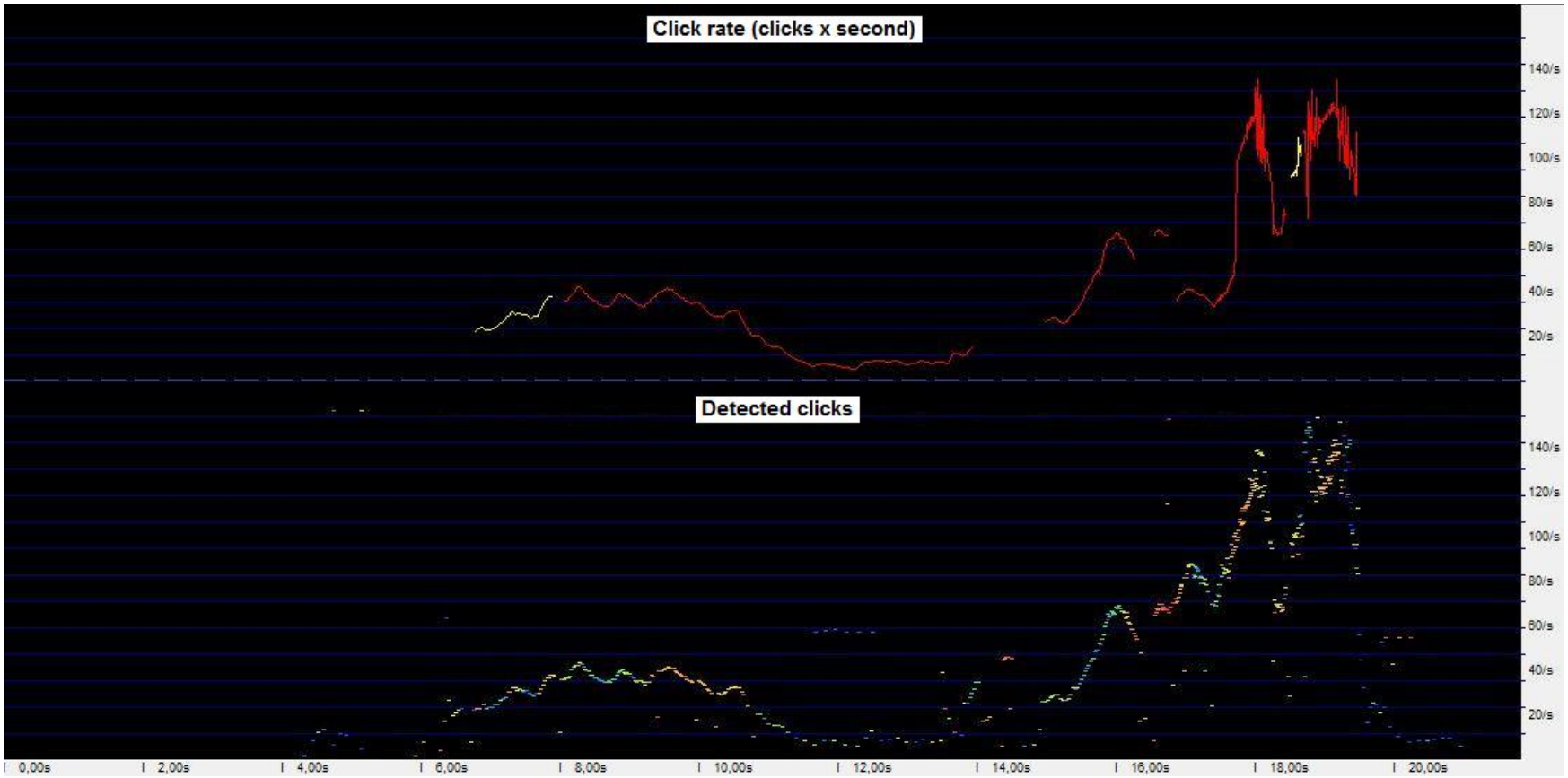

Figure 8. The number of echolocation clicks detected (bottom panel) by the C-POD at Beluga River, Cook Inlet, during a ~20 second period in early July, 2009. The click rate (top panel) variation in the last ~10 seconds is indicative of a 'feeding click train' and the 'terminal buzzes' are an acoustic behavior exclusive behavior.