Alaska SeaLife Center Cook Inlet Beluga Whale Remote Monitoring Pilot Study
May – August 2011

Prepared by

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Overview and Partner

This is the final report of a pilot study by the Alaska SeaLife Center conducted with the collaboration of LGL Alaska Research Associates. This report covers activities and results from May 2011 to August 2011.

Objectives

The study has two primary objectives:

1. Evaluate the use of remotely-controlled video cameras for studying Cook Inlet beluga whales.
2. Monitor the frequency of occurrence, relative abundance, and surface behavior of beluga whales near the mouth of the Little Susitna River during the ice-free months of 2011.

Evolution of Methods

Location

The study site was located near the mouth of the Little Susitna River, Upper Cook Inlet, Alaska. The video cameras and tower were located at (N61.26652, W150.29140), approximately 1.5 river miles (2.4 km) from the confluence of the Little Susitna River and the waters of Cook Inlet, at mean low tide (Figure 1).

This camera system consisted of two cameras mounted to a 9 meter steel tower embedded in the ground at the study site (Figure 3). Batteries, electronics, and the recharging system to run the cameras were located in a hard case mounted at the base of the steel tower and the live image from the cameras was transmitted via microwave signal to a receiver. The receiver was located on the ConocoPhillips building in Anchorage, which affords a line-of-sight relay for the remote acquisition of video data. The signal was transmitted to an office in the ConocoPhillips building complete with computer, recorder, and editing equipment. The video camera was operated remotely by observers who were based in the office.

The video camera system utilized remotely operated camera technology (SeeMore Wildlife Systems, Homer, AK) that allows an observer to remotely manipulate the cameras (e.g., pan, zoom, capture still images, wipe lens, etc) in real-time via a microwave link. This technology has proven to be reliable and cost effective for remote observations during daylight, which can approach 20 hours per day in summer (Figure 2).

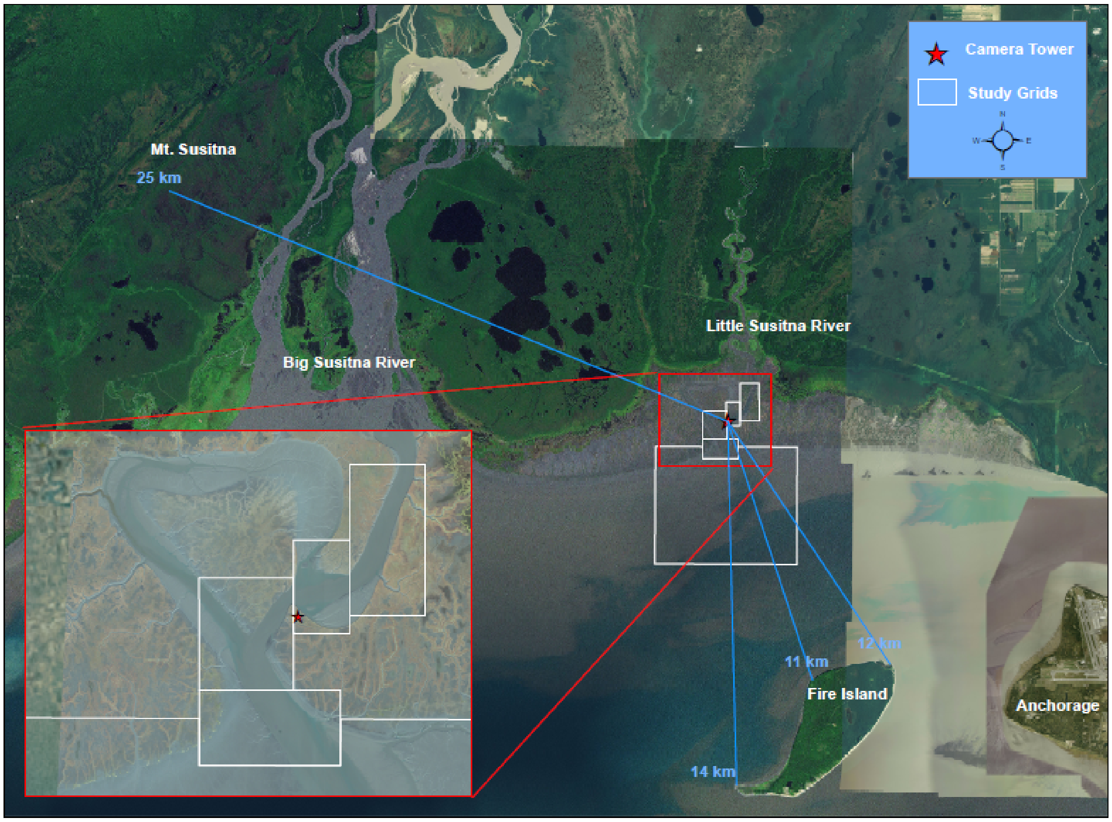


Figure 1: Map of the Little Susitna River study area and surrounding area including Upper Cook Inlet waters adjacent to the city of Anchorage. The study area is shown with distances to landmarks visible through monitoring cameras. The inset is a close up view of the river delta study area.

Figure 2: Panoramic view of the study site during high tide compiled from still pictures taken from the remote monitoring cameras using zero zoom setting.

Figure 3: Camera tower with two cameras mounted near the top, arrows pointing towards cameras.

Observing and Data Collection Protocol

Scanning Protocol

The observer monitoring shifts were scheduled to cover seven days a week during high-water periods in the study area, as water level during low tide stages was thought to be low enough to prohibit access by beluga whales. During the end of July and the month of August observer shifts began overlapping five to six days a week and alternating weeks of full daylight monitoring coverage and partial monitoring coverage. The shift change was an adaptation to allow for additional time for data entry and analysis. Monitoring effort remained targeted around high tide. Scans of the study area were conducted every 20 minutes throughout each monitoring shift. For each scan, the observer would position the camera at the farthest south or north position and slowly move the camera through the study area against the tidal current. Movement of the cameras is incremental, not a continuous movement. With each movement of the camera the observer paused long enough to determine if whales were present before moving the camera. Scans usually lasted between 10 and 15 minutes, but were longer if belugas were present to allow for accurate data collection. During intervals between scans, the camera was positioned at a single location and checked frequently for opportunistic sightings. The location of the camera between scans was positioned towards the area with greatest possibility of having an opportunistic sighting determined by distance from the camera and visibility due to current tidal stage.

Data Collection and Video Archiving

Data for each scan were recorded on standardized data sheets (Appendix A). All information from these sheets was entered into a database created in Microsoft Access specifically for this project. A manual was created for interpreting and using the database for analysis and is included within the database file.

During May, the first month of the study, video recording was initiated when belugas were first observed and was terminated at the end of the sighting. Beginning in June, video was recorded during the entire length of the observers shift and selected video segments (belugas, boats, harbor seals, etc) were retained for archiving. Footage without animals or humans was discarded. See the *Equipment Function* section for any conditions under which video was not archived. Video and still photos were saved into separate folders by date and named according to a standard naming convention: mm.dd.yy(date)_hhmm(time)_BG(beluga)Group#_videoseries#.

Beluga Data Collection

When belugas were present, observers noted group location, size, composition, and behaviors, and used paper data sheets to record data. Additionally print outs of the study area were used as needed to accurately record of the movement of the group. Observers determined how long to follow a group depending on the situation, the goal being to get the most comprehensive data from the study area, in terms of beluga numbers, different groups, and behaviors. For example, observers might follow a group for a shorter period of time before scanning the area for other groups if it was at the beginning of a monitoring shift, since they were less aware of activity going on in the remainder of the study area. Initially during May, due to the inability to positively identify individual whales in a group, once a group was out of view of the observer, any new group sightings were recorded as separate groups even if they were suspected to be the same group previously sighted. However, there was concern that this method of recording data would artificially inflate the number of whales reported by counting the same group of whales multiple times. Due to the limited field of view created by the cameras, it was determined that with reasonable certainty a group sighted in successive scans was the same group (same archive group number), based on size, location, and composition.

In order to accurately capture the dynamic movements of whales within the study area without inflating total numbers of whales reported, a two-pronged data collection scheme was implemented in June and continued through the remainder of the study. Consistent with previous protocols, upon sighting a group of whales for the first time the observer would keep them in view long enough to accurately assess location, composition, and behavior. After recording these data the observer would continue to scan the study area for the presence of other groups of whales. On successive scans whales sighted were assigned a new group number and a new line of data was recorded, again documenting composition, location, and behavior, and comments made on the data sheet indicating that this was most likely the same group as previously recorded.

Within the database, whale sightings were assigned two identification numbers, a “day group” number reflecting the actual group number recorded on the data sheet and an “archive group” which would remain the same for successive sightings of the same group. For example, a group sighted on four successive scans would be assigned “day group” numbers of 1, 2, 3, and 4 for each scan, but the “archive group” number would remain the same for all four scans. If a single group of whales split into distinct segments, letters were used to denote subgroups of the same parent group (e.g. group 1 split into group 1a, 1b, etc.). Day group numbers were reset at the beginning of each new monitoring day and archive group numbers were assigned consecutively for the duration of the study period. If two distinct groups (group 1 and group 2) merged (group 1 joined group 2) the combined group was given the archive group number of the group that was joined (in this case group 2 archive number).

For reporting purposes, beluga whale “groups” are in reference to archive groups in order to accurately reflect the total number of groups and individuals observed. Beluga whale “sightings” are in reference to behavior, composition, and/or location data recorded within the confines of a single scan (day group) in order to reflect dynamic changes within the study area by a single group.

Group location was documented using a grid system consisting of five grids (A, B, C, D, E) covering all portions of the study area visible through the camera (Appendix B). Grid A consisted of an array of 500m x 500m cells. Grids B, C, D, and E consisted of arrays of 100m x 100m cells. A group code was given to each group representing the spatial arrangement of belugas (Appendix C).

Beluga behavior recorded by activity codes (Appendix D) onto data sheets allowed the recording of the top three activities of each group. Specific locations of secondary and tertiary activities occurring within only a portion of the total group location were also noted. If observers were able to obtain close-up video of whales with distinctive markings, still photos of these events were sent to LGL for potential use in their beluga photo-identification project. Presence and behavior of any other marine mammals or humans (including vessel traffic), was also recorded, and video of interesting events were recorded and archived.

Reviewed Video Data Collection

Recorded video from four days of beluga sightings in May, June, and August were reviewed at a later date to evaluate this as a form of data collection as well as comparing the results from both methods and observer accuracy throughout the study period. Data from reviewed videos were recorded using the same live monitoring data collection protocol and datasheets (Appendix A).

Original data and notes were not examined prior to reviewing video in order to avoid bias. Data including group size and composition, duration of sightings, and beluga behaviors from live monitoring were compared to data from reviewed videos taken during the same times to examine the efficacy of both methods.

Nightly Reviewed Video

Beginning July 16th, when conditions were acceptable (weather, video space, etc) the video cameras were left on and programmed to turn off at 22:00, when diminishing daylight reduced visibility, and to conserve battery life. Video was reviewed for presence of belugas, humans, and other marine mammals, and any significant events were recorded and archived.

Environmental Conditions

Environmental conditions were recorded for every hour of observation during the project. Environmental data collected through visual observations included the presence of glare within the study area, Beaufort sea state, the presence of white caps, visibility distance, cloud cover, precipitation, and overall visual monitoring conditions. The overall monitoring conditions were ranked as excellent, moderate, or poor, based on the presence of wind, whitecaps, sun glare, rain, haze, smoke, snow, and fog. A ranking for monitoring conditions were recorded with each scan starting in June. Wind direction, wind speed, and air temperature were collected from the Anchorage airport station on the weather underground website (http://www.wunderground.com/US/AK/Anchorage.html).

Reporting Protocol

Monitoring Effort

Monitoring effort was defined as the time when observers conducting regular scans over the entire survey area. When meetings, guests, or technical issues were present, it was noted in daily data sheets that monitoring effort was discontinued for a period of time. These times were eliminated in the calculations for monitoring effort (Appendix D). Because the camera was positioned in one location for nightly video, effort and results from nightly reviewed video was not included in regular monitoring effort and beluga whale presence.

Tidal Stages

Tidal Stages were calculated by finding the difference between the consecutive high and low tide times as reported by National Oceanic and Atmospheric Administration, Tide and Currents verified data for Anchorage, AK (http://tidesandcurrents.noaa.gov/geo.shtml?location=99501). The number was then divided by the six tidal stages that make up a tidal cycle and times for tidal stages were calculated. During analysis, a tidal stage was considered covered by monitoring if there was monitoring for at least 45 minutes of the tidal stage. The percentage of tidal stages covered by monitoring was calculated by dividing the number of tidal stages monitored by the total number of tidal stages during that time period. The percentage of monitoring effort per tidal stage was calculated by dividing the number of tidal stages covered by monitoring in that tidal type by the total number of tidal stages across all tidal types during that time period. The rate of beluga presence during monitoring effort was calculated by dividing the number of tidal stages when belugas were present by the number of tidal stages monitoring effort occurred per tidal type. The percentage of beluga presence per tidal stage was calculated by dividing the number of tidal stages with belugas present during a tidal type by the number of tidal stages that belugas were present across all tidal types.

Spatial Distribution

All grid cell locations recorded for each beluga whale sighting were tabulated at the end of each month. Total sightings for each grid cell were imported into ArcGIS ArcInfo 10.0 (ESRI, Redlands, CA). Cells were color coded based on the total number of sightings for that location. Specific locations for behaviors of note (suspected feeding, diving, spyhopping, breaching, bobbing, showing pectoral fins, and excessive splashing) and presence of confirmed calves were tabulated for the entire season, imported into ArcGIS, and color coded based on total number of sightings of each for each grid cell.

Results

<u>Monitoring Effort</u>

In total 720 hours of monitoring were conducted over 93 days from May 22 to August 31. Throughout the project the average percentage of the day that was covered by monitoring over a 24 hour period was 32% (Table 1). Daily monitoring effort is presented was recorded but is not presented in this report.

Table 1: Monitoring effort by month

Month	Number of Monitoring Days	Total Monitoring Hours (hrs:min)	Percent of Month Covered by Monitoring Effort (24 hrs per day, 7 days per week)	Average per Day Covered by Monitoring Effort	Average Monitoring Effort Hours per Day of Monitoring
May	10	42:33	18%	18%	4:15
June	30	255:06	35%	35%	8:30
July	29	222:28	30%	32%	7:40
August	24	199:24	27%	33%	7:58
Total	93	719:31			

<u>Equipment Function</u>

May

Camera 1 was the only functioning camera for the duration of the May observation period. Image quality and clarity was lower than anticipated. Animal numbers could be captured, but assessment of behavior, age class, and identification was limited or not possible.

May 23, 2011 – At 15:08, during the 15:00 to 15:20 scan, the camera stopped responding to control inputs and pointed towards the ground. Once the camera came to rest, response to control inputs immediately resumed. Several image quality issues were present, including: black bars, trouble focusing; Sony Video software not flowing smoothly with frequent skips; and a “no image” display.

May 31, 2011 – At 21:01, the camera abruptly lost connection and showed visual static in the display window. Camera operators fixed the problem by rebooting the system and normal operations were immediately resumed.

June

There were several instances where the camera would not move vertically. On June 7, 8, and 9th, Camera 1 would not move vertically for long periods of time (10 minutes to several hours). Restarting software and rebooting computer did not help. On June 9th, we started using both Camera 1 and Camera 2. Camera 2 had a large part of the tower blocking a section of the scan area; therefore it was necessary to use both cameras during a scan. SeeMore went out to the site on June 17th to replace Camera 1 and move Camera 2 to eliminate the blocked view by the tower. In order to increase storage space on the computer, a new computer CPU was obtained on June 10th. The CPU was installed the same day; however the Sony recording software was not able to record due to an error reading there was not enough disk space available. There was no ability to record video for the majority of the day on June 11th. SeeMore suggested observers switch to using the Real Shot Sony Recorder (not the original Sony recording software), by the end of the day video recording resumed. The Real Shot Sony Recorder brought its own problems, for example files could only be exported in 3 to 5 minute clips and it took a couple of weeks to figure out how to export into AVI files (first have to export into CAM files then to AVI).

Observers spent time on multiple instances speaking with a Sony IT representative trying to solve the latter problems. On the 24th of June it was discovered that the Real Shot Sony Recorder deletes video after 10 days and since there were issues in exporting video to AVI, video was lost from the 11th, 16th, and 17th.

July

In an attempt to improve video quality a new DVDR recorder was installed at the ConocoPhillips building on July 6th, but the picture quality was not visibly improved. New WEB recording software was installed to replace the Real Shot Sony Recorder. By July 10th the WEB recorder was determined to have worse video quality than before; therefore observers reverted back to using the Real Shot Sony recorder.

In another attempt to improve video quality, SeeMore went to the camera tower site on July 30th to replace cameras. The new cameras had different video input settings. In the process the video feed was lost through both the SeeMore software and the Sony Real Shot Recorder, and it was inoperable for the rest of the day. On Monday the 1st of August the SeeMore software had the video feed but not the Sony Real Shot recorder. It was determined that during the camera exchange the Sony Real Shot recorder was permanently destroyed and observers returned to using the lower quality WEB recorder.

August

On August 4th, SeeMore visited the ConocoPhillips building to conduct a test to determine if a direct recording of the analog signal, without compression to a digital signal (which was how the video was currently being viewed) would provide a more clear and crisp video image than from the system in the office. At a later date the uncompressed video was assessed for quality. It was determined that the image quality had very minor improvements but was not as sharp or as clear as expected.

SeeMore installed 2 new cameras (with altered settings) on August 9th, in another attempt to improve picture quality. There was no significant change in picture quality.
Camera 2 stopped moving left and right on August 30th, therefore we switched to using Camera 1 which is grainier and highly saturated in color. We tried making adjustments to settings however this did not help picture quality. We believe Camera 1 picture quality is worse than Camera 2.

<u>Beluga Whales</u>

Belugas were observed on 38 of the 93 days during the May to August study period. In total, 69 groups of beluga whales were observed within the study area. Belugas were seen most often in August at 45% of monitoring effort and only 4% in July (Table 2). Groups ranged in size from one to 59 whales. Calves were observed within 21 groups. The greatest number of groups with calves (13 groups) was observed during August. Time groups remained in the study area ranged from one to 498 minutes (8.3 hours; Table 3). More than half of groups observed (52%) remained in the study area for less than one hour.

Spatial Distribution

Beluga whales were observed throughout the study area in all study grids. A majority of groups (39 of 69; 57%) were observed either spread across or traveling through multiple study grids. The greatest number of groups (42) was observed in grid D. The fewest number of groups (5) was observed in grid E (Figure 4). The greatest number of calves was observed in grids C and D (Figure 5).

Tidal and Temporal Beluga Presence

Although belugas were seen during all tidal stages, high slack tide had the highest percent of beluga presence per monitoring effort at 34% (belugas were present in 32 of 95 monitored high slack tide stages). High slack also had the highest percent of monitoring effort for the tidal stage at 47%. The percent of belugas seen during high slack over other beluga presence during tidal stages was 33%. Belugas were also seen during low ebb for 11% of the time that belugas were observed (Table 4; Figure 6). Belugas were seen during the majority of daylight hours that monitoring occurred (6:45 to 20:24). Nightly reviewed video indicated that belugas were present up the river during low slack, low flood, high slack, high flood, and high ebb (data not included in table 4, see section Nightly Reviewed Video Results). Monthly monitoring effort and beluga presence with respect to tidal stages is compiled but was not included in the reports due to page limitations.

Behavior

Primary behaviors of beluga whales were recorded as milling, traveling, and unknown. Secondary behaviors were recorded as milling, traveling, feeding suspected, diving, spyhopping, and other. Tertiary behaviors were recorded as traveling, feeding suspected, diving, spyhopping, tail slapping, and other. Secondary or tertiary activities recorded as “other” were described as headstands, bobbing, listing while showing pectoral fins, and excessive splashing (Table 3). Additionally, extended adult/calf interactions were observed, but this was not part of our directed behavioral observations therefore are an ancillary observation. Diving and suspected feeding behavior were seen most frequently in grids C and D (Figures 7, 8). Spyhopping was observed in grids B, C, and D. Tail slapping was recorded once in grid C. Headstands occurred in grids B, C, and D. Bobbing and showing pectoral fins occurred in grid C. Excessive splashing occurred in grid B (Figure 9).

Table 2: Monthly observation effort and beluga sightings.

Month	# Days of Effort	# Days Belugas Observed	% Observation Days Belugas Observed	# Hours of Observation	# Hours Belugas Observed	% Observation Hours Belugas Observed	# Beluga Groups Observed	# Groups with Calves
May	10	2	20	42.6	3.0	7.0	11	6
June	30	11	37	255.1	18.2	7.1	16	2
July	29	5	17	222.5	9.4	4.2	8	0
August	24	20	83	199.8	91.0	45.5	34	13
2011 Total	**93**	**38**	**41**	**719.5**	**121.6**	**16.9**	**69**	**21**

Table 3: Beluga whale sighting data summary per month from May 22, 2011 – August 31, 2011.

Month	Longest Sighting Duration (min)	Locations	Largest # of White	Largest # of Gray	Largest # of Dk. Gray	Largest # of Unknown	Largest Total*	Largest # of Calves**	1° Activity	2° Activity	3° Activity
May	33	Grid A, B, D, E	15	16	6	0	30	6	1,8	1,2	-
June	344	Grid A, B, C, D E	36	5	3	21	46	3	0,1,8	1,2,7,8	1,2
July	158	Grid B, C, D	9	3	0	6	14	0	1, 8	1, 7,8	7
August	498	Grid A, B, C, D, E	38	15	4	26	59	3	0, 1, 8, 99	1, 2, 4, 7, 8, 99	1, 2, 4, 7, 10, 99

Activity Codes: 0-Unknown 1-Traveling/Moving 2-Diving 3-Mating 4-Spyhopping 5-Breaching 6-Feeding Observed 7-Feeding Suspected 8-Milling 9-Startled Effect 10-Tail Slapping 11-Avoiding Predation 12- Calving 13-Abrupt Dive 14-Disperse 99-Other

* Reported totals of white, gray, dk. gray, and unknown whales reflect the maximum number reported over all groups during the month. Relative numbers of each color class may change from scan to scan based on whales in view, lighting conditions, or distance from the camera. It is important to note that the total number of whales reported reflects the maximum number of whales recorded during that month and may NOT be equal to the sum of the color classes.

** Number of calves should be included in dk. gray and total.

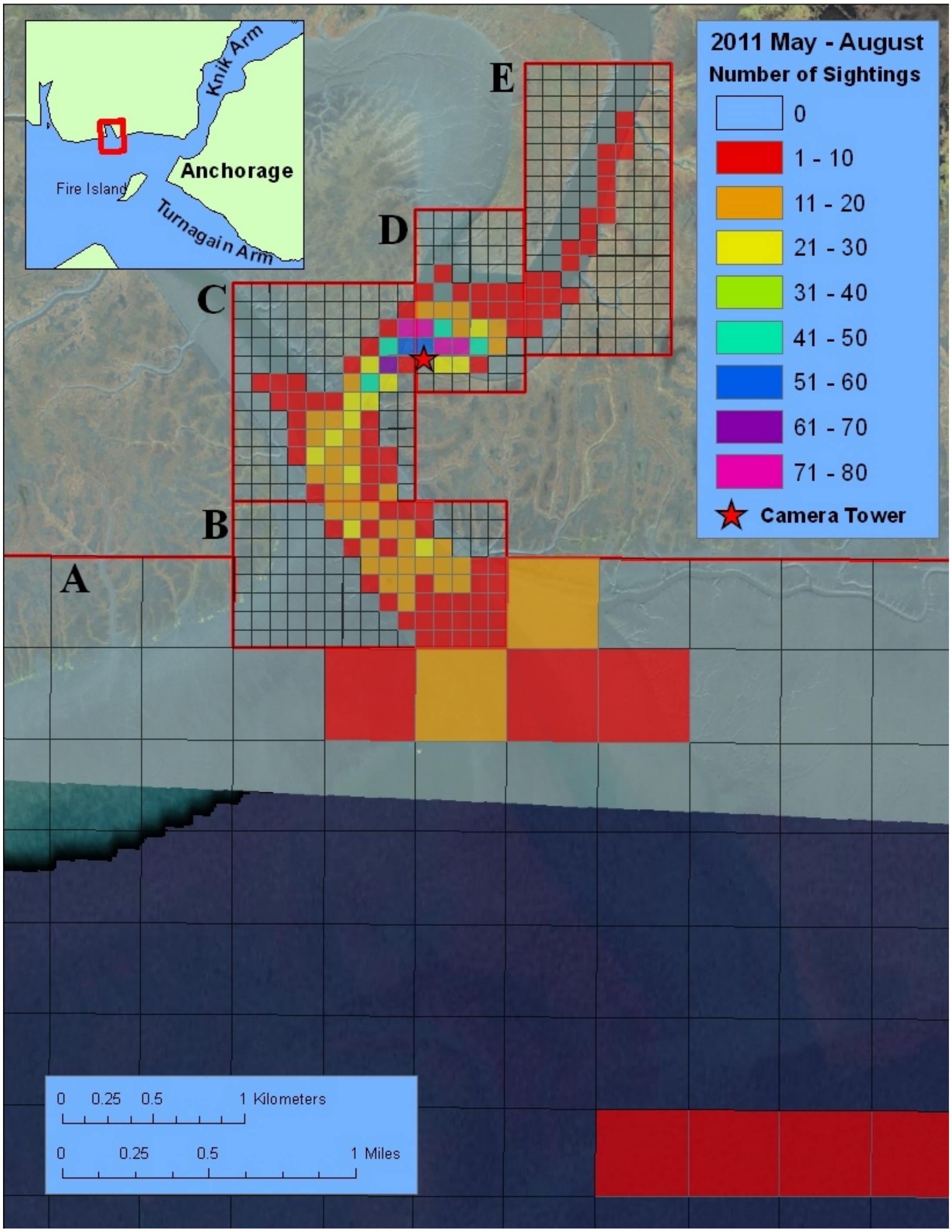


Figure 4: Spatial distribution of beluga whale sightings in May – August 2011 with an inset of the relative position of the study area within Upper Cook Inlet. A sighting is defined as the presence of beluga whales during the duration of a single scan. Highlighted grid cells represent locations where beluga whale groups were observed. Color scale indicates total number of sightings in each grid cell during 2011. Beluga whales were observed in Grids A, B, C, D, and E. Sighting rates were highest in Grids C and D.

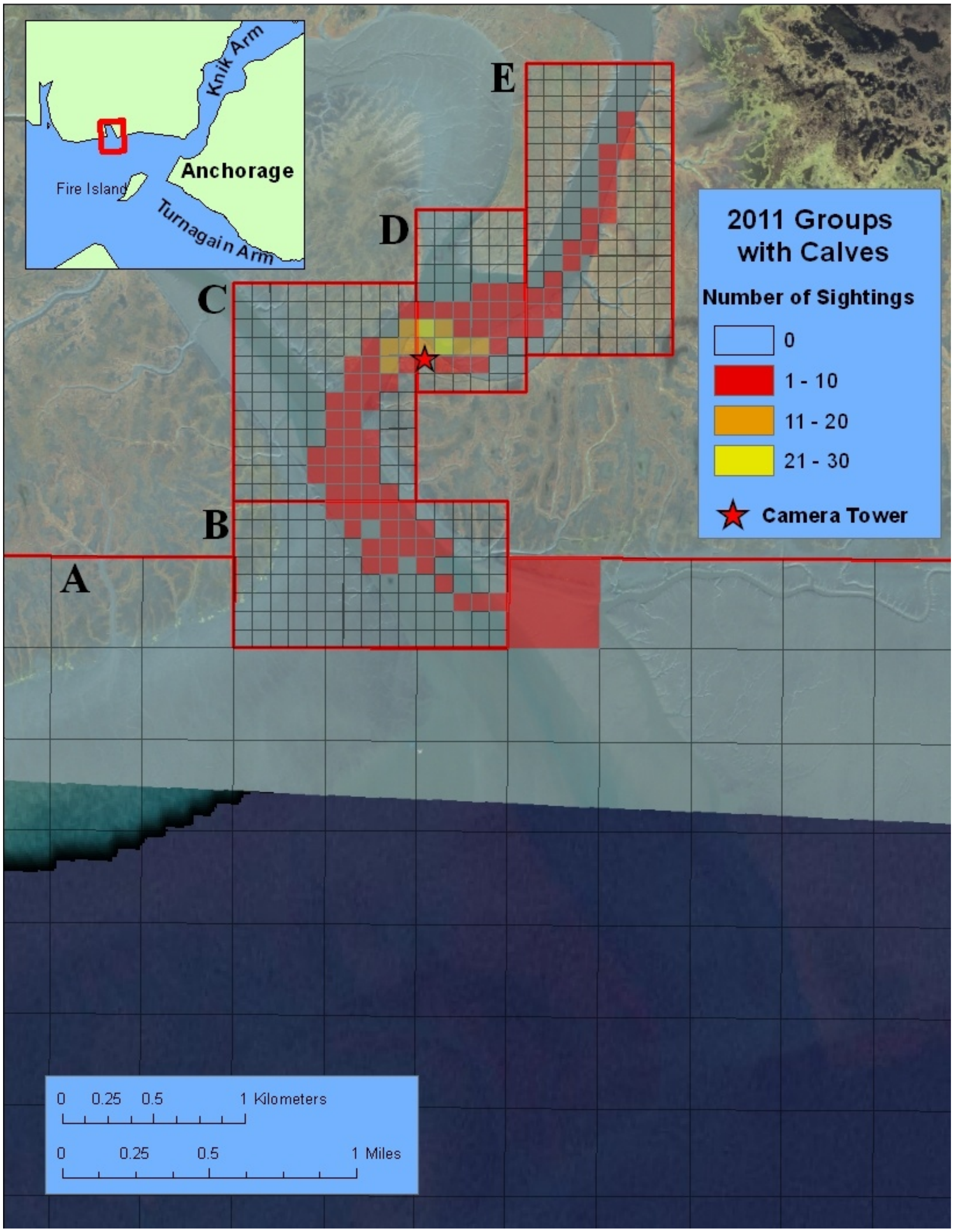


Figure 5: Spatial distribution of sightings of beluga whale groups with calves in May – August 2011 with an inset of the relative position of the study area within Upper Cook Inlet. A sighting is defined as the presence of beluga whales during the duration of a single scan. Highlighted grid cells represent locations where beluga whale groups with calves were observed. Color scale indicates total number of sightings in each grid cell during 2011. Beluga whale groups with calves were observed in Grids A, B, C, D, and E. Sighting rates were highest in Grids C and D. Although groups with calves ranged through all grids, confirmed sightings of calves occurred only in Grids C and D due to visibility limitations associated with the camera system.

Table 4: Tidal stages with monitoring effort and beluga presence from May 22, 2011 – August 31, 2011.

Tidal Stages with Monitoring Effort and Beluga Presence						
	Number of Tide Stages covered by Monitoring Effort	Tide Stages Covered by Monitoring*	Monitoring Effort per Tidal Stage	Number of Tidal Stages with Beluga Presence	Rate of Beluga Presence during Monitoring Effort	Beluga Presence per Tidal Stage
Low Ebb	55	27%	13%	11	20%	11%
Low Slack	38	19%	9%	3	8%	3%
Low Flood	50	25%	12%	9	18%	9%
High Flood	85	42%	21%	21	25%	22%
High Slack	94	47%	23%	32	34%	33%
High Ebb	73	36%	18%	20	27%	21%

*201 Tidal Stages per Tidal Type, 24 hours per day (5/22/11 - 8/31/11). Tidal stage was considered covered by monitoring if there was monitoring for at least 45 minutes of the tidal stage.

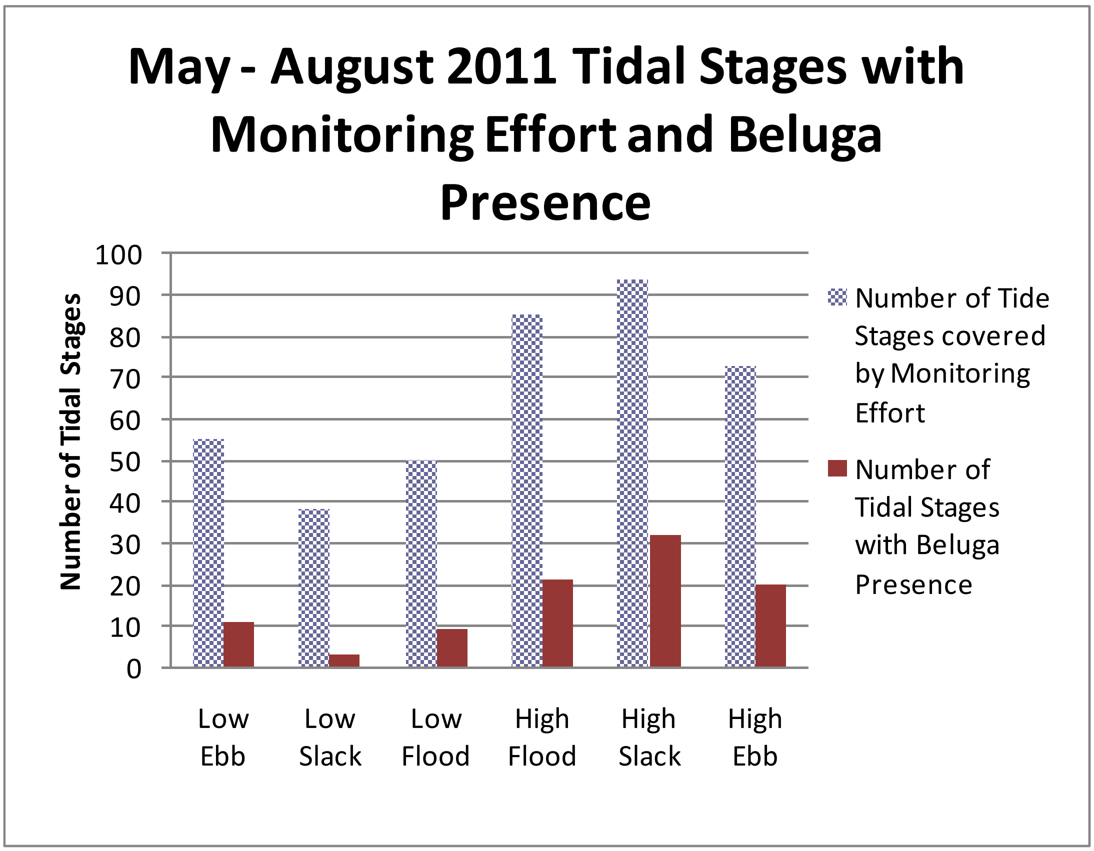


Figure 6: Comparison beluga presence (as # of tidal stages with belugas) and monitoring effort (as # of tidal stages monitored) by tidal type. A tidal stage was considered monitored if scanning covered at least 45 minutes of the tidal stage. Belugas had greatest presence during high flood and high slack tide stages. The greatest monitoring effort occurred during high slack and high flood tide stages.

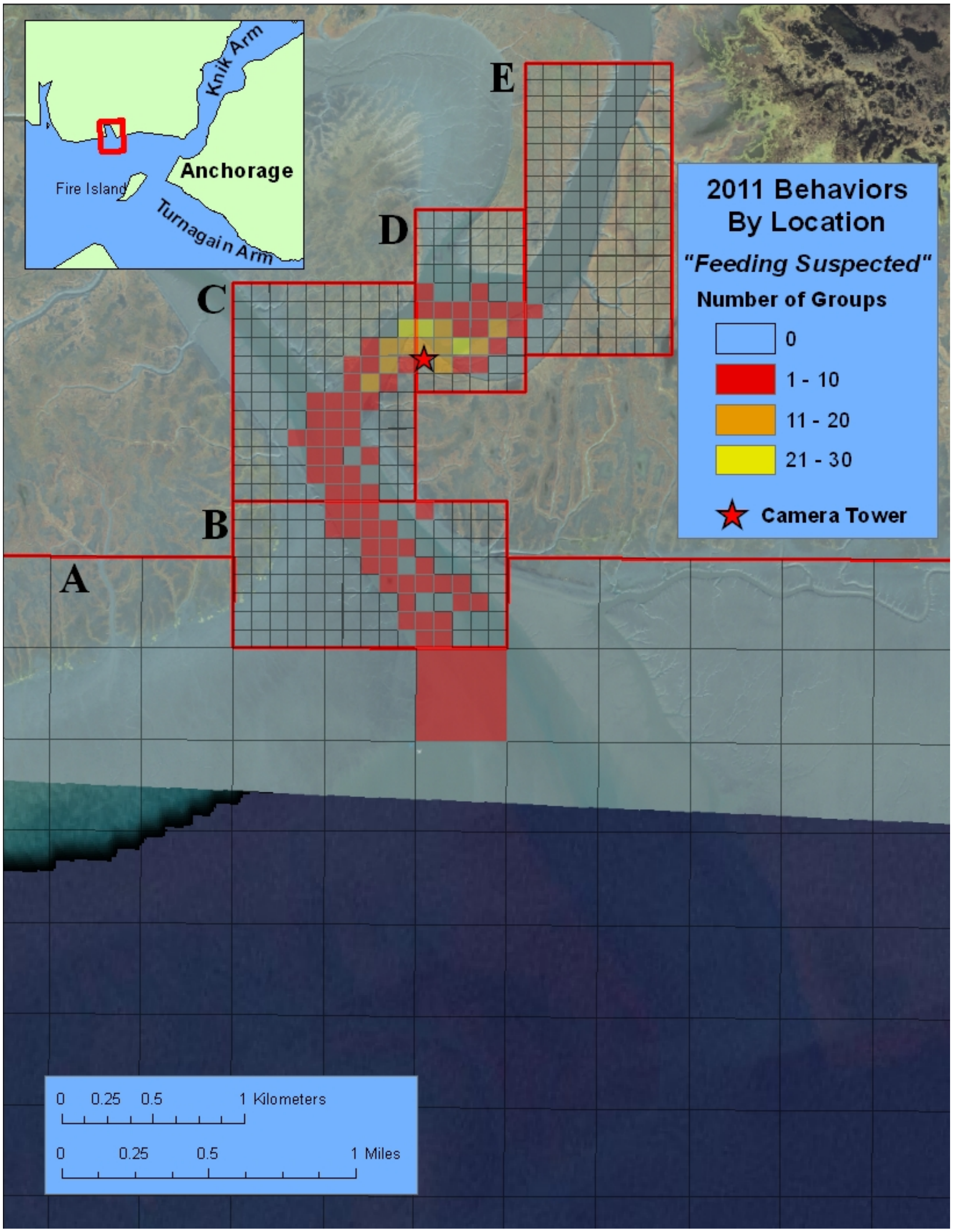


Figure 7: Spatial distribution of sightings of beluga whale groups engaged in suspected feeding behavior in May – August 2011 with an inset of the relative position of the study area within Upper Cook Inlet. A sighting is defined as the presence of beluga whales during the duration of a single scan. Highlighted grid cells represent locations where beluga whale groups were observed engaged in suspected feeding behavior. Color scale indicates total number of sightings in each grid cell during 2011. Beluga whales were observed engaged in suspected feeding behavior in Grids A, B, C, D, and E. Suspected feeding behavior was observed most often in Grids C and D.

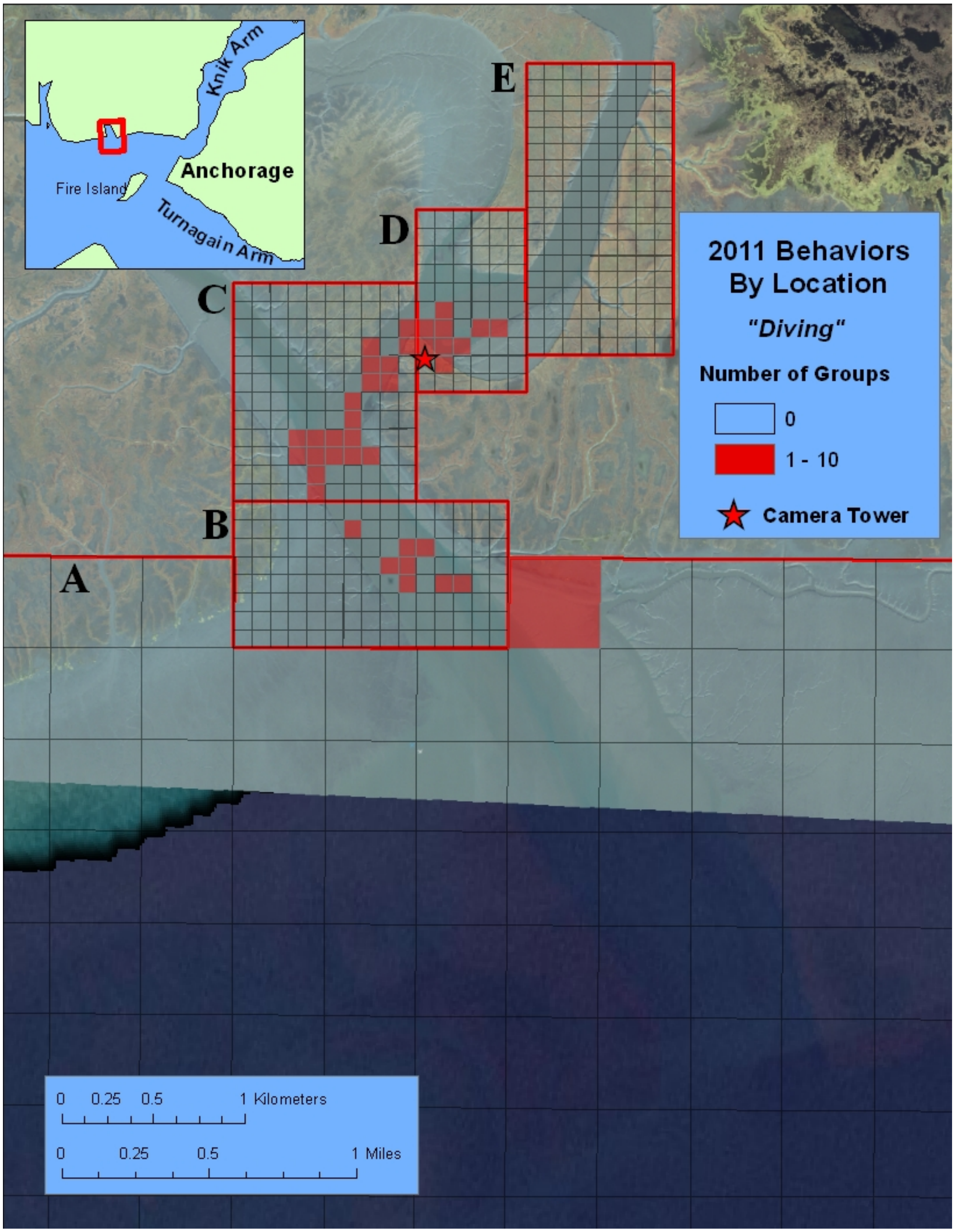


Figure 8: Spatial distribution of sightings of beluga whale groups engaged in diving behavior in May – August 2011 with an inset of the relative position of the study area within Upper Cook Inlet. A sighting is defined as the presence of beluga whales during the duration of a single scan. Highlighted grid cells represent locations where beluga whale groups were observed engaged in diving behavior. Color scale indicates total number of sightings in each grid cell during 2011. Beluga whales were observed engaged in diving behavior in Grids A, B, C, and D. Diving behavior was observed most often in Grids C and D.

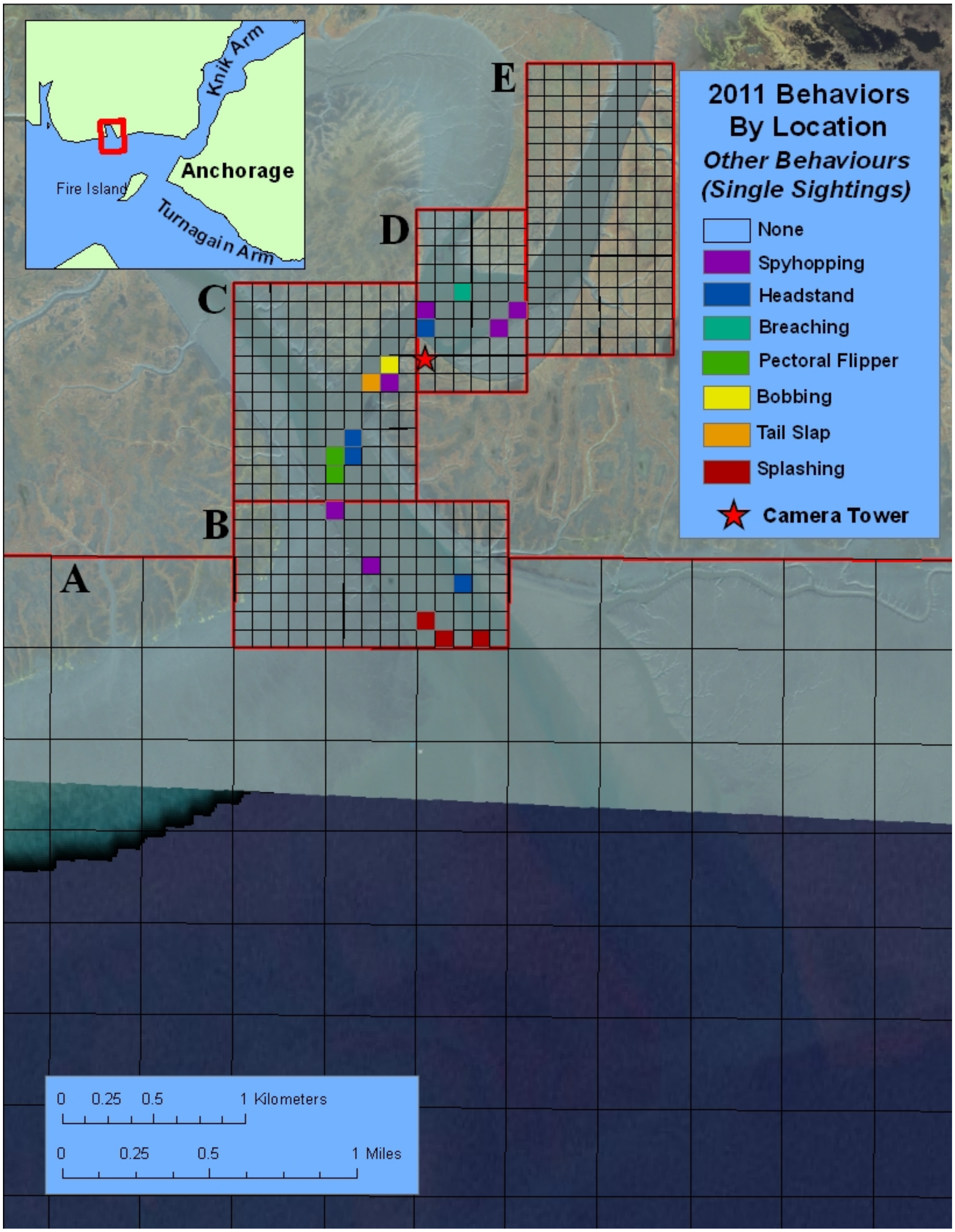


Figure 9: Spatial distribution of single sightings of beluga whale groups engaged in spyhopping, headstand, breaching, displaying pectoral fins, bobbing, tail slap, and excessive splashing behavior in May – August 2011 with an inset of the relative position of the study area within Upper Cook Inlet. A sighting is defined as the presence of beluga whales during the duration of a single scan. Highlighted grid cells represent locations where beluga whale groups were observed engaged in these behaviors. Color scale indicates specific behavior observed in each grid cell during 2011.

<u>Other Marine Mammals</u>

Harbor Seals were recorded on 91 of the 93 days of monitoring from May 22 to August 31 (recorded in 1170 scans). The average number of harbor seals observed during a scan was approximately 10. The largest group of harbor seals recorded in a scan was 42, 40 of them hauled out at the mouth of the river with two in the water near belugas. Harbor seals were observed with fish in their mouths 18 times, on 15 days during the study. Harbor seals were recorded near (one to 100 meters) belugas in 49 of the scans and on 20 of the monitoring days. There was an increase in the maximum group size of harbor seals per day during late July and into August. The maximum group size of belugas increased in August soon after the harbor seal increase (Figure 10). Other marine mammals known to inhabit Cook Inlet, such as orcas, Steller sea lions, and porpoises, were not observed.

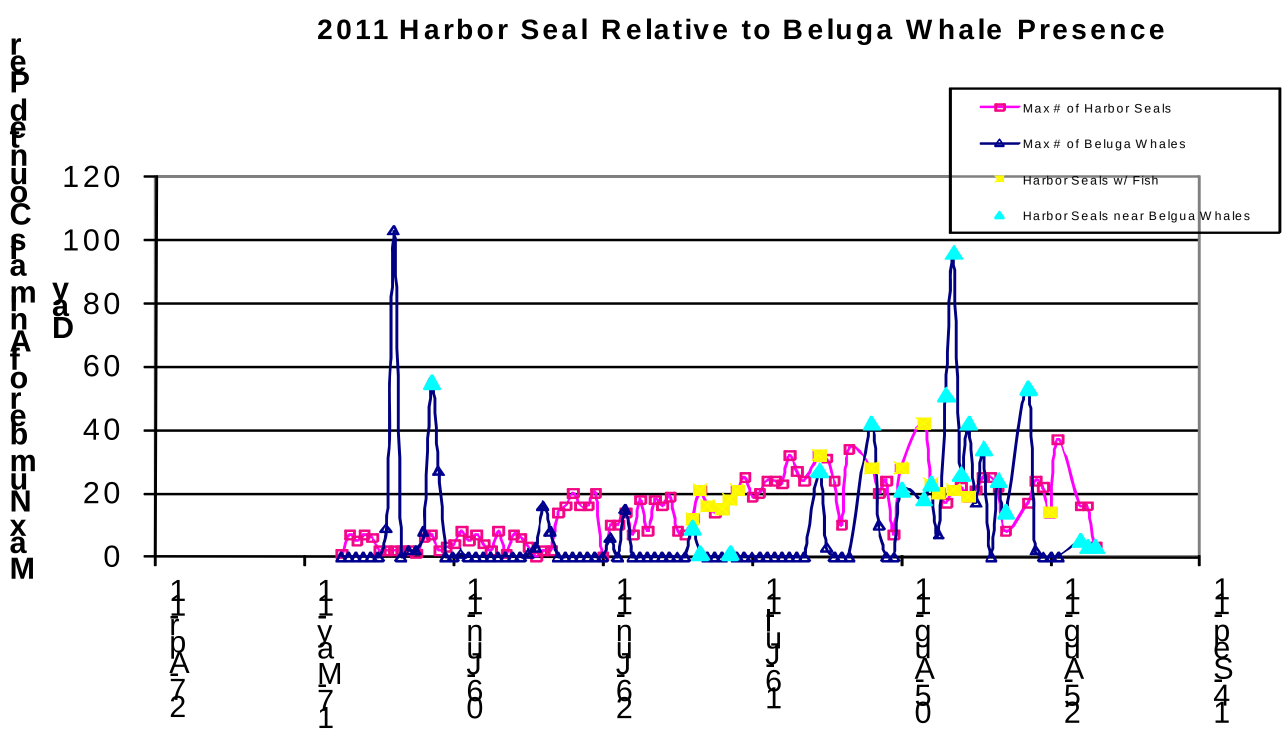


Figure 10: Comparison of maximum harbor seal numbers and maximum beluga whale numbers per day. Harbor seal numbers increased in mid July with beluga whale presence and numbers increasing at the beginning of August. There was also an increase in the presence of harbor seals near belugas and harbor seals observed feeding on fish in late July and August.

Human Activity

May

Vessel traffic through the Little Susitna River was recorded twice during May monitoring efforts. On May 23, a vessel with the Alaska Department of Fish and Game was recorded in the area installing acoustic equipment from 11:28 – 12:05. The second recorded vessel traffic occurred during a Beluga sighting on May 29. The small boat came from upstream and slowed down when Belugas were present.

June & July

Vessel traffic was recorded in the river during 14 of the scans in June and 8 during scans in July. Four of these sightings were of the LGL survey boat, looking for belugas and getting track lines for the ASLC project. Belugas were not recorded through the camera or by the LGL survey boat during this time. The majority of vessel activity was recorded as driving upstream or downstream. In June one man tied his boat up near the tower, got out and walked around the tower before getting back in his boat and leaving.

Also on June 16th, a boat was observed driving back and forth in the river (near the mouth) before its occupants were observed attempting to club a harbor seal with a paddle. They continued attempting to club harbor seals for several hours. Observers immediately contacted NOAA law enforcement, who investigated the situation by viewing the live and recorded video. Enforcement was sent to ship creek to meet the boat as it returned to the harbor. It was determined that the three gentlemen were natives. They also informed law enforcement that all their attempts failed and they did not kill any harbor seals. The boat was checked and information was confirmed.

August

Vessel traffic was recorded on 10 of the 24 days on monitoring in August, with 11 different sightings. Two of the sightings were of the LGL survey boat looking for belugas and getting track lines for the ASLC project. During the two LGL vessel sightings belugas were not seen by the LGL boat or by observers through the camera. Vessel types included inflatable zodiacs, skiffs, and jet skis. Belugas were present during four of the vessel traffic sightings. In two of these sightings (small skiff and jet skis) vessels were recorded slowing down when belugas were present. In another, two boats came to a stop when belugas were in close proximity but also were observed speeding through an area where belugas were present based on previous scans containing belugas. There was also one sighting in August where a small boat was observed speeding through an area where beluga presence was observed.

Reviewed Video

Live Monitoring Compared to Recorded Video

Video reviewed from May and June included 20 groups of whales recorded over four days was reviewed and compared to originally reported data (Table 4). In total, 258 whales (177 white, 51 gray, 14 dark gray, and 16 unknown) were recorded via live monitoring. In total, 190 whales (116 white, 39 gray, 7 dark gray, and 28 unknown) were recorded via recorded video review. Total duration of sightings was 205 minutes for live monitoring and 170 minutes for recorded video. Primary behaviors included milling, traveling, and unknown for live monitoring and milling, traveling, and diving for recorded video. Secondary and tertiary behaviors included milling, traveling, suspected feeding, and diving for live monitoring and traveling, suspected feeding, diving, abrupt diving, and tail slapping for recorded video. On June 4th, ten groups in 27 sub-groups were documented via live monitoring. The same ten groups were documented as 21 sub-groups via recorded video.

Two Days from August were also selected to be reviewed and compared to live data collection as well as observer accuracy changes through the study period. During August 16th and 31st, 11 groups of whales were recorded in both the live and reviewed video data however one addition subgroup was recorded during live video and not in the recorded data. In total, 151 whales (96 white, 18 gray, 7 dark gray, and 27 unknown) were recorded via live monitoring with a comparable total of 152 whales (92 white, 13 gray, 10 dark gray, and 43 unknown) during recorded video. The duration of sighting time was 225 minutes for live monitoring and 232 minutes for recorded video. Primary behaviors for both live monitoring and recorded video were milling and traveling. Secondary and tertiary behaviors during live monitoring included milling, traveling, suspected feeding, and diving. Secondary and tertiary behaviors, observed in the recorded video included traveling, suspected feeding, diving, and other behaviors not coded in the project activity list.

Table 4: Comparison of live monitoring and recorded video data May and June 2011.

Date	Duration of Sighting (min)	Location	Day Group #	White	Gray	Dk. Gray	Unknown	Total	Calves	1° Activity	2° Activity	3° Activity
Live Monitoring Data												
May 28, 2011	8	Grid A	1	2	0	0	0	2	0	1	-	-
May 28, 2011	8	Grid B	2	5	0	2	0	7	2	8	2	-
May 28, 2011 Total	**16**			**7**	**0**	**2**	**0**	**9**	**2**	**1, 8**	**2**	**-**
May 29, 2011	11	Grid A	1	15	4	6	0	25	6	8	2	-
May 29, 2011	33	Grid D, E	2	6	3	1	0	10	1	8	1	-
May 29, 2011*	1	Grid B	3*	1	0	2	0	3	2	1	-	-
May 29, 2011*	5	Grid D	4*	1	0	0	0	1	0	8	1	-
May 29, 2011	2	Grid B	5	0	3	0	0	3	0	1	-	-
May 29, 2011	7	Grid D	6	2	5	0	0	7	0	8	1	-
May 29, 2011	38	Grid B	7	4	7	2	0	13	2	8	2	-
May 29, 2011	9	Grid D	8	14	16	0	0	30	0	1	2	-
May 29, 2011*	30	Grid B	9*	6	4	1	0	11	1	8	2	-
May 29, 2011 Total	**100**			**41**	**38**	**9**	**0**	**88**	**9**	**1, 8**	**1, 2**	**-**
June 2, 2011	2	Grid D	1	2	0	0	0	2	0	1	-	-
June 2, 2011	7	Grid C, D	2	0	0	0	6	6	0	1	-	-
June 2, 2011 Total	**9**			**2**	**0**	**0**	**6**	**8**	**0**	**1**	**-**	**-**
June 4, 2011	2	Grid B	1a	4	0	0	0	4	0	1	2	-
June 4, 2011	10	Grid C, D	2a	18	3	1	0	22	1	8	7	-
June 4, 2011	6	Grid B, C, D	3a,b,c	12	2	0	1	15	0	1	-	-
June 4, 2011	10	Grid B, C, D	4a,b,c	7	3	1	1	12	1	1	-	-
June 4, 2011	7	Grid B, C, D, E	5a,b	15	2	0	1	18	0	1, 8	-	-
June 4, 2011	16	Grid C, D, E	6a,b,c,d,e	24	2	0	3	29	0	1, 8, 0	1, 8	2
June 4, 2011	16	Grid A, B, C, D, E	7a,b,c,d,e,f	15	1	1	4	21	1	1, 8, 0	8	-
June 4, 2011	7	Grid A, C	8a,b,c,d	10	0	0	0	10	0	1, 8	2	-
June 4, 2011	3	Grid B	9a	9	0	0	0	9	0	8	7	-
June 4, 2011	3	Grid B, C	10a	13	0	0	0	13	0	8	-	-
June 4, 2011 Total	**80**			**127**	**13**	**3**	**10**	**153**	**3**	**0, 1, 8**	**1, 2, 7, 8**	**2**
Live Total	**205**			**177**	**51**	**14**	**16**	**258**	**14**	**0, 1, 8**	**1, 2, 7, 8**	**2**
Recorded Video Data												
May 28, 2011	1	Unable to Determine	1	2	0	0	0	2	0	1	-	-
May 28, 2011	8	Unable to Determine	2	4	0	1	0	5	0	8	2	-
May 28, 2011 Total	**9**			**6**	**0**	**1**	**0**	**7**	**0**	**1, 8**	**2**	**-**
May 29, 2011	4	Grid A, B	1	3	0	0	6	9	0	8	1	-
May 29, 2011	29	Grid D, E	2	9	4	0	0	13	0	8	7	1
May 29, 2011						Video Lost						
May 29, 2011						Video Lost						
May 29, 2011	1	Grid C	5	0	2	0	0	2	0	1	-	-
May 29, 2011	1	Unable to Determine	6	0	0	0	5	5	0	1	-	-
May 29, 2011	2	Grid D	7	8	2	3	0	13	1	8	-	-
May 29, 2011	1	Grid C	8	2	3	0	2	7	0	8	7	-
May 29, 2011 Total	**38**			**10**	**7**	**3**	**7**	**27**	**1**	**1, 8**	**7**	**-**
June 2, 2011	2	Grid C	1	2	0	0	0	2	0	1	8	-
June 2, 2011	9	Grid C, D	2	0	0	0	5	5	0	1	9	-
June 2, 2011 Total	**11**			**2**	**0**	**0**	**5**	**7**	**0**	**1**	**8, 9**	**-**
June 4, 2011	2	Grid B	1a	5	0	0	0	5	0	1	2	-
June 4, 2011	12	Unable to Determine	2a	17	3	1	2	23	1	8	7	-
June 4, 2011	10	Grid B, C, D	3a,b	13	2	0	2	17	0	1, 8	1	-
June 4, 2011	19	Grid B, C, D	4a,b	6	3	0	3	12	0	1, 8	-	-
June 4, 2011	14	Grid B, C, D, E	5a,b	10	3	0	2	15	0	1	2	-
June 4, 2011	23	Grid C, D, E	6a,b,c	11	6	2	2	21	1	8	1, 2	-
June 4, 2011	16	Grid A, B, C, E	7a,b,c,d,e	10	10	0	3	23	0	2, 8	1, 2	-
June 4, 2011	8	Grid A, C	8a,b,c	8	1	0	1	10	0	1, 8	10	-
June 4, 2011	4	Grid B	9	5	0	0	1	6	0	8	-	-
June 4, 2011	4	Grid B, C	10	13	4	0	0	17	0	8	-	-
June 4, 2011 Total	**112**			**98**	**32**	**3**	**16**	**149**	**2**	**1, 2, 8**	**1, 2, 7, 10**	**2**
Recorded Total	**170**			**116**	**39**	**7**	**28**	**190**	**3**	**1, 2, 8**	**1, 2, 7, 9, 10**	**1, 2**

*Video was lost due to the beginning of the project and observers learning the new system. The data was eliminated from totals for comparison purposes.

Table 5: Comparison of live monitoring and recorded video data August 2011.

Date	Duration of Sighting (min)	Location	Day Group #	White	Gray	Dk. Gray	Unknown	Total	Calves	1° Activity	2° Activity	3° Activity
Live Monitoring Data												
August 16, 2011	37	Grid B, C, D	1	13	2	1	0	17	1	8	7	-
August 16, 2011	41	Grid B, C, D	2	26	2	1	3	34	1	8	1	7
August 16, 2011	38	Grid B, C, D	3	19	4	2	2	27	2	8	7	-
August 16, 2011	13	Grid C, D	4a	2	1	2	5	10	2	8	7	-
August 16, 2011	22	Grid B, C	4b	16	3	0	1	20	0	8	7	4
August 16, 2011	16	Grid C, D	5a	3	3	1	4	11	1	8	7	-
August 16, 2011	11	Grid A, B	5b	8	3	0	6	17	0	8	7	-
August 16, 2011	5	Grid A, B	6	1	0	0	3	4	0	8	7	1
August 16, 2011	**183**			**88**	**18**	**7**	**24**	**140**	**7**	**8**	**1, 7**	**1, 4, 7**
August 31, 2011	8	Grid D	1	3	0	0	0	3	0	8	1	-
August 31, 2011	1	Grid C	2	2	0	0	0	2	0	1	-	-
August 31, 2011	1	Grid B	3	1	0	0	0	1	0	1	8	-
August 31, 2011	6	Grid C, B	4	2	0	0	0	2	0	1	-	-
August 31, 2011	26	Grid C, B	5	0	0	0	3	3	0	1	-	-
August 31, Total	**42**			**8**	**0**	**0**	**3**	**11**	**0**	**1, 8**	**1,8**	**-**
Live Total	**225**			**96**	**18**	**7**	**27**	**151**	**7**	**1, 8**	**1, 7, 8**	**1, 4, 7**
Recorded Video Data												
August 16, 2011	37	Grid B, C, D	1	12	2	3	2	19	2	8	7	99
August 16, 2011	42	Grid A, B, C, D	2	26	1	1	2	30	1	8	1	7
August 16, 2011	39	Grid A, B, C, D	3	17	5	2	2	26	2	8	7	99
August 16, 2011	40	Grid A,B C, D	4	18	4	2	7	31	2	8	7	4
August 16, 2011	17	Grid C, D	5a	2	1	2	8	13	2	8	7	99
August 16, 2011	12	Grid B	5b	6	0	0	12	18	0	8	7	99
August 16, 2011	5	Grid A, B	6	0	0	0	4	4	0	8	1	-
August 16, 2011	**192**			**81**	**13**	**10**	**37**	**141**	**9**	**8**	**1, 7**	**7, 99**
August 31, 2011	8	Grid D	1	3	0	0	0	3	0	8	1	99
August 31, 2011	1	Unable to Determine	2	1	0	0	0	1	0	1	-	-
August 31, 2011	2	Grid B	3	1	0	0	0	1	0	8	7	-
August 31, 2011	9	Grid B	4	3	0	0	3	3	0	1	99	-
August 31, 2011	20	Grid C, B	5	3	0	0	3	3	0	1	7	99
August 31, Total	**40**			**11**	**0**	**0**	**6**	**11**	**0**	**1, 8**	**1,7,99**	**99**
Recorded Total	**232**			**92**	**13**	**10**	**43**	**152**	**9**	**1, 8**	**1, 7, 99**	**4, 7, 99**

Nightly Reviewed Video

A total of 67.5 hours of video recorded over 13 nights was reviewed for presence of belugas, humans, and other marine mammals. On five of the 13 nights belugas were seen in the video viewing area (pointed towards grid Dh1). On all five nights that belugas were observed during nightly reviewed video, belugas were also observed during high tide earlier in the day during scheduled monitoring efforts. Belugas were observed during all tidal stages except low ebb, however low ebb was only in nightly reviewed video twice. During these sightings belugas were seen milling the majority of the time; however, diving, breaching, and a tail slap were also recorded. Vessel traffic was observed five of the nights, traveling both up and down stream. Harbor seals were viewed swimming in the area nine of the nights, with one record of a harbor seal swimming near belugas.

Discussion

Evolution of Methods

The objectives of this project were two-fold 1) to evaluate the use of remotely-controlled video cameras for studying Cook Inlet beluga whales and 2) to document the frequency of occurrence, relative abundance, and surface behavior of beluga whales near the mouth of the Little Susitna River during the ice-free months of 2011.

Because this was a pilot project both the feasibility and efficacy of remote monitoring for this species were unknown at the outset, therefore operating protocols were developed during the initial days of monitoring. With the project goals in mind, changes to these protocols were made as observers discovered the limitations and benefits of the camera system design.

Beluga Whale Monitoring

Initial protocols were based largely on other marine mammal monitoring programs, including protocols used for other projects monitoring upper Cook Inlet beluga whales. The purpose of adopting these methods was to maintain enough consistency of data to be able to collaborate and share results with other groups examining the habitat use patterns of belugas in waters adjacent to Anchorage, AK. The biggest alteration made to these standard monitoring protocols by observers on this project was the decision to accept reasonable suspicion based on location and group composition as sufficient for determining that successive sightings were actually the same group of whales. Conventionally, if beluga whales are out of direct view of the observer for more than a few minutes they must be considered a new group when they reappear. However, the cameras used for this project offer a very limited field of view compared to on-site, live observations. Even when a group of whales was present, observers operating the remote cameras needed to continue to regularly scan the study site to avoid missing whales in other areas which on-site observers might have been able to detect in their peripheral vision while simultaneously keeping the original group in view.

During the first few days of sightings it quickly became apparent that large groups of belugas were not only present in the Little Susitna River Delta, but that they tended to linger for long periods of time. After much discussion with project managers and consultants, it was determined that following traditional protocols regarding new group designations would likely, in this case, result inartificially inflated numbers of whales reported. To avoid this, monitoring protocols were altered to allow observers to use their best judgment to determine whether successive sightings were the same group as previously sighted or not.

A benefit of this change was the ability to track the dynamic movements of these groups over the duration of their stay in the study area. Observers would note that whales were part of the same group for reporting of total numbers of whales and groups present, while continuing to document the position, composition, and behaviors of the group on successive scans to create a comprehensive picture of their use of the habitat.

A potential system dividing the study area into sectors instead of grids was also explored in attempt to overcome the problem of limited field of view. According to this plan, each sector would consist of the portion of the study area visible through the camera at a given time. The operator would view a sector for one to two minutes, determine if whales were present, and if so document their number, composition, and behavior, then quickly move on to the next sector. The classification of groups would be discontinued. Repeated use of this method would also document dynamic changes without inflating total numbers. However, it was quickly determined that equipment limitations would render this method unfeasible. When exploring the study area using the cameras for potential sector divisions several problems were noted; the degree of rotation of the camera was different when moving the camera to the left or right so simply relying on camera position to designate sectors would not work, moving the camera in either direction required more than 100 steps to survey the entire area which would result in too many sectors, and the uniformity of background landscape would make creation and recognition of sectors based on landmarks impossible.

Initially, spatial orientation and estimating location within the study area was a challenge. In mid-June, following a camera replacement by SeeMore Wildlife, X, Y, and Z coordinates were visible on the monitoring screen representing vertical (X) and horizontal (Y) position of the camera as well as the current zoom setting (Z). Once position of X=0 was determined using background landscape as a reference, X values could be used to gauge the rotation of the camera and location of visible area. For a short period of time X, Y, and Z values were recorded for sightings, however observers were informed that these values were subject to some drift over time so they should not be relied upon too strongly. Considering this, observers regularly checked the location of X=0 and X values became a reference to estimate position using a compass overlay on the grid map. This greatly increased the speed and accuracy with which beluga locations could be determined and assigned to a grid-cell on the map.

Video Recording and Archiving

The method of recording and archiving video was altered several times to capture the most comprehensive library of beluga whale sightings while accounting for hardware and software limitations. At the outset of the project recording was initiated at the beginning of each scan and terminated at the end. When beluga sightings began, it was determined that video should be recorded continuously in order to capture opportunistic sightings between active scans. Constant recording continued through the duration of the study. The plan was to save all video recordings for potential review to determine if any sightings had been missed, however it soon became clear that the size of these files would become prohibitive. Video clips of any beluga whale sightings or other noteworthy events were then extracted and archived in a timely fashion as the computer hard drive did not have sufficient memory to save more than four days worth of video at a time.

Observer Scheduling and Monitoring Effort

Initially, monitoring shifts ranged from 06:30 to 22:00, seven days per week, with shifts primarily scheduled to cover the highest possible tide stages on days when a single observer was scheduled or to maximize the number of daylight hours monitored on days when both observers were scheduled. A few drawbacks to this schedule became apparent as the season progressed.

Observers had little contact with each other when only scheduled to overlap for one hour three days a week, making project planning and method development difficult. Also, a significant backlog of data management, reporting, and other administrative tasks accumulated by July because of the difficulty of accomplishing anything significant in the few minutes available between scans. To overcome these difficulties, observers began overlapping full shifts on Fridays beginning the last week of July. Due to this change in scheduling, no monitoring took place the last two Sundays in July.

Increased overlap quickly resulted in much more efficient data management and reporting, as well as allowing observers increased opportunity to deal with problems and brainstorm on project methodology. To maximize this, observers began in August overlapping five to six days a week, alternating weeks between full daylight coverage and partial coverage. Overlapping schedules resulted in reduced monitoring coverage, however the benefits to the project as a whole in terms of planning, reporting, and maintaining a high quality, comprehensive database, were significant. As this is a pilot project, these qualities will likely result in a well developed project plan and operating protocols for potential future monitoring seasons.

Environmental and Equipment Conditions

Environmental conditions hindered the monitoring effort during high winds, low tide, and glare (reflection of sunlight off of the water). High winds caused the camera to shake, which resulted in poor and sometimes obstructed visibility. Monitoring conditions often deteriorated during low tide due to low water levels and higher possibility of reflection off surface of the water. There were also instances when glare was not present, but ambient lighting along the water created poor visibility. It is important to note that when environmental conditions effecting monitoring efforts were recorded it did not necessarily hinder the entire study area.

During the pilot study, there were several equipment and software technical problems. These problems detracted from scans, data entry, and monthly reporting time. Poor picture quality decreased the likelihood of identifying belugas unless there were large distinguishing markings. Even with large distinguishing markings on a few of the whales, recorded images from only one individual beluga whale was of sufficiently high image quality to allow for positive identification through LGL's Cook Inlet beluga photo-identification project. With increased image quality, photo-id of belugas would be more feasible.

Because of the project goal of optimizing image quality, numerous changes were made to equipment and operating software throughout the course of this study. However, the time spent installing and becoming familiar with these changes far outweighed the minimal increases in image quality afforded by these changes.

Beluga Whales

Spatial Distribution

Groups were seen through all grid areas however the greatest belugas were seen most often and in the greatest numbers in grids B, C, and D. Observers believe that beluga whales may have been present more frequently than recorded in grid A but due to distance and environmental conditions visibility in that area of the study was often poorer than other grids and whales that could have been present may not have been detected. Also if belugas traveled by the river mouth but did not enter the river, they were less likely to be visible and therefore less likely to have been recorded in the datasheets.

Groups of belugas were observed to spend longer periods of time near shore than mid-river. Belugas were seen up close near the shore in grids C and D, around a river bend. Because of the hydrodynamics of this location fish may become disoriented and/or concentrated, making them easier for belugas to capture compared to other locations in the study area.

The greatest numbers of calves were observed in Grids C and D, however these grids were also the areas closest to the camera. Observers believe that if calves were present in grids A, B, and E they may not have been visible through the camera because of greater sighting distance and the resulting diminished image quality.

Tidal and Temporal Beluga Presence

With this project in its pilot year, observer shifts were scheduled around high tide. Even though belugas were most often seen around high tidal stages, monitoring effort was also greater during this tide. The frequency of beluga presence during monitoring effort for two of the low tidal stages (low ebb and low flood), were more comparable to the frequency of beluga presence during high tidal stages than anticipated. However, the largest group sizes did occur during high tide. Unless future research study objectives are framed around high tide, future observations would be best if evenly distributing observer hours across all tidal stages.

The frequency and number of beluga whales increased drastically in August as did the number of groups containing calves and the observance of rare behaviors. Beluga sightings in August occurred almost everyday of monitoring effort and for longer durations than sightings in May, June, and July. Unfortunately this was also when observers decided to overlap shift hours, which reduced overall monitoring effort (see monitoring effort methods and discussion sections).

Behavior

Unusual behaviors were documented several times during this study period that has been uncommonly observed during other beluga whale studies in the Cook Inlet population. The majority of these behaviors occurred in grids C and D. This could be due to better visibility and closer proximity to the camera. It could also be because the behaviors were seen up the river away from the mouth near the camera site, which is sheltered and has fewer disturbances in comparison to the river mouth. Several behaviors not classified in activity codes were observed and recorded as “other” (see recommendations). It is unsure at this time if these behaviors display socializing by play or aggression.

<u>Other Marine Mammals</u>

Throughout the study period, harbor seals were seen hauled out, in the water swimming, feeding on fish, socializing, and quickly dispersing into the water from shore. The majority of harbor seals were seen hauled out at the mouth of the river, and were usually in one to two groups. Harbor seals were recorded swimming throughout the study area. Harbor seals were also seen feeding on fish (presumed to be salmon based on the size and shape of the fish) in close proximity (a minimum of a meter) to belugas therefore this could potentially be set as a proxy for suspected feeding of beluga whales. Large amounts of splashing were observed immediately followed by harbor seal heads breaking the surface of the water were recorded on multiple occasions. In several instances, large groups of hauled out harbor seals were seen suddenly dispersing into the water although, there were no obvious environmental conditions observed that may have caused the behavior.

There was an increase in harbor seal numbers in the study area approximately two weeks before an increase in beluga whale numbers and frequency was observed throughout the study area. Though September data was not incorporated in this report, it is important to note that there was a sharp decline in the number of harbor seals in September, with a concurrent decrease in the number of belugas. In future studies changes in harbor seal presence could be used as a proxy for predicting when beluga presence changes. During August when there was an increase in the number of harbor seals and belugas there was also an increase in the number of harbor seals seen near belugas and harbor seals with fish in their mouth.

<u>Human Activity</u>

Throughout the monitoring period there were very few occurrences of human activity within the study area. Much more frequent human presence was anticipated based on proximity of the study site to upstream recreation areas, the Port of Anchorage, and prime fishing and duck hunting locations. The majority of vessels passing through the study area were small, personal watercrafts. On the occasions when beluga whales were present, operators usually slowed or stopped to minimize the potential for contact and/or disturbance. Several times passengers were seen taking advantage of the proximity to whales to take photographs and/or video. This low level of disturbance maybe one reason that beluga groups remained in the study area for long periods of time and why such a diverse variety of behaviors, including extended adult/calf interactions, were observed. On one occasion belugas appeared to move in close and gather around a small boat which was stopped in the area.

On two occasions vessels, however, did fail to slow or yield when belugas were in close proximity. It is likely that operators were unaware of the presence of whales at these times.

Because of the endangered status of this species, an increased effort towards educating boaters about wildlife awareness would be beneficial.

Due to relatively poor image quality, identification of vessel registration numbers and individual persons was not possible unless they passed very close to the camera tower. Using this project to monitor for illegal or destructive human activity seems less than feasible with the current system based on this limited ability coupled with the potential for retribution against equipment.

Reviewed Video

One of the distinct advantages of this project over those, which rely solely on live, real-time monitoring, is the ability to review recorded video. Real-time beluga whale data collection frequently creates a high pressure, frenetic atmosphere as observers rush to document accurate numbers, behaviors, and group composition before whales disappear from view. Collecting data from video of previously recorded beluga groups allows observers to review events as many times as necessary to achieve highly accurate documentation.

Many interesting beluga whale behaviors happen in a flash and are therefore likely to be missed by observers if they look away for a moment. The ability to pause video when taking notes increases the likelihood of catching these elusive events. For example, a tail slap and a startled response were documented in recorded video from May and June, although these behaviors were not captured in real-time data from the same time period.

When monitoring in real-time it is often difficult to recall exactly when a beluga sighting ends. Frequently observers find themselves waiting a few minutes or more to be sure that a sighting was actually the last observation of a particular group. Because of the ability to rewind video, resulting sighting times and durations are thought to be more precise. One caveat, however, is that an observer collecting data from previously recorded video would have no way of knowing if whales were present before or after video clips.

Live Monitoring Compared to Recorded Video

Curiously, the total number of whales reported via live monitoring (258 whales) was higher than the total obtained from reviewing video (190 whales), recorded at the beginning of the study period. This could be because individual whales were counted multiple times as real-time observers had to look away to take notes whereas reviewed video observers could train their eyes on a group for longer durations and get a clearer idea of the same whale resurfacing versus distinct individuals. However, it is important to note that this portion of data that was compared was collected at the very beginning of the study period when observers were less acclimated to live monitoring conditions. When video from the end of the study period was reviewed the difference in total whale count was one from live monitoring (151 whales) and recorded video (152 whales). Observers could have been more acclimated to study area and protocol to produce the same numbers for both methods. Behaviors not indicated on the projects activity code list also were recorded more frequently when reviewing video. Observers noticed an increase in comments recorded when reviewing video due to the ability to pause the video and take notes. The comments obtained during reviewing video included more detailed and accurate timing of behaviors and harbor seal interactions. Training from previously recorded video prior to the field season would be advised for future collections.

A distinct disadvantage of reviewing video that was noted by observers is the lack of broader spatial context of conditions in, or relation to, other portions of the study area, and temporal context of the larger scale movements of groups of whales over multiple scans or video segments. This often resulted in an inability to determine location of whales within the study area in a particular video and no sense of the bigger picture of large scale group dynamics and factors influencing observed behaviors.

Nightly Reviewed Video

Even though the entire study area was not captured in nightly video, night recordings gave valuable information about beluga presence outside of standard monitoring efforts. Due to nightly video, it was determined that belugas travel to parts of the study area during both high tides of the day. Unique behaviors (e.g. breaching) to belugas were also captured during nightly video that were never captured during monitoring efforts. Vessel traffic was also noted and night- time monitoring was helpful in determining if there were changes in vessel traffic during times when observers were not on shift.

Project Challenges

As with any method of marine mammal monitoring and data collection, there were advantages and disadvantages to this method, which became apparent over the course of the season. Remote video monitoring allowed for the ability to monitor over the majority of daylight hours during the entire study period and the archiving of large amounts of video. However video quality was a constant struggle. Many changes to both hardware and software yielded little improvement in overall quality and resolution of video. This was a challenge when trying to determine counts, color, calf presence, and beluga behavior in areas of the study site further from the cameras. It also made identification of individuals nearly impossible. In addition, the poor image quality also reduces the potential positive impact of this study when videos are shown to the public or professional peers.

One advantage that observers in the field have over observing using the camera system is peripheral vision. The field of view available through the human eye is much wider than possible through the camera lens. This is why on-site observers are able to survey more of any study site without losing sight of whales in view. The limited view through the camera forces observers to move the camera away from groups of whales periodically to ensure that no other groups are present within the study site. This sometimes resulted in losing track of a group entirely if it moved out of the study area while the observer was scanning elsewhere, and may have resulted in missing interesting and noteworthy events. The addition of a second camera that had a wider field of view that can be run concurrently with the camera focused on the whales would potentially address this issue.

The lack of on-site technical support became problematic at times as observers struggled to install and become familiar with frequent changes to equipment and operating software as well as the myriad of technical glitches which arose frequently. Similarly, lack of on-site project management forced observers to occasionally liaise directly with SeeMore wildlife systems, project stakeholders, and any interested parties who happened to stop by the office. Usually this resulted in positive experiences for all parties; however there were a few occasions when this responsibility caused a level of discomfort for observers as they struggled to deal with technical upgrades or organizational questions without direct management input.

Recommendations

Study Site

Locations of beluga whales in the Little Susitna Delta were estimated during this project using grid cell arrays placed over a background aerial photograph of the study site. This area is known to have undergone significant changes to the river path in recent years. The most recent available photo is from 2004, and while it does depict the current flow path, observers suspect that several areas have changed shape since this photograph was taken due to erosion over time. Track-lines taken by the LGL survey boat seem to confirm this assessment (Figure 11). The water level and resulting area available to beluga whales also changes significantly between high and low tide. Up to date aerial photographs of the study area at several tide stages would enable increased accuracy of location estimates and spatial distribution analysis.

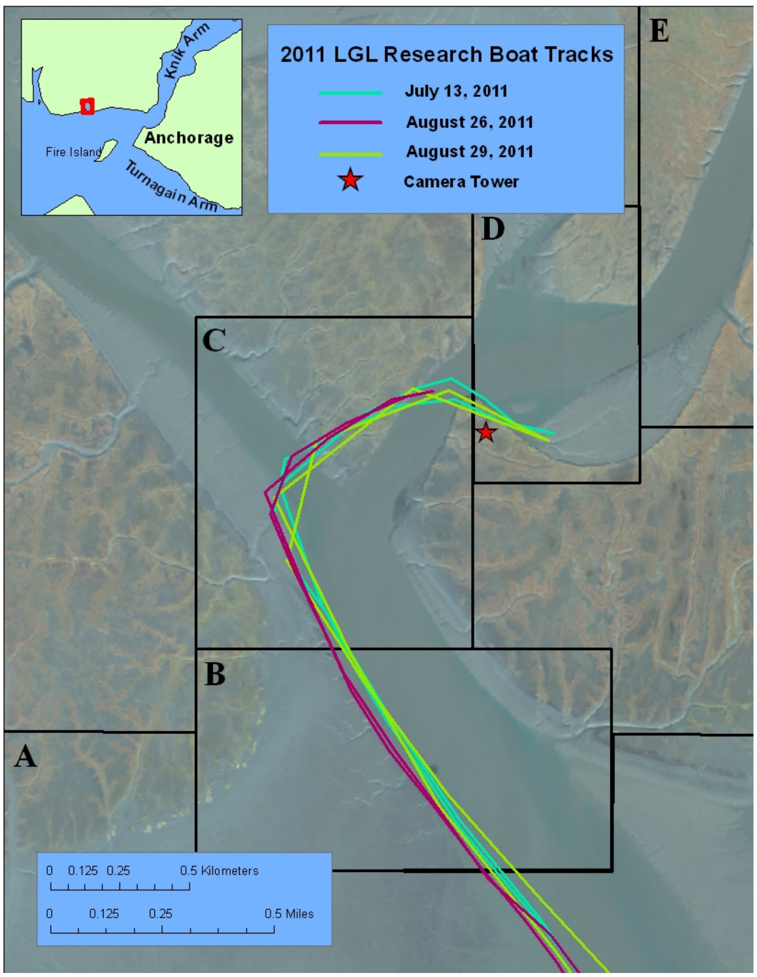


Figure 11: GPS track lines collected by the LGL research boat on July 13, August 26, and August 29, 2011. Tracks passing over land areas in the background map indicate that the river path has changed since this image was taken (2004). Updated aerial photographs of the study site would enhance observers' ability to accurately record beluga whale locations and spatial distribution.

Preparation

Based on this season's events, future observers would likely benefit from some level of pre-season training. Opportunities to educate observers about defining and recognizing behaviors, group orientation, and environmental conditions would help to prepare them for the large variety of variables which need to be assessed on the fly during sightings. Previously recorded video could be utilized for these trainings as examples of what to expect as well. Tests could be administered near the conclusion of training using videos and standard data sheets to assess the level of variability between observers. Observers would also likely benefit from some practice using the cameras and software systems to become oriented with operation functions, the study site itself, and the challenges related to estimating locations based on camera position and background landscape features.

Video and Camera Setup

Because there are two cameras at the study site, the ability to independently control and monitor video from both cameras simultaneously would greatly benefit this project. If this were possible observers could keep one camera trained on a group of whales while scanning the area for the presence of other groups with the second camera. This would eliminate the difficulties and potential for error associated with determining whether successive sightings are actually the same group of whales. One of the challenges observers have encountered is losing sight of other whales in a group while attempting to zoom in on individuals to capture specific behaviors or images for identification. The ability to keep one camera on the group as a whole while zooming in with a second camera could mitigate this problem as well as facilitating capture of interesting behaviors which might be missed while zoomed in on an individual. It might be worth exploring whether a wide-angle, fish-eye lens on one of the cameras would increase the available field of view. There have been consistent issues throughout the duration of this project regarding less than desired video resolution and the resulting inability to capture quality still images for use in photo-id efforts, behavioral archiving, and information sharing. If possible, the addition of a high definition digital camera with a remote shutter which could move in concert with the video camera could overcome this. Although images would only be recoverable be visiting the site, it would be a worthwhile endeavor if any positive identifications of individuals or rare behaviors were captured.

A persistent question during this project has been how to enable observers to capture highly detailed data abut group location, structure, composition, size, and behavior during real-time monitoring. Currently, observers take hand written notes about size, composition, overall sighting time, and the specific time and location of any noteworthy behaviors or events and later transcribe these notes onto data sheets. This note taking process required the observer to look away from the screen frequently increasing the potential to miss important events. A problem that arose frequently was the need to immediately resume a successive scan after one had ended, leaving no time to fill in the data sheets. This could result in a loss of detail as time between observing events and recording data increased. The use of a digital voice recorder to record observations while scanning could help to preserve a high level of detail and allow observers to keep eyes on the screen constantly. Observers would then be able to listen to audio notes and transcribe highly detailed data at a later time.

Staff and Schedule Structure

An important consideration going forward is the need for observers to have both experience with wildlife monitoring as well as comfort and familiarity with advanced computer technology. Because there is not currently an IT specialist available on-site to staff members, at least one observer should be familiar with video recording, formatting and editing software and computer systems.

Behaviors and Proxies

On several occasions during this study, observers recorded behaviors which were not adequately described by any of the pre-defined activity codes. As a result they were coded with the blanket category of “other” and notes were taken describing the details of the behavior. While this process effectively documented these behaviors, the lack of specific codes makes quantitative analysis of their frequency impossible. Because they were all observed on multiple occasions, adding categories to the list of activity codes for headstands, showing pectoral flukes, resting, bobbing, bubbling, and extreme splashing would be beneficial.

Standard practice when recording marine mammal data is to only indicate active foraging is taking place if target animals are seen catching and consuming prey. Otherwise, potential foraging is documented as "feeding suspected." Due to the opaque quality of Upper Cook Inlet waters from glacial silt, belugas have not been documented feeding in the study area even though it is highly likely that active foraging is taking place a majority of the time. On multiple occasions, harbor seals holding fish in their mouths were observed in close proximity to beluga whales. Groups of birds were also observed near beluga groups several times. Acceptance of these events, actively foraging seals and concentrated groups of seabirds, as proxies indicating presence of prey and active foraging by belugas could create a more accurate record of beluga behavior and habitat use.

Conclusions

With this program being in its pilot year it was determined to be a success in establishing the capabilities of remote video cameras as well as accessing the frequency of occurrence, relative abundance, and surface behavior of beluga whales in the Little Susitna River. Because this was a pilot year, observers were left to create the majority of project protocols during active data collection. While this seemed daunting at the outset, the ability to hone these protocols in response to events as they unfolded resulted in a set of guidelines which are simultaneously contemporaneous with other existing Cook Inlet beluga monitoring programs and uniquely adapted to the needs of this system.

A wealth of benefits to video monitoring became apparent through the course of the season as well. Cameras could be left on at night to capture video when observers were not present in the office. This was very beneficial for determining whether belugas were present at night during the late daylight hours of mid-summer. Observers actively manipulating the cameras were able to capture extreme close-ups of individual whales, including newborn calves, and rare behaviors with absolutely no physical disturbance to these animals.

The ability to review archived video for data collection and validation purposes resulted in a more accurate dataset than could be captured in real-time. In the future, archived video could be used to train future observers, educate the public, and for a wealth of potential research questions. Remote observations are also less dependent on favorable weather conditions, which also lead to reduced observer fatigue in the field. Field safety protocols are not necessary with remote monitoring either. Combined, these factors allow a single observer to monitor for up to eight hours without excessive fatigue or threats to physical safety. There is no travel time or cost (gas, food, etc.) associated with remote monitoring which would be incurred by observers operating in remote locations.

One of the most rewarding and valuable aspects of this project has been recording video of behaviors rarely captured, such as breaching, spyhopping, and extended clips of adult and newborn calf interactions, as they are infrequently seen by observers in the field. The frequency with which these behaviors were recorded as part of this study could be due in part to the sheltered, low-disturbance, and abundant forage fish qualities of the Little Susitna Delta.

Because of the nature of beluga whales and the endangered status of the Cook Inlet population, compiling a comprehensive habitat use assessment of Cook Inlet is difficult in general, and impossible for any single monitoring program or research method. Land-based visual observations, aerial surveys, satellite tagging, acoustic surveys, and photo-identification studies are all adding valuable pieces of information to this effort. Through this pilot study, remote video monitoring has demonstrated to be another essential piece of the puzzle. Information provided by remote video monitoring in the 2011 field season includes spatial and temporal distribution patterns of belugas in the Little Susitna River during ice-free months. Behaviors observed in this secluded location through remote cameras, including potential calving and nursery habitat use, add finer detailed information to the existing body of knowledge about this species. The use of remote video monitoring in other areas in Upper Cook Inlet with similar physical qualities could be very beneficial to a more comprehensive understanding of the relationship between Cook Inlet belugas and their habitat.

Acknowledgements

This research project would not have been possible without the support of many others. We would like to acknowledge and extend our gratitude for the following people and companies that have made this pilot project a success: National Oceanic and Atmospheric Administration for funding the project. Ian Dutton, CEO of the Alaska SeaLife Center for the project concept. ConocoPhillips, with special thanks to Caryn Rea, for office space, technical support, parking, and encouragement. Without this support this project would not have been possible. Discovery Drilling, Anchorage, for tower design and installation. The project could not have begun without your help. U.S. Department of Defense for scientific expertise on camera location and project focus.

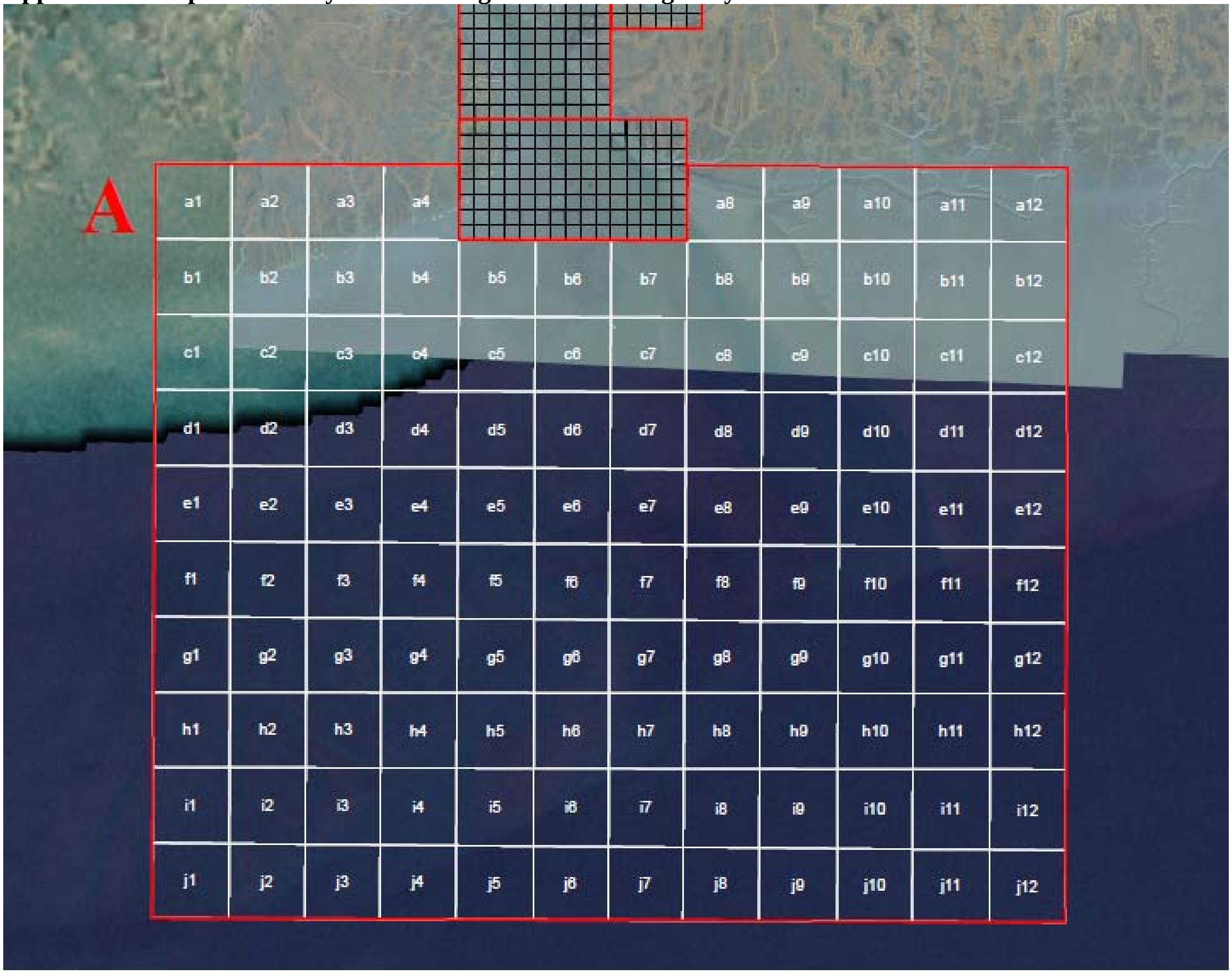
Appendix A: Marine Mammal data collection sheet, front (page 44) and back (page 45).

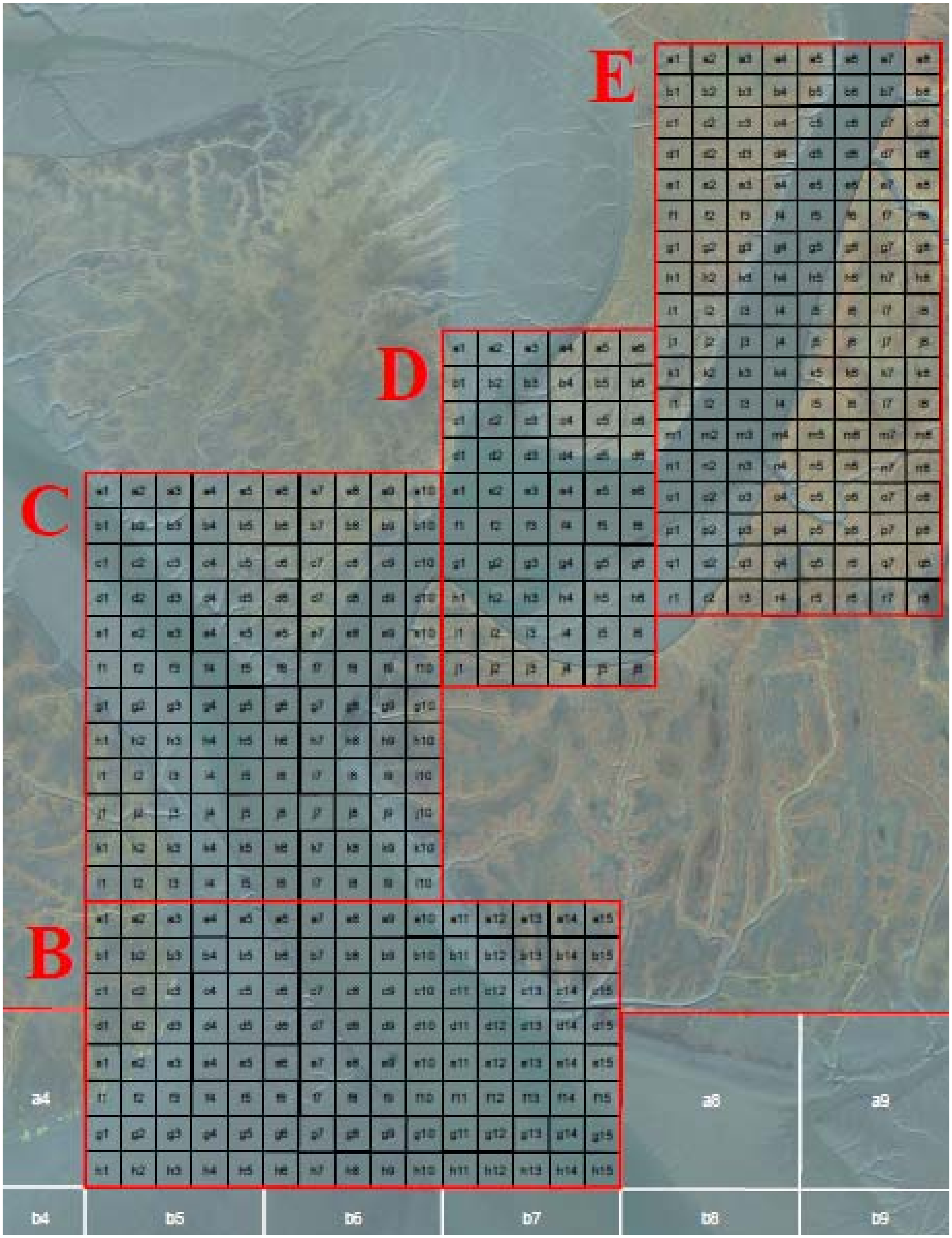
Date:		Observer 1:		Observer 2:				Scan # Change:				H Tide Time:						H Tide Height:					
						Beluga Count																	
Scan #	Start Time	End Time	Sighting Start Time	Sighting End Time	Group #	White	Grey	Dk Grey	Unknown Color	Total	Calves*	Group Code	1? Activity	2 ? Activity	3? Activity	Grid Position	Travel Direction	Confidence (%)	Best Sample (y/ n)	Other MM (#)	Human Interaction (y/n)	Monitoring Conditions	Video Saved (X)

* Calves should be already included in dark gray and in Total.

Scan #	Group #	Beluga Comments	Marine Mammal	Human Comments	Environment Comments

Appendix B: Map of the study area showing the location of grid systems A-E




E
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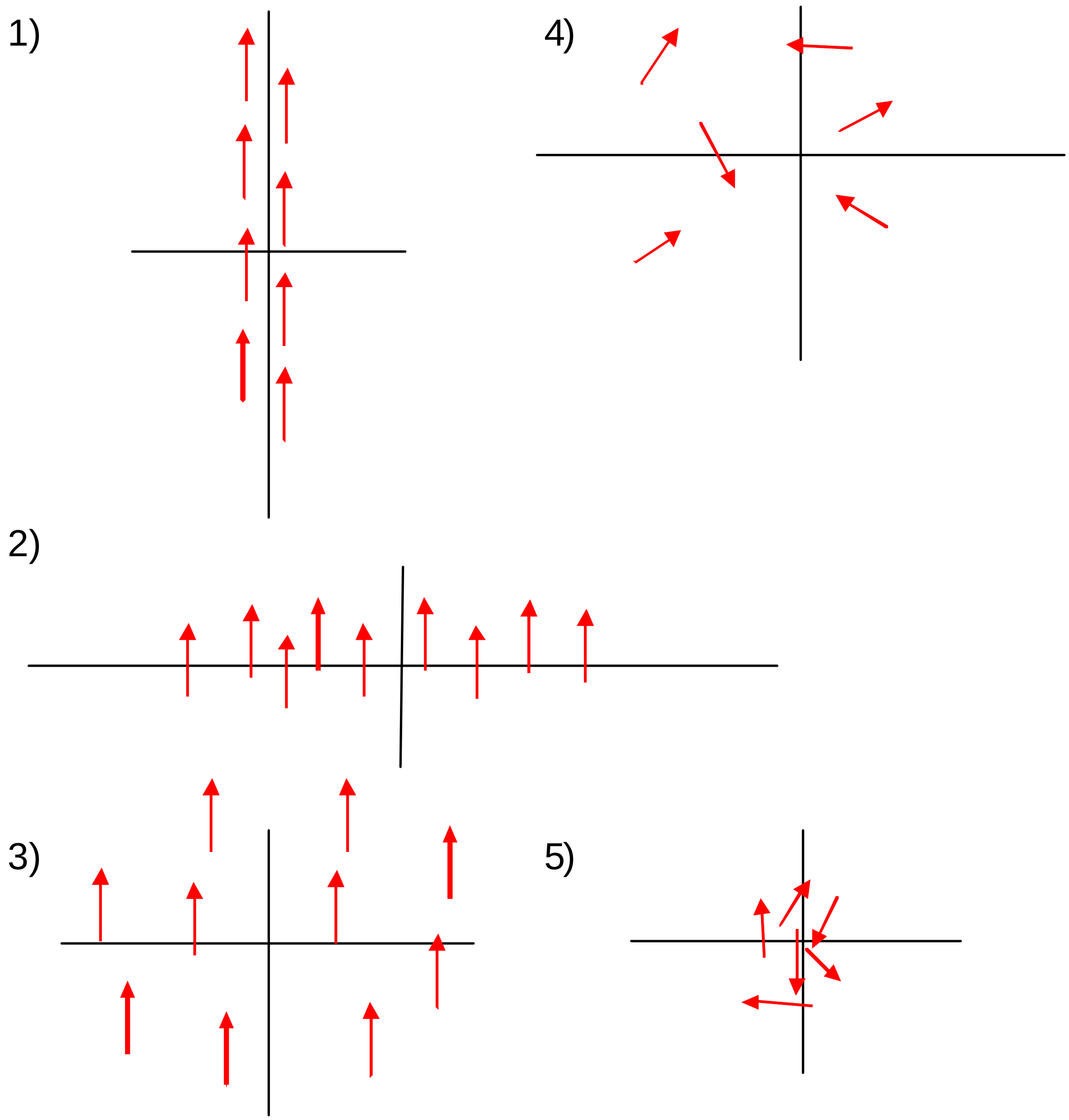
Appendix C: Group Code Standards

Group Codes



Appendix D: Activity Codes and Definitions

Code	Activity	Activity Description
0	Unknown	Behavior indistinguishable due to monitoring conditions and/or lack of ability watch whale for length of time to determine behavior.
1	Traveling/Moving	Belugas progressing in a particular direction.
2	Diving	Beluga has arched back usually with tail fluke briefly coming out of water before disappearing.
3	Mating*	Extensive splashing with ventral to ventral contact or orientation between individuals.
4	Spyhopping*	Leading with the head beluga comes out of water perpendicular to the surface.
5	Breaching*	At least 3/4 of body clears the water (not directly perpendicular to surface).
6	Feeding Observed	Beluga seen with fish directly in mouth.
7	Feeding Suspected	Belugas thought to be foraging based on movement patterns and/or environmental proxy.
8	Milling	Random movement in multiple directions.
9	Startled Effect	Sudden drastic change in behavior.
10	Tail Slapping	Rapid peduncle flex causing fluke to quickly hit surface of the water with force producing a splash.
11	Avoiding Predation	Belugas abruptly change directions in response to observed predator.
12	Calving*	Calving was a potential behavior added because of the study area. Visual identification description is unknown at this time.
13	Abrupt Dive	Several belugas diving together unexpectedly. See diving definition.
14	Disperse	Belugas in general vicinity of one another abruptly scattered in multiple directions.
99	Other	Behavior that is distinguishable but not listed above.

*Please see recommendations for potential definition changes and additional behaviors for future research projects.