

**Marine mammal monitoring at Ladd Landing in Upper Cook
Inlet, Alaska, from July through October 2007**

Final Report

Submitted by



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EXECUTIVE SUMMARY

Marine mammals were monitored near Ladd Landing from July through October 2007 to describe seasonal presence, timing, and group composition of beluga whales, *Delphinapterus leucas*, and other marine mammals in the vicinity. The monitoring was a continuation of a study begun in 2006 to assess the potential effects of constructing and operating an approach trestle to deliver coal to cargo ships moored offshore. The data collected in 2007 will supplement the 2006 study and be used in permit applications that require baseline information and estimates of potential disturbance to marine mammals.

Surveys conducted in 2006 during the ice-free period (April through October) indicated that whale sighting rates were lowest from July through October, and that these months were thus the ones in which construction would be least likely to affect beluga whales. The goal of the work in 2007 was to collect another year of data during this potential construction time (July through October) to assess interannual variation in whale presence near Ladd Landing (hereafter, “Ladd”). The specific objectives in 2007 were to repeat the following aspects of the 2006 monitoring:

1. Describe number and timing of marine mammals visible from a bluff observation site at Ladd Landing from July through October;
2. Describe group composition (color class) of beluga whales;
3. Record behavior and movement of beluga whale groups relative to tide.

Additionally, intertidal sites sampled for fish in 2006 were re-sampled four times in 2007 to gather data during a second year.

Beluga whales

Nine groups of beluga whales were seen from the Ladd observation site in 2007, ranging from July 26 to October 21. Seven of these groups were within 10 km (6 mi) of Ladd; the other two groups were in the Susitna Flats, an estimated 20 km (12 mi) from Ladd, during windows of exceptionally good viewing conditions. Whales were seen at Ladd in July (1 day), September (2 days) and October (1 day) but not in August. Group sizes ranged from one to ten whales. Beluga whales were also seen in the Susitna Flats on 2 days in August (20 whales in each of two groups). All whale groups seen were within 6 km (4 mi) of the shoreline at high tide. The overall duration of whale sightings near Ladd ranged from 4 to 7 minutes. Whale color class composition was 75% white whales, 16% gray whales, and 10% whales whose color could not be determined.

Whales seen from Ladd in 2007 were primarily traveling, but were also detected milling, diving, and feeding. Whales at Ladd did not differ in duration of time spent on flood and ebb tides. No whale groups at Ladd were detected moving against the tidal current. Anecdotal observations from community members and from biologists commuting by plane supported most survey results from Ladd, and identified an additional three groups not detected at Ladd.

Other marine mammals

Harbor porpoises (*Phocoena phocoena*) were seen at Ladd. Harbor porpoises were sighted 345 times, which may have included duplicate counts. Sightings were highest in July, then lower and relatively equal from August through October.

Harbor seals (*Phoca vitulina*) were the only seals seen and were also seen at Ladd in 2007. Harbor seals were sighted 349 times, which may have included duplicate counts. Sightings were highest in July and August, and diminished in September and October.

Intertidal fish

In 2007, fish sampling was conducted with a small, versatile net on four dates at the same seven sites sampled from 2006. Fourteen species or genera were caught, all of which had been documented in 2006. Total catch was relatively even among salmonids, gadids (cod) and osmerids (smelt); flatfish and stickleback were also caught. Several species caught in 2006 were not seen in 2007, which is not surprising given the use of lighter gear and decreased emphasis on fish sampling in 2007.

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INTRODUCTION

Marine mammals were monitored near Ladd Landing from July through October 2007 to describe seasonal presence, timing, and group composition of beluga whales, *Delphinapterus leucas*, in the vicinity. The monitoring was a continuation of a study begun in 2006 to assess the potential effects of constructing and operating an approach trestle to deliver coal to cargo ships moored offshore (Nemeth et al. 2007). The data collected in 2007 will supplement the 2006 study and be used in permit applications that require baseline information and estimates of potential disturbance to marine mammals.

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2. Describe group composition (color class) of beluga whales;
3. Record behavior and movement of beluga whale groups relative to tide.

Additionally, intertidal sites sampled for fish in 2006 were re-sampled four times to gather data during a second year.

METHODS

Marine Mammal Monitoring at Ladd

Monitoring protocol

The area near Ladd was surveyed for marine mammals from July through October 2007 from an elevated observation site known as Ladd Landing Site (LLS). This was also the main site used in 2006. In 2007, surveys were conducted from this site for 20 consecutive days each month, for 60 to 80% of the daylight hours each day. Each hour of observation consisted of six 10-minute observation rounds. During each round, an observer made a minimum of two full sweeps of the marine area with binoculars, and spent the remainder of the time searching with the naked eye. Spotting scopes (Bushnell 20x60) were used to zoom in on features detected with binoculars (Bushnell, Fujinon or West Marine 7x50, equipped with an internal compass) or the unaided eye. This protocol was similar to that used by Nemeth et al. (2007) at Ladd in 2006 and Funk et al. (2005) in Knik Arm in 2004 and 2005.

When marine mammals were sighted, observers recorded species, date, location, time, direction of travel, and primary and secondary behavior. For beluga whales, group-swimming formation,

movement relative to tidal current, and color class of each animal (white, gray or dark) were also recorded. Multiple whales swimming from one to 13+ body lengths apart could be defined as a group. Whales that were spaced further apart could be considered to belong to the same group if they engaged in synchronous behavior. Marine mammal behavior was assessed for both primary and secondary activities. Primary behavior was the main activity of the group, or the only activity by a majority of the group. Secondary behavior was a less-frequent activity observed sporadically in the midst of primary activities, or the main behavior exhibited by a minority of the group. Categories used to describe beluga behavior were described by Funk et al. (2005) and Nemeth et al. (2007) and included:

1. Traveling – moving in a linear or near linear direction, transiting through an area;
2. Milling - non-linear weaving movement within an area;
3. Diving - movement directed downward through the water column, with the head entering the water first;
4. Resting - very slow movement, nearly still in the water;
5. Spying - stationary with body positioned vertically in the water, with head out of water (cetaceans);
6. Socializing - touching, rubbing or vocalizing;
7. Splashing- splashes of water seen from flippers or flukes slapping on water or throwing body to the side, and;
8. Feeding - chasing or apparently chasing fish as evidenced by bursts of speed, possibly with focused diving in a particular location.

Whale behavior was recorded each time whales were sighted, and each time there was a change in whale group location, size, or behavior. This enabled the observers to document any changes that occurred if whales remained in view for more than one sighting event.

If a group was seen multiple times, observers designated which count of each group was the best count. Only observed whales were included in group counts, and observers did not attempt to correct for animals not seen due to poor sighting conditions or animals that were under water. Thus group counts were minimum numbers of whales within the group. When a group split or joined with another group, or was lost from sight for more than 10 minutes, a split or join was noted, and it was considered to be a new group. This may have provided duplicate counts of whale groups, but eliminated the chance that a new group would go unreported and thus forced any bias towards an overestimate of the number of whale groups in the area.

When beluga whales were sighted, observers took a bearing using the internal compass in the binoculars, and estimated distance from shore based on known landmarks (e.g., the Phillips oil platform off of Ladd [9 km, or 5.6 mi] or numerous fishing buoys that ranged from 100 m to 1 km [328 ft to 0.62 mi] offshore). This bearing and distance was used to place the whale group on a 1 km² (0.38 mi²) grid overlaid onto a map of the marine area near Ladd with ArcView Arc GIS® 9.1 software (ESRI, Redlands, WA; Nemeth et al. 2007).

Counts, behavior, and locations of all other marine mammals were recorded as described for beluga whales. Harbor porpoise (*Phocoena phocoena*) age class was recorded as adult or calf

based on the comparatively small body size of calves, proximity to cow, and synchronous diving behavior. Pinniped (seal) behaviors were recorded as:

1. Looking – stationary with body positioned vertically in the water, with head out of water.
2. Sinking – submerging by moving downward in the water column, with the top of the head entering the water last.

Environmental conditions that may have affected the ability to see whales were recorded once per hour or when environmental conditions changed. Variables recorded included air temperature, wind speed (measured with an anemometer), percent cloud cover, glare on water surface, and glare bearing measured with an internal compass in the binoculars. Descriptors of the water surface that were recorded were swell height in meters (estimated), presence of white caps, and sea state from 0 to 4 on the Beaufort Sea scale (0 = sea like a mirror, 1 = ripples but without foam crests, 2 = small wavelets, 3 = large wavelets, 4 = small waves). Observers estimated the maximum viewing distance, up to 10 km (6 mi). Sighting conditions were rated as poor, good, or excellent based on a subjective assessment of the observer for each hour (every six 10-minute sampling rounds), and for the entire day, based on the hourly recordings.

Incidental sightings of beluga whales from the community of Beluga, AK were documented to complement the surveys conducted at Ladd. Biologists documented community sightings for whales seen from the Susitna Flats area to the Ladd area. Beluga whale incidental sighting information included date, time, and tidal stage when whales were seen; the location, color class, and behavior of whales were also recorded.

Biologists were also able to record whale presence during commuter flights over the area from Anchorage to Beluga. These flights were made from four times to six times per month, and were standard enough in flight path to make useful comparisons of whale presence and location over time. Flights took approximately 20 minutes, and were always with Sperrnak Air (Anchorage, AK) and were always in small planes (a Cessna 206, or similar). Observations were made by one of six different biologists, all of whom also surveyed for whales from Ladd Landing Site in 2007. Pilots did not alter the flight path to accommodate observations.

Data entry and analysis

During each shift, all data were recorded on standard datasheets developed for the study. After each observation period, datasheets were checked for completeness and accuracy by a second person not involved in data recording. The data were then entered into a Microsoft® Access database, and checked against the individual datasheets to ensure accuracy. Data were organized and analyzed using Microsoft® Access and Microsoft® Excel.

Daily sighting rates were calculated for both individual beluga whales (whales per hour) and for groups (whale groups per hour). Best counts per day for each group were used to calculate sighting rates and to avoid duplicate counts. Sighting rates of individual whales and groups were calculated for two categories of location, those within 10 km (6 mi) of Ladd and those further than 10 km (6 mi) from Ladd.

Color class composition and behavior of beluga whales were summarized by month. Color classes were calculated using only the best counts of individuals within discrete groups.

The number of minutes spent by whales near Ladd (within 10 km [6 mi]) was recorded, and classified by tidal direction (flood or ebb). Median group size and sighting duration were calculated for each month to examine changes in group size and time spent by whales in the Ladd area.

Tide stages during whale sightings were assessed by applying a correction factor of +1:40 (*i.e.*, +100 minutes) to the tide station at Nikiski, Alaska (available at <http://tidesandcurrents.noaa.gov>; station #455760), based on personal communications with T. Howland of TerraSond, Ltd., and tidal research conducted at Ladd by TerraSond in 2006 (Smith and Khoklov 2006).

The tidal cycle was divided into two stages for use in data analysis; tides were classified as ebb (time from high tide to the next low tide) and flood tide (time from low tide to the next high tide). The number of whale groups arriving on flood and ebb tides were then summarized; whale groups observed within ten minutes or less of another sighting were removed from this summary to reduce the chance of counting the same group twice and positively biasing that tidal category. Next, the duration of whale group presence (in minutes) and the time spent in observations were classified as ebb or flood. Proportion of observation effort was then calculated for ebb and flood, and compared to the duration of time (not the number of whales) we detected whale groups from Ladd at flood and ebb tides. A chi-sq test (Zar 1996) was used to determine whether whales were more likely to be seen from Ladd on flood versus ebb tides. Only whale groups seen within 10 km (6 mi) of Ladd were included in tidal analyses.

Movement of beluga whale groups relative to the current direction during ebbing and flooding tidal states was analyzed to examine whether directionality of whale movements varied at Ladd by tidal stage. Whale group movement was classified as with, against, or neutral to the direction of the tidal current. Whale groups observed multiple times during the same survey were assigned an overall movement direction, which was either a combination of directions (*e.g.*, NE for movements N and E) or variable (*e.g.*, for movements N and SE).

For other marine mammals, mean daily sighting rates (mean number of animals per hour) were calculated as for beluga whales. Behavior was also recorded for harbor porpoise and harbor seal seals (*Phoca vitulina*).

Intertidal Monitoring of Fish at Ladd

Intertidal fish sampling was conducted monthly at the seven sites sampled in 2006 (full site descriptions in Nemeth et al. 2007). Three primary sites were sampled at the proposed trestle location and 1 km (0.6 mi) to the north and south: Ladd Landing, Ladd Landing-north and Ladd Landing-south. Secondary sites with differing habitat types were sampled at Threemile Creek, Grant's Landing, Ladd Cabins, and the Chuit River mouth. All sites in 2006 were sampled with the same 15-m (49-ft) seine net used in 2007, using the parallel set method (Robards et al. 1999). The monthly sampling covered all seven sites in the same day, over a range of tide heights. All

seine tows were classified by the field crew as good, fair, or poor based on the execution of the tow. Unless a poor tow was made, only one tow was made per site.

Captured fish were identified to species and counted. Species identifications were made using several fish guides and keys, notably those by Phillips (1977), Pollard et al. (1997), Morrow (1980), and Mecklenburg et al. (2002). Invertebrates caught in the beach seine were identified to group and counted. Water temperature and salinity were measured at the beach seining sites.

Fish body lengths were measured from the first 20 fish of each species from each seine haul. Species with forked tails (e.g., salmonids) were measured to fork length; species with rounded or square tails were measured to total length. All lengths were recorded to the nearest millimeter. Separate counts of juveniles and adults were kept for all salmon species.

Weights and scale samples were also taken from subsamples of the captured fish. Scale samples and weights were taken from juvenile salmon. Weights were recorded to the nearest gram, and scales were taken from the preferred location posterior to the dorsal fin, above the lateral line, following the methods of Jearld (1983). Scales were then archived on gum cards.

RESULTS

Nearshore Marine Mammal Surveys near Ladd

Observation effort

Surveys for marine mammals were conducted at LLS for a total of 785.2 survey hours, during 80 days from July 12 to October 30, 2007. This represented a 50% increase in effort over the months of July through October in 2006 (522.5 hours at LLS, Table 1; Nemeth et al. 2007). During each month, surveys were conducted over a block of 20 consecutive days, covering 62% (July) to 80% (October) of daylight hours during a 20-day survey block. Across all of the days sampled from July through October, 71% of daylight hours were covered (Table 1). Survey effort declined as days shortened, from 221.9 hrs in July to 152.6 hrs in October (Table 1).

Beluga whale timing and distribution

Nine groups of beluga whales were seen from LLS in 2007, ranging from July 26 to October 21 (Tables 1 and 2). These six dates represented 8% of the days surveyed in 2007 (Table 2). The maximum number of groups seen per month was three during July (33% of all group sightings); the greatest number of individuals seen was during August when a group of 20 whales was observed 20 km (12 mi) from LLS, near the mouth of the Theodore River on two consecutive days (Table 3). Duration of group sightings ranged from 2 minutes (two group sightings on two different dates) to 55 minutes (one group sighting, on August 30, 2007; Table 3).

In 2007, belugas were sighted in 13 of the 1-km² (0.39-mi²) grid cells. The greatest numbers of belugas were seen near the Theodore River mouth and in the intertidal zone between the Beluga River and the Chuit River (Figure 1). Whales were seen offshore less frequently; all of the whale

sightings (based on grid cell locations) occurred within 6 km (4 mi) of the high tide shoreline (Figure 1).

Whales were seen during all months surveyed in 2007 (July through October; Figure 2). For whales seen < 10 km (6 mi) from Ladd, monthly sighting rates were lowest in August (no whales were seen near Ladd) and highest in October (0.08 whales per hour, 0.01 groups per hour). For whales \geq 10 km (6 mi) from Ladd, whales were seen only in August, when sighting rates were 0.22 whales per hour and 0.01 groups per hour (Figure 2). These whales were groups seen on consecutive days near the mouth of the Theodore River, during times of exceptionally good viewing conditions.

Beluga whale group composition

Beluga whale group size near Ladd (within 10 km [6mi]) ranged from one to 10 individuals per sighting, with a median group size of two whales (Table 4). Whales seen between July and October 2007 were made up of 75% white whales, 16% gray whales, and 10% whales for which color could not be determined ($n=63$ sightings of individuals from LLS during 2007).

Color class ratio changed throughout the four months belugas were seen during 2007. White whales were seen during each month surveyed, and comprised from 15% (during October) to 100% (during August, near the Theodore River mouth) of whales seen (Figure 3). Whales of unknown color were seen during the months of October and July in 2007, and comprised 31% and 50% of whales seen during those months, respectively, from LLS (Figure 3).

Mean duration of sightings (length of time whales remained in sight) was 5.5 minutes for sightings within 10 km (6 mi) of LLS, and ranged from 4.0 minutes in October to 7.0 minutes in July (Table 4).

Beluga whale group behavior

Traveling was the most common primary behavior of whales seen from Ladd (Figure 4). Other primary behaviors seen were milling (July and August) and feeding (October). Secondary behaviors included diving (July and September), feeding (August), and milling (August; Figure 4).

Beluga whale groups were seen within 10 km (6 mi) of Ladd from two hours after low tide to four hours after low tide (e.g. on the flooding tide; Figure 5). Survey effort was 52% on flood tides and 48% on ebb tides; 29% of whale sightings were (12 of 42 minutes) on flood tides and 71% (30 of 42 minutes) were on ebb tides (Table 5; $n= 6$ beluga whale groups). The duration of time spent by whales near Ladd did not differ between flood and ebb tides (Figure 6; $\chi^2= 3.064$, $df=1$, $P=0.08$).

Whale groups traveled with and neutral to the tidal current direction. During flood tides, whales traveled neutrally (August) and with (September and October) the tidal current direction (Figure 7). On ebb tides, whales traveled with (July and September), and neutral to the tidal current

direction (July and August; Figure 7). Whales were not seen traveling against the tide during 2007 (Figure 7).

Aerial observations

Observers searched for beluga whales from the Susitna Flats to the Ladd area during 18 commuter flights from July 10 to October 30, 2007. The Ladd area was visible on ten commuter flights; whales were seen there on July 10 (before land-based marine mammal observations began at Ladd on July 12) offshore and southwest of the Beluga River, but were not observed near Ladd during any subsequent overflights for the rest of the study. The offshore area from the Little Susitna River to the Beluga River was also visible during 13 commuter flights. During these, one group of whales was seen between the Little Susitna and Susitna rivers (August 29) and two groups were seen between the Big Susitna and Beluga rivers (July 10 and August 30). Whales were also seen twice in freshwater, once in the Little Susitna River (August 11) and once in the Beluga River (August 28).

Activity of other marine mammals

Harbor porpoises

A total of 345 harbor porpoise sightings were recorded in 2007. Porpoises were seen in all months, on 54% of the total days surveyed from July through October (Table 6). The highest sighting rates were in September and October (0.16 and 0.17 porpoises per hour respectively; Figure 8). Most sightings were of solitary individuals, but cow-calf pairs were seen each month.

Traveling was the most common primary behavior of porpoises sighted from LLS during all months in 2007; other primary behaviors included milling (July, September, and October), diving (July and October), feeding (July, September, and October), splashing (July) and resting (September). During all months, diving was the most common secondary behavior of porpoises. Other secondary behaviors of porpoises included feeding (July and August), milling (August and October), and traveling (August and October; Figure 9).

Harbor seals

A total of 349 harbor seal sightings were recorded in 2007. Harbor seals were seen on 58% of days surveyed (Table 7). Most sightings were of solitary individuals, though groups were also seen. Harbor seal sighting rates ranged from a low of 0.05 seals per hour in October to 0.42 seals per hour in August (Figure 10). “Looking” was the most frequently observed primary behavior of harbor seals seen from Ladd (this behavior was termed ‘stationary’ in 2006). Other primary behaviors of seals at Ladd were traveling (all months), feeding (July through September), diving (July) and milling (August). Sinking (usually after looking) was the most common secondary activity of harbor seals from July through September; during October, the most common secondary behavior was traveling. Other secondary behaviors seen at Ladd included diving (all months), feeding (July through September), looking (July through September), milling (July and August) and splashing (September; Figure 11).

Observation conditions and environmental records

Viewing conditions for sighting marine mammals were rated as good to excellent on all days, with daily condition ratings of 2.0 to 3.0 for all days in July, August and October. A small number of days during September (5% of days sampled that month) were rated as good to poor (1.5; Table 8). Observers' estimated maximum visibility was 10 km (6 mi, the maximum possible entry) for 85% (July) to 94% (August) of hourly environmental observation periods. Sea states were calmest during August and September when sea states of 0 on the Beaufort Sea scale made up 42% and 40% of hourly weather observations. Sea conditions were roughest during July, when 8% of hourly observations were a Beaufort score of 3 (Table 8). Precipitation occurred during observations in all months, and glare was present on the surface of the water on the majority of days each month (Table 8).

Intertidal Fish Surveys near Ladd

Sampling effort

Fish surveys were conducted on four dates between August 29 and October 22, at the same seven sites sampled in 2006. As in 2006, the sites were grouped into primary sites (three sites near Ladd, all with similar beach habitat), and secondary sites (four sites farther from Ladd with variable habitat that also differed from Ladd). In 2007, four seine tows were made at each site, for a total of 28 tows during the season (Table 9). Sampling was conducted at all tidal stages, but only during conditions in which the sampling area did not have breaking waves.

Fish community composition and relative abundance at Ladd and nearby sites

Fourteen species or genera were caught in 2007. Saffron cod, *Eleginus gracilis*, made up the greatest proportion of the catch during the study period for all months except July, when eulachon (*Thaleichthys pacificus*) were caught in greater numbers. Eleven species and three groups not identified to species (sculpins, Cottidae; larval cods, Gadidae; and larval smelt, Osmeridae) were caught (Table 10).

Species richness varied from three to 11 species among all sites in 2007 (Table 11). The four non-Ladd sites had slightly higher species richness and diversity than the three Ladd sites, but evenness was greater at the Ladd sites. Overall species richness in the Ladd area (all sites combined) was 14 species, and overall diversity (H') was 2.26 (Table 11).

Catch per unit effort (CPUE) for the entire season ranged from 1.0 fish/tow at Ladd Landing-south to 8.0 fish/tow at Threemile Creek (Table 12). Total CPUE was examined by month for each of the five species groupings that were classified in 2006, and compared between primary (Ladd) and secondary (non-Ladd) sites. The five species groupings were:

1. Salmonids – all members of the family Salmonidae, including salmon, Dolly Varden (*Salvelinus malma*), and Bering cisco (*Coregonus laurettae*);
2. Salmon – only the salmon species (chum, *Oncorhynchus keta*; coho, *O. kisutch*; and sockeye salmon, *O. nerka*);

3. Gadids - cods, including pacific tomcod (*Microgadus proximus*) and saffron cod;
4. Osmerids - smelt, including eulachon and longfin smelt (*Spirinchus thaleichthys*);
5. Flatfishes – flounders.

Salmonidae was the most commonly caught fish group over the study period (all months and sites combined), comprising up 33% (24 of 73 fish) of the total catch near Ladd. Total catch varied by month across all sites, with gadids making up 30%, osmerids making up 27%, salmon making up 12%, and flatfish making up 3% of the total catch. The salmonidae group dominated catches in August (38%) and October (42%), whereas gadids were the most commonly caught fish (34%) in September (Table 13).

Across all months and sites, fish from the family salmonidae CPUE (1.0 fish/tow) were most commonly caught. The most commonly caught fish group alternated between the salmonidae group and gadids; in August the family salmonidae dominated catches. In September gadids were most commonly caught, then salmonids again dominated catches in October (Table 14, Figure 12). Salmonidae was the most commonly caught group at primary sites (Ladd sites; 0.6 fish/tow); gadids were most commonly caught at the secondary sites (non-Ladd sites; mostly eulachon; 1.3 fish/tow), closely followed by salmonidae (1.2 fish/tow; Table 15).

Specific CPUE results by species group are summarized below:

Salmon

Salmon were caught during all months, and consisted of juvenile sockeye, chum, and coho salmon. No adult salmon were captured in 2007. Salmon CPUE was highest in August, declined in September, then rose in October (Tables 10 and 16; Figures 13 and 14).

Gadids

Saffron cod and Pacific tomcod were the only gadid species caught in 2007. Saffron cod CPUE was higher in August and September than in October (Tables 10 and 16; Figures 13 and 14). Only one Pacific tomcod was caught in 2007.

Osmerids

Osmerids were caught during all months surveyed, and consisted of eulachon and longfin smelt. Osmerid CPUE declined over the survey period, from a peak CPUE in August to a lowest CPUE in October (Tables 10 and 16; Figures 13 and 14).

Flatfish

Starry flounder (*Platichthys stellatus*) was the only flatfish species caught. Starry flounder were caught at low levels in August and September, and were not caught in October (Tables 10 and 16; Figures 13 and 14).

Salmonidae

The only salmonidae captured besides salmon were Dolly Varden and Bering cisco. These species were caught at four sites during all months from August through October (Tables 10, 12, and 16; Figures 13 and 14).

The only species caught in 2007 that was not included in these groups was ninespine stickleback (*Pungitius pungitius*), which was caught at three sites during September and October, 2007. CPUE was highest in October, as in 2006 with the 15-m seine (49-ft; Tables 10 and 12; Figures 13 and 14).

Environmental conditions

Water temperatures at the fish sampling sites decreased steadily from a mean of 16°C (60°F) at all sites in August to 5°C (41°F) in October (Figure 15). Mean salinity at all sites was similar in August and September (13 and 11 ppt) and higher in October (15 ppt; Figure 16).

DISCUSSION

Marine Mammals near Ladd

Beluga whale timing and distribution

In 2007, beluga whales were seen near Ladd (within 10 km [6 mi]) in July, September, and October, but not in August. Sightings in 2007 were similar to sighting rates during the same time period in 2006. Monthly sighting rates ranged from 0.00 to 0.08 whales per hour in 2006 vs. 0.00 to 0.13 whales per hour in 2007. No belugas were sighted during the month of August near Ladd (within 10 km [6 mi]) in either year. Survey effort was 50% higher in 2007 than 2006, and whales were seen on 8% of the observation days in 2007 compared to 3% in 2006. In both years, beluga whale sightings at Ladd were relatively infrequent and of short duration.

As in 2006, it is likely that some belugas transiting the Ladd area were not detected during the study. Survey hours accounted for 29% of the total elapsed time between July 12 and October 30, 2007, and whales could only be documented when at the surface of the water. Community members reported three groups of whales that were not seen during surveys at Ladd, one each in July, August, and September (Appendix A). Nevertheless, the surveys provide a good index of whale usage during the survey period, and a useful comparison to sightings from the same location during the same months the prior year. Whales were not seen at Ladd from thirteen commuter flights taken by biologists during the survey period. Whales were seen in other areas during these flights, including a group in the Susitna Flats a few hours after seeing a group near the Theodore River from LLS on August 29.

In both 2006 and 2007, beluga whales were seen more frequently in nearshore areas than in offshore areas. Most of the whales sighted were along the coastline between Threemile Creek and the Chuit river mouth, the part of the coastline that observers could see the best. In 2007, whales were seen from Ladd Landing Site along the shoreline from southwest of the Beluga River to the Chuit River mouth, and near the mouth of the Theodore River. Whales were seen at estimated distances of up to 20 km (12 mi, on two days with exceptional visibility) from Ladd in 2007 and 8 km (5 mi) from Ladd in 2006 (Figure 1).

No whales were seen during aerial surveys by NMFS (National Marine Fisheries Service) in the Ladd area, flown on August 1 and 2, 2007; the closest whales to Ladd were near the Ivan River mouth (Shelden et al. 2007).

Harbor porpoises and harbor seals were present in both 2006 and 2007 near Ladd, with some interannual variability both in timing of peak sighting rates and number of individuals seen. Harbor porpoises were seen during the months of August through October at relatively even rates during 2007, whereas there was a distinct peak in sighting rates in September of 2006. Harbor seal sightings in 2006 peaked in September and in August in 2007. More sightings of both species occurred in 2007 when compared with 2006.

Beluga whale group composition

Color classes of beluga whales observed from Ladd in 2007 were similar to those from 2006. Over the two years, beluga sightings were made up of 60-75% white whales, 16-18% gray whales, and 10-22% unknown whales. Gray whales are of special interest because they are most likely to be immature or juvenile whales, and thus indicators of reproduction in the population.

In 2007, white whales were seen during all months, and made up 15% to 100% of whales seen. In 2006, white whales were seen during all months surveyed, and made up 44% (October) to 100% (July) of whales sighted. Gray beluga whales were seen during September and October in 2007, and made up 50% and 54% of whales seen during those months; gray beluga whales were seen during May, June, September and October during 2006, ranging from 4% (June) to 56% (October) of whales sighted during those months (Figure 3).

Behavior and tidal stage pattern of whales at Ladd

The behaviors of whales seen at Ladd in 2007 were similar to those in 2006, in that whales both years were primarily traveling. The primary behavior of all but one whale group seen near Ladd in 2007 was traveling; one group in July was also seen milling. The secondary behavior, when present, was diving. Whales seen offshore from Ladd in August, at the Theodore River mouth, were suspected to be feeding.

In 2007, whales at Ladd were seen from two to four hours after low tide. This was similar to 2006, except that whales were seen from four hours before low tide to six hours after low tide. Whales were not seen near Ladd on the high end of an ebb tide (i.e., soon after high slack tide) in either year (Figure 5).

Because the duration of whale presence at Ladd was significantly longer on flood than ebb tides in 2006, this duration by tidal stage was examined again in 2007. However, the low sample size (number of whale groups) in 2007 prevented a useful analysis of the 2007 data alone. Mean duration of group sightings was relatively short (2007=5.5 minutes, 2006=12.6 minutes) during both years. Whales were not seen moving against the tide in 2007, unlike in 2006 (Table 17; Nemeth et al. 2007).

Intertidal Fish Communities at Ladd

Overall, the composition of fish catches near Ladd in 2007 was similar to that seen in 2006. No species were caught in 2007 that were not caught in 2006, indicating that our description of the fish community at Ladd in 2006 did not exclude any key species. Of the 19 species and six groups not identified to species in 2006, 11 of the same species and two of the same groups were captured in 2007. Species caught during both years included Bering cisco, juvenile chum salmon, juvenile coho salmon, Dolly Varden, eulachon, longfin smelt, ninespine stickleback, pacific tomcod, saffron cod, juvenile sockeye salmon, and starry flounder. Sculpins and larval cods were not identified to species in both years. The same trends in body size were observed in 2007 as in 2006 over the months of August through October. Data were fewer in 2007 than in 2006 because the smaller net was less effective at catching fish, but more versatile for use among sites. This gear was a good fit for the purpose of the 2007 sampling, which was to verify the 2006 results with low-intensity sampling.

Diversity was lower in 2007 than in 2006, possibly due to fewer sampling days over a shorter time period. Absent from the 15-m beach seine catch in 2007 were: juvenile Chinook salmon, adult chum salmon, adult coho salmon, herring, Pacific cod, both juvenile and adult pink salmon, snake prickleback, steelhead/rainbow trout, and threespine stickleback. Only one grouping not identified to species was caught in 2007 but not in 2006 – larval smelt.

There were some differences from 2006 in the 2007 catch at Ladd: total monthly CPUE was somewhat lower in 2007 when compared with 2006, and some species were caught at different rates or in different months than in 2006. CPUE was highest for smaller, younger eulachon in August and lower in September 2007; in October 2007, they were not caught. In 2006, smaller, younger eulachon were caught each month through October. Catch per unit effort of saffron cod was fairly even from month to month from August through October, and was slightly higher than in 2006. CPUE of juvenile sockeye salmon in 2007 was similar to low catch levels during other months they were caught in 2006. Sockeye were caught in October 2007, a month during which they were not captured in 2006; in 2007, they were not caught during August or September unlike they were in 2006.

Timing of species presence was similar during the months sampled in both years. During 2007, Bering cisco, longfin smelt, ninespine stickleback and starry flounder were all caught at similar rates and in the same months as in 2006. In 2007, most of the same species known to be beluga prey were also caught in 2006: salmon, saffron cod, eulachon, and starry flounder (Hobbs et al. 2006; Nemeth et al. 2007). Longfin smelt were caught only in October in both 2006 and 2007.

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Table 1. Survey effort for marine mammals at Ladd Landing land-based observation site (LLS), July through October, 2007.

Month	Effort		Daylight	Daylight	Survey dates	
	Hours	Days	hours	covered	Start date	End date
July	221.9	20	359.3	62%	12-Jul	31-Jul
August	216.8	20	308.5	70%	11-Aug	30-Aug
September	194.0	20	250.2	78%	10-Sep	29-Sep
October	152.6	20	191.8	80%	11-Oct	30-Oct
Total	785.2	80	1,109.8	71%		

Table 2. Beluga whale group sightings, age composition, survey effort (days), and number of days whale groups were observed from Ladd Landing Site (LLS) by month, July through October, 2007. Best counts of each group are shown.

Month	Groups	Number of whales				Total	Days	Days	% of days
		White	Gray	Unknown	surveyed		observed		
July	3	2	0	2	4	20	1	5%	
August ¹	2	40	0	0	40	20	2	10%	
September	2	3	3	0	6	20	2	10%	
October	2	2	7	4	13	20	1	5%	
Total	9	47	10	6	63	80	6	8%	

¹Whale groups seen during August from Ladd Landing were observed 20 km (12 mi) northeast of Ladd, on days with exceptional visibility.

Table 3. Number of beluga whales seen by color class during land-based observations from Ladd Landing Site (LLS), July through October 2007. Data reported show best count for distinct groups observed on a day, thereby minimizing the potential for duplicate counts of individual whales. The groups seen on August 29 and 30 were observed over 10 km (6 mi) northeast of Ladd, on days with exceptional visibility.

Month	Date	Group no.	Start time	End time	Duration	Tidal Stage	Beluga whale counts by color class		
							White	Gray	Unknown
July	26-Jul	1	6:57	6:59	0:02	Ebb	1	0	1
		2	7:19	7:31	0:12	Ebb	0	0	1
		3	7:34	7:41	0:07	Ebb	1	0	0
August	29-Aug	1	13:50	14:23	0:33	Ebb	20	0	0
	30-Aug	1	14:39	15:34	0:55	Flood	20	0	0
September	10-Sep	1	14:42	14:46	0:04	Flood	1	1	0
	28-Sep	1	11:23	11:32	0:09	Ebb	2	2	0
October	21-Oct	1	12:29	12:35	0:06	Flood	2	5	3
		2	12:58	13:00	0:02	Flood	0	2	1

Table 4. Median monthly group size and mean monthly duration of sightings near Ladd Landing in 2007 (less than 10 km [6 mi] away). Sample size (n) is number of beluga whale group sightings.

Month	n	Median group size	Range	Mean duration of
July	3	1	1-2	7.0
September	2	3	n/a	n/a
October	2	7	3-10	4.0
All months	6	2	1-10	5.5

Table 5. Duration and proportion of land-based survey effort and beluga whale group sightings by tidal stage near Ladd Landing in 2007 (less than 10 km [6 mi] away), July through October, 2007.

	<u>Tide Stage</u>		Total
	Flood	Ebb	
Survey effort			
Duration (hours)	405	380	785
Percent	52	48	100
Beluga whale group sightings			
<i>n</i> (groups sighted)	3	3	6
Duration (minutes)	12	30	42
Proportion	29	71	100

Table 6. Total number of harbor porpoises seen, survey effort (days), and days porpoises were observed from Ladd Landing Site (LLS) by year and month, 2006 through 2007.

Year (Site)	<u>Number of Harbor Porpoises</u>								Days	Days	% of days
	April	May	June	July	August	September	October	Total	surveyed	observed	
2006 (LLS)	0	17	2	3	5	16	7	50	135	22	16
2007 (LLS)	n/a	n/a	n/a	129	79	78	59	345	80	43	54
Total	0	17	2	132	84	94	66	395	215	65	30

Table 7. Total number of harbor seals seen, survey effort (days), and days seals were observed from Ladd Landing Site (LLS) by year and month, 2006 through 2007.

Year (Site)	<u>Number of Harbor Seals</u>								Days	Days	% of days
	April	May	June	July	August	September	October	Total	surveyed	observed	
2006 (LLS)	3	56	21	2	19	34	4	139	135	54	40
2007 (LLS)	n/a	n/a	n/a	98	213	31	7	349	80	46	58
Total	3	56	21	100	232	65	11	488	215	100	47

Table 8a. Precipitation, daily condition rating and glare at at Ladd Landing Site (LLS) during land-based surveys for marine mammals, July through October, 2007. Values for percent of days with precipitation types may add up to more than one hundred when more than one precipitation type was noted by observers during a day.

Month	Precipitation (% of days)			Daily Condition Rating (% of days) ¹					Glare
	Rain	Fog	Snow	1.0	1.5	2.0	2.5	3.0	% of days
July	35	15	0	0	0	20	25	55	85
August	40	15	0	0	0	10	10	80	65
September	40	5	0	0	5	5	25	65	90
October	30	5	20	0	0	10	15	75	85

¹Daily overall condition rating was assigned based on hourly ratings on a scale from 1.0 (poor) to 3.0 (excellent) with increments of 0.5.

Table 8b. Visibility and Beaufort sea state at Ladd Landing Site (LLS) during land-based surveys for marine mammals, July through October, 2007. Maximum visibility was considered 10 km.

Month	Visibility (% of hourly observations)		Beaufort sea state ² (% of hourly observations)			
	<10 km	10 km	0	1	2	3
July	15	85	12	50	30	8
August	6	94	42	41	12	5
September	14	86	40	47	14	0
October	12	88	7	60	33	0

²Beaufort sea states: 0=Sea like a mirror, 1=Ripples but without foam crests, 2=Small wavelets, 3=Large wavelets

Table 9. Number of tows with the 15-m beach seine by site and month, July through October, 2007.

Station	August	September	October	Total
Threemile Creek	1	2	1	4
Grant's Landing	1	2	1	4
Ladd Landing - north	1	2	1	4
Ladd Landing	1	2	1	4
Ladd Landing - south	1	2	1	4
Ladd Cabins	1	2	1	4
Chuit River mouth	1	2	1	4
Total	7	14	7	28

Table 10. Numbers of fish captured by species and month in the Ladd area with the 15-m beach seine, August through October, 2007. Numbers are not standardized for effort, and all sites are combined.

Species	Scientific name	August Number	% of Month	September Number	% of Month	October Number	% of Month	Season Number	% of Season
Bering cisco	<i>Coregonus laurettae</i>	3	12	4	11	2	17	9	12
Chum salmon (juvenile)	<i>Oncorhynchus keta</i>	0	0	1	3	1	8	2	3
Cod spp.	<i>Gadidae</i>	2	8	1	3	0	0	3	4
Coho salmon (juvenile)	<i>Oncorhynchus kisutch</i>	4	15	2	6	0	0	6	8
Dolly Varden	<i>Salvelinus malma</i>	3	12	2	6	1	8	6	8
Eulachon (hooligan)	<i>Thaleichthys pacificus</i>	6	23	8	23	0	0	14	19
Longfin smelt	<i>Spirinchus thaleichthys</i>	0	0	0	0	2	17	2	3
Ninespine stickleback	<i>Pungitius pungitius</i>	0	0	1	3	2	17	3	4
Pacific tomcod	<i>Microgadus proximus</i>	0	0	1	3	0	0	1	1
Saffron cod	<i>Eleginus gracilis</i>	5	19	10	29	3	25	18	25
Sculpin spp.	<i>Cottidae</i>	1	4	1	3	0	0	2	3
Smelt spp.	<i>Osmeridae</i>	1	4	3	9	0	0	4	5
Sockeye salmon (juvenile)	<i>Oncorhynchus nerka</i>	0	0	0	0	1	8	1	1
Starry flounder	<i>Platichthys stellatus</i>	1	4	1	3	0	0	2	3
Total		26	100	35	100	12	100	73	100

Table 11. Species richness (S), diversity (H') and evenness (J') for the 15-m beach seine and different combinations of sampling sites in the Ladd area in 2007.

Sampling group	S	H'	Hmax	J'
All sites				
Threemile Creek	11	1.99	2.40	0.83
Grant's Landing	5	1.55	1.61	0.96
Ladd Landing - north	4	1.39	1.39	1.00
Ladd Landing	4	1.33	1.39	0.96
Ladd Landing - south	3	1.04	1.10	0.95
Ladd Cabins	5	1.49	1.61	0.93
Chuit River Mouth	6	1.63	1.79	0.91
Total	14	2.26	2.64	0.86
Primary and secondary sites				
Primary sites	7	1.87	1.95	0.96
Secondary sites	14	2.24	2.64	0.85

Note: S = Species richness; H' = Shannon-Wiener index of diversity ($-\pi(\ln\pi)$); Hmax = $\ln(s)$; J' = Pielou's estimate of species evenness (H'/Hmax).

Table 12. CPUE by station (all dates combined) for the 15-m beach seine. Sites are listed left to right in order from north to south: Threemile Creek (3MC), Grant's Landing (FBL), Ladd Landing -north (LBS-N), Ladd Landing (LBS), and Ladd Landing -south (LBS-S), Ladd Cabins (LDC), and Chuit River mouth (CRM). See Methods section for calculation of CPUE.

Species	Site						
	3MC	FBL	LBS-N	LBS	LBS-S	LDC	CRM
Bering cisco	1.3	0.0	0.3	0.0	0.5	0.0	0.3
Chum salmon (juvenile)	0.3	0.0	0.0	0.0	0.0	0.3	0.0
Cod spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Coho salmon (juvenile)	0.5	0.0	0.3	0.0	0.0	0.3	0.5
Dolly Varden	0.0	0.5	0.0	0.3	0.3	0.7	0.0
Eulachon (hooligan)	2.0	0.3	0.3	0.0	0.0	0.0	1.0
Longfin smelt	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Ninespine stickleback	0.3	0.0	0.3	0.3	0.0	0.0	0.0
Pacific tomcod	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Saffron cod	2.3	0.5	0.0	0.7	0.3	1.0	0.3
Sculpin spp.	0.3	0.3	0.0	0.0	0.0	0.0	0.0
Smelt spp.	0.3	0.0	0.0	0.7	0.0	0.0	0.3
Sockeye salmon (juvenile)	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Starry flounder	0.3	0.3	0.0	0.0	0.0	0.0	0.0
Total	8.0	1.8	1.3	2.0	1.0	2.7	3.0

Table 13. Number of fish captured for five groups of species and month in the Ladd area, August through October, 2007. Numbers are not standardized for effort, and all gear types and sites are combined. Months may add up to more or less than 100% because some species did not belong to these groupings, and the three species of salmon caught are included in both the all salmon and Salmonidae groupings.

Group	<u>August</u>		<u>September</u>		<u>October</u>		<u>Season</u>	
	Number	% of month	Number	% of month	Number	% of month	Number	% of month
All salmon	4	15	3	9	2	17	9	12
Gadids	7	27	12	34	3	25	22	30
Osmerids	7	27	11	31	2	17	20	27
Flatfish	1	4	1	3	0	0	2	3
Salmonidae	10	38	9	26	5	42	24	33

Table 14. Mean monthly and season CPUE (all sites combined) for groups of fish species caught in the 15-m beach seine, August through October, 2007. See Methods section for calculation of CPUE.

Group	August	September	October	Season
All salmon	0.6	0.2	0.4	0.4
Gadids	1.0	0.9	0.6	0.9
Osmerids	1.0	0.8	0.4	0.8
Flatfish	0.1	0.1	0.0	0.1
Salmonidae	1.4	0.7	1.0	1.0

Table 15. Mean CPUE (all months combined) for groups of species caught at the primary and secondary beach seining sites¹ in the 15-m beach seine, August through October, 2006. See Methods section for calculation of CPUE.

Group	Mean catch per tow	
	Primary sites	Secondary
All salmon	0.1	0.5
Gadids	0.3	1.3
Osmerids	0.3	1.1
Flatfish	0.0	0.1
Salmonidae	0.6	1.2

¹Primary beach seining sites were Ladd Landing (LLS), Ladd Landing -north, and Ladd Landing -south. Secondary beach seining sites were Threemile Creek, Chuit River mouth, Grant's Landing, and Ladd Cabins.

Table 16. Mean monthly CPUE (all sites combined) for fish species caught in the 15-m beach seine, August through October, 2007. See Methods section for calculation of CPUE.

Species	August	September	October	Season
Bering cisco	0.4	0.3	0.4	0.4
Chum salmon (juvenile)	0.0	0.1	0.2	0.1
Cod spp.	0.3	0.1	0.0	0.1
Coho salmon (juvenile)	0.6	0.2	0.0	0.2
Dolly Varden	0.4	0.2	0.2	0.2
Eulachon (hooligan)	0.9	0.6	0.0	0.6
Longfin smelt	0.0	0.0	0.4	0.1
Ninespine stickleback	0.0	0.1	0.4	0.1
Pacific tomcod	0.0	0.1	0.0	0.0
Saffron cod	0.7	0.8	0.6	0.7
Sculpin spp.	0.1	0.1	0.0	0.1
Smelt spp.	0.1	0.2	0.0	0.2
Sockeye salmon (juvenile)	0.0	0.0	0.2	0.0
Starry flounder	0.1	0.1	0.0	0.1
Total	3.7	2.7	2.4	2.9

Table 17. Beluga whale behavior and movement relative to tidal current direction at Ladd Landing, after combining data from 2007 with those reported for 2006 (Nemeth et al. 2007). Behaviors other than traveling included diving, milling, socializing, feeding, and combinations of multiple behaviors. Sample sizes (*n*) are beluga whale groups. Whale sightings more than 10 km (6 mi) distant were removed from this analysis.

Movement relative to current direction	Traveling		Other		Total	
	<i>n</i>	% of groups	<i>n</i>	% of groups	<i>n</i>	% of groups
Ebb						
With ¹	6	67%	0	0%		
Against ¹	0	0%	0	0%		
Neutral ²	1	11%	1	22%		
Ebb subtotal	7	78%	1	22%	8	100%
Flood						
With	8	31%	2	8%		
Against	5	19%	1	4%		
Neutral	4	15%	5	23%		
Flood subtotal	17	65%	8	35%	25	100%
Total	24	69%	9	31%	33	100%

¹Whale movement could be identified as parallel to main current direction, either north or south along the shoreline. Depending on the tide, this was either with or against the current.

²Whale movement could be identified as perpendicular or mixed parallel and perpendicular to main current direction (generally milling or movement with a main east/west axis).

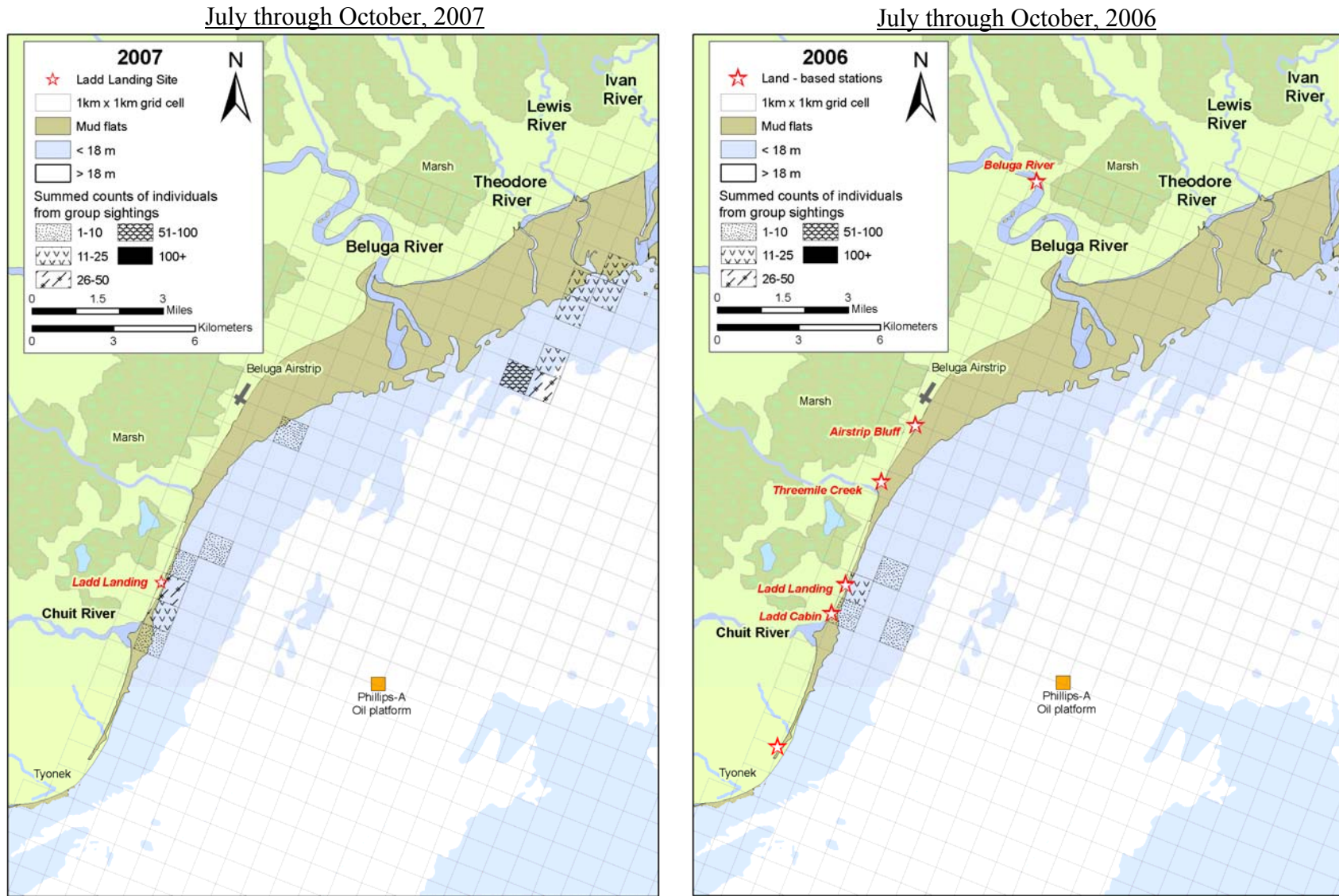


Figure 1. Beluga whale distribution in the Ladd area, presented as the sum of all whale counts per grid cell from sightings from all land – based sites, from Ladd Landing Site (LLS) during July through October, 2007 and July through October, 2006. Shaded grid cells correspond to the sum of whale counts in each grid cell. Note that these counts include repeat sightings of the same individuals over time and are intended to show level of use rather than abundance.

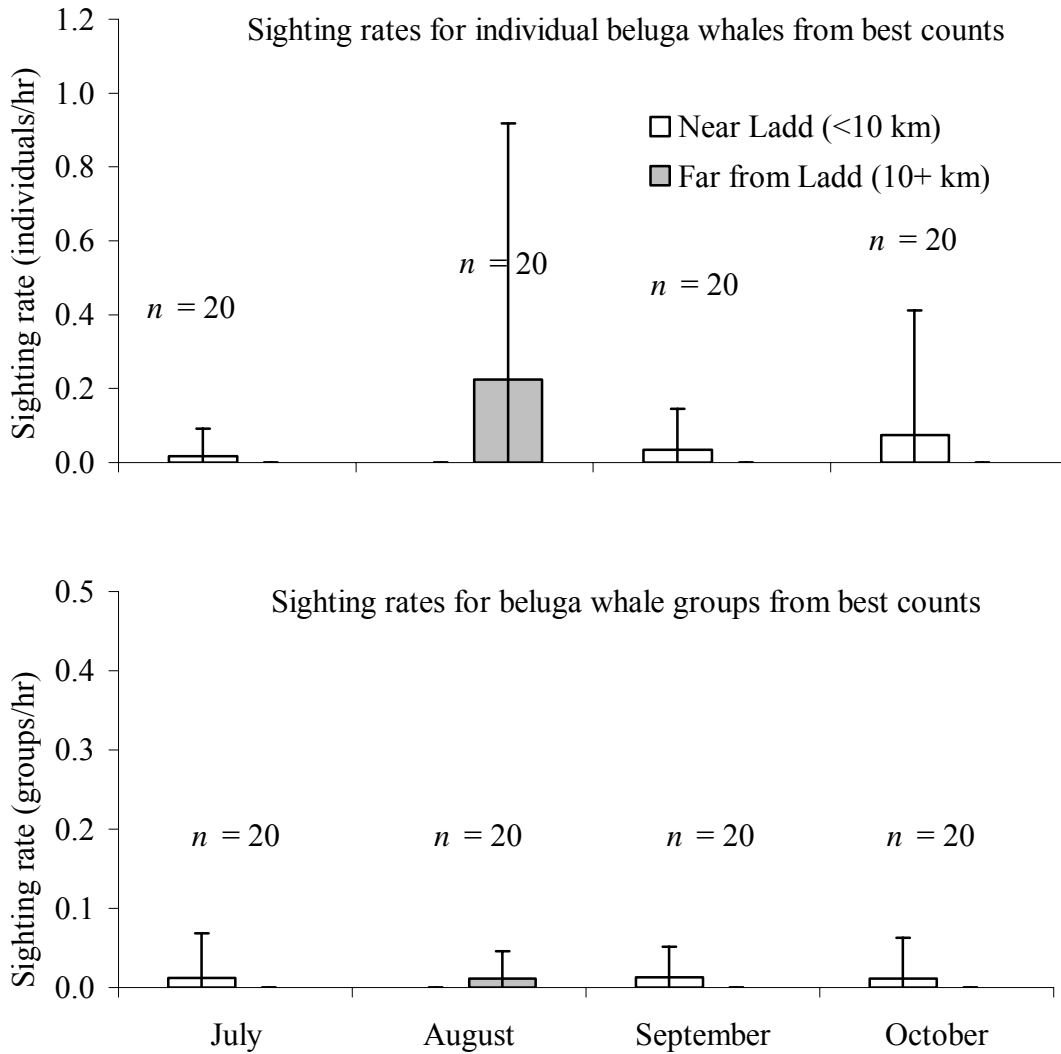


Figure 2. Mean daily sighting rate less than 10 km from Ladd (near) and 10 or more km (6 mi) from Ladd of best counts of individual beluga whales (a) and beluga whale groups per hour (b), shown by month at Ladd Landing (LLS), July through October, 2007. Error bars indicate standard deviation, and sample sizes are shown in days.

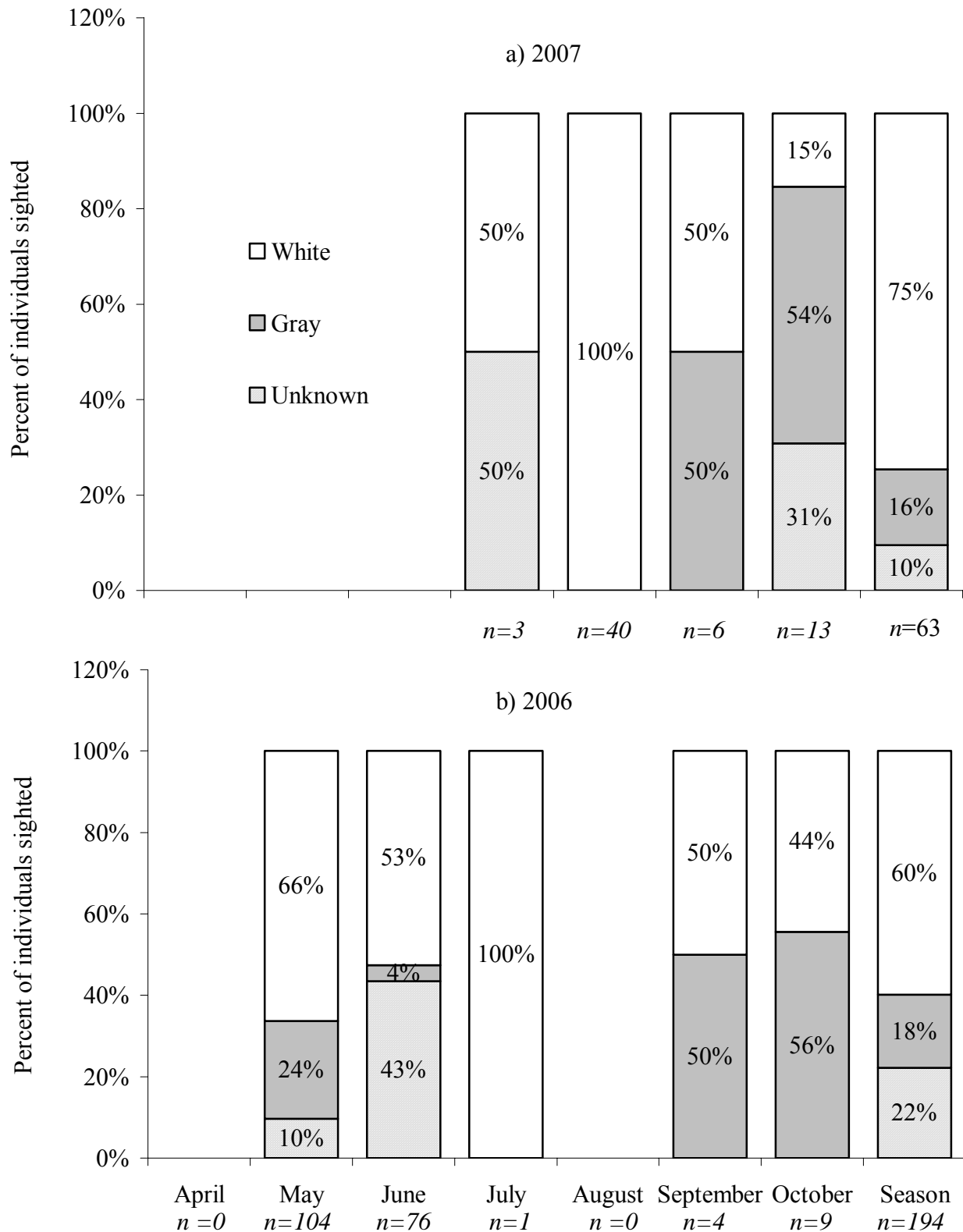


Figure 3. Beluga whale color class distributions from best counts of whales each month and for the season from a) July through October, 2007 and b) April through October, 2006. Stacked bars represent the proportion of white, gray and whales of unknown color. Sightings are from Ladd Landing Site (LLS) during 2007 and at LLS and four other sites during 2006. Whales seen in August 2007 were more than 10 km (6 mi) from LLS.

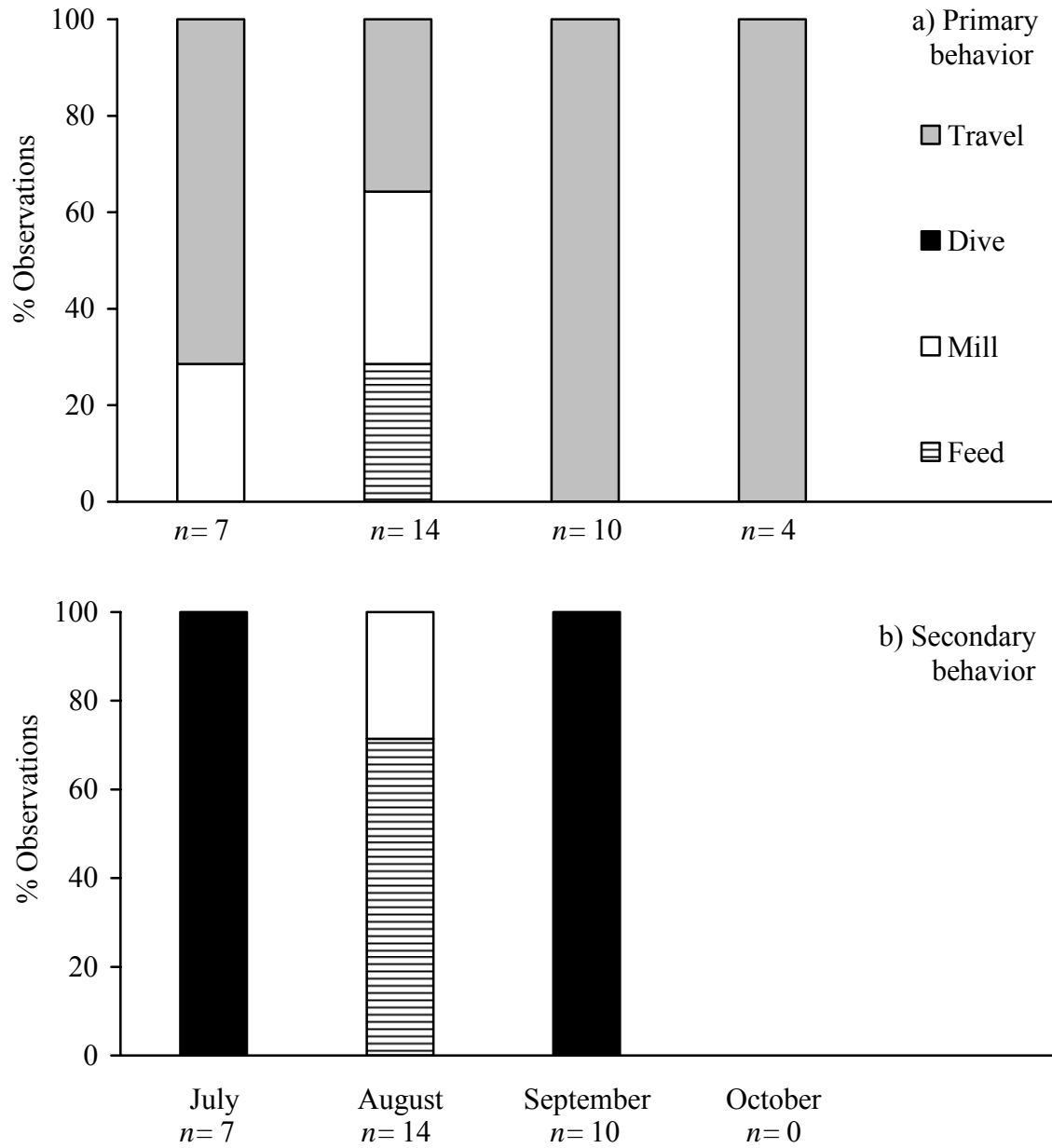


Figure 4. Beluga whale primary a) and secondary b) behavior by month, for all observations from Ladd Landing (LLS), July through October, 2007. Sample sizes are given in number of behavioral observations, and include repeat sightings of beluga whale groups. Not all whale groups displayed a secondary behavior.

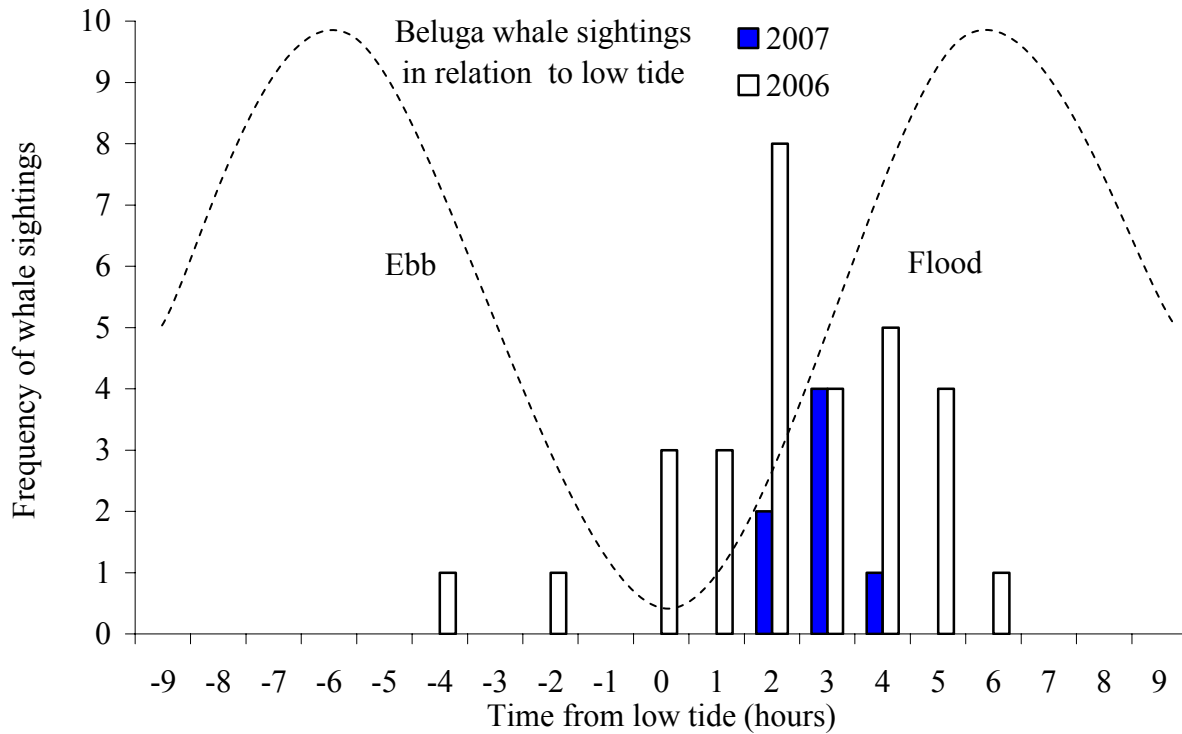


Figure 5. Frequency of all discrete beluga whale group sightings (2007: $n=7$; 2006: $n=30$) at Ladd Landing (LLS) in relation to low tide. Multiple whale groups seen on the same date and at the same time were only counted once to eliminate duplication errors. Dashed line represents the average generalized tidal cycle of two oscillations over an 18-hr time period. Whale sightings more than 10 km (6 mi) distant were removed from this analysis.

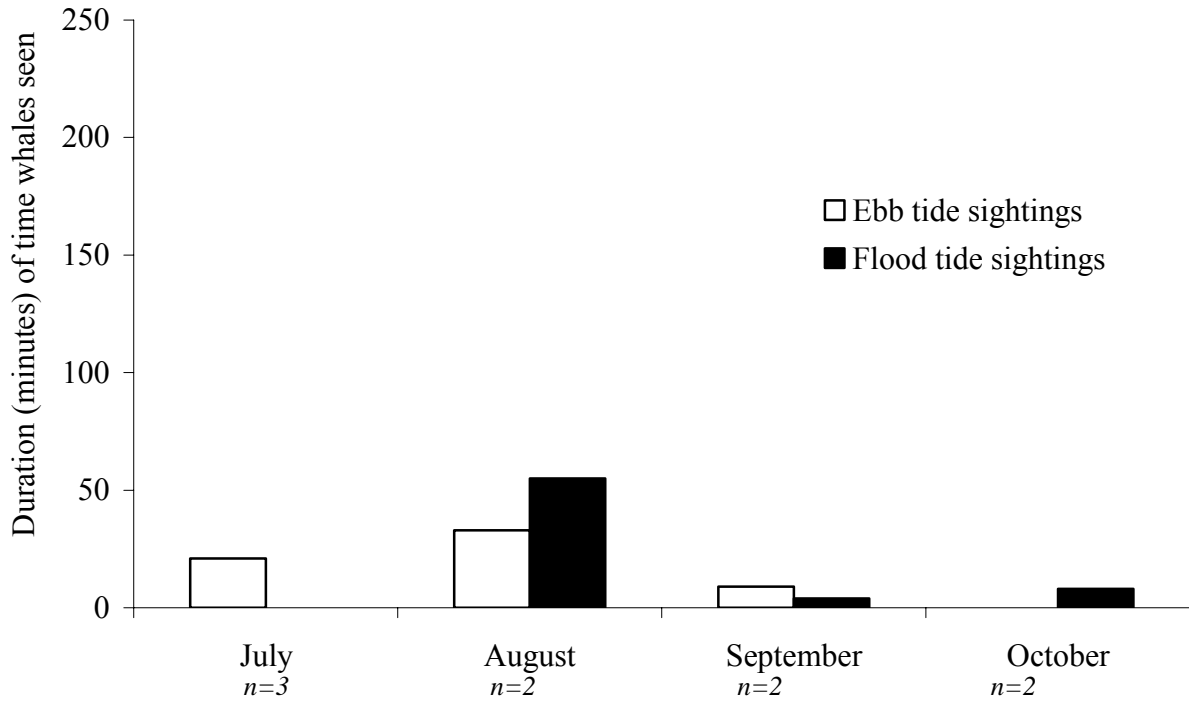


Figure 6. Beluga whale group sighting duration by tidal stage at Ladd Landing (LLS), July through October, 2007. Sample sizes are shown in number of groups. Whales seen in August 2007 were more than 10 km (6 mi) from LLS.

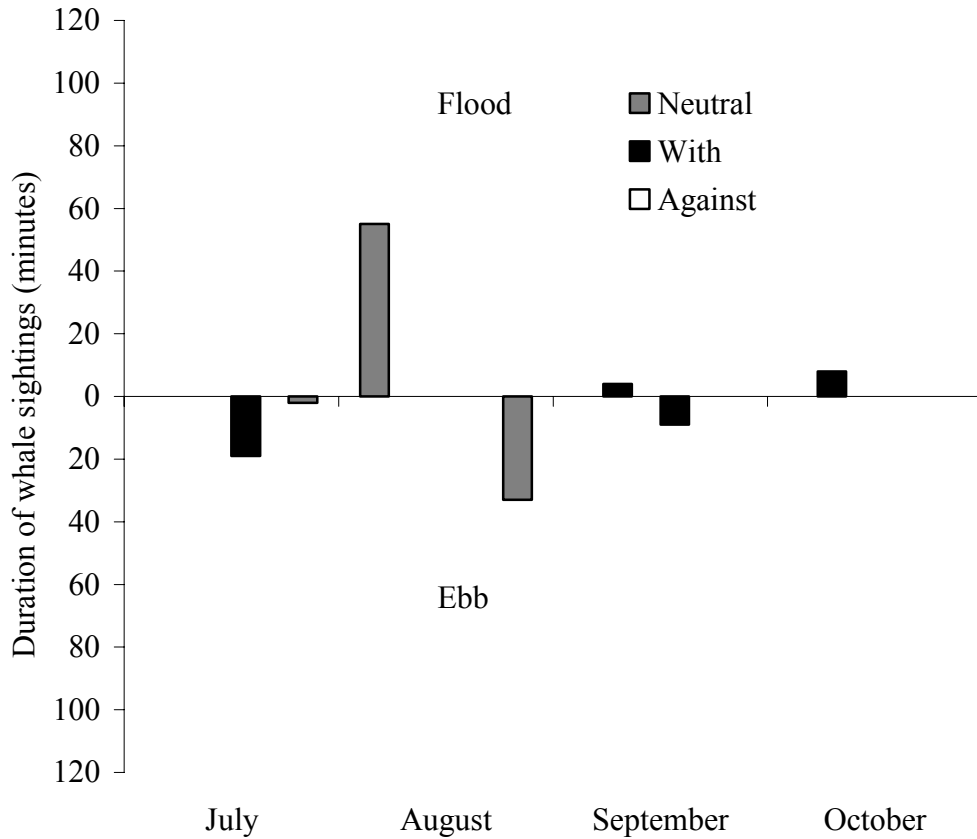


Figure 7. Duration of whale sightings by tidal stage and direction of travel for July through October, 2007 at Ladd Landing (LLS). Sample size ($n = 9$) is beluga whale group sightings. Whales seen in August 2007 were more than 10 km (6 mi) from LLS.

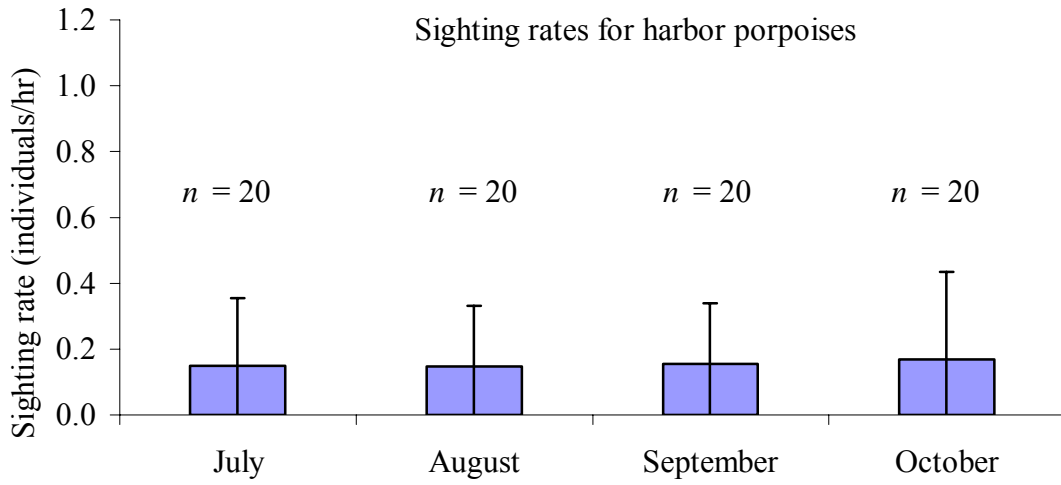


Figure 8. Mean daily sighting rate of harbor porpoises, shown by month at Ladd Landing (LLS), July through October, 2007. Error bars indicate standard deviation, and sample sizes are shown in days.

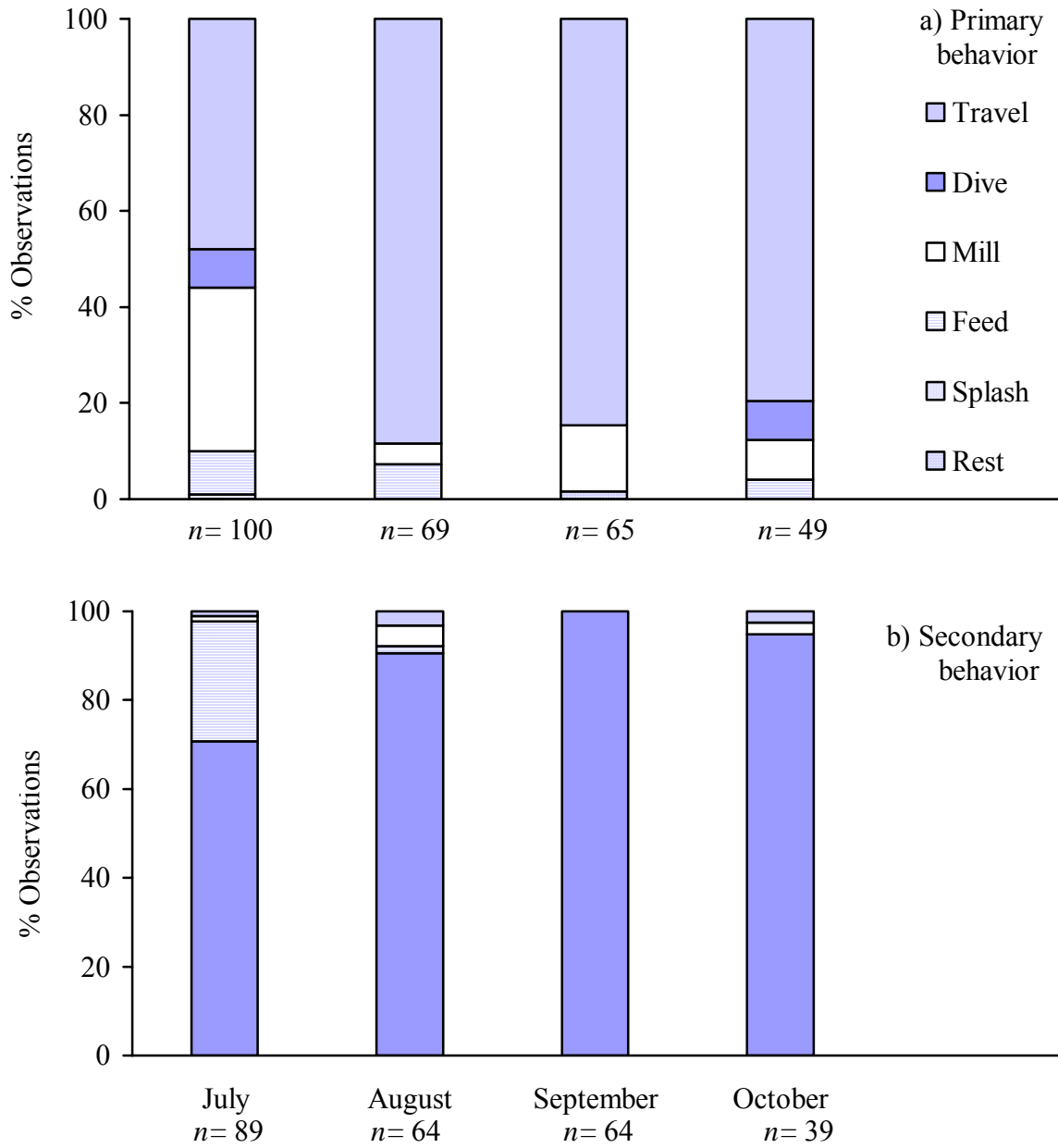


Figure 9. Harbor porpoise primary behavior a) and secondary behavior b) by month, for all observations from Ladd Landing (LLS), July through October, 2007. Sample sizes are given in number of observations of harbor porpoise. Repeat sightings of porpoises observed were included in this figure.

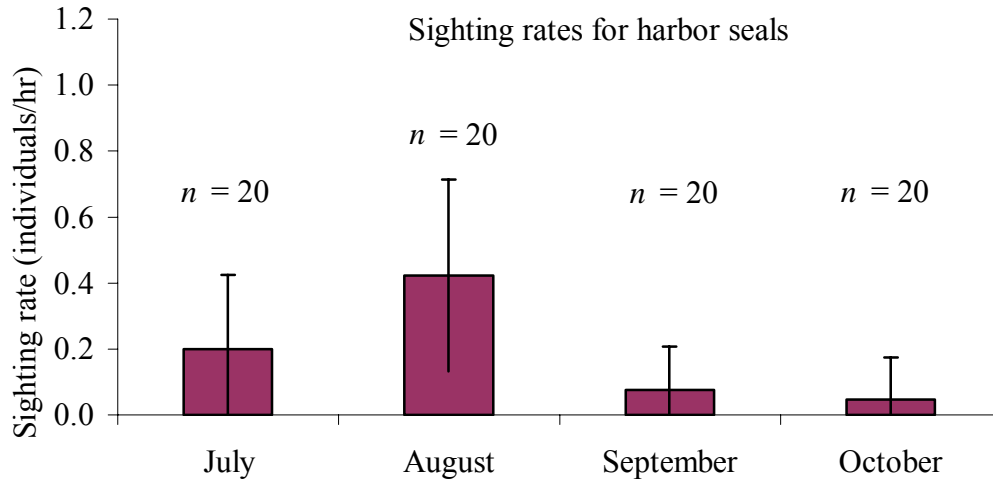


Figure 10. Mean daily sighting rate of harbor seals, shown by month at Ladd Landing (LLS), July through October, 2007. Error bars indicate standard deviation, and sample sizes are shown in days.

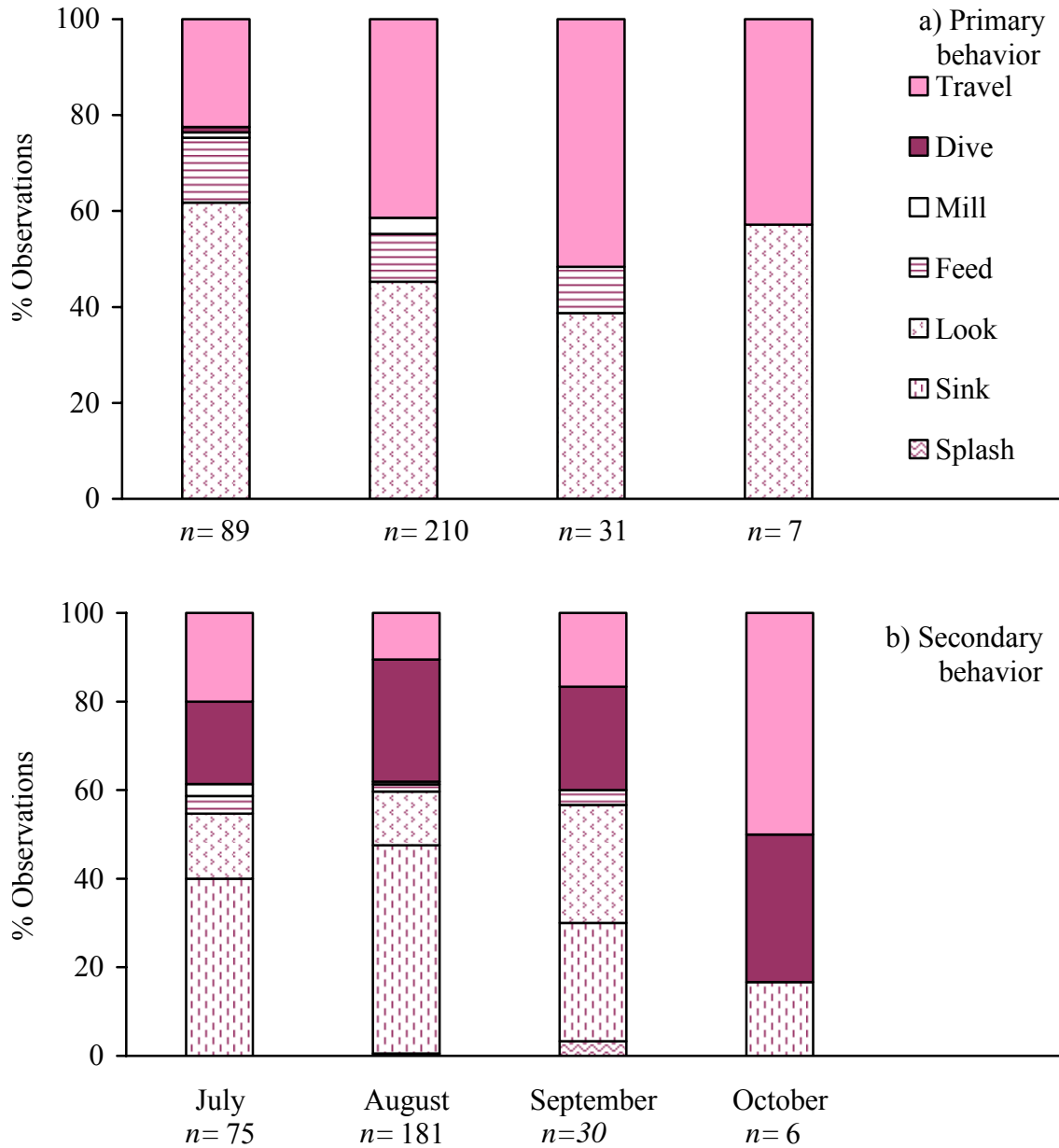


Figure 11. Harbor seal primary a) and secondary b) behavior by month, for all observations from Ladd Landing (LLS), July through October, 2007. Sample sizes are given in number of observations of harbor seals. Repeat sightings of seals were included in this figure.

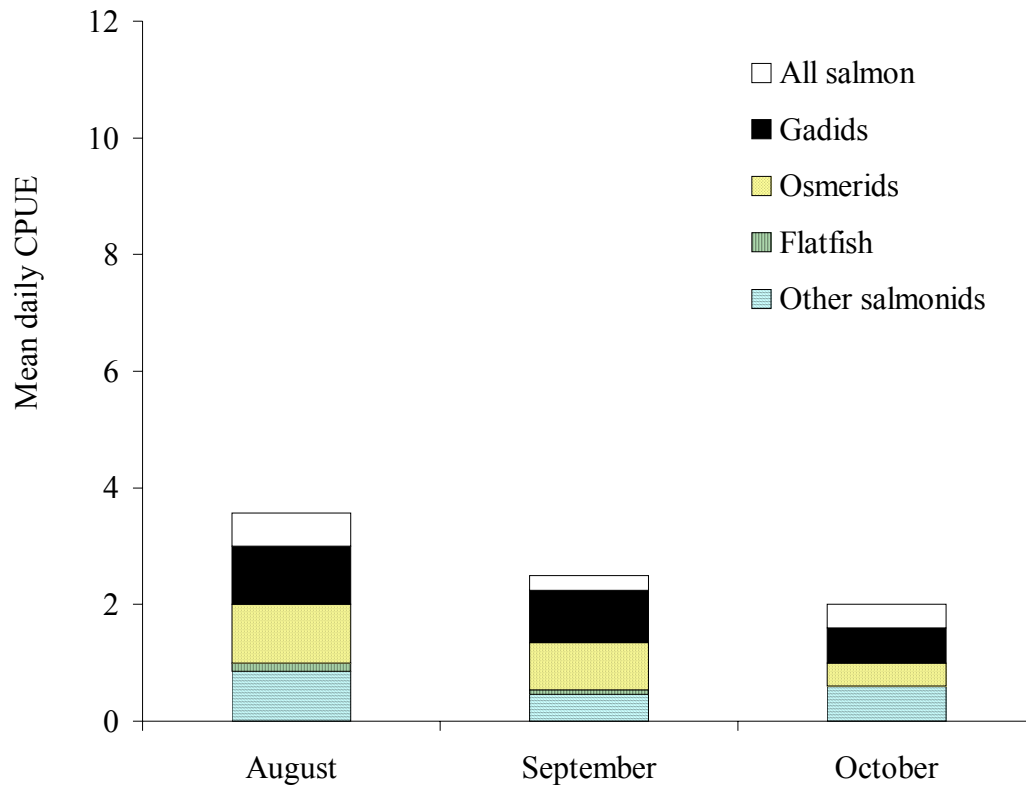


Figure 12. Mean daily CPUE by month and species group (all sites combined) for the 15-m beach seine, August through October, 2007. See Methods section for calculation of CPUE.

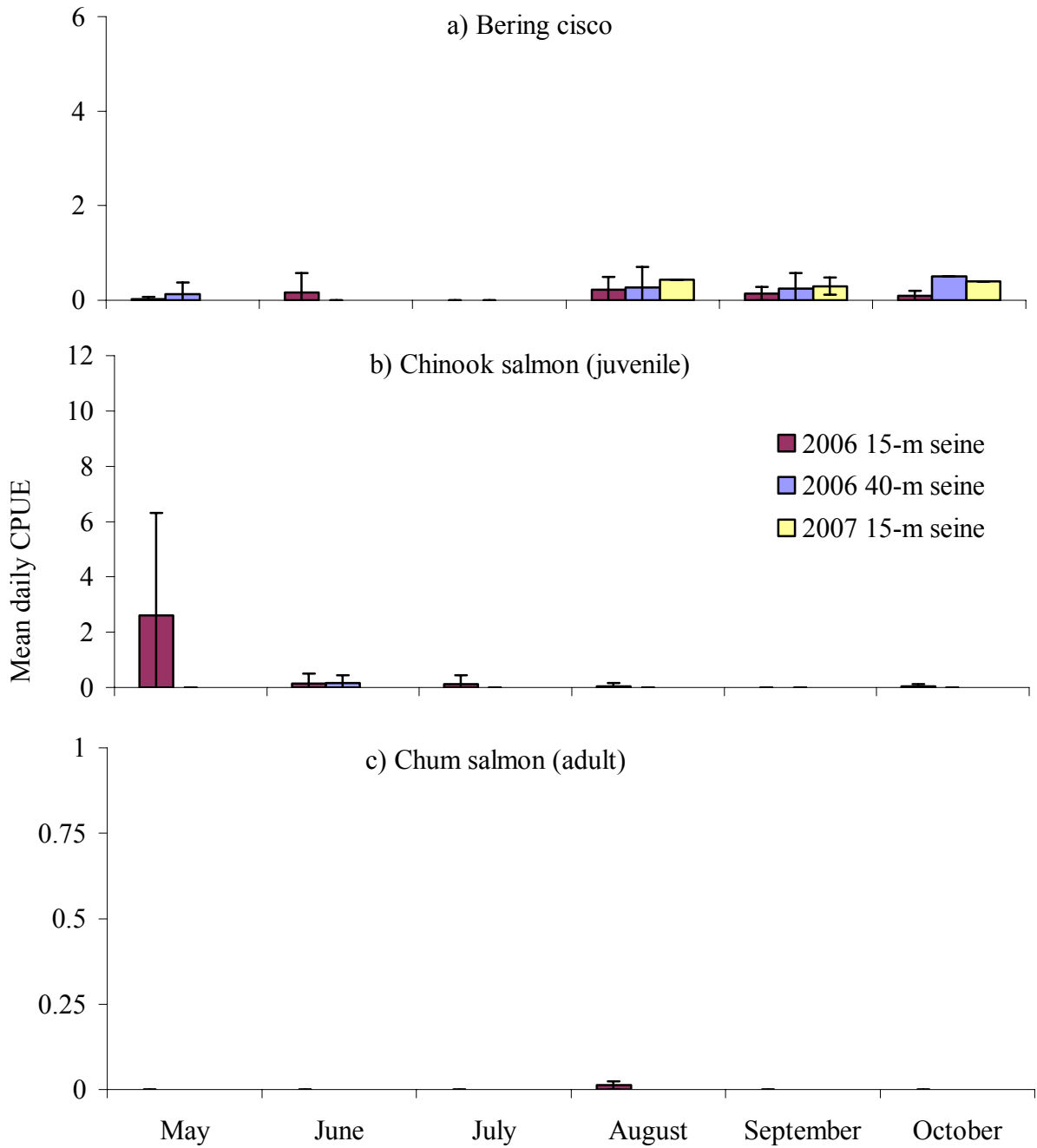


Figure 13. Mean daily CPUE by month and net (all stations combined) for a) Bering cisco, b) Chinook salmon (juvenile), and c) chum salmon (adult). Error bars represent standard deviation of daily means. See Methods section for calculation of CPUE.

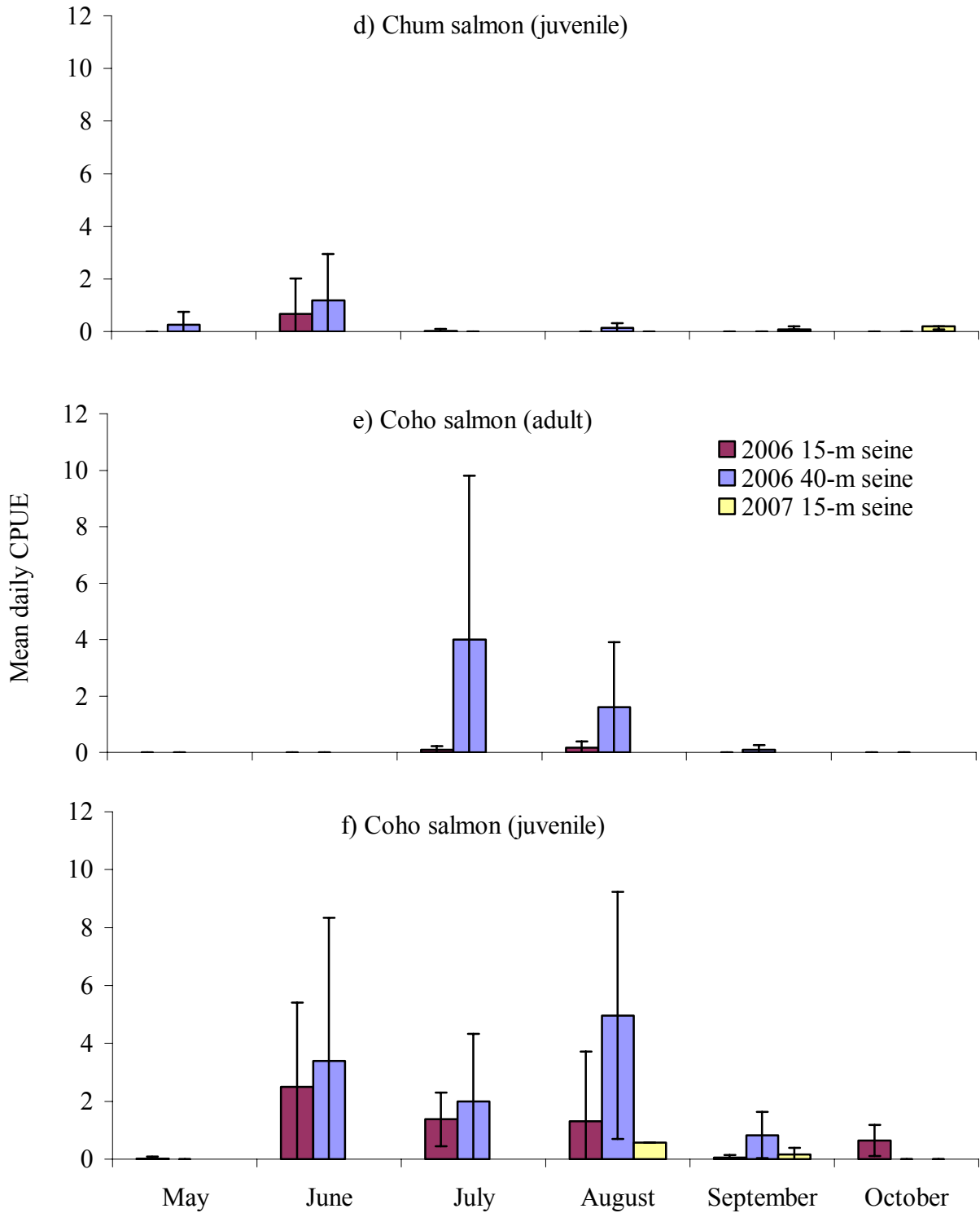


Figure 13 (continued). Mean daily CPUE by month and net (all stations combined) for d) chum salmon (juvenile), e) coho salmon (adult), f) coho salmon (juvenile). Error bars represent standard deviation of daily means. See Methods section for calculation of CPUE.

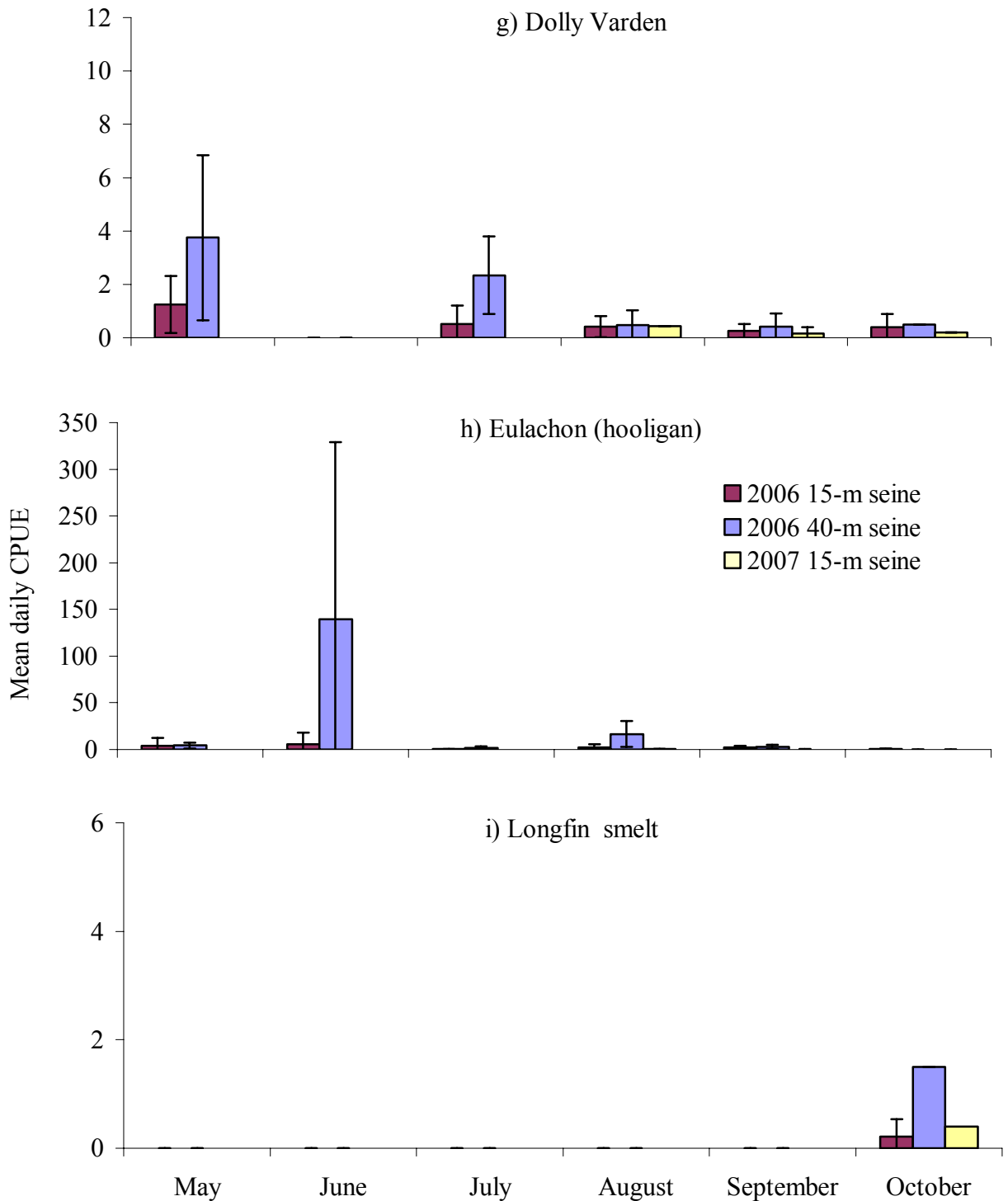


Figure 13 (continued). Mean daily CPUE by month and net (all stations combined) for g) Dolly Varden, h) eulachon, and i) longfin smelt. Event is defined as unique combination of date, site and net. Error bars represent standard deviation of daily means. See Methods section for calculation of CPUE.

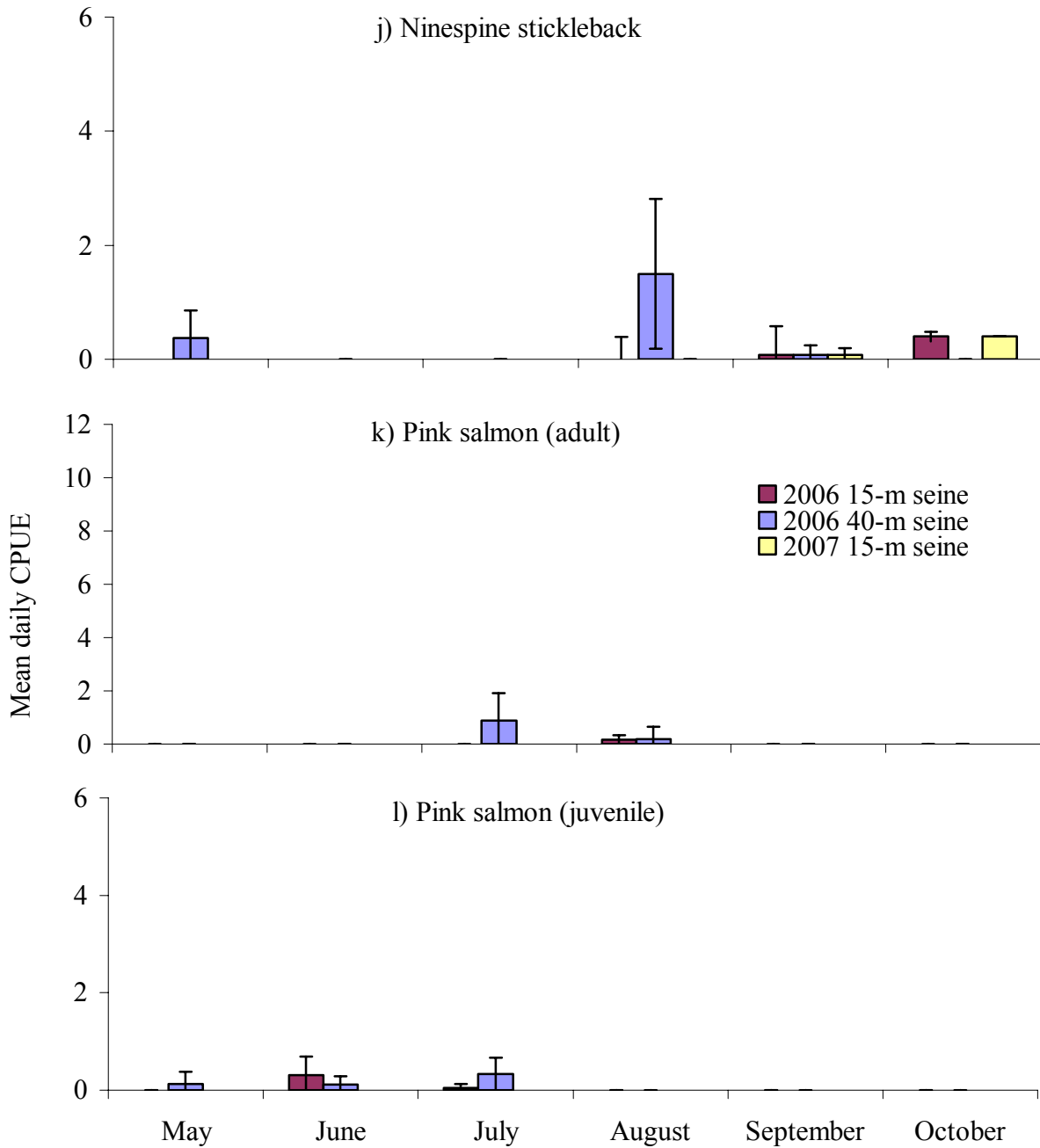


Figure 13 (continued). Mean daily CPUE by month and net (all stations combined) for j) ninespine stickleback, k) pink salmon (adult) and l) pink salmon (juvenile). Error bars represent standard deviation of daily means. See Methods section for calculation of CPUE.

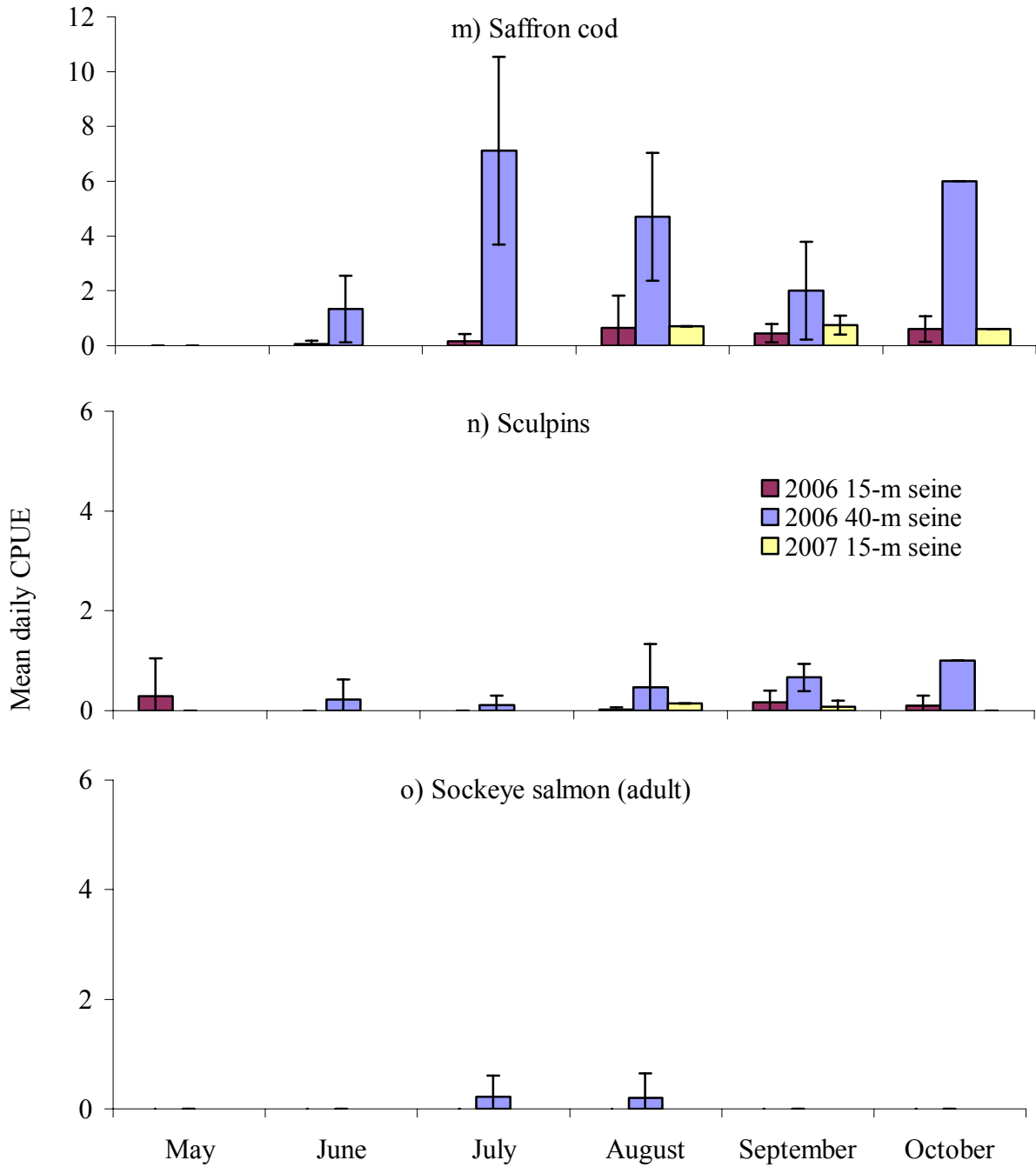


Figure 13 (continued). Mean daily CPUE by month and net (all stations combined) for m) saffron cod, n) sculpins, and o) sockeye salmon (adult). Error bars represent standard deviation of daily means. See Methods section for calculation of CPUE.

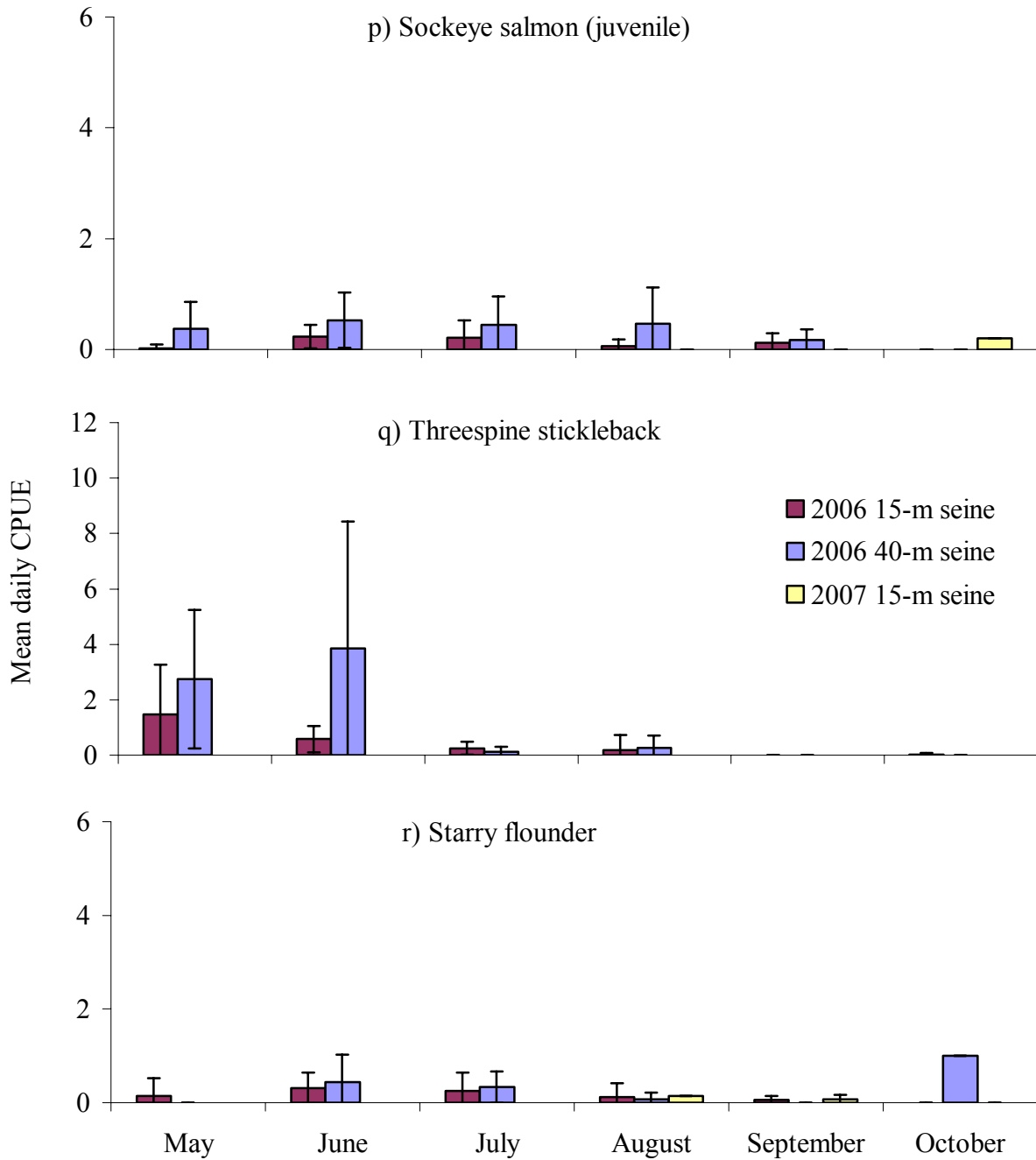


Figure 13 (continued). Mean daily CPUE by month and net (all stations combined) and p) sockeye salmon (juvenile), q) threespine stickleback and r) starry flounder. Error bars represent standard deviation of daily means. See Methods section for calculation of CPUE.

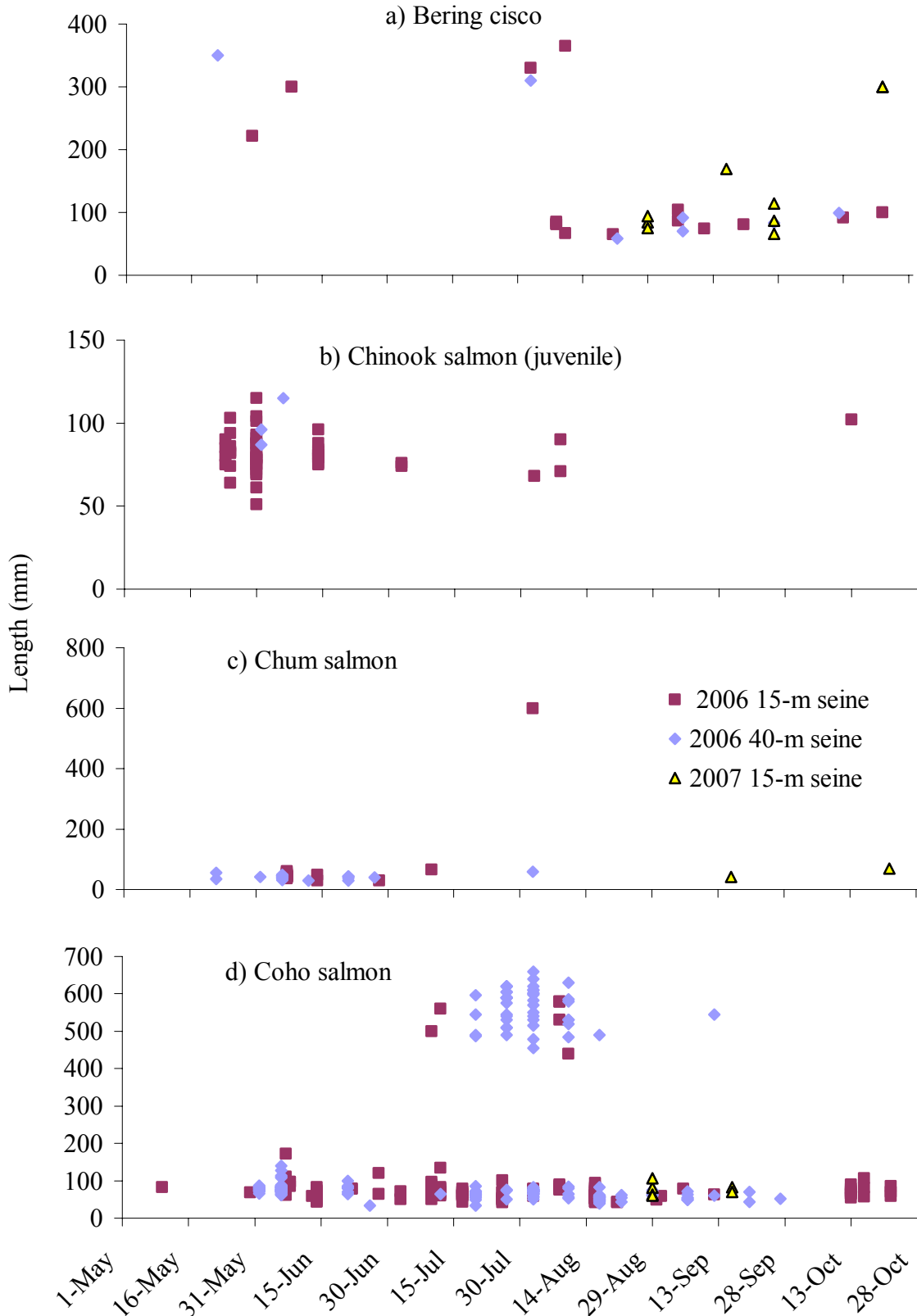


Figure 14. Lengths of a) Bering cisco b) Chinook salmon, c) chum salmon, and d) coho salmon caught in the 15-m and 40-m beach seines, May through October, 2006 and August through October, 2007.

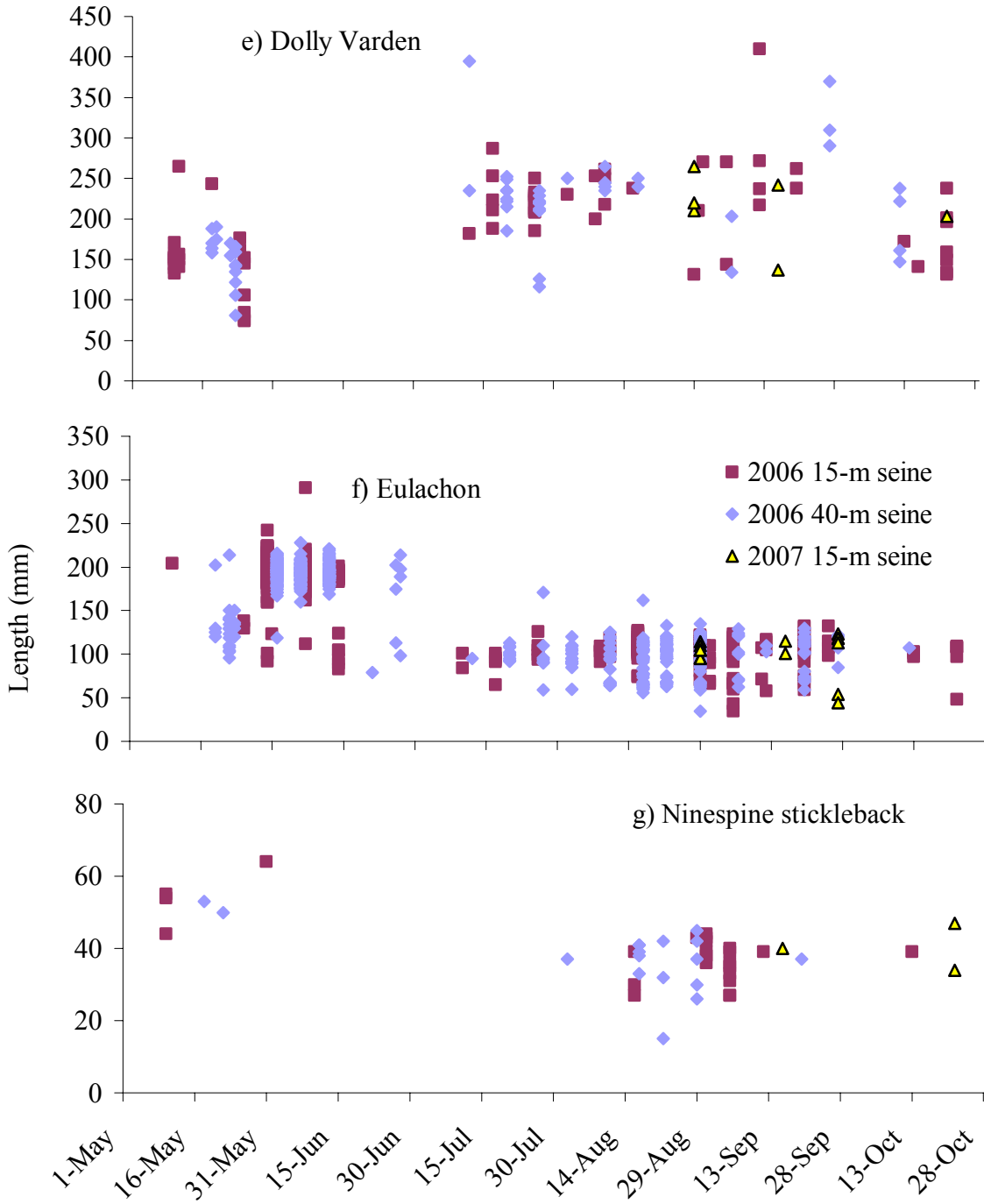


Figure 14 (continued). Lengths of e) Dolly Varden, f) eulachon (hooligan), and g) ninespine stickleback caught in the 15-m and 40-m beach seines, May through October, 2006 and August through October, 2007.

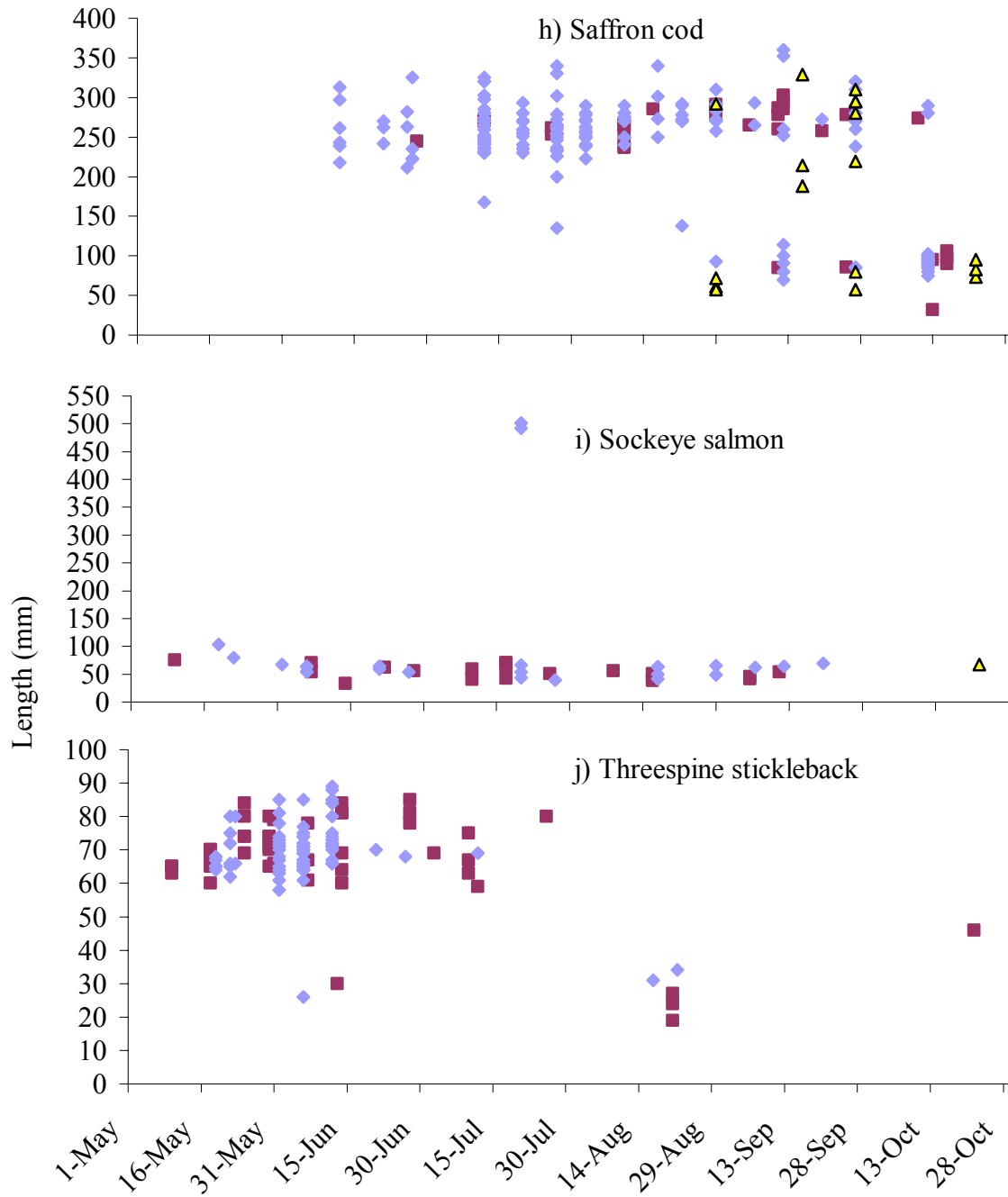


Figure 14 (continued). Lengths of h) saffron cod, i) sockeye salmon, and j) threespine stickleback caught in the 15-m and 40-m beach seines, May through October, 2006 and August through October, 2007.

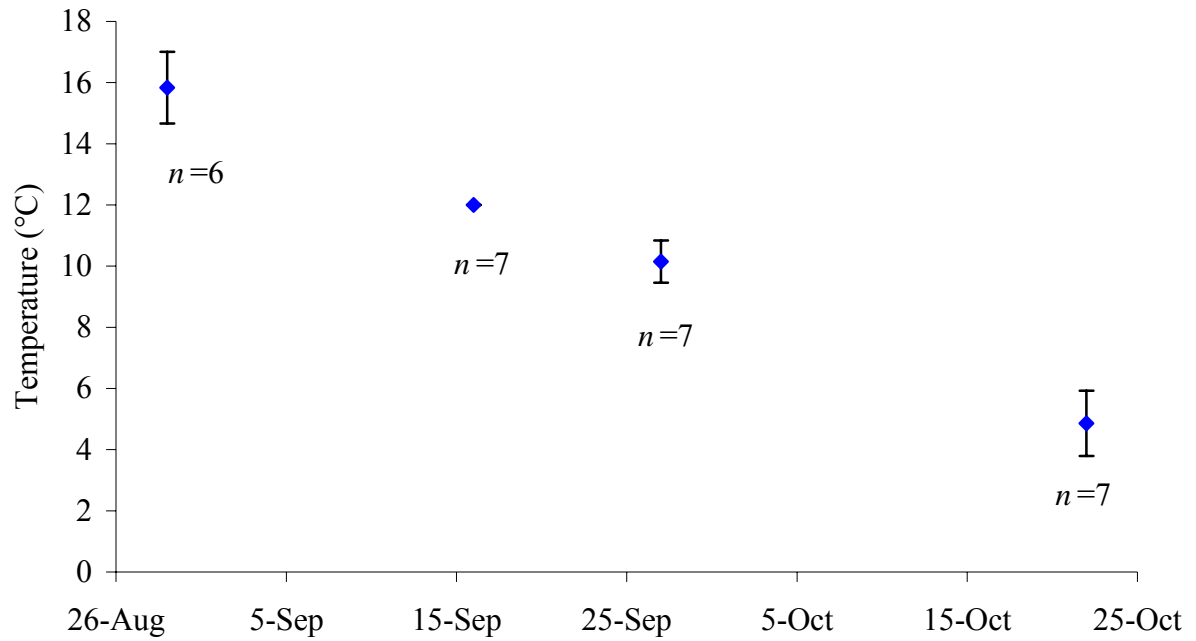


Figure 15. Mean water temperature by date at all intertidal fish sampling sites, August through October, 2007, with error bars of one standard deviation. Sample sizes are given in number of sites sampled per day.

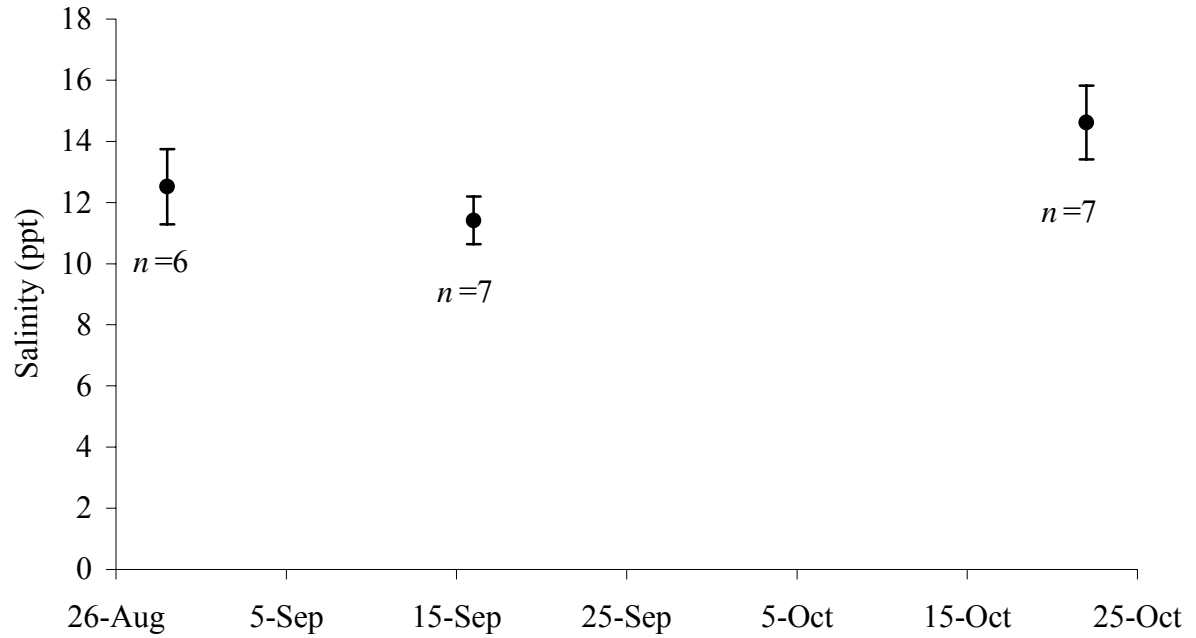


Figure 16. Mean salinity by date by date at all intertidal fish sampling sites, August through October, 2007, with error bars of one standard deviation. Sample sizes are given in number of sites sampled per day.

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APPENDIX A

Incidental Sightings Reported to Staff by Community Members in Beluga, AK

Sightings were recorded between July 10 to October 30, 2007. Tides (HT=time of high tide and LT=time of low tide) were corrected for Ladd, AK and are +1:40 from NOAA Nikiski tide gauge unless noted (ANC=tides from NOAA Knik Arm gauge). Sightings reported were from the Susitna Flats area west to the Ladd area.

July 2007

1. July 2, 2007: 8 whales seen offshore from Grant's landing at approximately 03:00-04:30. Whales were milling and "fishing." HT 07:44, LT 02:16. Reported to A. Prevel-Ramos on 7/14/07.
2. July 5, 2007: 47 whales seen between Little Susitna River and Susitna River, from plane from Anchorage to Beluga. HT 10:07, LT 16:47. Reported to A. Prevel-Ramos on 7/21/07.
3. July 6, 2007: 30 to 40 whales in the mouth of the Beluga River, seen at 20:00-22:00. Whales were milling, heard underwater vocalizations, apparently chasing fish. HT 23:52, LT 17:36. Reported to A. Prevel-Ramos on 7/14/07.
4. June –July, 2007: Approximately 30 whales seen along beach from Grant's landing to Chuit River. Seen daily from late June through early July. Reported to A. Prevel-Ramos on 7/10/07.
5. July 11, 2007: Whales seen upriver in Theodore, Susitna, and Beluga Rivers at 11:30. Numbers unknown. HT 17:04, LT 10:48. Reported to A. Prevel-Ramos on 7/13/07.
6. July 17, 2007: 40-60 whales seen just north of the Susitna River, traveling north, seen from plane at 10:00-10:30. HT 08:37, LT 15:16. Reported to A. Baker on 7/17/07.
7. July 23, 2007: One adult beluga whale, seen offshore of Grant's Landing at 21:30. Whale rolled once, then snorkeled, exposing only its blowhole, then dove. HT 14:28, LT 20:53. Reported to A. Prevel-Ramos on 7/24/07.
8. July 31, 2007: 8 whales total, 1 group of 5 and another group of 3, seen at Susitna River, from flight from Anchorage to Beluga. HT 07:34, LT 14:21. Reported to A. Prevel-Ramos on 7/31/07.

August 2007

9. August 8, 2007: 20 whales in mouth of Little Su, seen mid-day on flight from Anchorage to Beluga. HT (ANC) 17:10, LT (ANC) 10:36. Reported to A. Baker on 8/14/07.

10. August 8, 2007: "Many" whales at the Susitna River, seen between 17:30 and 18:00, on flight from Anchorage to Beluga. HT 15:38, LT 21:42. Reported to A. Baker on 8/14/07.
11. August 9, 2007: Three white whales at the Chuit River mouth seen in the afternoon on rising tide. Whales were milling and splashing, feeding was suspected. HT 17:03, LT 10:39. Reported to A. Prevel-Ramos on 8/12/07.
12. August 9, 2007: 50 whales immediately offshore and just to E of Lewis River mouth, seen at 17:50 on flight from Anchorage to Beluga. Whales were milling in place, loosely spaced. HT 17:03, LT 10:39. Reported to A. Prevel-Ramos on 8/11/07.
13. August 5-11: Belugas seen in Beluga River mouth during the week of August 5-11. Reported to A. Baker on 8/20/07.
14. August 15, 2007: Four to five white whales at the Theodore River mouth and more whales 3/4 mile upriver in Little Susitna River, seen at 11:45. Feeding was suspected> HT (ANC) 09:26, LT (ANC) 16:15. Reported to A. Baker on 8/20/07.
15. August 23, 2007: One whale stranded in the Susitna River, seen from the 17:30 flight from Anchorage to Beluga. The whale was 2/3 out of the water and working its tail. Whale was stranded near the west bank of the Susitna River. HT (ANC) 17:30, LT (ANC) 23:10. Reported to A. Baker on 8/25/07.
16. August 28, 2007: Unknown number of whales seen at 10:20 at the Theodore River mouth. Feeding suspected. HT (Ladd) 06:39, LT (Ladd) 13:17. Reported to A. Baker on 8/29/07.

September 2007

17. September 17, 2007: 1-4 whales seen upriver in Little Susitna (well into river mouth). Seen from Spernak flight from Anchorage to Beluga, at 07:30. HT (ANC) 09:42, LT (ANC) 04:12. Reported to A. Baker on 9/18/07.
18. September 22, 2007: 2-3 whales, seen far offshore of Tyonek dock. Seen from helicopter in afternoon, exact time unknown. HT 16:35, LT 10:07. Reported to A. Prevel-Ramos on 9/22/07.
19. September 27, 2007: 6 whales, some adults present, others unknown color, seen from Cottonwood camp (near Beluga airstrip on the coastline) at 0800. Whales headed south towards Ladd along shore, traveling. HT 07:02, LT 13:24. Reported to A. Prevel-Ramos on 9/27/07.

October 2007

20. October 16, 2007: 1 whale seen at mouth of Susitna River in West channel. Whale was stationary at surface, entire body in view. Seen from Spernak flight from Anchorage to Beluga at 10:30. HT (ANC) 10:54, LT (ANC) 05:05. Reported to A. Baker on 10/16/07.