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UNUSUAL MORTALITY IN THE DEPLETED COOK INLET BELUGA (*DELPHINAPTERUS LEUCAS*) POPULATION

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In 2003, an unusually high number of beluga (*Delphinapterus leucas*) deaths occurred in Cook Inlet, Alaska. This small population of whales is segregated geographically and genetically from all other populations of belugas in Alaska waters (O'Corry-Crowe and others 1997). Cook Inlet belugas display strong site fidelity and many remain year-round in the Inlet (Rugh and others 2004), making this population vulnerable to impacts from anthropogenic and environmental hazards (Calkins 1983; Moore and DeMaster 2000; Moore and others 2000). Factors that may presently impact the Cook Inlet beluga population include harvest by Alaska Natives, contaminants, boat traffic, killer whale (*Orcinus orca*) predation, strandings, disease, forage base decline, human-induced habitat changes, and an ocean regime shift (Vos 2003).

The National Marine Fisheries Service (NMFS) receives reports of live strandings and dead whales from a variety of sources that include the public, air taxi services, State troopers, and other agencies. When possible, NMFS biologists go to live strandings and conduct aerial surveys after stranding events to search for dead whales. A concerted effort is made to confirm any reports of dead whales, to examine carcasses, and to take appropriate samples. A veterinary pathologist is contracted to help perform necropsies and analyze results. Samples taken from dead belugas (depending on stage of decomposition) may include skin for genetic analysis; blubber, kidney, liver, and muscle for contaminant analyses; histology samples from organs to be examined for abnormalities and disease; a lower jaw with teeth intact for aging; blubber for fatty acid analysis; the stomach for diet analysis; and the female reproductive tract for fecundity analysis. Dead whales are examined for tumors, parasites, and other abnormalities, and also for trauma from such sources as killer whales, boat strikes, net entanglement, and gun shots.

Between 1994 and 2002 (years in which records are fairly reliable), the average number of beluga deaths reported was 9.6 (Table 1: range = 3 to 13 deaths per year, excluding Alaska Native harvest). The high number of documented beluga mortalities in Cook Inlet in 2003 may be partially attributed to a greater awareness and increased reporting by the public. Since the decline of the beluga population (documented from 1994 to 1998; Hobbs and others 2000), there has been extensive media coverage on belugas and widespread public awareness.

During 2003, there were 20 confirmed beluga deaths in Cook Inlet (Fig. 1 and Table 2). Several of the documented mortalities in 2003 were large adults. Of the 17 whales of known length, 8 were over 400 cm (13′1″) long, with the largest being 477 cm (15′8″) long (Table 2). Some of these deaths may have resulted from live strandings. Cetaceans have difficulty shedding heat even in cold weather, and the lack of water to support the body can cause compression of the chest cavity leading to respiratory fatigue and distress. Within a few hours of stranding, some may go into shock or vascular collapse leading to poor circulation and impaired organ function. Once the animal goes into shock, even if it is able to swim free, its health has been impaired, which may prevent recovery (Geraci and Lounsbury 2002).

Mass live-strandings are not uncommon in Cook Inlet where tidal ranges exceed 9.5 m (30 ft), and tidal bores of up to 3.2 m (10 ft) occur in Turnagain and Knik Arms (Moore and others 2000). Belugas often survive stranding through part of a tide cycle (up to 6 h) to refloat and swim away on the incoming tide. Deaths during strandings appear to be rare (total known mortalities = 12 belugas out of 650 that stranded between 1988 and 2000; Moore and

TABLE 1. Yearly summary of total mortality and live stranding events of Cook Inlet beluga (Moore and others 2000; NMFS unpublished data).

Year	Total mortalities per year	No. of belugas per live stranding event (mortalities associated with live-stranding)	Date of stranding	Location
1988	0	27 (0)	Oct. 23	Turnagain Arm
1989	3			
1990	2			
1991	1	70–80 (0)	Aug. 31	Turnagain Arm
1992	5	2 (2)	Oct. 6	Kenai River
1993	3	10+ (0)	July 6	Turnagain Arm
1994	10	186 (0)	June 14	Susitna River
1995	3			
1996	12	63 (0)	June 12	Susitna River
		60 (4)	Aug. 28	Turnagain Arm
		20–30 (1)	Sept. 2	Turnagain Arm
		1 (0)	Sept. 8	Knik Arm
		10–20 (0)	Oct. 2	Turnagain Arm
1997	3			
1998	10	30 (0)	May 14	Turnagain Arm
		5 (0)	Sept. 7	Turnagain Arm
1999	12	58 (5)	Aug. 29	Turnagain Arm
		12–13 (0)	Sept. 9	Turnagain Arm
2000	13	8 (0)	Aug. 27	Turnagain Arm
		2 (0)	Oct. 24	Turnagain Arm
		15–20 (0)	Sept. 24	Turnagain Arm
2001	10			
2002	13			
2003	20	2 (0)	April 18	Turnagain Arm
		46 (5)	Aug. 28	Turnagain Arm
		26 (0)	Sept. 6	Turnagain Arm
		32 (0)	Sept. 14	Turnagain Arm
		9 (0)	Oct. 6	Turnagain Arm

others 2000). In 2003, 115 belugas live-stranded in 5 events. Five mortalities occurred after the 28 August 2003 stranding in Turnagain Arm of at least 46 belugas (Table 2). Although mortalities occurred after other stranding events (Table 2), most of the carcasses examined were in the moderate to advanced decomposition stage, and it is not possible to know if they were directly linked to a specific live stranding event.

Trauma marks (for example, boat propeller, net entanglement, gun shot, killer whale tooth marks) were observed on only 1 of the 20 dead whales examined (Table 2). This beluga (examined 25 August 2003) had obvious trauma in the form of killer whale tooth marks and internal hemorrhaging. Based on observations and historical data, it is estimated that at least 1 Cook Inlet beluga is killed per year by killer whales and that strandings of belugas and killer whales on mudflats within Cook Inlet appear to be associated with these attacks (Shelden and others 2003). On every occasion when killer whales were seen in Turnagain Arm, belugas were chased, stranded, consumed, or later found dead (Shelden and others 2003).

One whale, a pregnant female, examined on 1 April 2003, was very thin with its vertebrae showing through the skin (Table 2). Alaska Natives have observed that belugas are thin in the spring (Huntington 2000). The body condition of this whale, in addition to carrying a fetus, may have contributed to its death.

Contaminant sampling was done on 12 whales. Results are pending, but previous analyses of Cook Inlet beluga samples have found contaminant loads lower or equal to the other Alaska populations (with the exception of copper levels) (Becker and others 2000). The toxicological implication of the copper levels is unknown (Becker and others 2000). No tumors, lesions, or abnormalities were found, and par-

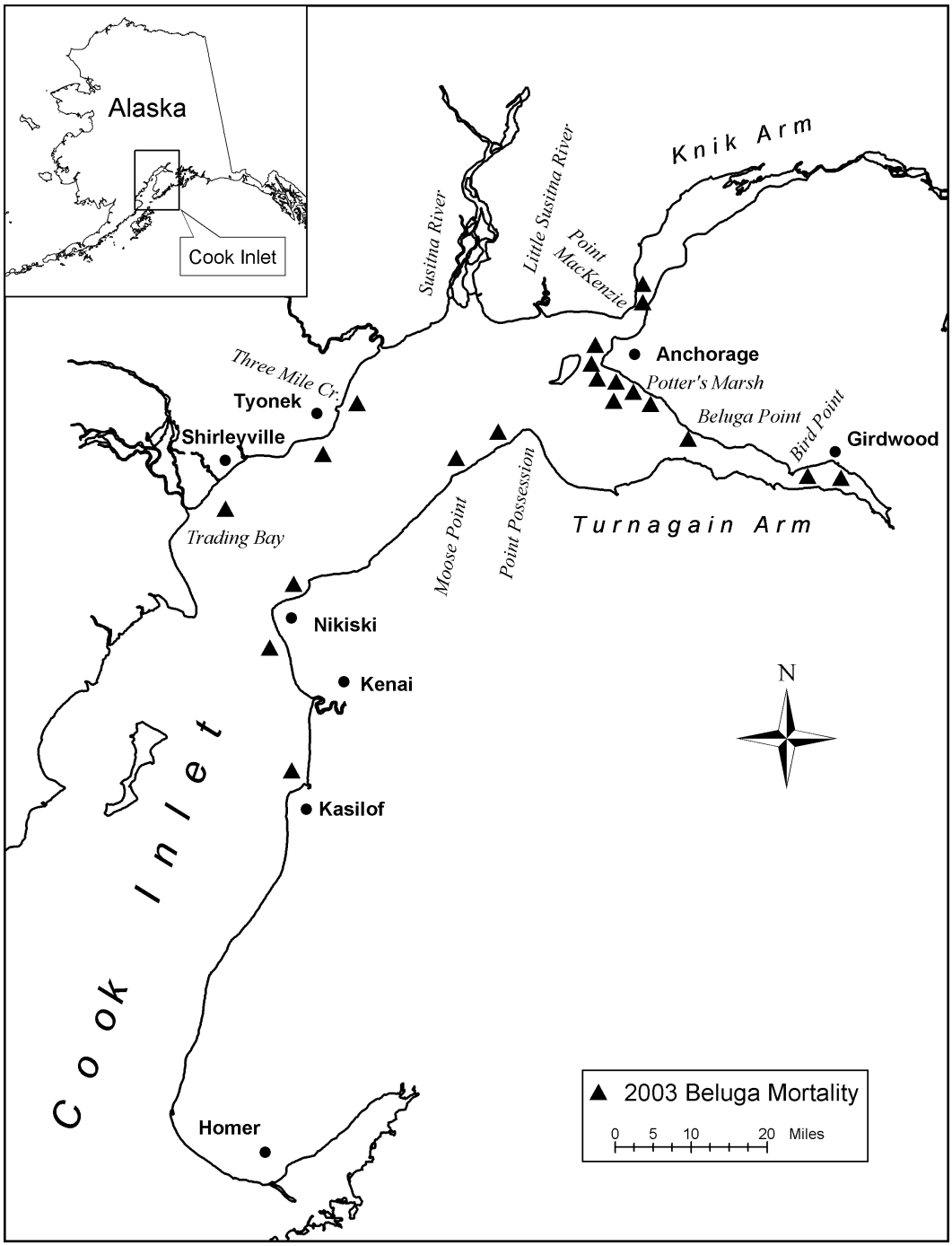

FIGURE 1. Locations of Cook Inlet beluga mortalities in 2003.

TABLE 2. Live strandings and 20 confirmed mortalities of Cook Inlet belugas in 2003.

Mortalities	Date observed	Location	Sex	Length	Condition[a]	Exam level[b]	Comments
Mortality	3/31/03	Nikiski	f	365 cm (12′)	3	C	pregnant, emaciated, vertebrae showing through skin
Live stranding	4/18/03	Turnagain, Girdwood	unk		1	A	1-2 live stranded, refloated with tide
Mortality	7/30/03	Kasilof	f	419 cm (13′9″)	4	B	floundering, then floating, beached at Kasilof, enlarged uterus, possible sign of recent birth
Mortality	7/27/03	Moose Point	m	~168 cm (~5′6″)	3	A	
Mortality	8/12/03	Three Mile Creek	m	405 cm (13′3″)	4	B	
Mortality	8/14/03	Knik Arm	m	338 cm (11′1″)	3	B	
Mortality	8/19/03	Shirleyville	m	152 cm (5′0″)	4	A	
Mortality	8/25/03	Knik Arm	m	474 cm (15′7″)	4	B	killer whale bite marks visible
Live stranding	8/28/03	Turnagain, Girdwood			1	A	~46 live-stranded, refloated with tide
Mortality	8/29/03	Turnagain, Girdwood	m	442 cm (14′6″)	3	C	mortality from ~46 stranded on 8/28/03
Mortality	8/30/03	Turnagain, Anchorage	m	467 cm (15′4″)	3	B	mortality from ~46 stranded on 8/28/03, missing head (melon in place)
Mortality	8/30/03	Turnagain, Potters Marsh	m	430 cm (14′1″)	3	C	mortality from ~46 stranded on 8/28/03
Mortality	8/31/03	Trading Bay	m	unk	3	A	mortality possibly from ~46 stranded on 8/28/03, floating, head missing
Mortality	9/01/03	Nikiski	m	~488 cm (~16′)	4	A	mortality possibly from ~46 stranded on 8/28/03
Live stranding	9/06/03	Turnagain, Beluga Point			1	A	~26 live-stranded, refloated with tide
Mortality	9/08/03	Turnagain, Anchorage	unk	unk	4	A	no length (head missing), will get gender from genetic analysis

TABLE 2. Continued.

Mortalities	Date observed	Location	Sex	Length	Condition[a]	Exam level[b]	Comments
Mortality	9/10/03	Turnagain, Potters Marsh	unk	171 cm (5′7″)	3	A	will get gender from genetic analysis
Mortality	9/12/03	Turnagain, Girdwood	f	372 cm (12′2″)	3	C	
Live stranding	9/14/03	Turnagain, Bird Point			1	A	~32 live-stranded, refloated with tide
Mortality	9/15/03	Turnagain, Anchorage	unk	191 cm (16′3″)	4	A	will get gender from genetic analysis
Mortality	9/15/03	S. of Pt. Possession	unk	~366 cm (~12′)	4	A	will get gender from genetic analysis
Mortality	9/21/03	Turnagain, Anchorage	m	477 cm (15′8″)	4	B	
Live stranding	10/06/03	Potters Marsh			1	A	4-9 live-stranded, refloated with tide
Mortality	10/13/03	Turnagain, Anchorage	m	463 cm (15′2″)	3	C	
Mortality	11/05/03	Turnagain, Beluga Point	f	369 cm (12′1″)	2	C	

[a] Condition: 1: alive, 2: fresh dead, 3: moderate decomposition, 4: advanced decomposition, 5: mummified/skeletal, 6; dead–condition unknown.
[b] Examination level: A: gross external; B: additional onsite information, such as other animals present and weather conditions. Biological sampling is kept to a minimum, mostly for age and reproductive determination; C: more complete biological sampling; may include muscle, organs, abnormalities, histology, parasites.

asite loads were within the normal range (Burek 1999a, 1999b).

The high rate of mortality in the small population of belugas in Cook Inlet is a concern. The Cook Inlet beluga population declined by 47% from 1994 to 1998 (Hobbs and others 2000). The decline of this population has been attributed, in large part, to overexploitation by Alaska Native hunters (NOAA 2003). Since 1998, the subsistence hunt has been co-managed by the NMFS and Alaska Native hunting groups who have reduced the hunt from >50 to <2 whales per year (Mahoney and Shelden 2000). In December 2000, as part of this co-management agreement and subsequent legal review, an emergency provision for unusual mortality was agreed upon by NMFS and Alaska Native groups (NMFS 2004). Upon reaching the 'trigger' threshold of 18 dead whales all hunting is suspended until the loss has been recovered through natural recruitment. The subsistence hunt was suspended for 2004. The maximum growth rate for Cook Inlet belugas was estimated to be 4% (NOAA 2003), but population growth has remained flat since 1998. Abundance surveys conducted in 1998 through 2004 have resulted in abundance estimates of 347, 367, 435, 386, 313, 357, and 366 whales, respectively (Rugh and others 2005).

This population may be less resilient to natural perturbations or anthropogenic impacts because of its small size and isolation. Monitoring will need to continue in the future. In 2003 the cause of death was identified in only 2 of 20 mortalities. It is recommended that a continued and expanded effort be made to examine each mortality in detail. Necropsies should be intensified and expanded to allow testing for biotoxins. A rapid response is needed in order to find fresh dead animals to allow for a full necropsy. When live strandings or moribund animals occur, personnel should stand by to examine any casualties. Data and specimens collected from mortalities are vital for the determination of individual animal health and for studies of the biology and health of the population. Stranding data and test results should be compiled and analyzed to look for patterns. Killer whale presence, associated beluga strandings, and predation of belugas by killer whales should be intensely monitored.

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