BRISTOL BAY DATA REPORT NO. 130

Belukha Whale Studies in Bristol Bay, Alaska

by

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Introduction

The river systems of Bristol Bay support the largest single-species salmon fishery in the world. In 1983, the catch of red salmon (Oncorhynchus nerka) was over 35 million fish, and the total run exceeded 45 million fish (C. P. Meacham, Alaska Department of Fish and Game, pers. commun.). During the peak fishing period in 1983, an estimated 1,000 drift-net boats and 344 setnet sites were fished in Kvichak Bay, and an additional 300-600 drift-netters and up to 230 setnetters were in Nushagak Bay. Collectively, over 450 km of gillnet were fished in the two bays.

Bristol Bay also supports a substantial number of belukha whales during the summer. During winter, these whales occur in the ice fringe and front from the Alaska coast to Siberia, as well as in regions of the Bering and Chukchi Sea pack ice where open water regularly occurs (Seaman and Burns, 1981). As the ice recedes in spring, a large segment of the population migrates north to summer in the coastal zone and along the pack-ice edge of the northern Bering, Chukchi, and Beaufort seas. Another group moves into Bristol Bay in April and May and remains there through the summer, feeding primarily on seasonally abundant smelt (Osmerus mordax), red salmon smolt, and adult salmon (Brooks, 1954; 1955). While there, belukhas are most commonly seen in Kvichak and Nushagak bays and their associated river systems.

In Bristol Bay, fishermen have long considered belukhas to be serious predators of salmon and in years of poor salmon returns have urged action to control the depredation of salmon. In response to that concern, in the mid-1950's the Alaska Department of Fisheries undertook studies of the natural history and ecology of belukhas, including detailed analyses of stomach contents (Brooks, 1954; 1955). Those

studies concluded that belukha predation on outmigrating red salmon smolt was a serious mortality factor which retarded the restoration of depleted salmon stocks and was costly to the greatly depleted fishery. Beginning in 1956, action was taken to displace belukhas from the Kvichak River during May and June. Nonlethal harassment by motorboats and small dynamite charges was conducted from 1956 through 1960, with moderate success (Lensink, 1961; ADF&G, 1969). After a break of 4 years, harassment activities were again undertaken in 1965, this time utilizing acoustic devices which transmitted the vocalizations of killer whales (Orcinus orca) (Fish and Vania, 1971). The "belukha spooker" program was discontinued after 1978, and organized attempts to displace the whales no longer occur. Since then, only limited studies have been made of whales in Bristol Bay. A project to consider the possible effects of belukha predation on red salmon stock-enhancement efforts in the Snake River was conducted by the Fisheries Rehabilitation, Enhancement, and Development Division of the Alaska Department of Fish and Game (ADF&G) (Fried et al., 1979). That study consisted of a series of aerial surveys flown in Kvichak Bay during summer 1979.

In 1982, this study was initiated through joint support of the Outer Continental Shelf Environmental Assessment Program and the ADF&G to study the distribution, abundance, and foods of belukha whales in Bristol Bay; to develop techniques for attachment of visual and radio tags; and to investigate the magnitude and causes of mortality to belukhas during their stay in the bay.

Methods

Field work was conducted from 15 June through 11 July 1982 and from 9 May through 15 July 1983. In 1982, studies were confined to Nushagak Bay and its associated river systems. In 1983, both Nushagak and Kvichak bays were included in our studies, with Kvichak Bay serving as the site of radio-tagging and tracking operations.

Information on the distribution, abundance, and movements of belukhas was obtained through systematic aerial surveys, radio-tracking of tagged whales, helicopter and boat observations made in conjunction with catching and/or tracking operations, and observations from shore. Nushagak and Kvichak bays were surveyed at approximately 2-week intervals from 15 April through 15 August. Surveys were flown along the coastline approximately 0.5-0.9 km offshore at an altitude of 305 m and speeds of 183-274 km/hr. Observers did not survey a specified transect width but instead counted all of the whales they could see on their respective sides of the aircraft. When large groups of whales were encountered and a single observer was present, the aircraft sometimes circled the groups in order to obtain the best possible estimate. The single exception to this method was a line-transect survey on 29 July, when a predetermined grid of both bays was flown and observations were confined to a 0.9-km strip on either side of the aircraft.

Radio transmitters were attached to two whales in 1983. One whale was caught by a local fisherman in a salmon setnet. The second whale was caught by herding into shallow water. OAR (Ocean Applied Research) backpack transmitters weighing approximately 575 g and measuring 24 cm long by 11 cm wide by 7 cm high were attached to the whales by bolting through the dorsal ridge. Movements and activity patterns of the

whales were monitored using Telonics receivers and two-element YAGI antennas. Each radio operated with a saltwater switch and therefore transmitted only when the antenna broke the surface. The radios had a range of from 20 to 60 km, depending on height of the receiving antenna.

Beach-cast and floating dead belukhas were located from aircraft and boats. During 1982, most observations of beach-cast belukhas in Nushagak Bay were made on an opportunistic basis. In 1983, systematic surveys were conducted in June and July. Aerial surveys were flown along the beach at altitudes of 25-50 m. Boat surveys were conducted by motoring along the shore, scanning the beach both visually and with the aid of binoculars. When a carcass was located, the animal was examined for cause of death and measured, its sex was determined, the lower jaw or several teeth were taken for age determination, and if condition permitted the stomach was examined for food remains. Additional information was obtained from ADF&G biologists in King Salmon and Dillingham and from salmon fishermen.

Fish remains in stomach contents were usually identified by their otoliths or characteristic bones. Information on probable foods was also obtained by observing feeding whales and by examining salmon caught in nets for the presence of belukha tooth marks. Since these types of information are not quantitative, most of the food habits data used in making calculations of fish consumption by belukhas are from the work of Brooks (1954; 1955).

Results and Discussion

Distribution and abundance.

The distribution of belukha whales in Nushagak Bay was similar in 1982 and 1983. Most whales were seen in four areas: the Igushik River, the Snake River, between the Snake River mouth and Clarks Point, and near the junction of the Wood, Little Muklung, and Nushagak rivers (Fig. 1). Small numbers of whales, usually fewer than 20, were present in the Igushik River during June 1982 and from April-June 1983. They were most often seen near or below the large horseshoe bend approximately 18 km upriver. Belukhas were not sighted in the Igushik in July of either year, although surveys were flown there on several occasions.

Whales were regularly seen in the Snake River and in both 1982 and 1983 were seen upriver as far as the junction of the Snake and Weary rivers, approximately 12 km from the river mouth. The largest sightings were of 15-25 whales on 13 and 14 July 1983. All others were of fewer than 10 individuals. No whales were seen in the Weary River.

The largest observed concentration of belukhas in Nushagak Bay occurred between the Snake River mouth and Clarks Point. Although the number seen there varied considerably, there was a clear trend of increasing abundance from late June to mid-July. From mid-April to mid-June, sightings were of fewer than 20 whales. In late June to mid-July, the number of whales estimated to be in this area ranged from 30 or 40 to 400 to 600 in 1982 and from 150 to over 400 in 1983. Many cows with newborn calves were in the area. In 1979, belukhas were also reported to be concentrated near the Snake River mouth in late June (Fried et al., 1979).

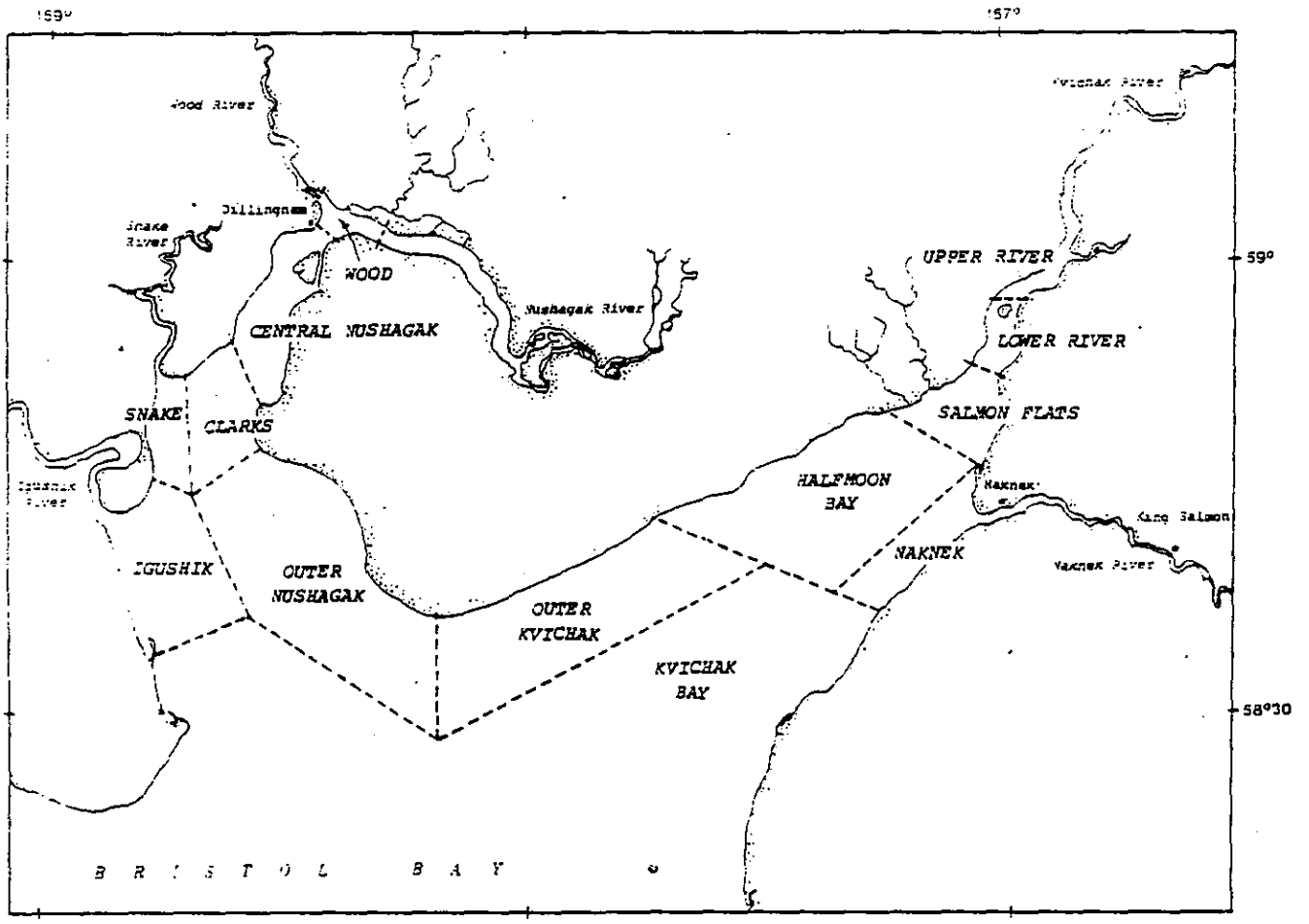

Figure 1. Bristol Bay study area showing geographical subareas.

Belukhas were sighted near the mouth of the Wood River and the Little Muklung River during May through early July. The number seen there varied considerably but was usually fewer than 50 in 1982, and in 1983 it was never more than 24. In both years we received reports of belukhas at Portage Creek, approximately 50 km up the Nushagak River from the Wood-Little Muklung area. Fried et al. (1979) also reported that belukhas regularly occurred off the mouth of the Little Muklung.

Observations on the distribution of belukha whales in Kvichak Bay were made from April to August 1983. In summarizing those observations, the region was divided into six geographical subareas, including the upper and lower Kvichak River, Salmon Flats, the Naknek River-Big Flat area, Halfmoon Bay, and outer Kvichak Bay (Fig. 1). The use of these areas changed markedly during spring and summer.

From mid-April to mid-May, belukhas were present in Halfmoon Bay, outer Kvichak Bay, Salmon Flats, and near the mouth of the Naknek River. On several occasions, the group at the mouth of the Naknek consisted of 70 or more whales. From mid-May to early June, belukhas were not seen near the mouth of the Naknek. From 25 May to 4 June, up

to 225 whales were seen in the upper Kvichak River each day. Twice daily, groups of whales moved upriver on the flooding tides, usually traveling at least to the mouth of the Alagnak River (18 km upstream), and returned downriver on ebbing tides. The whales were usually seen traveling in mid-river or milling in rips or current eddies, probably feeding on smelt or red salmon smolt present in the river during this period. Prior to 25 May, we did not make regular observations in the Kvichak River and were thus unable to determine when regular use of the upper river began. Brooks (1954) also reported that, from early May until mid-June 1954, belukhas swam up the Kvichak on each incoming tide and returned to the bay on ebbing tides. He estimated that about 250 whales used the river in 1954 and about 100 in 1955. During the same 2-week period that belukhas used the upper Kvichak River on high tides, they were common in the lower river, Salmon Flats, and Halfmoon Bay on low tides. After 7 June, belukhas were not again seen in large numbers in the Kvichak River. Small groups of fewer than 10 whales were occasionally seen later in the summer. These whales were usually swimming close to the riverbank and appeared to be feeding on adult salmon.

From 6 to 16 June, belukhas were present off and south of the mouth of the Naknek River. At least 100-200 were present most days, feeding at low tide over Big Flat. At high tide they moved up toward Salmon Flats. At least some whales were also present in Halfmoon Bay. After about 16 June, belukhas were no longer seen in the Naknek River-Big Flat area. Instead, from then until our studies terminated in mid-July, they occurred in the lower Kvichak River-Salmon Flats area at high tide and moved to Halfmoon Bay, or in some instances outer Kvichak Bay, at low tide.

Our best information on abundance of belukhas comes from systematic aerial surveys in which an attempt was made to cover all areas of Kvichak and Nushagak Bays where whales regularly occurred. The total number of whales present was estimated by using counts from those surveys, multiplied by correction factors developed from dive time-surface time data from radioed whales. The correction factors are applied to account for whales not at the surface during passage of the aircraft and vary depending on speed of the survey aircraft. For the two aircraft used, the correction factors were 2.75 (survey speed of 180 km/hr) and 3.7 (survey speed of 275 km/hr).

The most complete survey was an aerial strip-transect survey flown at 180 km/hr on 29 June (Fig. 2). In known concentration areas, transect lines were spaced 1.8 km apart. In intervening areas, a single track was flown approximately 1 km offshore from the coast. On that day 126 belukhas were counted in Nushagak Bay and 208 in Kvichak Bay, for a total of 334 whales. When the correction factor is applied to these counts, it yields estimates of 347 whales in the Nushagak and 572 in the Kvichak, for a total of 919 whales (Table 1). Total counts on all other days were lower and yielded corrected estimates of 237-692 whales. In Nushagak Bay, the highest estimated number of whales, 496, occurred on 14 July in the Snake River-Clarks Point area. In Kvichak Bay, maximum corrected counts of 584 and 572 occurred on 5 May and 29 June. The correction factor was not considered applicable to the counts made in Kvichak Bay on 14 August as the whales were in very shallow water and the observer considered that more than the usual proportion was counted.

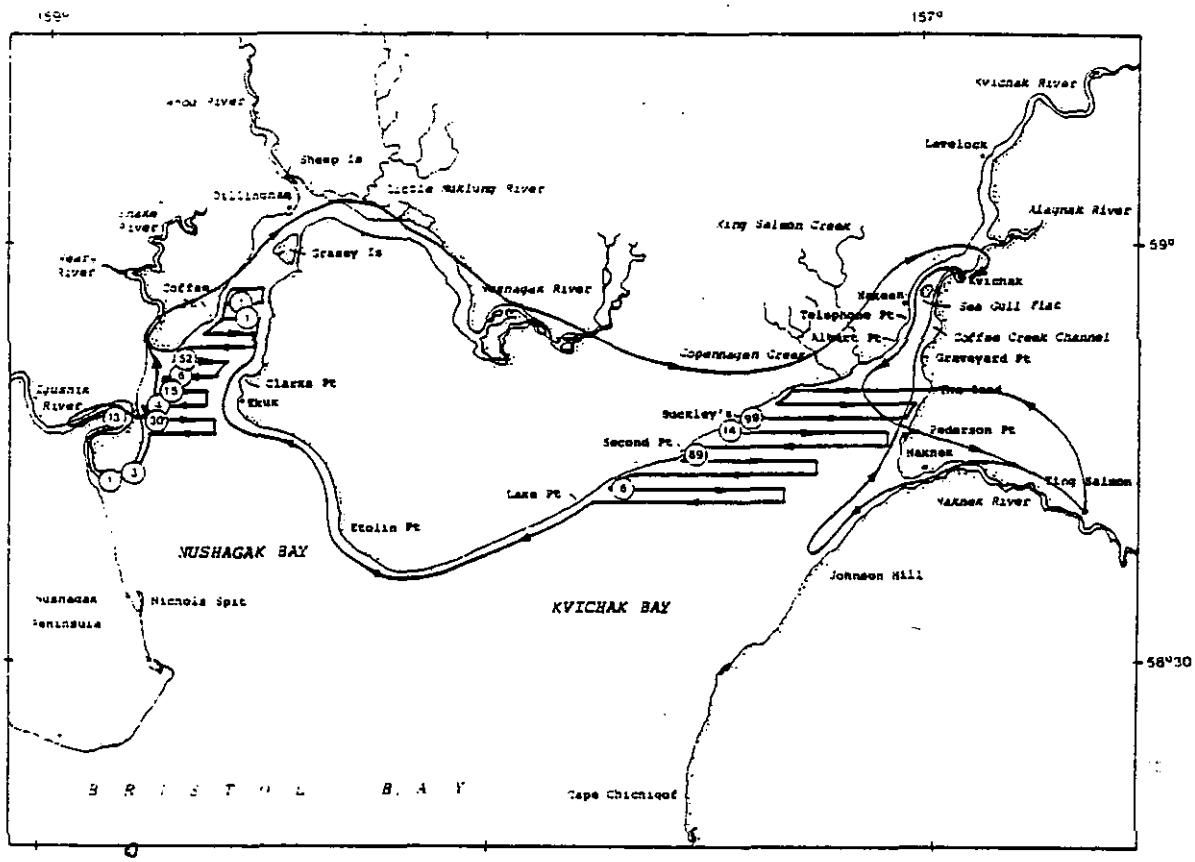

Figure 2. Aerial survey for belukhă whales in Nushagak and Kvichak bays, 29 June 1983. Numbers indicate the number of belukhas counted along the survey track.

Table 1. Aerial survey counts and corrected estimates of abundance for belukhas in Nushagak and Kvichak bays, April-August 1983.

	Nushagak Bay		Kvichak Bay		Total	
Date	counted	corrected estimate	counted	corrected estimate	counted	corrected estimate
15 Apr	59	218	128	474	187	692
2/5 May	11	41	158	584	169	625
17 May	23	85	74	274	97	359
31 May	10	27	77	212	87	239
4 Jun	--	--	101	278	--	--
14 Jun	18	49	94	259	112	308
18 Jun	--	--	126	347	--	--
24 Jun	66	182	20	55	86	237
27 Jun	93	256	--	--	--	--
29 Jun	126	347	208	572	334	919
14 Jul	134	496	49	181	183	677
14 Aug	0	0	309	n/a	309	n/a

Foods and feeding.

During the 1982 and 1983 field seasons, five whales were examined in which the stomachs were suitably fresh for examination and contained food. The three 1983 whales had died in May. Two had mostly flatfish (F. Pleuronectidae) remains in their stomachs, while the third contained primarily rainbow smelt with lesser amounts of flatfish and shrimp (Crangon sp.). None of the stomachs were full; the largest volume of contents was 163 ml. Of the 1982 whales, one had probably died in late May or early June; its stomach contained mostly otoliths from rainbow smelt and a few from sculpins (F. Cottidae). The other whale died in the Snake River in late June and had eaten entirely red salmon. Its stomach was the fullest of the five and contained 415 ml.

Most available data on the foods of belukha whales in Bristol Bay were collected in the 1950's and 1960's (Brooks, 1954; 1955; Lensink, 1961; ADF&G, 1969) and are summarized below. During May and early June, belukhas feed in the rivers, particularly the Kvichak, on smelt and red salmon smolt (Table 2). Smelt were eaten in the greatest numbers in the earliest May samples from a given year, followed later by red salmon smolt. Smelt overwinter near the mouths of rivers, move upriver in March to early May to spawn, then return to the bay after spawning (R. B. Russell, ADF&G, pers. commun.). Belukhas congregate in the rivers and at river mouths to feed on smelt during and after spawning. In mid- to late May, the red salmon smolt outmigration begins, and almost immediately the diet of belukhas switches to primarily smolt. Smolt travel downstream in large, dense schools, moving within a few feet of the surface, and are apparently more easily caught by belukhas than smelt, which also may be abundant but swim closer to the bottom (Brooks, 1955). In the Kvichak River, most of the red salmon smolt outmigration occurs within a few weeks, and by mid-June it is largely over.

The first adult red salmon appear in Kvichak and Nushagak bays around mid-June, with peak numbers usually present from the last week in June through the first 2 weeks in July. A few king salmon (Oncorhynchus tshawytscha) are present in early June. After mid-July, the red salmon run tapers off and other species of salmon (chums, O. keta; pinks, O. gorbuscha; and silvers, O. kisutch) are present, although their runs are much smaller than that of the red salmon (Nelson, 1981). Brooks collected no belukhas between mid-June and 1 July. By 1 July, smelt and red salmon smolt had disappeared entirely from the whales' diet and had been replaced by adult salmon, which composed the bulk of the diet for the subsequent 7 weeks (Table 3). During the first 3 weeks of July, reds were the predominate species of salmon eaten. After that, chums, pinks, and silvers became relatively more important. Chums first showed up in the diet during the 2nd week of July, pinks in the 3rd week, and silvers in the 4th week. Only a very few kings were eaten. After the 15th of August, stomachs contained very few salmon. Some had small quantities of shrimp or other fish such as sculpins, flounder, or lampreys (Lampetra japonica), as did stomachs of eight belukhas taken in September 1959 and 1960 (Lensink, 1961).

Table 2. Stomach contents of belukha whales from the Kvichak River and its estuary, May and June 1954, 1955, 1965, and 1966. (Brooks, 1955; ADF&G, 1969).

Date	Mean number per stomach			
	smelt	salmon smolt	shrimp	other fish
26-28 May 1954 n = 3	501	*		
22-24 May 1955 n = 2	548	73		
20-22 May 1966 n = 3	62	Ø	2	*
31 May-6 Jun 1954 n = 5	17	983	*	
26-31 May 1955 n = 8	29	607	6	*
29-31 May 1965 n = 3	Ø	283		
1-7 Jun 1955 n = 9	20	873		*
11-17 Jun 1954 n = 4	3	399	*	7
8-14 Jun 1955 n = 6	90	201	4	*
11-12 Jun 1965 n = 4	Ø	125	*	

* Trace (average of < 1 per stomach).

Table 3. The occurrence of adult salmon in belukha stomachs on a weekly basis from 1 July-18 August 1954-1955 (Brooks, 1955).

Date	No. of belukhas (excl. calves)	No. of salmon		Average/belukha	
		red	all species	red	all species
1-7 Jul	6	32	34	5.3	5.7
8-14 Jul	10	33	45	3.3	4.5
15-21 Jul	14	41	74	3.0	5.3
22-28 Jul	5	5	50	1.0	10.0
29 Jul-4 Aug	10	8	31	0.8	3.1
5-11 Aug	15	10	59	0.7	4.0
12-18 Aug	10	8	21	0.8	2.1

Consumption of Salmon.

In 1955, Brooks estimated the consumption of red salmon smolt in the Kvichak River using the following assumptions, which were based on his 1954-55 field studies: an average meal consisted of 685 smolt; each whale averaged 1.5 meals/day and fed on smolt for 19 days; and 150 belukhas fed in the river each day during the smolt run. Based on these assumptions, he calculated that belukhas ate approximately 3 million salmon smolt per season.

The consumption of smolt by belukhas in 1983 was estimated in the following manner. During late May and early June, the number of whales estimated to be in Kvichak Bay ranged from 210 to 280. We regularly counted groups of 75-225 in the river and consider 200 to be a reasonable estimate of the average number feeding there during this time. The large groups of whales were in the river for 14 days from 25 May through 7 June, after which we did not see them there. We made no observations in the Kvichak prior to 25 May. In recent years, the smolt run in the Kvichak has lasted for about 30 days from approximately mid-May to mid-June (Meacham, 1981). Since whales clearly did not use the river after mid-June, and since they probably did use it before 25 May, 19 days seems a reasonable approximation of the period spent feeding on smolt.

Daily ration can be calculated as a product of predator size and consumption rate. Brooks (1954; 1955) and Lensink (1961) collected and measured 82 belukhas of all ages from Nushagak and Kvichak bays. Mean length of those animals, excluding calves, was 326 cm. Similar mean lengths were reported by Nelson (1887), who found that the average adult in the Yukon-Kuskokwim area was 305-366 cm long, and by Doan and Douglas (1953), who found that the average length of 1,077 belukhas from Churchill, Northwest Territories, was 308-325 cm. Weight data are not available for belukhas from Bristol Bay. However, Sergeant and Brodie (1975) plotted a length-weight regression for belukhas from Churchill, which are similar in size to those from Bristol Bay. On the basis of Sergeant's and Brodie's data, a whale averaging 326 cm in length will weigh about 350 kg.

Sergeant (1969) summarized data on the daily ration of six captive belukhas and found that they consumed 4-7% of their body weight per day. The average for four of those measuring 300-400 cm in length was 5.1% per day; therefore, a 350-kg whale will consume about 18 kg per day. Based on estimated weight of prey items, we calculated that the stomach of an average whale collected during the smolt run in 1954-55 contained 7-8 kg. Estimated numbers of smolt, and therefore weight of food per stomach, are almost certainly low due to the difficulty of counting partially digested fishes. During the peak of the adult salmon runs, that average was 15 kg per stomach and, later in the season, 6-11 kg. Assuming two meals per day, daily consumption would therefore be about 15 kg of smolt or 12-30 kg of adult salmon. Using data on the number of fishes eaten, and information on the average size of fishes, it was estimated that smolt composed 73% of the diet during the 19 days when the whales ate them, or approximately 13 kg eaten per whale per day. That number can then be divided by the average weight per smolt (+ 8 g, taking into account the ratio of age I and II smolt and their mean sizes based on the 20-year average provided in Meacham, 1981) to estimate the number of smolt eaten per whale per

day. Using the above assumptions, the consumption of red salmon smolt can be calculated as follows:

200 belukhas X 1625 smolt/day X 19 days = 6,175,000 salmon smolt

The average annual smolt run in the Kvichak from 1971-1980 was approximately 122 million (Meacham, 1981). Consumption by belukhas represents about 5% of that average. If no predation had occurred and 10% of these smolt survived to spawn (Huttenen, 1982), they would number about 618,000, or approximately 3% of the 1983 commercial salmon catch in Kvichak Bay. Belukha predation on salmon smolt undoubtedly also occurs in the Nushagak, but we do not have the information necessary to make calculations for that area.

Brooks (1955) calculated the predation on adult salmon based on the average number of salmon per stomach for the whales he collected (2.1 reds, 5 total), a 49-day period of eating salmon, and an estimated 800 whales in 1954 and 450 in 1955. In 1954, estimated consumption was 196,000 (82,320 reds), and in 1955 it was 99,225 (41,674 reds).

Based on observations of feeding and data on the duration of salmon runs in 1983 (ADF&G, unpubl.), we consider 70 days as a more realistic estimate of the period during which belukhas prey on adult salmon. Brooks's data indicate that fewer salmon are taken in August than in July and that even during the peak salmon run other prey are eaten. By multiplying data on the number and kinds of salmon and other species eaten per day over a 7-week period by average fish size, and assuming a total daily consumption of 18 kg per whale, the average daily consumption of salmon from 17 June through 25 August was estimated as 13 kg. Based on our most complete aerial survey in late June 1983 (Table 1), we consider 920 whales to be a reasonable estimate of the number of belukhas (older than calves) present during the adult salmon runs. Using these assumptions, then, the estimated 1983 consumption of adult salmon by belukhas is:

920 whales X 70 days X 13 kg salmon/whale/day = 837,200 kg adult salmon

If the total amount of salmon is allocated by species according to Brooks's data, excluding pinks since there were essentially none present in 1983, then the 837,200 kg represents approximately 182,000 red salmon and 101,000 salmon of other species. The catch of red salmon in Kvichak and Nushagak bays in 1983 was close to 27 million, out of a run of slightly over 33 million, so that belukha predation was the equivalent of less than 1% of the commercial catch and just over 0.5% of the total run. Catch of other species was approximately 1.1 million, with belukha consumption equaling about 9% of that number.

Mortality.

During June and July 1983, we conducted 856 km of systematic aerial or boat surveys for beach-cast, dead belukhas and located 25 carcasses, of which 19 were original sightings and six were resightings. Of the 19, 15 were recently dead (within the past 2-3 months), and four probably had been dead for over 6 months. Five additional dead belukhas were located in the course of other activities. Carcasses were found in both Kvichak and Nushagak bays, with the greatest number on the exposed beaches of Etolin Point, Halfmoon Bay, and near the Igushik

River mouth. It is probable that most carcasses flushed out with the tide, then washed back onshore with incoming tides and onshore winds.

Measurements were taken and sex was determined for 21 carcasses. Of those, one was probably an abortus and seven were recently born calves. Standard length for the seven neonates ranged from 137 cm to 150 cm, with a mean of 141 cm. The remaining animals ranged from 192 cm to 410 cm standard length. Sex ratio for all 21 carcasses was 13 males: 7 females (1 unknown). Of the eight neonates (including the abortus), six were males and two females. Of those 1 year or older, seven were males and five were females.

By combining information from all sources, an estimate was compiled of the rates and causes of mortality during May-July 1983 (Table 4). In general, it was difficult to ascertain cause of death of beach-cast carcasses unless fishermen were present nearby to tell us whether or not the whales had been caught in nets. In some instances net marks in the form of superficial cuts around the caudal peduncles and flukes were obvious. The flukes had been cut off of one large whale and a pectoral flipper from each of two neonates, presumably to disentangle carcasses from nets. However, in at least two instances when whales were known to have been killed in setnets within the previous few days, no net marks or other indications of cause of mortality were obvious. Rapid degradation of the skin upon exposure to wind and sun aggravated this problem. Of the known fishing-related mortalities, two were caught in king salmon setnets, four in king salmon drift nets, three in red salmon setnets, and one in a red salmon drift net. In addition, the small whale we radio-tagged had been caught in a king salmon setnet.

Table 4. Known mortality of belukha whales in Nushagak and Kvichak bays, May-July 1983.

Area	Cause of death			Total
	hunting	fishing-related	unknown	
Nushagak Bay	2	6	3	11
Kvichak Bay	2	6	12	20
			Total	31*

* Four of these are possibly duplicate sightings.

Hunting mortality was determined through interviews with ADF&G biologists and with local residents. One of the deaths attributed to hunting was a beach-cast carcass with obvious bullet wounds in the mid-body region. It could have been a hunting loss or possibly an animal shot at for some other reason. One of the remaining carcasses was probably an abortus. The others had no obvious marks, bullet holes, or wounds indicating cause of death.

When belukhas are caught in nets, they become entangled in two ways. Some, especially neonates and juveniles because of their small size,

become entangled in the web of the net, catching pectoral flippers or tail flukes. In at least some instances, fishermen are able to disentangle and release these individuals before they drown. The small male animal that we tagged on 9 June had been caught in a net. He had superficial cuts in the skin and blubber and slightly dry skin but apparently suffered no long-term damage when set free. Several days later he was over 20 km from the release site and swimming with other whales. Larger individuals are able to break through net webbing but sometimes become entangled in the lead and cork lines. They roll and thrash when hitting the net, wrapping themselves so tightly that they have to be cut out. The tail flukes may be cut off in the process.

Approximate time of entanglement was known for six whales, five of which were caught by set-netters and one by a driftnetter. All but one (the small whale that was rescued and radio-tagged) were caught at night or on early morning tides.

In Nushagak Bay in 1982, carcasses of six dead belukhas were located. One of those was missing the tail flukes and had a bullet wound in the head; its death was considered to be fishing related. Cause of death for the other four, two of which were neonates, could not be determined.

If the number of belukhas present in Nushagak and Kvichak bays in summer 1983 is estimated at 919, the number extrapolated from maximum aerial survey counts on 29 June, then the 27-31 dead animals located in May-July represent 2.9-3.4% of that total group of whales. Gross productivity for belukhas has been estimated at 9-12% (Brodie, 1971; Sergeant 1973), which in a group of 919 whales would result in 83-110 calves. The seven dead neonates located by us in summer 1983 would represent 6-8% of that year's calf production. Actual mortality is undoubtedly greater as our mortality figures are based only on carcasses we personally located or happened to hear about. We did not systematically interview fishermen, yet heard of at least four dead belukhas through casual conversation. Although aerial survey efforts were considerably more extensive in 1983 than in 1982, carcasses were probably missed in the Nushagak system which we surveyed less frequently and less intensively. In 1982, three of the six carcasses we found were located up the Snake River in the grass along the riverbank. Such carcasses are extremely difficult to see from the air and probably would not have been noticed on the 1983 aerial surveys.

Conclusions

A comparison of studies conducted in the 1950's and our more recent work suggests that the distribution and abundance of belukha whales in Bristol Bay are largely the same today as they were 30 years ago. Like Brooks, we conclude that the predation by belukhas on adult red salmon is negligible, accounting for less than 1% of the commercial catch of that species. Predation on other species may be somewhat more significant, amounting in total to almost 9% of the commercial catch of king, silver, and chum salmon. Since the 1950's, the then-depleted red salmon runs have recovered fully, attaining close to all-time high levels in the last few years. Predation by belukhas on red salmon smolt, once considered to be a major source of salmon mortality, amounts to less than 5% of the total smolt outmigration.

The major change in the interaction between belukhas and fisheries in the past 3 decades has been the apparent increased incidence of entanglement of whales in nets during the red salmon fishery. In the 1950's, Brooks documented no net-caused mortality (J. Brooks, National Marine Fisheries Service, Juneau, pers. commun.). Since then, some mortality (estimated at about 5-10 whales per year) has been known to occur in conjunction with the king salmon fishery (J. J. Burns, ADF&G, pers. commun.). In 1983, we documented a minimum of 27 dead whales, at least 12 of which were known to have been killed in nets. Six of those were killed in king salmon nets, four in red salmon nets, and two in nets of unknown type. The cause of this apparent increase in entanglement warrants further study.

References Cited

Alaska Department of Fish and Game. 1969. A report on beluga whales in Alaska. Unpubl. ms. prepared for the Board of Fish and Game Meeting, Anchorage, AK, 1969. 12 pp.

Brodie, P. F. 1971. A reconsideration of aspects of growth, reproduction, and behavior of the white whale (Delphinapterus leucas) with reference to the Cumberland Sound, Baffin Island, population. J. Fish. Res. Board Can. 28:1309-1318.

Brooks, J. W. 1954. Beluga. Pages 51-57 in Annual Report for 1954. Alaska Dep. Fish., Juneau.

Brooks, J. W. 1955. Beluga investigation. Pages 98-106 in Annual Report for 1955. Alaska Dep. Fish., Juneau.

Doan, K. H., and C. W. Douglas. 1953. Beluga of the Churchill region of Hudson Bay. Fish. Res. Board Can. Bull. 98. 27 pp.

Fish, J. R., and J. S. Vania. 1971. Killer whale, Orcinus orca, sounds repel white whales, Delphinapterus leucas. Fish. Bull. 69:531-535.

Fried, S. M., J. J. Laner, and S. C. Weston. 1979. Investigation of white whale (Delphinapterus leucas) predation upon sockeye salmon (Oncorhynchus nerka) smolts in Nushagak Bay and associated rivers: 1979 aerial reconnaissance surveys. Unpubl. rep., Alaska Dep. Fish and Game, Dillingham. 15 pp.

Huttenen, D. C. 1982. 1981 Bristol Bay sockeye salmon smolt studies. Alaska Dep. Fish and Game Tech. Data Rep. No. 73. 63 pp.

Lensink, C. J. 1961. Status report: beluga studies. Unpubl. rep., Div. Biol. Res., Alaska Dep. Fish and Game, Juneau. 20 pp.

Meacham, C. P., ed. 1981. 1980 Bristol Bay sockeye salmon smolt studies. Unpubl. rep., Alaska Dep. Fish and Game, Anchorage. 45 pp.

Nelson, E. W. 1887. Report upon natural history collections made in Alaska between the years 1877 and 1881. H. W. Henshaw, ed. Congressional Ser., U.S. Public Doc. No. 2349, U.S. Gov. Printing Off., Washington, DC.

Nelson, M. L. 1981. Annual management report 1981 - Bristol Bay area 1981. Unpubl. rep., Alaska Dep. Fish and Game, Anchorage. 175 pp.

Seaman, G. A., and J. J. Burns. 1981. Preliminary results of recent studies of belukhas in Alaskan waters. Rep. Int. Whaling Comm. 31:567-574, SC/32/SM 13.

Sergeant, D. E. 1969. Feeding rates of Cetacea. Fisk. Dir. Skr. Ser. Hav Unders. 15:246-258.

Sergeant, D. E. 1973. Biology of white whales (Delphinapterus leucas) in western Hudson Bay. J. Fish. Res. Board Can. 30:1065-1090.

Sergeant, D. E., and P. F. Brodie. 1975. Identity, abundance, and present status of white whales, Delphinapterus leucas, in North America. J. Fish. Res. Board Can. 32:1047-1054.