



PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR

VOLUME 6 – NUMBER 3

SPRING 1986



Cover Photo:

*Whale #236 lunge feeding in the Lower West Arm of
Glacier Bay (Story p. 3).*

Glacier Bay Research Supports Humpback Whale Management

By Anjanette Perry

Each summer, between 10 and 24 humpback whales (*Megaptera novaeangliae*) feed in the waters of Glacier Bay National Park, Alaska (Fig. 1). Historically, most of these whales remained in the bay and its inlets for the greater part of the summer. In 1978, however, 17 of the 20 whales abruptly departed the bay soon after their entry.

Two hypotheses were advanced: the first asserted that vessel traffic disturbed the whales and that the recent dramatic increase of vessel traffic had forced the whales to "abandon" the bay; the second proposed that the departure resulted from a natural decline in the availability of the whales' prey within Glacier Bay.

Concern for the welfare of this endangered species prompted the Park Service to consult with the National Marine Fisheries Service (NMFS). Following NMFS' recommendations in a 1979 Biological Opinion, the park published temporary regulations restricting the numbers of vessels entering the bay and prohibiting close approaches to the whales. In 1981 the park initiated a multidisciplinary study of humpback whales, their behavior, the distribution of their prey, and their acoustic environment.

Studies of humpback whale prey in Glacier Bay were carried out by Ken Krieger and Bruce Wing of the Auke Bay NMFS Laboratory, using a chart-recording fathometer. A fathometer introduces short pulses of high frequency sound into the water through a hydrophone or transducer; the echoes are then evaluated for timing and strength. The timing of the echo's return gives the depth of the "target"; the strength provides information about the size and density of the target. Target species are then confirmed using net tows. The use of fathometers or echosounders to detect and evaluate biological targets is generally referred to as "hydroacoustics," to distinguish it from bioacoustics or the study of biologically generated sounds.

Krieger and Wing found that the distributions, densities, and species compositions of whale forage varied considerably year to year. For example, a large school of capelin was present in Bartlett Cove in 1982, but no significant whale feed was present there in 1983, 1984, or 1985. Similarly, in 1984 schools of walleye pollock were concentrated in Sitakaday Narrows, where they had not been common before. In general, during the early 1980s Glacier Bay humpback whales fed primarily on schooling fishes found at discrete locations in the bay's lower reaches. In the 1970s, however, swarms of euphausiids in the mid and upper bay were speculated to be the main prey item. Since these swarms were not quantitatively assessed, it is not known whether prey densities were higher before 1978 than at present.

Glacier Bay's acoustic environment was surveyed by Paul Miles and Chuck Malme of Bolt, Beranek, and Newman, Inc. Using a calibrated hydrophone and tape recorder system, they collected radiant noise signatures of several cruise ships, tour boats, and smallcraft operating in the bay. The noise of individual vessels at a standardized speed of 10 knots varied considerably both within and across vessel classes. Generally, diesel-powered ships were

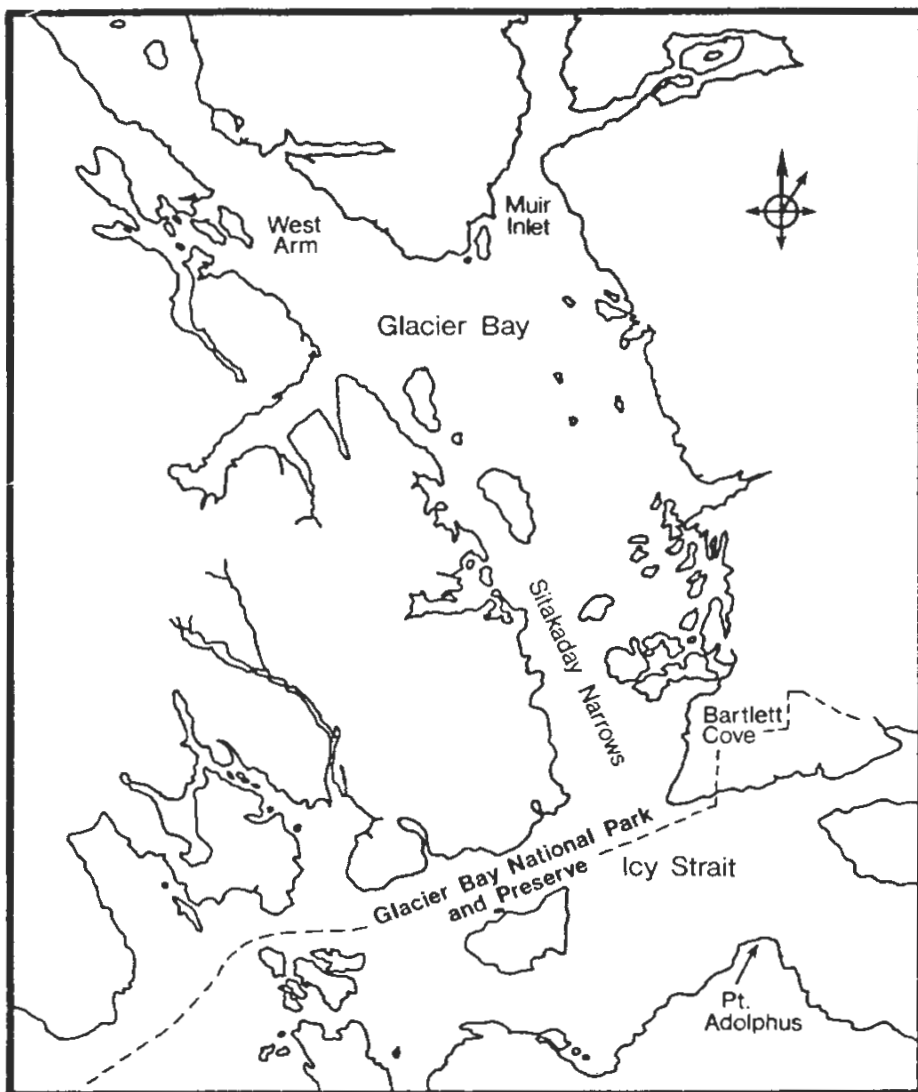


Figure 1. Glacier Bay and adjacent waters.

about 10 dB noisier than steam-powered ships. Variations in smallcraft noise were a function of engine types, propeller conditions, and hull types. Long-term synoptic ambient noise levels were obtained using sonobuoys (buoys with attached hydrophones) set in mid-bay. Miles and Malme also investigated topographic sound "shadowing," in which features such as islands or peninsulas create zones of lower noise associated with a ship operating in the area. Such shadows do occur in Glacier Bay, and may reduce received noise levels by as much as 20dB.

A team of researchers led by Louis Herman of the University of Hawaii (UH) conducted behavioral research. Scott Baker headed the field research until 1984, when the author served as field director. To observe whale behavior in the presence and absence of vessels, we set up shore-based observation posts at several locations around the bay. From these posts, positions of whales and of vessels relative to whales were measured with a high-precision sur-

veyor's theodolite. Behaviors of whales were recorded on a microprocessor-aided time-event recorder. We also photographed whales from small boats for individual identification. The coloration, shape, and scarring pattern of the ventral surface of a whale's tail flukes are particularly useful for identification (Fig. 2).

The UH team demonstrated that loud vessel noise or erratic vessel movement can cause short-term disturbance of humpback whale feeding and social behavior. Two vessel avoidance strategies employed by the whales were described: (1) vertical avoidance if vessels were 0 to 2000 meters from the whale, and (2) horizontal avoidance if vessels were between 2000 to 4000 meters from the whale. Vertical avoidance involved increased dive times (though not necessarily to deeper depths), decreased respiration intervals, and decreased whale speeds. The horizontal avoidance strategy involved decreased dive times,

Continued on next page

Glacier Bay Research

Continued from page 3

longer intervals between respirations, and greater speed of movement. Whales apparently moved into topographic shadows on a few occasions, although such movement was not statistically quantified. The presence of large ships was significantly correlated with aerial behaviors such as breaches and tail slaps. There was also close correlation between sudden changes in sound intensity and the onset of aerial behaviors. Many of the intensity changes resulted from variations in engine speed or propeller pitch.

The lack of comparable data prior to 1978 prohibited drawing the conclusion that either vessel traffic or changes in prey was solely responsible for the whales' exodus. However, in June of 1983 NMFS issued a second Biological Opinion which stated in part:

We reiterate the conclusion in our 1979 Biological Opinion that if the amount of vessel use were allowed to increase without limit in Glacier Bay . . . the associated disturbance would be likely to jeopardize the continued existence of the Southeast Alaska humpback whale stock.

After reviewing the Biological Opinion, NPS established permanent regulations for protection of the humpback whale. These regulations limit the numbers and classes of vessels that can enter the bay during the summer months, establish vessel operating restrictions, provide a mechanism for designating whale waters (specially restricted areas) and vessel limits, and prohibit the harvest of certain species of fish and crustaceans that are prey species of the humpback whale.

Glacier Bay's Resource Manager, Gary Vequist, now hires a whale biologist each season. Scott Baker, who has held this position the first two seasons, employs many of the techniques and procedures he developed while conducting the behavior study. His present duties include monitoring the number of humpback whales that enter the park's waters, determining how long individual whales remain, and recording feeding and social behavior. Park Supt. Mike Tollefson will base future whale management decisions, such as changes in the number of cruise, tour, and private vessel entries, partly on continuing evaluation of the whale biologist's findings.

Ultimately, the management of humpback whales and their habitat will require solid understanding of the natural history of this endangered species. The observations and photographs by the University of Hawaii team and the whale biologist provided extensive data over the past four summers. Comparison of findings from the four summers of 1982 to 1985 describes both the across-season patterns and within-season variations of Glacier Bay humpback whale population dynamics. Additional historical information is available from the work of Charles Jurasz, a biologist who studied the whales in Glacier Bay during the 1970s. Reference to Jurasz's photographs and reports has provided up to 13 consecutive years of data on the life histories of some individual Glacier Bay whales.

Knowing the number of whales that enter the park each summer is of primary importance to their management. Over the past four seasons their abundance has fluctuated considerably. In 1982 and 1984 we identified photographically a total of 22 and 24 whales, respectively. In 1983 only 10 whales were

identified. Three more whales briefly entered the bay that year, for a total of 13, but photographs of these were of too poor quality for individual identification. In 1985, 15 whales were present and individually identified over the summer. In all, 40 different whales were seen over the four years. Many of these whales had visited the park in previous seasons; 15 already were frequent park visitors in the early 1970s. Although most whales departed the bay in 1978, we know that at least these 15 did not leave permanently.

The duration of each whale's visit, known as its period of residency, was traditionally an important parameter for evaluating whale use in Glacier Bay. In recent years resident versus transient behavior has been complicated by the behavior of certain whales. These individuals have extended their range to include the waters near Pt. Adolphus, just outside the park, and they move in and out of park boundaries repeatedly during the summer. Therefore, at the end of each season the whale biologist prepares a diagram including the dates of all sightings of each whale, whether in the park or at Pt. Adolphus (Table

1). Resource Management makes use of these diagrams to track individual whales' movements, to determine their reproductive status (whether a whale has a calf in a given year), and to monitor overall use trends across years.

At about six months of age, a humpback whale is first brought by its mother to a feeding area such as Glacier Bay after completing the migration from southern calving grounds. Some of Glacier Bay's whales provide evidence that in later years the young animal returns to the same feeding region. One animal, nicknamed Garfunkle by Charles Jurasz, is the oldest whale known to have come to Glacier Bay as a calf. Garfunkle was first photographed in 1974, and has returned to the Glacier Bay area every year since. In 1985, two other animals first sighted as calves were documented returning to the bay. One was born in 1982, the other in 1984. Since 1982, tail fluke photographs of three more calves have been collected. Future studies will attend to the possible return of these calves.

Continued on page 4

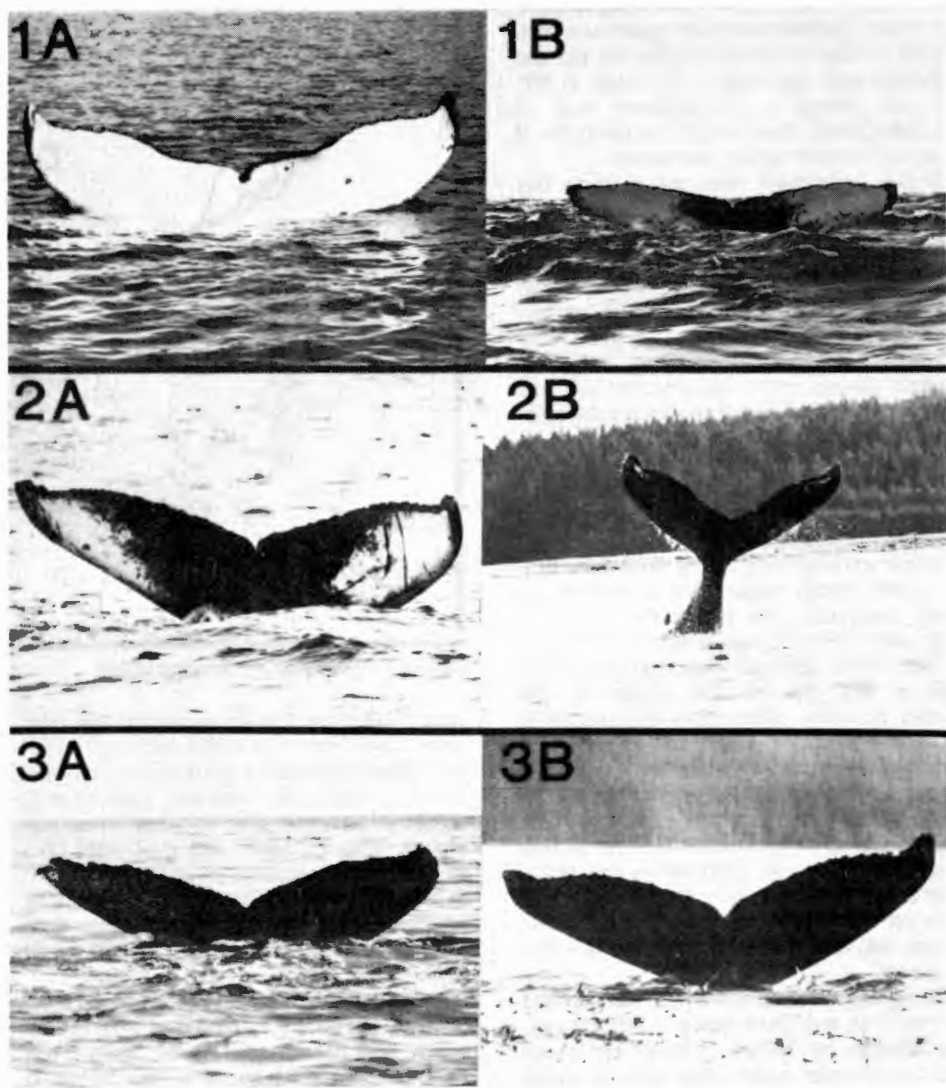


Figure 2. Representative humpback whale flukes. Individual animals' flukes differ in shape, percentage of white pigmentation, and scarring patterns. Fluke photographs are categorized according to their proportion of pigmentation. Whales 1A and 1B are predominantly white (white extends across more than 50 percent of each fluke); 2A and 2B are moderately white (white covers less than 50 percent of each fluke); and 3A and 3B are dark (no white except for what appears to be scarring).

Glacier Bay Research

Continued from page 4

Resighting these calves over the long term is of scientific interest for two reasons. When densities of schooling fish are high, whales frequently feed on them in cooperative "packs" of up to 10 animals. We suspect these social affiliations are composed of related whales. The resighting of females feeding with their offspring would support this hypothesis. Secondly, biologists judge the age of humpback whales by the number of growth rings in the ear plug. Without an independent means of calibrating this technique we don't know whether growth rings are formed yearly or semi-annually. The age of first reproduction occurs when 8-12 rings have formed, but it is unclear whether females are four to six years or eight to twelve years old at this time. The only Glacier Bay whale of known age old enough to have given birth is Garfunkle. After 11 years of sighting him/her unaccompanied by a calf, it seems likely, though not certain, that Garfunkle is a male. Although determining the age of first reproduction for female humpback whales could be a long process, the importance of this information justifies its research priority.

We photograph humpback whales throughout the year, both in southeastern Alaska and on the Hawaiian wintering grounds. Glacier Bay whales are frequently resighted. These data augment those collected during the summers, providing further insights into migration patterns, feeding ecology, and breeding biology. The NPS commitment to continuing the Glacier Bay work is allowing for increased understanding and improved management of this remarkable resource.

Perry is an oceanographer, currently working at the University of Hawaii under contract to the NPS.

Table 1.
Resight histories of whales photographed in the
Glacier Bay - Point Adolphus region during 1984.

Name	ID#	July				August			September		
		2	10	18	26	3	11	19	27	4	12
1. Chop Suey	118	GGGGG	GGGGGGG					GGGG	G		G
2. Gertrude	587	G	GG GG	G		G					
3. Calf of 587	+	G	GG GG	G		G					
4. Curly Fluke	566	G		G	G						
5. Quits	535	GG GG									
6. Calf of 535	349	GG GG									
7.	348	G	G								
8. MD	157	GG A		A	GA	A		GA	A A		
9.	351	GG G G	GGGG					GG			
10.	350	GGG GG				G					
11. Cow	573		A			AA		GGG			
12. Calf of 573	382		A			AA		GGG			
13. Dike	237		G G		AG						
14.	159		GGGA		GG	AA		G GGG	G		
15. Spot	235		G		GG						
16. Calf of 235	+			G	GG						
17. White Eyes	117				GGG						
18. Garfunkle	516				A	GGA		GG AA			
19.	381				G			G			
20.	387					A					
21. Notchfin	232						G G		G		
22.	593						G G				
23. Little Spot	236							GG G	GG		G
24. Calf of 236	383							GG G	GG		G

KEY: G = Glacier Bay

A = Point Adolphus

+ = calves for which there is no fluke photograph do not have an ID #.