WHALE BEHAVIORAL RESPONSES AND HUMAN PERCEPTIONS: AN ASSESSMENT OF HUMPBACK WHALES (*Megaptera novaeangliae*) AND VESSEL ACTIVITY NEAR JUNEAU, ALASKA

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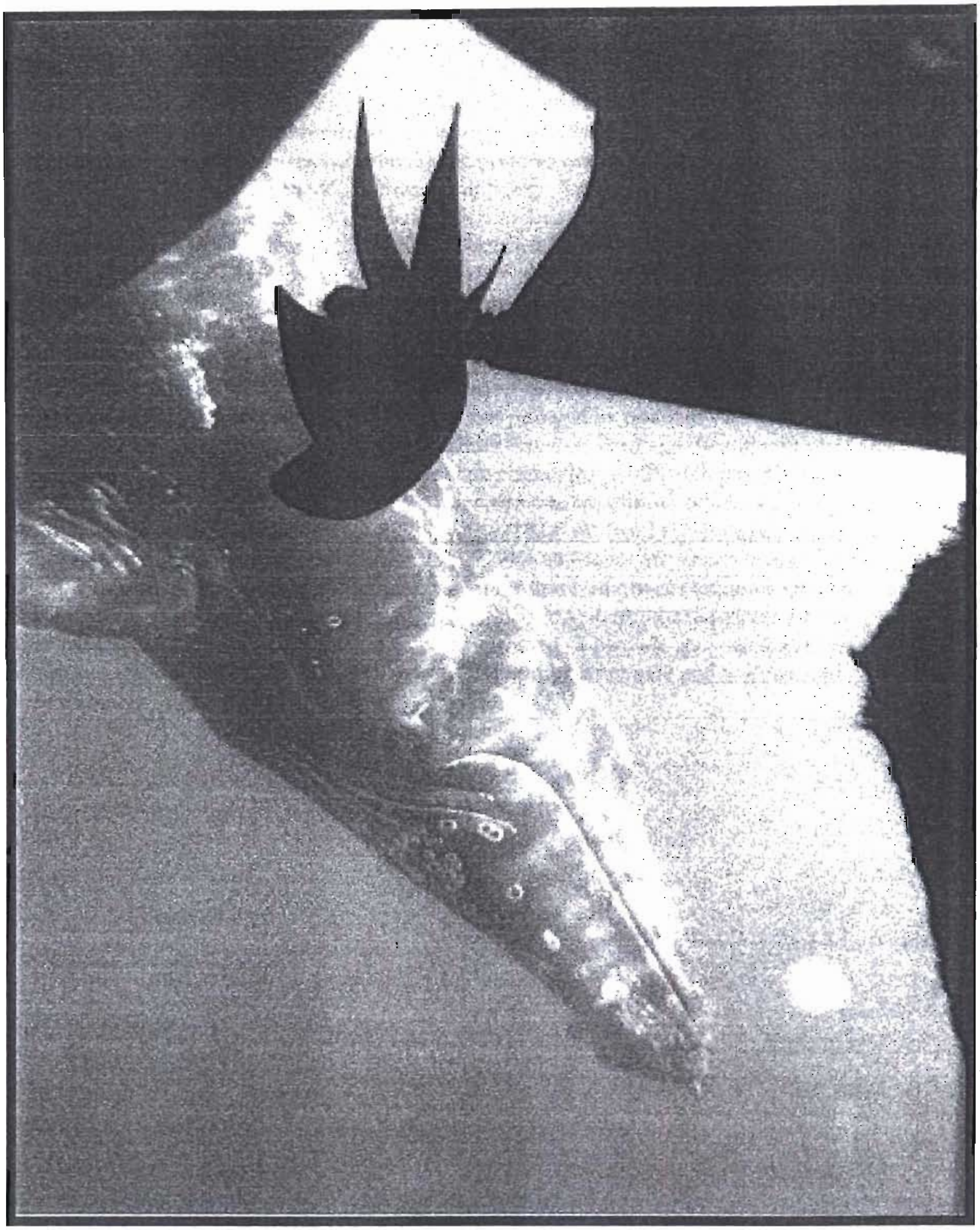

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Abstract

I studied the effects of vessel activity on the behavior of humpback whales (*Megaptera novaeangliae*) near Juneau, Alaska, from 6 July to 25 August 2000. I collected behavioral data from a 7 m inboard-outdrive research vessel in Stephens Passage and Lynn Canal, where feeding Central North Pacific humpbacks are the focus of a burgeoning whale watching industry. Utilizing continuous and point behavioral sampling, I recorded locations, identities, and behaviors of 27 humpback whale focal pods for 39.6 observation hours. I also recorded number, type, approach style, length of stay, and proximity of whale watching boats within 400 m of each focal pod. I observed 16 pods (1404 total min.; 261 surface intervals) when at least one whale watching boat was present for more than ten minutes, and observed 11 pods (972 total min.; 191 surface intervals) when no whale watching boats were present. I compared whale behavior between the two conditions, whale watching vessels present and whale watching vessels absent. Average whale respiratory activity was almost identical in the two conditions. However, individual whales followed by whale watching boats showed significantly greater variance in time spent at the surface and number of blows per surfacing than did whales not pursued by boats ($F=2.87$, $p<0.05$; $F=3.14$, $p<0.05$). Additionally, whales with whale watching boats showed significantly greater variance in the proportion of time spent engaging in surface-active behavior ($F=284.60$, $p<<0.001$), and collectively exhibited surface behaviors more frequently, than did whales without whale watching boats. Over 80% of whale watchers remained at least 200 yards (182.8 m) from focal whales; however, almost 30% of whale watchers violated NOAA Fisheries' *Alaska Marine Mammal Viewing Guidelines* by staying with pods for more than 30 minutes. I found that humpbacks exhibit subtle short-term behavioral responses to whale watching boats, but that long-term consequences of heavy vessel traffic for this whale population remain to be determined. I provide recommendations to NOAA Fisheries charged with assisting the recovery of the humpback whale and with managing Alaska's whale watchers.

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And yonder, glistening amid the irised spray, is a still more striking revelation of warm life in the so-called howling waste—a half-dozen whales, their broad backs like glaciated bosses of granite heaving aloft in near view...and plunging down home in colossal health and comfort.
(John Muir, 1879)[1]

Introduction

Central North Pacific Humpback Whales

The humpback whales (*Megaptera novaeangliae*) that John Muir witnessed from his canoe in 1879 were probably abundant and widely distributed throughout Southeast Alaska's Inside Passage. The extensive hunting of North Pacific humpbacks would not begin in Alaska until approximately 26 years later. Between 1905 and 1965, an estimated 28,000 North Pacific humpbacks were killed before the International Whaling Commission (IWC) protected these animals from harvest in 1966 (Rice and Wolman 1982, Straley 1994). Rice (1978) estimated that close to 15,000 humpbacks—or roughly 12% of the worldwide population—plied North Pacific waters when Muir ventured north to Alaska. Now just over 6,000 humpbacks are believed to inhabit the same oceanic basin over a century later (Calambokidis 1997 et al., NOAA Fisheries 2000).

At least three populations of humpbacks inhabit the North Pacific, based on data from genetic analyses and aerial, vessel, and photo-identification surveys (Calambokidis et al. 1997, Baker et al. 1998, NOAA Fisheries 2000). One such population, the Central North Pacific stock, comprises an estimated 4,005 humpbacks that mate and calve in the Hawaiian Islands throughout the winter and spring, and migrate north to feed in eastern Alaska during the summer and fall (Baker et al. 1990, Perry et al. 1990, Calambokidis et al. 1997). Central North Pacific humpbacks show some degree of fidelity to distinct feeding areas throughout Alaska; that is, many whales return to feeding areas where mothers first brought them as calves (Martin et al. 1984, Baker et al. 1987). The humpbacks Muir encountered were probably ancestors to some of the estimated 404 current members of the Southeast Alaska feeding aggregation, the largest in the state (Straley 1994).

The presence of over 400 individuals in a single feeding aggregation is encouraging. Indeed, Rice (1978) estimated that only 1,000 humpbacks remained in the entire North Pacific when the IWC officially protected these whales in 1966. Humpbacks of the North Pacific have most definitely grown in number during the last three decades. And although some scientists characterize their recovery as slower than predicted (Johnson and Wolman 1984), their recovery hasn't gone unnoticed.

Whale Watching

Thousands, perhaps millions, of people have watched humpbacks—the "Merry Whales"—sometime in the last thirty years, somewhere in the North Pacific. Many have observed these charismatic baleen whales from their own boats, from friends' boats, from cruise ships, and from ferries and freighters. Moreover, commercial whale watching became an industry in Hawaii in the late 1970s, and is now a burgeoning industry in Alaska (NOAA Fisheries). According to a recent economic study sponsored by the Marine Sanctuaries Division, nearly 370,000 people experienced the "Great Winged Whale" in Hawaii in 1999—and paid between US$11-16 million to do so (Utech 2000).

The coastal areas of the North Pacific are, of course, not the only hotbeds of whale watching activity in the world. In *Whale Watching 2000,* Erich Hoyt announced that commercial whale watching is now a US$1 billion industry worldwide. According to Hoyt, "[This industry makes] socioeconomic, educational, environmental, and scientific contributions…" to more than 492 communities around the globe. Nine million people in more than 87 countries went out on a boat to see whales—mostly large whales— in 1999, said Hoyt. This statistic represents only those individuals who participated in commercial whale watching excursions, and doesn't include people who went out on their own boats to watch whales. Yet even this conservative estimate far outnumbers the range of 300,000-500,000—the approximate number of large whales on the planet today (Gerber et al. 2000).

Clearly, a large number of people are interacting with a relatively small number of whales. In 1983, the IWC first considered whale watching as a non-consumptive "use" of whales (Constantine 1998). Ten years later, the IWC officially recognized whale watching as a legitimate tourism industry that involved the sustainable use of cetaceans (IFAW 1995). Finally, in 1994, the IWC formed the Sub-Committee on Whale Watching to create an international forum for discussing issues related to the exploding industry (Kato 2000).

Many people view whale watching as a benign and sustainable "use" of whales that is more desirable than harvesting whales for products (Tyack 1989). But others are increasingly concerned about the impacts of whale watching activities on the whales themselves—many of whom are classified as *endangered* or *vulnerable* by the World Conservation Union (Baillie and Groombridge 1996). As early as 1977, biologists, policymakers, and Hawaiian residents gathered to discuss the state's growing whale watching industry at the *Workshop on the Problems Related to Humpback Whales in Hawaii* (Norris and Reeves 1978). Likewise, in 1988, scientists and policymakers gathered in Monterey, California, for the *Workshop to Review and Evaluate Whale Watching Programs and Management*

Needs (Atkins and Swartz 1989). International audiences attended similar meetings, including the 1995 IFAW-sponsored *Workshop on the Scientific Aspects of Managing Whale Watching* in Italy and the 1998 *Whale Watching Research Workshop* held at the World Marine Mammal Science Conference in Monaco (Malcolm and Duffus 1998). Finally, conferences that addressed whale watching recently convened in locations as diverse as Latin America, New Zealand, and the Azores (Rossiter 1998).

Impacts of Vessel Activity on Humpback Whales

Because humpbacks are a popular focus of whale watching activities worldwide, a few scientists have tried to characterize the impacts of vessel activity on these animals. Some researchers feel that localized concentrations of vessel traffic may lead humpbacks to alter their distribution patterns (e.g., Herman 1979, Glockner-Ferrari and Ferrari 1985, Tyack 1989, Smultea 1994) and/or their behavior (e.g., Jurasz and Jurasz 1978, Dean et al. 1985, Beach and Weinrich 1989).

Only a handful of studies have attempted to describe short-term impacts of vessels on humpbacks in areas with seasonally high numbers of this species: the Hawaiian breeding grounds (Bauer and Herman 1986, Salden 1988, Glockner-Ferrari and Ferrari 1990, Green and Green 1990, Bauer et al. 1993); the Cape Cod, Massachusetts feeding grounds (Watkins 1986, Schilling et al. 1989); the Hervey Bay, Queensland resting area for southward-migrating whales (Corkeron 1995, Lalime-Bauer 2001).

Most of the above researchers provided qualitative descriptions of humpback whale behavioral responses to boat activity. But Corkeron concluded that humpback mother-calf pairs in Hervey Bay spent significantly more time submerged and traveling when whale watching vessels were within 300 m. Likewise, Bauer et al. found in Hawaii that smaller pods containing calves were more affected by boat activity than were larger pods without calves. Bauer and Herman concluded that humpbacks attempting to avoid vessels surfaced without exhaling, and initiated dives without raising their flukes, more frequently. Additionally, Green and Green reported that when boats approached humpbacks in Hawaii within ½ mile, the whales spent less time at the surface, dove for longer periods, altered their directions, and reduced their speed after boats departed.

In 1981 and 1982, Baker and Herman (1989) also conducted a systematic study in Southeast Alaska to assess vessel impacts on humpbacks. Specifically, the research team attempted to quantify behavioral responses of humpbacks to vessel traffic in Frederick Sound and the Glacier Bay/Icy Strait region as part of a report to the National Park Service. This study was prompted by the abrupt departure of humpbacks from Glacier Bay in the summer of 1978—a departure that was coincident with an exponential increase in vessel traffic in the previous five years. Land-based research assistants observed whale behavior with and without experimental and opportunistic vessel approaches. Baker and Herman concluded that changes in whale behavior were significantly correlated with vessel number, speed, size, and proximity. Additionally, the researchers found that whales' respiratory behavior and orientation were the most sensitive indicators of vessel disturbance.

Regulating Boat Activity Near Whales

Largely in response to Baker and Herman's findings, the National Park Service implemented specific restrictions on boat activity within Glacier Bay National Park and Preserve (GBNPP) in 1985 (50 FR 19886). These restrictions specify that boaters inside Park boundaries may not approach humpbacks within ¼ mile. The National Park Service passed this final rule even though Baker and Herman's conclusions were based on small sample sizes, and many researchers argued that a low food supply—not increased vessel pressure—drove the humpbacks out of the Bay in 1978 (Bryant et al. 1981, Dean et al. 1985, Gabriele 2001).

Subsequent to the implementation of GBNPP boat activity restrictions, several nations adopted regulatory approaches to managing their own whale watching industries. The most common regulations restrict the number of vessels close to whales and specify minimum approach distances, as enacted in GBNPP (Carlson 1996). For example, the state of Queensland, Australia, permits a maximum of three vessels within 300 m of a whale and allows boaters to approach whales as close as 100 m (Queensland Department of Environment and Heritage 1994).

Countries (and portions of individual countries) that have implemented whale watching regulations have taken precautionary measures despite considerable scientific uncertainty. A dearth of research involving boat impacts on large baleen whales persists, though numerous studies have recently examined the impacts of boat activity on smaller toothed whales (e.g., Kruse 1991, Gordon et al. 1992, Blane and Jaakson 1995, Samuels and Spradlin 1995, Janik and Thompson 1996, Nowacek 1999, Bejder et al. 1999, Allen and Read 2000). Moreover, researchers face a formidable challenge: impacts of vessel traffic on cetaceans are not only difficult to quantify, but they are also apt to vary by type of vessel activity and by whale species, habitat, behavior, and/or age (Atkins and Swartz 1989, Gerber et al. 2000, Kato 2000).

Studies have so far provided policymakers with little quantitative information to design effective strategies for minimizing impacts of vessel traffic on whales. Additional studies of how various boat activities may disturb different cetaceans in different global regions is critically needed.

Case Study: Juneau, Alaska

Background

Juneau, Alaska's capital city, is now experiencing multiple benefits from whale watching. This community of 31,000 people in Southeast Alaska is also grappling with whether and how to mitigate the negative impacts of vessels on humpback whales.

As the state capital, Juneau is the center of tourism—and the hub of whale watching activity—in the southeastern portion of Alaska. But the immediate Juneau area has never been a summer home for many humpback whales, according to marine biologist Jan Straley (2000), who has studied Southeast Alaska humpbacks for over two decades. Indeed, Juneau biologist, Charles Jurasz (1978, 1979, 1981), conducted most of his humpback whale studies—including his monitoring of boats around humpbacks—in Frederick Sound and Glacier Bay, more than one hundred kilometers from Juneau. As the number of humpbacks in the Southeast Alaska feeding aggregation has gradually increased to over 400 animals, the number of humpbacks near Juneau has also risen, albeit slowly.

Straley believes the Juneau area didn't attract enough humpback whales to support a whale watching industry until the early 1990s. At this time, the appearance of commercial whale watching boats in Juneau coincided with an influx of humpbacks. Now over twenty boats (affiliated with at least six companies offering daily whale watching charters) traverse the narrow waterways north of Juneau in search of humpbacks each summer. These are the boats that interact with humpbacks *regularly*. Eco-tourism excursion vessels, charter and recreational sportfishing boats, Alaska State Ferries, cruise ships, kayaks, and skiffs also operate continuously, and more sporadically, around the same few whales (usually less than five on a given day in July or August 2000). Boating is a way of life for Juneau residents and visitors; no roads lead in or out of this community.

Rising Concerns

Almost immediately after companies began to run whale watching charters near Juneau, complaints started to trickle into the Protected Resources Division (PRD) of Juneau's NOAA Fisheries Alaska Region Office. Most who called or wrote the agency were concerned that increased vessel traffic might harm the small group of humpbacks feeding near Juneau. Some individuals emphasized that this handful of whales had yet to be formerly studied by scientists (Fadely 2000). In response to these concerns and in an effort to control the activities of commercial boats around humpbacks in Alaska, Juneau's NOAA Fisheries PRD published voluntary *Alaska Marine Mammal Viewing Guidelines* in 1996 (Appendix A).

However, PRD soon decided that they must do more to manage vessel traffic around humpbacks in Alaskan waters. The agency faced what they felt was a lack of compliance with the 1996 viewing guidelines, despite PRD's efforts to educate boaters about them. The agency faced scientific uncertainty about the humpbacks feeding near Juneau and about the possible impacts of boats on these whales. The agency faced growing whale watching industries in other Alaskan communities, such as Sitka, Petersburg, and Seward (Appendix B). And the agency faced mounting complaints from Juneau and non-Juneau residents alike.

On June 26, 2000, NOAA Fisheries placed the following proposed rule "Out for Public Comment" on the Federal Register (Appendices C and D):

> *NMFS [National Marine Fisheries Service] proposes to prohibit the approach within 200 yards (182.8 m) of a humpback whale, Megaptera novaeangliae, in waters within 200 nautical miles (370.4 km) of the coast of Alaska. Under these regulations, it would be unlawful for a person subject to the jurisdiction of the United States to approach, by any means, within 200 yards (182.8 m) of a humpback whale. This action is necessary to minimize disturbance to humpback whales in waters off Alaska. It is intended to promote the conservation and recovery of humpback whales* (65 FR 39336).

NOAA Fisheries originally requested comments on the proposed rule through August 10, 2000. The agency later extended the official comment period until October 15, 2000, after the *United Fishermen of Alaska* urged that commercial fishermen would not be able to respond until the conclusion of the busy summer fishing season (Brix 2000).

Legal Mandates

The proposed humpback whale approach regulations of Juneau's NOAA Fisheries PRD were promulgated under the authority of both the Endangered Species Act of 1973 (ESA) and the Marine Mammal Protection Act of 1972 (MMPA). The humpback whale is listed as *endangered* under the ESA and the Central North Pacific humpback stock is listed as *depleted* under the MMPA. Both the ESA and the MMPA give NOAA Fisheries jurisdiction over humpback whales (and other endangered and depleted cetaceans in U.S. waters). Section 11(f) of the ESA provides NOAA Fisheries with rulemaking authority to enforce provisions of the Act. Likewise, Section 112(a) of the MMPA provides NOAA Fisheries with broad authority to prescribe regulations necessary to carry out the goals of this statute. NOAA Fisheries' national Office of Protected Resources (PR), specifically, provides national policy guidance on the conservation of endangered species and marine mammals in U.S. waters.

Within the State of Alaska, PRD of the NOAA Fisheries Alaska Region Office in Juneau is the counterpart to PR at the national level. As such, PRD is charged with developing management and conservation programs for Alaska's marine mammals—including the North Pacific humpback whale—and with drafting regional policy to protect and restore marine mammal populations in Alaskan waters. Individual states may petition NOAA Fisheries for management authority over marine mammals in state waters; however, the State of Alaska has not petitioned for the responsibility of protecting and restoring humpback whales.

Both the ESA (Section 9) and the MMPA (Section 101) place a moratorium on "taking" protected species such as the humpback. The term "take" is defined under the MMPA (16 U.S.C. 1361 *et seq.*) to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (Section 3(13)). Furthermore, on March 20, 1991, NOAA Fisheries published a final rule amending the regulatory definition of "take" under the MMPA (56 FR 11693). "Take" now also means "the negligent or intentional operation of an aircraft or vessel...which results in disturbing or molesting a marine mammal" (Section 216.3). Under the ESA (16 U.S.C. 1531 *et seq.*), "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect [an endangered species], or to attempt to engage in any such conduct" (Section 3(18)). Additionally, "harm" and "harass" are further interpreted under the ESA to mean actions that may interfere with the breeding, feeding, or sheltering behavior of a listed species.

The MMPA also addresses "harassment" in more detail in both the original 1972 version of the Act and in the 1994 amendments to the statute. As amended, the MMPA defines the term "harassment" in Section 3(18)(A) to mean "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B Harassment]."

In its "Background to Proposed Regulations" (65 FR 39336), NOAA Fisheries provided the following rationale behind their proposal: "The rule is an appropriate mechanism to promote conservation and recovery of humpback whales, and to enhance enforcement under the ESA.... Given that close approaches to humpback whales could harm, harass, injure or otherwise 'take' one or more of this endangered species, the proposed rule provides a safeguard against Section 9(a) [of the ESA and Section 101(a) of the MMPA] violations."

NOAA Fisheries has not yet implemented any protective regulations for humpbacks in Alaska, beyond the ESA and MMPA prohibitions on "taking" marine mammals (Brix 2000). Approaches to humpback whales within 200 nautical miles of Hawaii may be no closer than 100 yards, per a regulation NOAA Fisheries implemented there in 1987 (50 FR 44912). Similarly, approaches to endangered North Atlantic right whales may be no closer than 500 yards in U.S. waters (62 FR 6729). These rules, as well as the restrictions imposed by the National Park Service in Glacier Bay National Park and Preserve, are the only federal regulations to date that limit vessel traffic around large whales in U.S. waters. NOAA Fisheries PR proposed national whale watching regulations in 1992 in an effort to limit vessel traffic around cetaceans in all U.S. waters. But tremendous opposition—mainly from the commercial whale watching industry—prevented this proposal from becoming a final rule (Brix 2000).

Questions

One doesn't have to look farther than two Alaskan newspapers, *Juneau Empire* and *Fairbanks Daily News-Miner*, to get a sense of the variety of people and viewpoints involved with the issue of regulating vessel traffic around whales in Alaska. The following are a few quotes excerpted from recent newspaper articles that discussed boats and humpbacks in Alaska (Appendices C, D, & E): "It's the only time of year the whales feed, so it's important not to disrupt them or the schooling fish they prey upon. If they don't get all the chow they need in Alaska, they may not make it back next year" (*a NOAA Fisheries Alaska Region enforcement agent*). "If we keep crowding these guys [the whales], there's a good chance they may move away from us here" (*a commercial whale watching captain*). "If we are forced to view whales from a minimum 200-yard distance, even the more understanding of our customers will be significantly disappointed and it will result in serious damage to our business" (*a commercial whale watching company president*). "[The proposed rule is] an easily enforceable but ultimately meaningless regulation" (*the director and chief scientist for a national conservation NGO*). "The whale watching industry has pretty much already followed the voluntary guidelines; it's the occasional deliberate approach we're trying to eliminate" (*a NOAA Fisheries Alaska Region wildlife biologist*).

The above comments clearly and succinctly reveal a range of opinions on NOAA Fisheries' proposed regulations. They also raise more questions—questions without clear, succinct answers. Just how *many* boats now directly interact with how *few* whales in Alaskan waters? Do most boaters comply with NOAA Fisheries' 1996 *Alaska Marine Mammal Viewing Guidelines*? Are boats *harassing* humpbacks in Alaskan waters? Or more pointedly, does boat activity lead to a *disruption of whale behavioral patterns*? Are most Alaska residents for or against NOAA Fisheries' proposed rule? Through this study, I seek to provide answers to these important questions.

Purpose

The purpose of my study was to begin to describe the humpbacks that feed and socialize north of Juneau, Alaska, to quantify the vessel activity near humpbacks in this region, as well as any whale behavioral responses to this boat activity, and to assess whether Alaskans feel that federal regulations are needed to govern boaters operating near humpbacks in Alaskan waters.

Objectives

Through this study, I sought: (1) to collect baseline behavioral, distribution, abundance, and photo-identification data for the humpback whale assemblage that feeds and socializes north of Juneau, Alaska, during the summer; (2) to describe vessel activity in the vicinity of humpbacks near Juneau; (3) to assess boater compliance with NOAA Fisheries' *Alaska Marine Mammal Viewing Guidelines*; (4) to determine whether vessel activity leads humpbacks to significantly alter their behavior in the short-term; (5) to assess human perceptions of both the current level of boat traffic near humpbacks in Alaska and of NOAA Fisheries' proposed humpback whale approach regulations; (6) to provide management recommendations to NOAA Fisheries, Alaska Region, who is charged with promoting the conservation and recovery of humpback whales in the North Pacific.

One of the major clues to the function of a behavior pattern is the rhythm of its occurrence. To understand whales, one must slow way down and be content to observe passively for a long time.
(Dr. Roger Payne, 1995)[2]

Methods

Study Area

Stephens Passage and Lynn Canal, located southwest, west, and northwest of Juneau, are deep glacial fjords that comprise the northern extremity of Alaska's Inside Passage (Figure 1). Throughout the summer, thousands of boats ply these channels that connect Juneau with numerous islands, communities, and waterways. This heavy vessel traffic includes 2000-passenger cruise ships, 800-passenger Alaska State Ferries, commercial fishing boats, eco-tourism excursion vessels, commercial whale watching vessels, charter sportfishing boats, and recreational cabin cruisers and skiffs. Most boats that traverse Stephens Passage and Lynn Canal are heading toward, or departing from, the ports of Juneau and Auke Bay Harbor, which is located approximately twelve miles north of the capital city.

The swift, productive waters of Stephens Passage and Lynn Canal also teem with wildlife. Killer whales, Steller sea lions, bald eagles, harbor porpoises, Dall's porpoises, marbled murrelets, harbor seals, and humpback whales find food in the swirling currents, tide rips, and nutrient upwellings that characterize this habitat. Although humpbacks are sighted in these waterways year-round (e.g., McGregor 2000), most humpbacks congregate in northern Stephen Passage and southern Lynn Canal between May and October. Humpbacks feed mostly on Pacific herring (*Clupea harengus pallasi*), but also opportunistically engulf sand lance (*Ammodytes hexapterus*), capelin (*Mallotus villosus*), and euphausiids (primarily *Euphausia pacifica* and *Thysanoessa spp.*) in this region (Bryant et al. 1981, Krieger and Wing 1984, Krieger and Wing 1986, Dolphin 1987, Straley 1990, Straley 1994). Single whales usually feed alone in these waters, but boaters occasionally observe the cooperative feeding of five or more whales in a single pod.

I conducted all of my fieldwork in waters stretching almost 45 km from Young Bay in northern Stephens Passage to Benjamin Island in Lynn Canal. Specifically, I concentrated most of my research effort near Lincoln Island and Shelter Island, which divides Stephens Passage at its northern terminus into Favorite and Saginaw Channels. I accessed the study area from Auke Bay Harbor, which opens into Stephens Passage and sits directly east of Admiralty Island's Mansfield Peninsula.

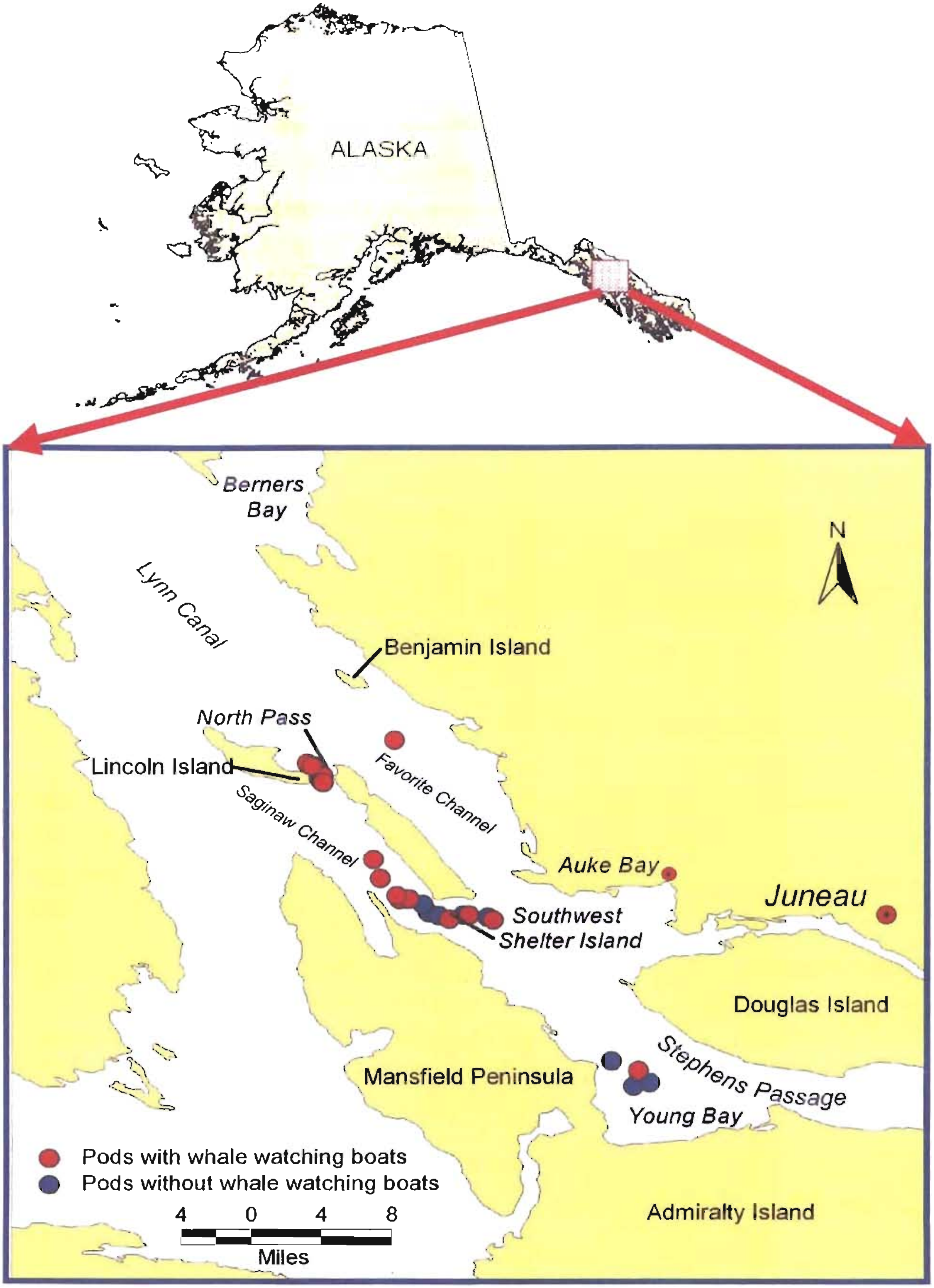


Figure 1. Study area, including Stephens Passage and Lynn Canal near Juneau, Alaska.

Pilot Study

I conducted a pilot study from 29 June 2000 to 5 July 2000, to develop protocols for recording vessel activity and for sampling humpback whale behavior. I modified these methodologies several times during the pilot study; consequently, I didn't include data from the pilot study in my analyses.

Formal Study

I conducted the formal study under Scientific Research Permit No. 895-1450-01 from 6 July 2000 to 25 August 2000. I made all observations of humpback whales and vessel activity from one of three vessels (7m *Bayliner Capri* with a 2-cycle 115 hp inboard-outdrive *Force L-Drive* engine; 8m *Bayliner Squaw* with a 350 hp inboard *Chevy* engine; 6 m *Lund* skiff with a 60 hp *Johnson* outboard motor). Land-based observations were not possible because whale pods were often far from shore, pods constantly moved, and there was not an elevated location on land to serve as an ideal vantage point. To minimize the research platform's impact on focal pods, I drifted with my engine in neutral and maintained a distance of at least 400 m between the research vessel and the whales whenever possible. I only approached focal pods to within 50 m when attempting to take fluke identification photographs at the conclusion of collecting behavioral samples.

I determined where I would attempt to conduct whale behavioral samples each day after discussing recent whale sightings with charter boat operators, pilots, fishermen, and whale watchers. When no whale sightings were reported on a particular morning, I began a search where the previous day's behavioral sample had ended or where whales had been previously observed. If I discovered a pod while en route to a reported whale sighting or to the previous day's research location, I usually stayed with this pod. When I realized how challenging it was to observe a pod *without* whale watching vessels present, however, I began to start each research day with a search for a pod that wasn't being followed by whale watching boats.

Documentation of Humpback Whale Assemblage Characteristics

I made an effort to identify and estimate the sizes of all encountered humpback whales. Ultimately, such information—in addition to behavioral, distribution, and abundance data—will lead to a more complete picture of the humpback whale assemblage that feeds in northern Stephens Passage and southern Lynn Canal throughout the summer.

I defined a whale "pod" as one or more individuals within several body lengths of one another who exhibited synchronous surfacings and common behavior (e.g., feeding, traveling, etc.).

I gave each pod an identification number consisting of the date of observation and a letter corresponding to the first, second, or third pod observed for that particular date ("Pod 817B," for example, corresponded to the second pod I observed on August 17th). If the pod comprised more than one whale, I also assigned individual pod members a "1," "2," "3," etc. Additionally, I sketched the flukes, dorsal fin, and any distinct markings (scarring, wounds, etc.) of individual whales.

I also identified individual humpbacks by taking photographs of the natural markings on the ventral surfaces of their flukes (Katona et al. 1979). To obtain such pictures, I slowly and cautiously approached whales from behind, at a steady speed of 1-3 knots and beginning at a distance close to 400 m. I took all photographs when the research vessel was positioned approximately 50 m directly behind the whale and used a 35 mm *Canon Rebel 2000* SLR camera, equipped with a motordrive, 100-300 lens, and 100 ASA slide film. If I wasn't able to obtain a fluke photo, I instead took a dorsal fin photograph, if possible. I was careful to record film roll number, frame number, date, pod identification number, and location for each photo taken, and I only made an approach to a whale for photography purposes when additional whale watching vessels were not present.

Humpback Whale Behavioral Sampling

I observed individual humpback whale focal pods in approximately 90-minute blocks. I recorded the following information at the beginning and end of each observation block: date, time (in hours and minutes), pod's position (as determined with a differential hand-held *Garmin GPS 12*), sea state (Beaufort Wind Scale rating), weather, percent glare, and tidal state.

I used continuous and point behavioral sampling techniques to assess the behavior of all animals in each pod (Altmann 1974, Mann 1999). I recorded the following behavior of all animals in each pod: respiratory activity (dive duration in minutes and seconds, surface interval in minutes and seconds, number of blows per surfacing, blow interval in seconds, and whether $\geq$ 2 whales were respiring synchronously); submergence type (slip under, peduncle arch, fluke-down dive, or fluke-up dive as described in Appendix F); frequency of "no blow rises" (whale lifts blowholes out of the water but doesn't exhale). I considered 60 seconds to be the breakpoint between a blow interval and an extended dive, with a "dive" representing a submergence $\geq$ 60 seconds in duration (Chu 1988, Dolphin 1988). Additionally, I recorded surface behaviors (such as pectoral fin slaps, peduncle throws, and breaches as described in Appendix F) on an *ad libitum* basis. If surface displays were of appreciable duration, I noted the behavior type and total duration; otherwise, I described surface behaviors as event frequencies.

Each time a whale pod surfaced, I recorded the following parameters to build a comprehensive picture of the whales' time budgets: whales' behavioral states ("resting," "milling," "traveling," "feeding," or "surface active," as outlined in Appendix G); whether the pod had traveled more than 300 m since the previous submergence (thus, whether pod "traveled" or "stalled" when submerged); whether the pod noticeably changed direction since the previous submergence (thus, whether pod was "on track" or "off track"). I recorded all behavioral data on a cassette recorder and later transcribed this information against time.

Assessment of Vessel Activity

Throughout each behavioral sample, I observed vessel activity in the vicinity of the focal pod. I recorded all "non-whale watching vessels" within 800 m of the pod, and attempted to describe—with pre-determined descriptive codes (Appendix H)—the types of boats operating near the focal pod. "Non-whale watching vessels" consisted of boats transiting or sportfishing boats trolling (idling or drifting with engine off) near a focal pod. If a boat first categorized as a "non-whale watching vessel" began to follow a humpback whale pod, I then considered it to be a "whale watching vessel" at that point in time. I also removed such a vessel from my list of non-whale watching vessels for a particular sample, so as not to count the boat twice.

I considered "whale watching vessels" to be those boats that followed a focal pod for at least 10 minutes. These were not necessarily commercial whale watching vessels, and I began to time a boat's length of stay with a focal pod when the vessel was 400 m from the whale(s). I recorded the following information for each vessel that actively watched a focal pod throughout a behavioral sample: type of vessel (approximate length, engine type, and whether a "commercial" or "recreational" boat, as described in Appendix H); time (in hours and minutes) and manner in which boat approached and departed a focal pod (driving speed, orientation to the pod and to other whale watching boats, etc., as outlined in Appendix H). Each time a pod surfaced, I noted the activities of all whale watching boats (driving speed, position relative to the pod, etc.), and I recorded the distance between the closest whale watching vessel and the pod. I estimated this distance, or I calculated it using a laser rangefinder, a protractor, and the Law of Cosines (Appendix H).

Assessment of Human Perceptions

I analyzed 42 letters submitted between 26 June 2000 and 15 October 2000 to the Alaska Regional NOAA Fisheries Office in Juneau. These letters were sent to NOAA Fisheries from across the country in response to the agency placing its proposed humpback whale approach regulations on the Federal Register, and thereby "Out for Public Comment" (65 FR 39336).

Data Analysis: Humpback Whale Assemblage Characteristics

I overlaid the GPS locations of all focal pods on an Alaska Department of Natural Resources GIS coverage of the study area with ArcInfo/ArcView software (Figure 1). I also compiled brief sighting histories to accompany fluke identification photos of each focal whale, and these histories include the following information: dates and locations whale was observed, other individuals with the whale during specific behavioral samples, and additional notes (Appendix I).

Furthermore, I compared all fluke identification photographs with those in Straley and Gabriele's *Humpback Whales of Southeastern Alaska: A Catalog of Photographs* (1998). The whales listed in this catalog were sighted in Southeast Alaskan waters outside my study area (primarily in Glacier Bay/Icy Strait, Sitka Sound, Frederick Sound, and Seymour Canal), but humpbacks feed in different regions of Southeast Alaska during the summer and fall. I confirmed that a whale I photographed north of Juneau had been sighted previously in another area when the flukes in one of my photos possessed the same coloration pattern, trailing edge, and additional distinctive markings as a cataloged photo. Jan Straley (2000) provided sighting histories of those whales I observed in the field and found in the Southeast Alaska catalog, and I included this additional information in my own sighting histories of each focal whale (Appendix I).

I plan to also compare my fluke-ID photos with von Ziegesar's photographic collection of humpbacks from Prince William Sound, Alaska (1992), in the near future. Additionally, I will submit my photographs of humpbacks observed near Juneau to the National Marine Mammal Laboratory in Seattle, Washington, as this agency maintains a database of all humpbacks sighted in the North Pacific.

Data Analysis: Humpback Whale Behavior

I divided all behavioral sample data into "no whale watching vessel samples" (n=11) and "whale watching vessel samples" (n=16), depending on whether or not at least one whale watching boat was present with a focal pod during the sample. I next calculated the following for the focal pods constituting the no whale watching vessel samples and for the focal pods constituting the whale watching vessel samples: (1) mean surface intervals, dive durations, numbers of blows per surfacing, and blow intervals; (2) mean proportion of time whale submergences were characterized by slip unders, peduncle arches, fluke-up dives, or fluke-down dives; (3) mean proportion of time whales spent traveling, milling, resting, surface active, or feeding (Appendices K and M).

Using the Shapiro-Wilk Test for Normality, I determined that the above behavioral data was not normally distributed; thus, I analyzed this data with non-parametric statistical tests. Specifically, I used Wilcoxon Rank Sum Tests to determine whether the above mean values were significantly different between the two conditions, whale watching vessels present or absent. I also used multiple Two-Sample F-Tests for Variances to determine whether the variances in the above mean values significantly differed between the two "treatments" (Martin and Bateson 1993).

To compare whale behavioral frequencies between the two sampling conditions, I calculated the number of times per hour focal whales with or without whale watching boats exhibited certain behaviors (such as pectoral fin slaps, peduncle throws, etc.). The frequencies with which whales engaged in surface behavior *per hour* were too low to compare statistically. Therefore, I also calculated the mean number of times whales with or without whale watching vessels showed certain behaviors (counting only those behaviors exhibited by whales sampled for at least 90 minutes). I then used Wilcoxon Rank Sum Tests to determine whether whales exhibited certain surface behaviors more often on average when with or without whale watching boats.

Finally, I compared behavioral data for two individual whales I observed multiple times with and without whale watching vessels (Appendix N). For these two focal whales, I divided the behavioral data mentioned above into no whale watching vessel samples and whale watching vessel samples, and calculated mean values for this information. I then performed Wilcoxon Rank Sum Tests and F-Tests to determine whether either of these two whales exhibited significantly different behavior between the two sampling conditions.

I used JMP IN Version 3.2.6 software to perform all statistical analyses.

Data Analysis: Vessel Activity

Non-Whale Watching Vessels

I calculated the following for the entire study area and for each of the three key regions—southwest Shelter Island, North Pass, and Young Bay—where I observed humpbacks most often: (1) total numbers of transiting and trolling vessels; (2) mean numbers of transiting and trolling vessels per sample; (3) mean numbers of transiting and trolling vessels per minute (Appendix O).

Whale Watching Vessels

I calculated the following for the entire study area, as well as for each of the three key regions identified above: (1) total number of whale watching vessels; (2) mean number of whale watching vessels per sample; (3) mean length of stay for whale watching vessels (Appendix O). I then determined how long individual focal pods were followed by one, two, three, four and five whale watching boats at a time (Appendix L).

Boater Compliance

I determined the extent to which whale watchers complied with NOAA Fisheries' *Alaska Marine Mammal Viewing Guidelines* (Appendix A) by calculating the following for the entire study area, as well as for each of the three key regions identified above: (1) the number of times boaters approached a focal pod within 200 yards or within 100 yards; (2) the number of boaters who followed a focal pod for over ½ hour; (3) the number of times, and under what circumstances, boaters effectively encircled a pod or trapped it against shore; (4) the number of times boaters didn't approach a focal pod from the rear (Appendix O).

Data Analysis: Human Perceptions

In my review of the comment letters submitted to NOAA Fisheries, I first determined how many letters were in favor of the proposed regulations, and how may were against them. I next determined what proportion of those letters for or against the agency's proposal were from: (1) Alaska residents; (2) whale watching industry members; (3) other tour operators; (4) non-profit organizations; (5) the federal government; (6) the scientific research community; (7) commercial fishing organizations; (8) private persons. I further characterized the perceptions highlighted in the letters by recording the multiple reasons *why* writers said they held a particular opinion. Finally, I also recorded *suggestions* writers proposed to NOAA Fisheries in addition to their individual petitions for or against the proposed rule.

The story of the whale is so remarkable, that were
there not so many witnesses, I would not venture
to tell it lest I be accused of exaggeration.
(J.D.B. Stillman, aboard the ship *Plymouth*, 1850)[3]

Results

Humpback Whale Assemblage Characteristics

From 6 July 2000 to 25 August 2000, I completed 27 focal follows of distinct humpback whale pods for 39.6 observation hours. Focal follow "samples" ranged from 16-160 minutes in length, and were 88 minutes long on average. Most focal pods were single animals (n=22), but two focal pods comprised two whales, two focal pods comprised three whales, and one focal pod comprised twelve whales. I followed five individuals on multiple occasions, as I usually observed no more than three to four whales each day in the study area. Two of these five individuals were present in the study area during most of July and August, and I followed the other three whales in August only.

I sighted only eighteen individual humpbacks—all adult animals—throughout the entire study season, and obtained useable fluke and dorsal fin identification photographs for nine of these animals (Appendix I). According to *Humpback Whales of Southeastern Alaska: A Catalog of Photographs* (Straley and Gabriele 1998), five of the nine whales I photographed were previously sighted in Southeast Alaska (in Frederick Sound, Sitka Sound, and the Glacier Bay/Icy Strait region). By my estimation, therefore, four of the animals I sighted are new to the database of Southeast Alaskan humpbacks.

I followed focal pods in three geographic regions within Stephens Passage and Lynn Canal: southwest Shelter Island, North Pass, and Young Bay (Figure 1).

Humpback Whale Behavior

Of the 39.6 total hours that I conducted focal follows, I spent 16.2 hours (972 min.) observing whales *without* whale watching vessels present during any portion of 11 observation periods. Likewise, I spent 23.4 hours (1404 min.) observing whales *with* whale watching vessels present at some point during each of 16 observation periods.

Mean Respiratory Activity

Focal whales exhibited similar breathing patterns, whether or not whale watching vessels were present (Table 1). Mean surface interval, mean dive duration, mean number of blows per surfacing, and mean blow interval for whales with whale watching vessels were not significantly different than those for whales without whale watching vessels (Z=0.6153, p=0.5384; Z= -0.1390, p=0.8895; Z=0.5702, p=0.5685; Z= -0.7674, p=0.4428, respectively).

Table I. Mean respiratory activity for whales with and without whale watching vessels. Data presented below are mean values and standard deviations.

Respiratory Parameter	*Whales without Whale Watching Vessels*	*Whales with Whale Watching Vessels*
Mean Surface Interval	**1.11 ± 0.37 min.** n=14	**1.09 ± 0.62 min.** n=17
Mean Dive Duration	**5.42 ± 1.29 min.** n=14	**5.84 ± 2.03 min.** n=17
Mean #Blows/Surfacing	**4.49 ± 1.03 blows** n=13	**4.13 ± 1.82 blows** n=16
Mean Blow Interval	**19.31 ± 4.92 sec.** n=13	**21.11 ± 5.06 sec.** n=16

However, whales with whale watching vessels showed significantly greater variance in their average surface intervals and in their average numbers of blows per surfacing than did whales without whale watching vessels (F=2.8724, p=0.0306; F=3.14, p=0.0260). When whale watching vessels were present, individual whales were more variable in the amount of time they spent at the surface; sometimes they surfaced for an appreciable amount of time and sometimes they spent little time at the surface between consecutive dives (Figure 2). Similarly, individual whales varied their numbers of blows per surfacing significantly more when whale watching vessels were present; they frequently oscillated between blowing several times to blowing only once or twice per surfacing (Figure 3). Individual whales without whale watching vessels were more *consistent* in the amounts of time they spent at the surface and in the numbers of times they exhaled during a surfacing.

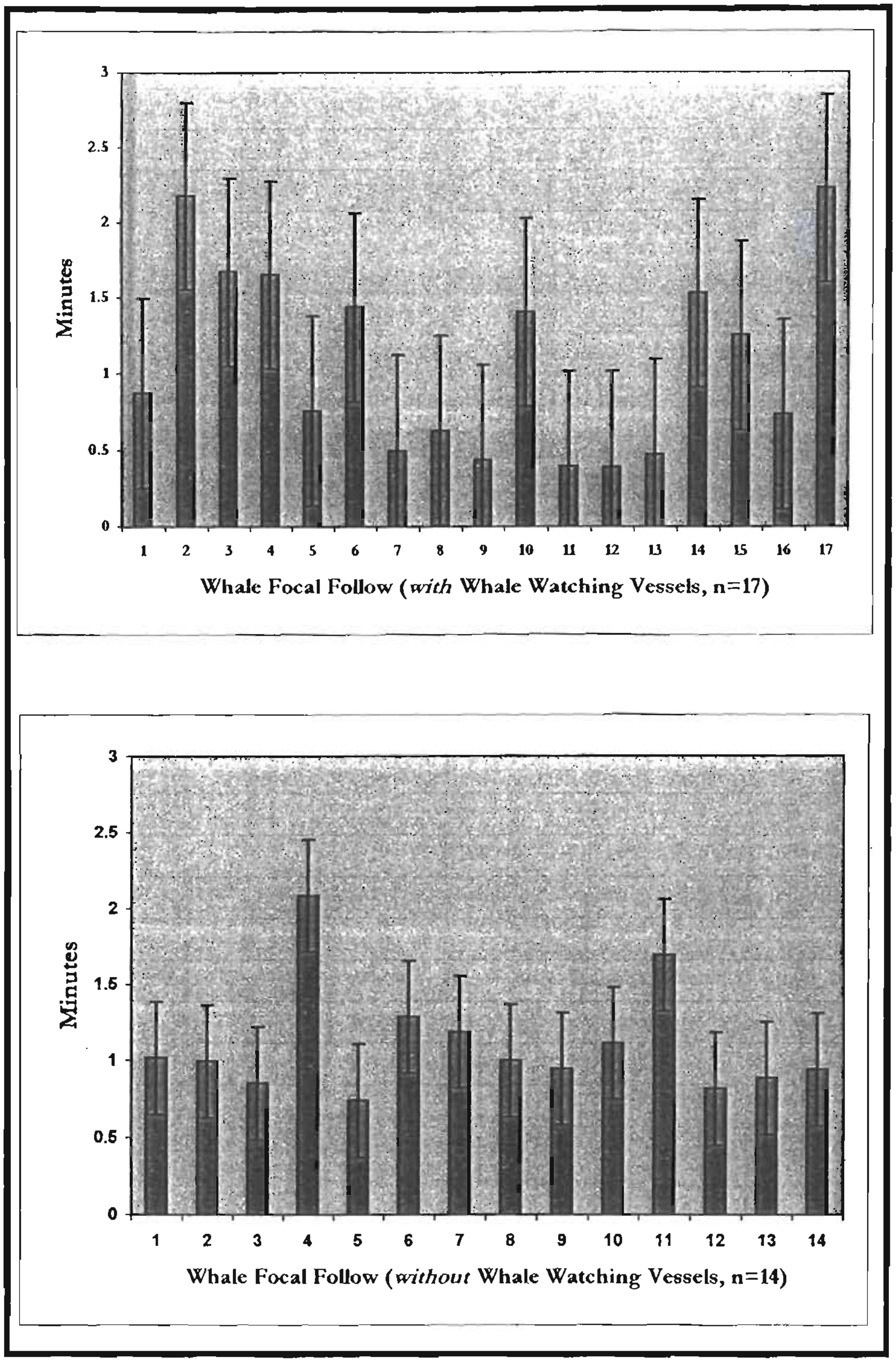


Figure 2. Mean surface intervals for whales with and without whale watching vessels. Error bars indicate one standard deviation above and below means.

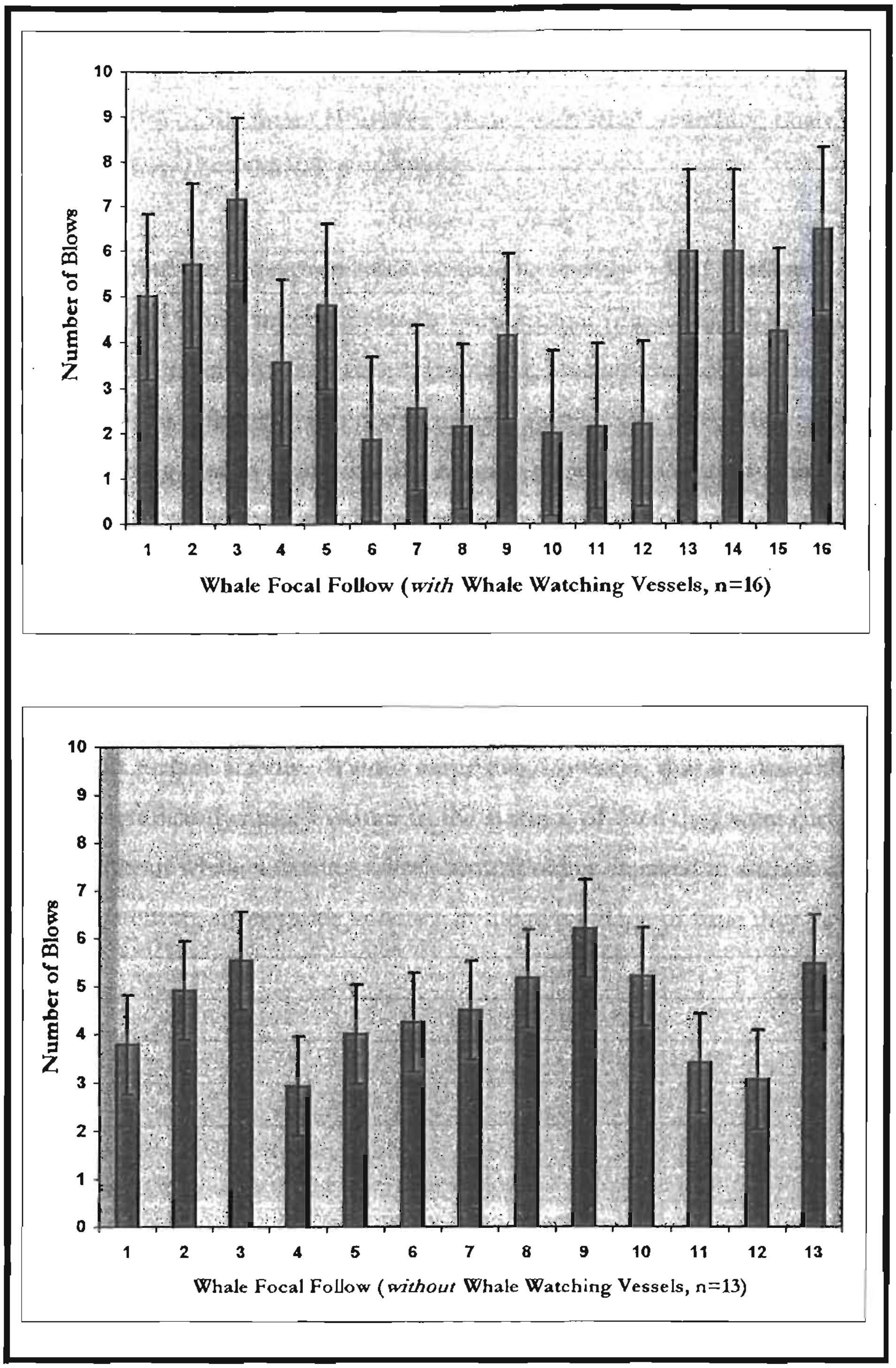


Figure 3. Mean numbers of blows per surfacing for whales with and without whale watching vessels. Error bars indicate one standard deviation above and below means.

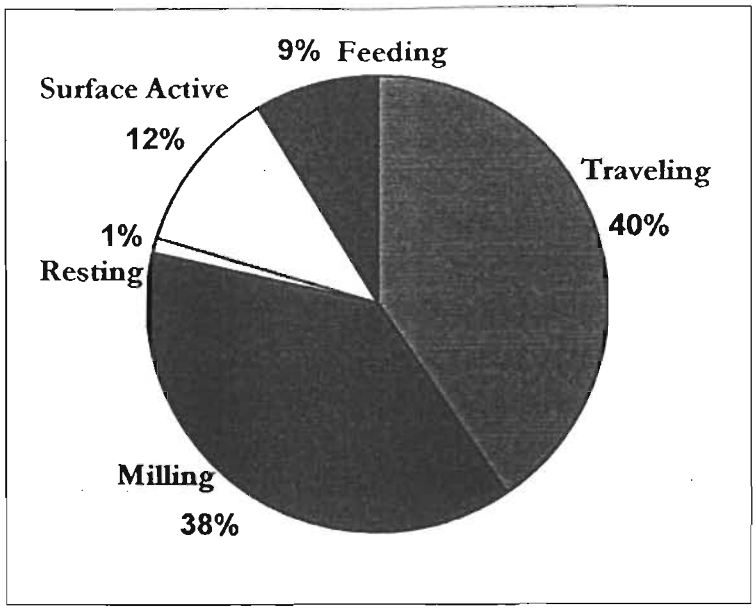
Proportion of Submergence Types

Whales without whale watching vessels initiated submergences by diving (exhibiting a peduncle arch, fluke-up dive, or fluke-down dive) approximately 75% of the time, and by slipping under 25% of the time. Similarly, whales with whale watching boats dove close to 70% of the time, and slipped under 30% of the time. However, whales with whale watching boats did not slip under significantly more often ($Z= -0.5395$, $p=0.5895$).

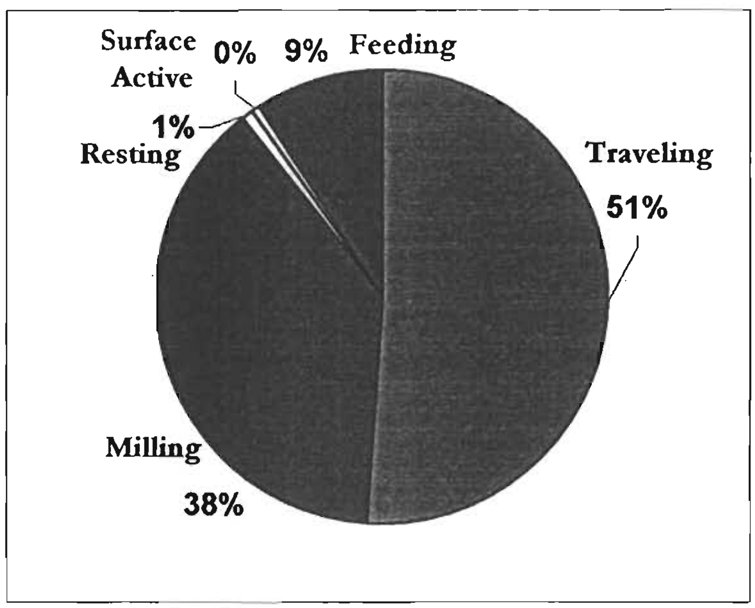
Average Time Budget

Whales devoted the same proportion of time to resting (~1%), feeding (~9%), and milling (~38%) whether or not whale watching vessels were present (Figure 4). Whales without whale watching vessels spent relatively more time traveling on average than did whales with whale watching boats, but this difference was not significant ($Z=1.2533$, $p=0.2101$). Additionally, whales without whale watching vessels spent virtually no time engaging in surface-active behaviors (~0%), as compared to whales with whale watching boats who were surface active 12% of the time.

Whales with whale watching boats were not surface active significantly more than whales without boats ($Z= -0.9197$, $p=0.3577$), but they did show significantly more variance in the average proportion of time they were surface active ($F=284.5993$, $p=6.84 \times 10^{-14}$). In other words, individual whales with whale watching vessels either spent a lot of time active at the surface, or spent almost no time engaging in surface activity. It's not surprising, however, that whales with whale watching vessels exhibited significantly more variance in the amount of time they were surface active. Because whales without whale watching vessels almost never engaged in surface-active behavior, they did not, by definition, show much variance in the percentage of time they devoted to surface activity.



Average Time Budget for Whales *with* Whale Watching Vessels (n=17)



Average Time Budget for Whales *without* Whale Watching Vessels (n=14)

Figure 4. Average time budgets for whales with and without whale watching vessels.

Behavioral Frequencies

As mentioned above, whales without whale watching vessels were rarely surface active. Table II provides a comparison of the frequencies with which I observed whales with and without whale watching boats perform different surface-active behaviors. Both the total numbers of times—and the numbers of times *per hour*— I observed whales with and without boats exhibit certain behaviors are given below.

I observed whales with whale watching boats exhibit a relatively high number of certain surface behaviors, such as tail swishes and no blow rises. Most of these surface behaviors were demonstrated by three individuals ("Spartacus," "Spot," and "Slash") throughout two samples and while I observed an active pod of twelve individuals for a single sample.

Thus, whales with whale watching boats did not exhibit significantly more tail swishes, tail cartwheels, tail slaps, pectoral fin slaps, no blow rises, and trumpet blows on average (per 90-minute samples) than did whales without following boats (Z= -0.4030, p=0.6869; Z= -1.8875, p=0.2345; Z= -1.4975, p=0.1343; Z= -0.7711, p=0.4407; Z= -0.6232, p=0.5332; Z= -0.2921, p=0.7702, respectively).

Table II. Surface-active behavior exhibited by whales with and without whale watching vessels. Both behavioral *frequency* (number of times whales showed a particular behavior per hour) and *number* of times we witnessed the behavior are given.

	Whales without Whale Watching Vessels (16.2 observation hours, n=14)		***Whales with Whale Watching Vessels (23.4 observation hours, n=17)***	
Behavior	**Frequency**	**Total Number**	**Frequency**	**Total Number**
full breach	0	0	0.13/hr.	3
half breach	0	0	0.04/hr.	1
peduncle throw	0.06/hr.	1	0.04/hr.	1
head lunge	0.12/hr.	2	0.04/hr.	1
lunge feed	0	0	0.13/hr.	3
feeding call	0	0	0.04/hr.	1
tail swish	0.12/hr.	2	2.53/hr.	59
tail cartwheel	0	0	0.51/hr.	12
tail slap	0	0	0.30/hr.	7
pectoral fin slap	0.06/hr.	1	0.69/hr.	16
no blow rise	0.12/hr.	2	0.86/hr.	20
trumpet blow	0.18/hr.	3	0.34/hr.	8

Behavior of Individuals with and without Whale Watching Vessels

I followed five individuals—including "Scar" and "Sharkfin"—on multiple occasions. Scar was with whale watching vessels in four samples, and without whale watching vessels in five samples. Likewise, Sharkfin was with whale watching vessels in two samples, and without whale watching boats in three samples (Appendix N).

Scar's Behavior

Scar exhibited almost identical surface intervals, dive durations, numbers of blows per surfacing, and blow intervals, whether or not whale watching vessels were present (Table III). Scar dove for 1.5 minutes longer when with whale watching boats than without boats, but this difference was not significant ($Z = -0.1235$, $p = 0.9017$). However, a power analysis revealed that the power of this test was only 0.27 (Statistics UCLA 2001). Thus, there's a 73% chance that I failed to reject the null hypothesis (of no difference) when it was actually false (Type II error).

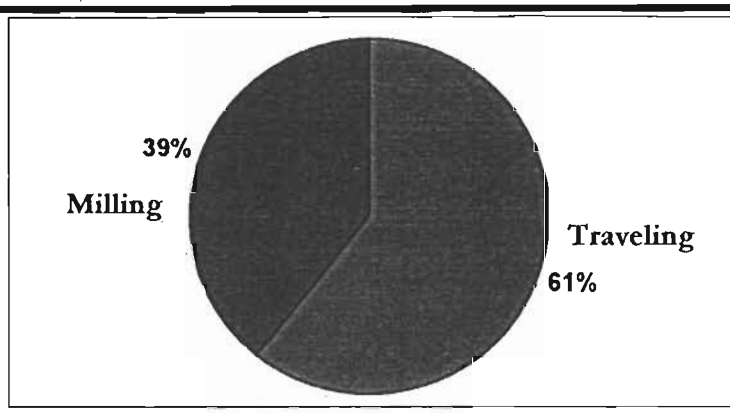
I observed Scar only milling or traveling (and not feeding, resting, or surface active) throughout all nine behavioral samples. Scar spent close to an average of 40% of his or her time milling and close to an average of 60% of his or her time traveling, whether or not whale watching vessels were present (Figure 5).

Sharkfin's Behavior

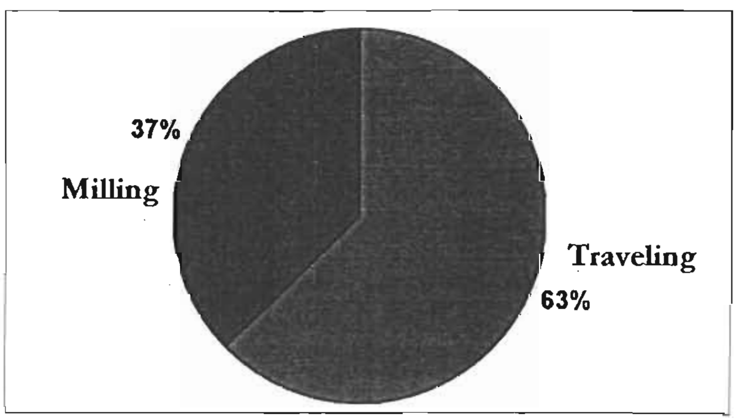
Sharkfin's mean surface intervals, mean dive durations, mean numbers of blows per surfacing, and mean blow intervals were very similar in both conditions (Table IV). Sharkfin devoted less time to traveling and more time to milling when with whale watching vessels. This whale also spent approximately 5% of his or her time resting—a behavioral state I rarely observed for any whale—when not with whale watching boats, but didn't rest when with whale watching vessels (Figure 6). The amounts of time Sharkfin devoted on average to traveling, milling, and resting were not significantly different between the conditions, however ($Z=0.2887$, $p=0.7728$; $Z=0.2887$, $p=0.7728$; $Z= -0.4083$, $p=0.6831$, respectively). Additionally, a power analysis revealed that the power of these tests were 0.05, 0.05, and 0.07, respectively (Statistics UCLA 2001). Again, then, it's highly probable that I also committed a Type II error in this case.

Table III. SCAR's mean respiratory activity with and without whale watching vessels. Data presented below are mean values and standard deviations.

Respiratory Parameter	(n=5) *No W.W. Vessels*	(n=4) *W.W. Vessels*
Surface Interval	0.97 $\pm$ 0.10 min.	1.13 $\pm$ 0.41 min.
Dive Duration	4.92 $\pm$ 0.31 min.	6.31 $\pm$ 1.29 min.
# Blows/Surfacing	5.25 $\pm$ 0.64 blows	5.58 $\pm$ 1.84 blows
Blow Interval	14.27 $\pm$ 2.15 sec.	15.41 $\pm$ 2.16 sec.



Scar's Average Time Budget *with* Whale Watching Vessels
n=4

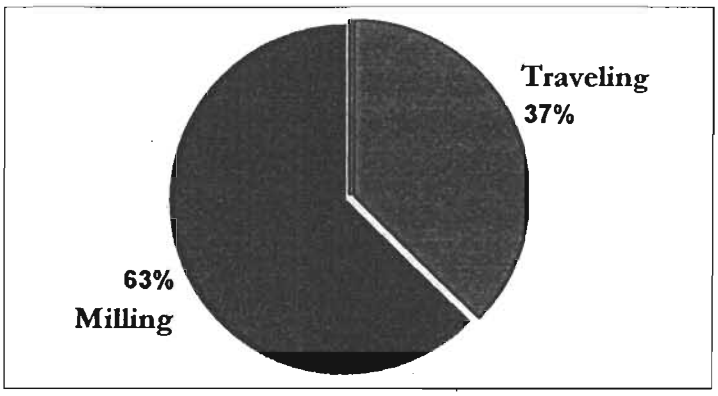


Scar's Average Time Budget *without* Whale Watching Vessels
n=5

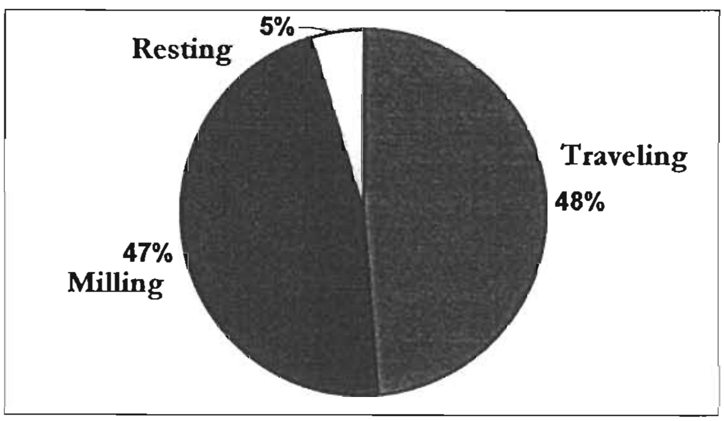
Figure 5. Scar's average time budgets with and without whale watching vessels.

Table IV. **SHARKFIN**'s mean respiratory activity with and without whale watching vessels. Data presented below are mean values and standard deviations.

Respiratory Parameter	(n=3) *No W.W. Vessels*	(n=2) *W.W. Vessels*
Surface Interval	1.52 ± 0.49 min.	1.54 ± 0.19 min.
Dive Duration	4.54 ± 0.84 min.	4.46 ± 0.02 min.
# Blows/Surfacing	4.59 ± 0.82 blows	4.92 ± 1.11 blows
Blow Interval	24.69 ± 3.19 sec.	23.26 ± 3.53 sec.



Sharkfin's Average Time Budget *with* Whale Watching Vessels
n=2



Sharkfin's Average Time Budget *without* Whale Watching Vessels
n=3

Figure 6. Sharkfin's average time budgets with and without whale watching vessels.

Vessel Activity

Non-Whale Watching Vessels

Throughout the entire study season, almost 350 transiting vessels and almost 300 trolling vessels operated close to the humpback whales that I followed. Additionally, I observed a mean of 0.16 transiting vessels per minute and an average of 0.12 trolling vessels per minute near focal pods.

Because the focal whales utilized three fairly distinct geographic regions (southwest Shelter Island, North Pass, and Young Bay), I also considered non-whale watching vessel traffic for each of these areas separately. Mean numbers of *transiting* vessels per sample and mean numbers of transiting vessels per minute were substantially higher near southwest Shelter Island than in North Pass or Young Bay. Likewise, I observed the highest mean numbers of *trolling* vessels per sample and per minute in North Pass.

Hundreds of transiting and trolling vessels flooded into Stephens Passage for the *Golden North Salmon Derby* when I conducted four behavioral samples (three near southwest Shelter Island and one near North Pass) on August 18th, 19th, and 20th. Because there were extremely high numbers of recreational boats in the study area during the derby, I tabulated non-whale watching vessel data with and without values recorded during this event (Table V).

The vast majority of transiting and trolling vessels I observed during the field season were recreational boaters and charter sportsfishing vessels, followed by commercial fishing vessels. Most of these transiting and trolling vessels were longer than 7 m and were equipped with an inboard/outboard engine and an additional trolling [outboard] motor.

Table V. A comparison of non-whale watching vessel traffic (transiting and trolling vessels) in three regions north of Juneau, Alaska: Southwest Shelter Island, North Pass, and Young Bay.

Location	*Total # Transiting Vessels*	*Mean # Transiting Vessels Per Sample*	*Mean # Transiting Vessels Per Minute*	*Total # Trolling Vessels*	*Mean # Trolling Vessels Per Sample*	*Mean # Trolling Vessels Per Minute*
SW Shelter Island n=14/**11	**244** [**106]	**17.42/sa** [**9.64/sa]	**0.22/min.** [**0.15/min.]	**141** [**41]	**10.07/sa** [**3.73/sa]	**0.11/min.** [**0.04/min.]
North Pass n=9/**8	**86** [**59]	**9.56/sa** [**7.38/sa]	**0.11/min.** [**0.09/min.]	**149** [**62]	**16.56/sa** [**7.75/sa]	**0.18/min.** [**0.10/min.]
Young Bay n=4	**18**	**4.5/sa**	**0.04/min.**	**6**	**1.5/sa**	**0.01/min.**
Total Values Across All Locations n=27/**23	**348** [**183]	**12.89/sa** [**7.96/sa]	**0.16/min.** [**0.11/min.]	**296** [**109]	**10.96/sa** [**4.74/sa]	**0.12/min.** [**0.06/min.]
Ranges Across All Locations n=27/**23		**0-54/sa** [**0-23/sa]	**0-0.60/min.** [**0-0.40/min.]		**0-87/sa** [**0-22/sa]	**0-0.85/min.** [**0-0.24]

** = Values without considering samples conducted during *Golden North Salmon Derby*.

Whale Watching Vessels

Throughout the entire study season, I monitored the activities of 67 whale watching vessels that stayed for 11-59 minutes—and an average of approximately 24 minutes—with humpbacks. For thirteen of the sixteen "whale watching vessel samples," focal whales were with at least one whale watching boat for most of the sample. In addition, I observed a range of 1-13 whale watching vessels per focal follow, and a mean number of just over four whale watching boats per sample. Usually one or two whale watching boats were with a focal animal at one time, but three or more whale watching boats were present at once in five of the sixteen whale watching vessel samples (Appendix L).

I observed only three whale watching vessels during one sample in Young Bay, but almost equal numbers of whale watching boats near southwest Shelter Island (n=8) and North Pass (n=7).

Whale watching boats tended to stay an average of ten minutes longer in North Pass, as compared to southwest Shelter Island, and I recorded an average of almost five whale watching vessels per sample in North Pass and an average of almost four whale watching vessels per sample near southwest Shelter Island (Table VI).

Approximately two-thirds of the whale watching vessels were commercial tour operators and one-third were recreational boaters. Most of the commercial whale watching boats were equipped with jet engines, but several were powered by inboard/outboard engines, and at least one utilized two outboard motors. The majority of the recreational whale watching boats were approximately 7 m in length on average and were powered by inboard/outboard engines.

Table VI. A comparison of whale watching vessel traffic in three regions north of Juneau, Alaska: Southwest Shelter Island, North Pass, and Young Bay.

Location	*Total # W.W. Vessels*	*Mean # W.W. Vessels Per Sample*	*Mean Length of Stay with Whales*
SW Shelter Island n=8	30	**3.75 vessels/sample**	**18 min.**
North Pass n=7	34	**4.86 vessels/sample**	**28 min.**
Young Bay n=1	3	**3 vessels/sample**	**34 min.**
Total Values Across All Locations n=16	67	**4.19 vessels/sample**	**24 min.**
Ranges Across All Locations n=16		**1-13 vessels/sample**	**11-59 min.**

Boater Compliance

I found that whale watching vessel operators usually complied with NOAA Fisheries' *Alaska Marine Mammal Viewing Guidelines* (Table VII). In fact, I would characterize boater compliance with the agency's "Code of Conduct" to be satisfactory. Few boaters approached humpbacks within 200 yards, and only twice did boaters approach whales within 100 yards. Moreover, out of the countless times I watched 67 whale watching boats jockey for position around moving humpbacks, I observed boaters approach focal pods head-on only eight times.

Almost 30% of all whale watching vessels (20 boats) stayed with focal pods for more than ½ hour. Whale-watching boaters effectively encircled focal pods and/or trapped them against the shore when three or more boats were with whales at one time (a situation I observed in five samples).

Table VII. Summary of the number of times whale-watching boaters violated NOAA Fisheries' 1996 *Alaska Marine Mammal Viewing Guidelines* while operating near humpbacks north of Juneau, Alaska.

NOAA Fisheries' 1996 *Alaska Marine Mammal Viewing Guidelines*	Number of Violations
Remain at least 100 yards from marine mammals.	**2 times**: Boats approached within 100 yards **12 times**: Boats approached within 200 yards
Time spent observing individual(s) should be limited to ½ hour.	**20 boats** : stayed > 30 min. (~**30%** of all w.w. boats)
Whales should not be encircled or trapped between boats, or boats and shore.	**every time ≥ 3 boats** with a pod (5 of 5 times): pod essentially "trapped"
If approached by a whale, put the engine in neutral and allow the whale to pass. Boat movement should be from the rear of a whale.	**8 boat approaches**: not from the rear of pod (boat approached pod head-on)

Human Perceptions

NOAA Fisheries received a record-breaking number of letters of comment on their proposed regional policy (Brix 2000). More than twice as many people who commented on the proposed humpback whale approach regulations were against (n=29), rather than for (n=13) the rule. Specifically, almost three-fourths of those against the proposed rule were Alaskans (or people who operate their business or organization out of Alaska), and over half of those in favor of the regulations were not Alaskans. Most respondents who opposed the proposed rule were members of a whale watching industry (not necessarily the Alaskan whale watching industry) or were affiliated with the commercial fishing industry. In contrast, the majority of respondents in favor of the proposed regulations were affiliated with a non-profit organization. Interestingly, respondents from the research community and from the federal government were equally divided in their support for or opposition to the proposed rule (Table VIII).

Those who submitted letters to the Alaska Regional NOAA Fisheries Office provided numerous, varied, and sometimes colorful comments on the issue of regulating boat activity around humpbacks in Alaskan waters. Most of the respondents who opposed the proposal described the rule as "arbitrary," and not based on scientific evidence of whale disturbance or boater non-compliance with NOAA Fisheries' *Alaska Marine Mammal Viewing Guidelines*. Most of the respondents in favor of the regulations, however, felt that the rule was warranted because an increasing number of boats now operate near a relatively small number of endangered humpbacks in Alaskan waters.

Finally, whether respondents were for or against the proposed rule, many provided similar additional suggestions to NOAA Fisheries. In particular , several respondents emphasized the need for vessel speed limits (implemented through guidelines or regulations) in regions where whales are predictably found. Likewise, many who wrote to NOAA Fisheries stressed that the agency should increase its efforts to educate both the public and Alaska's commercial whale watching industry about operating vessels as safely as possible around protected humpbacks.

Table VIII. The general affiliations and opinions of the respondents who wrote to NOAA Fisheries during the public comment period for the agency's proposed whale approach rule.

Respondent Affiliation	*Respondents FOR the Proposed Rule n=13*	*Respondents AGAINST the Proposed Rule n=29*
Alaskan	**6 (46%)**	**21 (72%)**
Private Person	**2**	**4**
Whale Watching Industry	**2**	**11**
Other Tour Operation	**1**	**3**
Federal Government	**2**	**2**
Research Community	**2**	**2**
Commercial Fishermen	**0**	**5**
Non-Profit Organization	**4**	**2**

Are there too many boats? Can there be too much of a good thing?
What are the cumulative environmental, educational, and aesthetic
impacts of vessels on whales? And what can be done to
control the situation if circumstances warrant action?
(Peter Borrelli, Center for Coastal Studies, 1999)[4]

Discussion

I observed surprisingly few humpback whales near Juneau, Alaska, during the peak of Summer 2000. I sighted eighteen different humpbacks in upper Stephens Passage and lower Lynn Canal throughout July and August 2000—and I observed twelve of these whales as a single large pod, once.

I planned to record the behavior of adult, juvenile, and mother-calf pods, but I observed only adult humpbacks in the study area. Several Juneau residents and local whale watching captains had reported sightings of multiple mother-calf pods near Shelter Island in previous summers (e.g., Warr 2000, Dupler 2000), but none were sighted in this region during my field season. In fact, whale watching vessel operators became used to seeing the same adult whales in waters near Juneau on a daily basis in July-August 2000. As mentioned earlier, I usually encountered a maximum of 2-4 humpbacks per day in this region during this time. Additionally, these few whales "resided" near Juneau for several weeks: I observed two focal whales throughout virtually all of July and August, and observed three focal whales throughout most of August.

Clearly, the same individual whales interacted with heavy vessel traffic for extended time periods during the duration of my study. Yet I rarely witnessed these whales responding to boats with avoidance behavior, such as that noted by other humpback whale researchers in Alaska and Hawaii (Baker and Herman 1989, Green and Green 1990, Bauer et al. 1993). Only twice did I see whales immediately dive and travel swiftly away from an approaching vessel. On one occasion, a whale I followed many times surfaced within approximately 50 m of a transiting skiff with an outboard motor and swam away, seemingly startled. On the second occasion, a whale I observed only once immediately left an area where he or she had been milling for several minutes, once two jet-powered commercial whale watching boats approached within 400 m.

Several researchers have reported that humpbacks will frequently engage in surface behaviors, such as breaching or tail-slapping, as "threats" to nearby vessels (Jurasz and Jurasz 1978, Dean et al. 1985, Bauer and Herman 1986, Bauer et al. 1993). Only once did I see a single whale—that had been rolling at the surface in bull kelp—suddenly slap its flukes twice towards a 7 m recreational boat with an outboard motor that slowly ventured to less than 100 yards from the animal.

In addition to noting that some humpbacks evade boats by swimming away, or threaten boats by exhibiting aerial behavior, Bauer and Herman (1986) suggested that other whale behaviors also reflect an avoidance strategy. According to these researchers, humpbacks attempting to avoid boats surface without exhaling, and initiate dives without raising their flukes more frequently. However, I did not find that focal whales with whale watching vessels exhibited "no blow rises" significantly more often, or initiated dives by slipping under (not raising flukes) with significantly greater frequency, than did whales without following boats.

If the presence of boats can lead to humpbacks showing evasive tactics, aggressive behavior, or sudden changes in speed and/or direction, we might also expect to see changes in the respiratory activities of these animals. Some researchers reported that humpbacks showed increased dive durations and decreased surface intervals when vessels in Hawaii or Southeast Alaska were within 2 km (Bauer et al. 1993, Baker and Herman 1989), and when vessels in Hawaii were within ½ mile (Green and Green 1990). In contrast, I found that humpbacks near Juneau exhibited virtually identical mean dive durations and mean surface intervals with and without whale watching boats present (within 400 m).

Notably, however, I found that humpbacks were more variable in their surface intervals—and in their numbers of blows per surfacing—when whale watching vessels were present. Thus, these whales near Juneau that spent more time at the surface seemed to show the opposite of vessel avoidance. Similarly, Bass and Duffus (1999) found that gray whales in Clayoquot Sound, British Columbia, spent increasingly more time at the surface as the number of vessels increased.

Furthermore, Bass and Duffus found that gray whales' foraging time decreased with increasing numbers of boats. I did not find that humpbacks near Juneau decreased their foraging time in this way; in fact, whales with and without whale watching boats devoted virtually the same proportion of time to feeding on average. Likewise, I did not find that whales with whale watching boats partitioned, on average, significantly more or less time to resting, milling, or being surface active than did whales without whale watching vessels. In contrast to Corkeron's findings with humpbacks in Hervey Bay, Queensland, the percentage of time whales with whale watching vessels traveled was not significantly greater than the proportion of time whales without boats traveled on average.

Scar and Sharkfin, the two individuals I followed numerous times with and without whale watching boats, reflected the behavioral trend I observed for all whales sighted near Juneau. Whales' mean respiratory activities and average time budgets were not significantly different when whale watching vessels were present. A close examination of Scar and Sharkfin's individual behaviors did reveal an interesting point, however: these animals appeared to follow fairly predictable breathing patterns and time budgets. And Scar's breathing profile and time budget were distinct from those of Sharkfin. Scar, on average, spent less time at the surface, spent more time submerged, lingered less between blows at the surface, traveled more, and milled less than did Sharkfin. These findings corroborate the ideas of Joline Lalime-Bauer (2001), a humpback researcher working in eastern Australia. She suggests that individual humpbacks show relatively distinct, predictable behavioral patterns, which are reflected in their breathing profiles, for instance, as well as in their reactions to vessels.

After this analysis of whale behavioral responses and vessel activity, the question remains: Are boats harassing humpback whales near Juneau, Alaska? To answer this, we must determine whether vessel activity in this region disrupts the behavioral patterns of humpbacks (Level B Harassment, MMPA Section 3(18)(A)). I found that whales with whale watching vessels were significantly more variable in their surface intervals and in their numbers of blows per surfacing than were whales without whale watching boats. Based on these findings, however, it is difficult to conclude that the behavioral patterns of humpback whales near Juneau are being disrupted. Thus, it is also impossible to conclude that humpbacks are being harassed by boaters in Stephens Passage and Lynn Canal, according to the MMPA's interpretation of harassment.

Vessel activity does not appear to have significantly altered humpback behavior near Juneau, nor does it appear to have altered the short-term distribution of humpbacks in this area. Glockner-Ferrari and Ferrari (1985, 1990) and Salden (1988) suggested that humpback distribution throughout the Hawaiian Islands has changed over time due to increasing vessel traffic. Specifically, they reported that mother-calf pairs have been sighted progressively farther from shore as the number of recreational boaters operating in near-shore waters has increased. In contrast, I observed that humpbacks are currently most often found in areas of heaviest vessel traffic north of Juneau: southwest Shelter Island and North Pass.

Even during the *Golden North Salmon Derby*—when hundreds of boats transited, trolled, and drifted for three days from south Shelter Island, through Saginaw Channel, and into North Pass—a handful of familiar humpbacks remained. Krieger and Wing (1984, 1986) noted that humpbacks appear less responsive to vessels when they are actively feeding. I found it difficult to assess whether a whale was actually foraging unless I saw visible signs of feeding at the surface (such as lunge feeding or bubblenets); consequently, my estimate of the proportion of time animals spent feeding was conservative. Nonetheless, it's plausible that whales near Juneau now seem to tolerate "mosquito fleets" of boats because of their need to feed constantly.

Although whales may now "tolerate" high numbers of nearby recreational and charter sportfishing boats, accidents may be imminent. Vessels often traversed areas such as North Pass and southwest Shelter Island at speeds above 10 knots, and didn't seem concerned about other boaters transiting or trolling in the vicinity. Moreover, boaters often didn't slow down when approaching an area where commercial whale watching operators were clearly idling, waiting for a whale to resurface. Finally, only twice did I hear (commercial whale watching) vessel operators inform nearby boaters of their intentions and of the most recent positions of sighted whales.

The reckless behavior of recreational boaters and charter sportfishing vessel operators stands in contrast to the behavior of most whale watching vessel captains. As mentioned earlier, most whale-watching boaters usually complied with NOAA Fisheries' *Alaska Marine Mammal Viewing Guidelines*. Surprisingly, very few whale watching vessels approached within 200 yards of humpbacks. Yet several whale watching industry members commented to NOAA Fisheries that restricting vessel approaches to ≥200 yards from whales would leave even their most understanding customers "disappointed." The fact that some whale watching vessel captains feel they are currently approaching humpbacks within 200 yards agrees with the findings of Burkhart et al. (1999): most people ***underestimate*** the distance over water from their position to a whale.

Of those who did approach whales closely (≤200 yards), most were recreational boaters (n=14). In fact, those who drove trolling boats most frequently approached whales at close-range; these boaters either quickly pulled their lines in and began to follow a pod, or they started to follow a pod with their lines still in the water. The two boaters who approached whales within 100 yards either knowingly violated the first viewing guideline or were unaware of NOAA Fisheries' Code of Conduct. But because recreational boaters and charter sportfishing vessel captains usually approached humpbacks the closest—and most often traveled at high speeds through groups of other boats—I agree with the letter-writers who urged NOAA Fisheries to increase boater safety education efforts and to consider speed limits in key areas. Furthermore, advising boaters to keep their distance from pods that are already being followed by three or more boats would be wise, as well. I observed that when more than three boats tried to watch a single pod—and keep a safe distance from one another—they fully encircled, or trapped, the whales every time.

Whale watching has enormous benefits,
as well as inevitable growing pains.
(William Rossiter, 1998)[5]

Management Recommendations

I recommend that NOAA Fisheries not implement its humpback whale approach rule as proposed. Instead, I urge the agency to implement regulations that prohibit all approaches within *100 yards (91.4 m)* of humpback whales in Alaskan waters.

NOAA Fisheries is justified in wanting to promulgate regulations that will protect and conserve humpback whales in waters off Alaska. Researchers believe that the total number of humpbacks in the North Pacific today is less than half of the number present in 1905, just prior to widespread, large-scale harvest. Although now protected from outright killing, North Pacific humpbacks face modification or destruction of their habitat, competition with humans for prey resources, possible entanglement in fishing gear, and dramatic increases in vessel traffic. In particular, humpbacks of the Central North Pacific stock experience the effects of burgeoning whale watching industries at *both* ends of their range: Alaska and the Hawaiian Islands. In Alaska, small groups of the same humpbacks—such as those near Juneau—are exposed to heavy traffic for several weeks or months during the summer.

Prohibiting approaches within 100 yards—rather than 200 yards—of humpback whales is a good decision. One hundred yards is the minimum distance NOAA Fisheries asks boaters to keep between themselves and whales in the agency's 1996 *Alaska Marine Mammal Viewing Guidelines*. And approaches within 100 yards of humpbacks have been prohibited in Hawaii since NOAA Fisheries established regulations there in 1987. Furthermore, I observed only two (recreational) boaters who approached whales within 100 yards, and only a dozen boaters who approached whales within twice that distance. Most boaters near Juneau—a center of whale watching activity in Southeast Alaska—keep their distance from humpbacks.

The majority of whale watching industry members who contacted NOAA Fisheries stated that they would support the agency's turning their 1996 viewing guidelines into enforceable rules. To most of these stakeholders, restricting approaches to a distance of over 200 yards from humpbacks seemed excessive. Moreover, they resented being "punished" (for following the current viewing guidelines) by being told to stay twice as far away from whales as boaters do in Hawaii. A final rule prohibiting approaches within 100 yards would probably be met with cooperation—rather than resentment—from Alaskan stakeholders.

Operators of commercial whale watching vessels who still protest a 100-yard restriction can be reminded of the protected status of North Pacific humpbacks under two precautionary statutes, the ESA and the MMPA. They can also be reminded of the findings of Kellert (1999) and Orams (2000). Both researchers separately concluded that most paying whale watching passengers do *not* consider a boat's proximity to whales to be an important influence on their overall enjoyment of a whale watching cruise.

I also recommend that NOAA Fisheries, Alaska Region, clearly announce two additional guidelines when implementing their humpback whale approach regulations. First, boaters should be advised to stay back [$\geq$500 m] from whales that are already being watched by three or more boaters within $\leq$400 m. As mentioned earlier, three or more whale watching vessels with a pod at once almost always effectively encircle the whales, or "trap" them against the shore. Many U.S. locations popular for watching baleen whales, including the Studds-Stellwagen Bank National Marine Sanctuary, have drafted guidelines aimed at limiting the number of boats allowed close to whales at once (Borrelli 1999).

Second, boaters should be advised to reduce their speeds in regions where whales are predictably found on a seasonal basis. In the Juneau area, these regions include the heavily-trafficked waters near southwest Shelter Island and North Pass. Letters to NOAA Fisheries suggested additional regions throughout Southeast Alaska that should similarly be considered "whale waters" where vessel speed is restricted: waters near Morris Reef in Chatham Strait, parts of Frederick Sound, and waters near Point Adolphus in Icy Strait. Already designated "whale waters," parts of Glacier Bay National Park and Preserve restrict vessel speed to $\leq$10 knots throughout the summer (Gabriele et al. 1999). I recommend such a restriction in other seasonal "humpback hot spots" throughout Alaska.

In addition, I recommend that speed restrictions in designated waters apply to all vessels. Indeed, Laist et al. (2001) recently announced that their studies of historical records and computerized stranding databases showed that all sizes and types of vessels can hit whales. I also recognize that speed restrictions may be the only viable method for cruise ships to avoid colliding with humpbacks in Alaskan waters. Laist et al. reported that collisions that killed or severely injured whales involved ships greater than 80 m in length traveling at speeds of 14 knots or faster. Cruise ships may not be able to immediately shift their engines into neutral if a humpback surfaces within 200 yards—and they may not see a whale at all before striking it. But cruise ships can be advised to maintain a speed of $\leq$10 knots when traversing "whale waters," as they do now inside Glacier Bay National Park and Preserve.

Baker and Herman (1989) noted that humpbacks altered their speed and orientation when larger ships passed within 4 km of them. Additionally, Malme et al. (1981) and Miles and Malme (1983) stated that the noise of larger ships dominated the ambient sound "out to a range of up to six miles in some measurements" in Glacier Bay and Frederick Sound (*in* Richardson et al. 1995). Cruise ships emit large amounts of high-intensity, low frequency, and constantly moving noise with which humpbacks must contend. As cruise ships become larger and more numerous in Alaskan waters, we must not overlook their potential for harassing—or killing—humpbacks.

I agree with the numerous people who advised NOAA Fisheries to increase their efforts to educate the public about humpback whales. Boaters will drive more responsibly around humpbacks if they know and understand what statutes and guidelines protect humpbacks in Alaskan waters. Secondly, boaters may drive more responsibly near whales if they are simply taught safer, potentially less disruptive ways to operate boats around these animals. Recreational boaters and charter sportfishing vessel captains were those who most often drove in a potentially hazardous manner near submerged, continually moving, 40-ton animals. We must teach *everyone* about optimal boat operation around humpbacks.

I encourage NOAA Fisheries to form partnerships with other organizations throughout Alaska to increase public awareness of humpback whales. NOAA Fisheries alone does not have the funds or the personnel to effectively educate Alaskan boaters. Through partnerships with local government, non-profit organizations, Chambers of Commerce, and Coast Guard Auxiliary, NOAA Fisheries can increase the likelihood that a message about safe driving around humpbacks will reach a wide audience.

Such partnerships are recommended in the *Final Recovery Plan for the Humpback Whale* (HWRT 1991), and could foster a range of educational campaigns. Television and radio public service announcements (PSAs), as well as large signs posted at popular harbors and launching ramps may go far in communicating the laws that protect humpbacks. These signs and PSAs must spell out what boaters may and may not do near whales. Other methods of educating the public about interacting with humpbacks include printed material on tide tables, visitor brochures, and flyers disseminated to sportfishers obtaining licenses.

Partnerships in other areas, such as that between the Virginia Marine Science Museum and the Virginia Coastal Program, serve as examples of organizations successfully working together to educate vessel operators about appropriate boating behavior around wildlife. This partnership's curriculum, *Boat Safely/Respect Wildlife*, outlines the appropriate operation of vessels near protected species—and it was recently incorporated into Virginia boating and personal watercraft classes. The two organizations also hope to see this curriculum included in national boater education courses and materials from the U.S. Coast Guard Auxiliary and the U.S. Power Squadron (Swingle and Barco 1999).

Lastly, cetacean experts like Memorial University's Dr. Jon Lien (2001), emphasize that no study has examined the impacts of vessels on whales over an extended time. While research on the short-term responses of cetaceans to vessels contributes important information on how different species react in varying geographic regions, we don't know the long-term consequences of this activity.

Several researchers have suggested that humpback whales, particularly, appear most responsive to *moving* sound sources, such as whale watching, recreational and commercial fishing vessels, and low-lying aircraft (Atkins and Swartz 1989, Beach and Weinrich 1989, Green and Green 1990, Richardson et al. 1995, Gerber et al. 2000). Indeed, both Malme et al. (1985) and Frankel and Clark (1998) reported that humpbacks in Southeast Alaska and Hawaii, respectively, often reacted visibly to nearby vessels—but not to playbacks of high energy, low frequency sound. Will the subtle short-term behavioral responses that humpbacks exhibit to boats lead to long-term population-level effects? Will increasing vessel activity eventually lead to decreases in the reproductive rates of whale populations—or to a displacement of whales from critical feeding and breeding areas?

Many questions will go unanswered until long-term studies of the effects of boat activity on cetacean populations are funded and conducted. Alaskan fisheries biologists believe that the Pacific herring population that spawns and over-winters in Lynn Canal may be recovering, after crashing in the late 1980s (McGregor 2000, Shirley 2000). Tourism—and concomitant vessel traffic—continues to boom in the Inside Passage. An important question to ask, then, is whether more humpbacks will start to feed on this growing prey population near Juneau, despite heavy vessel traffic. Only through the study of humpbacks and boat activity will we better understand the sustainability of Alaskan marine-based tourism, as well as the health of the dynamic ecosystem of which humpbacks are such a vital part.

Conclusion

This study represents an important start to understanding interactions between humpback whales and vessel activity near Juneau, Alaska. Clearly, only a few humpbacks share northern Stephens Passage and southern Lynn Canal with many boats during the summer. Throughout June and August 2000, humpbacks north of Juneau—especially in North Pass and near southwest Shelter Island—were rarely without boats (within 800 m). Boater compliance with NOAA Fisheries' *Alaska Marine Mammal Viewing Guidelines* was satisfactory during the summer of 2000. Boaters infrequently approached humpbacks within 200 yards—and only twice approached whales within 100 yards.

Humpbacks showed subtle behavioral changes when whale watching vessels were present. Whales with boats varied their surface intervals and their numbers of blows per surfacing significantly more than did whales without boats, but I conclude that boats are not harassing humpbacks near Juneau. However, there is a need for long-term research to determine whether vessel traffic leads to humpbacks devoting significantly less time to critical activities like feeding and resting.

Finally, more than twice as many comment letters submitted to NOAA Fisheries were written by those against—rather than for—the agency's proposed humpback approach rule. Whether or not respondents were for or against the regulations, many stressed the need for speed limits around humpbacks and for public education focused on responsible driving around these animals. In light of this, as well as my observations of potentially hazardous boating near Juneau, I encourage NOAA Fisheries to: (1) implement a final rule that prohibits approaches within 100 yards (*not* 200 yards) of humpbacks in Alaskan waters; (2) advise boaters to limit the number of boats within ≤400 m of a pod at one time; (3) advise boaters to travel slowly (≤10 knots) through "whale waters," including North Pass and southwest Shelter Island; (4) form partnerships with local agencies and organizations to increase public awareness of humpbacks in Alaska through various educational campaigns; (5) support long-term studies of the impacts of vessel activity on humpbacks in Alaskan waters.

I do not fear for the whales and dolphins, but I care for them, and I would trust that you care for them as well. They were here hundreds—perhaps thousands—of years before we came. Hopefully they will still be here long after we are gone. Caring for them can be our legacy to the sea....
(Joana McIntyre Varawa, 1991)[6]

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Appendices

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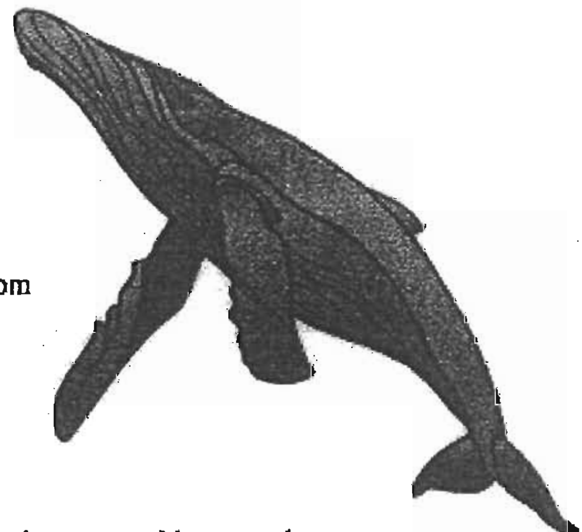
Appendix A.
NOAA Fisheries' "Code of Conduct" for Marine Mammal Viewing Sign

"Code of Conduct" for Marine Mammal Viewing



1. Remain at least 100 yards from marine mammals.
2. Time spent observing individual(s) should be limited to a ½ hour.
3. Whales should not be encircled or trapped between boats, or boats and shore.
4. If approached by a whale, put the engine in neutral and allow the whale to pass. Boat movement should be from the rear of a whale.

Pursuit of marine mammals is prohibited by law.

***Bring binoculars along on a viewing excursion to assure a good view from the recommended viewing distances.* The "Code of Conduct" is not a replacement for federal law.**

For a copy of the Alaska marine mammal viewing guidelines or to report marine mammal injury or abandonment, please call:

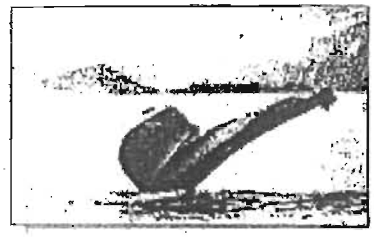
National Marine Fisheries Service
Protected Resources
Alaska Region
Visit us on the web: www.fakr.noaa.gov
P.O. Box 21668
Juneau, AK 99802
907-586-7235

Appendix B.

Anchorage Daily News Editorial on Alaska Whale Watching (January 26, 1992)

ANCHORAGE DAILY NEWS
SUNDAY, Jan. 26, 1992

As whale watching grows in popularity, some say the activity threatens Southeast humpbacks. Others say the growing number of cruises ship doesn't affect the population. Glacier Bay National Park is the center of the debate.



LOVING THEM TO DEATH?

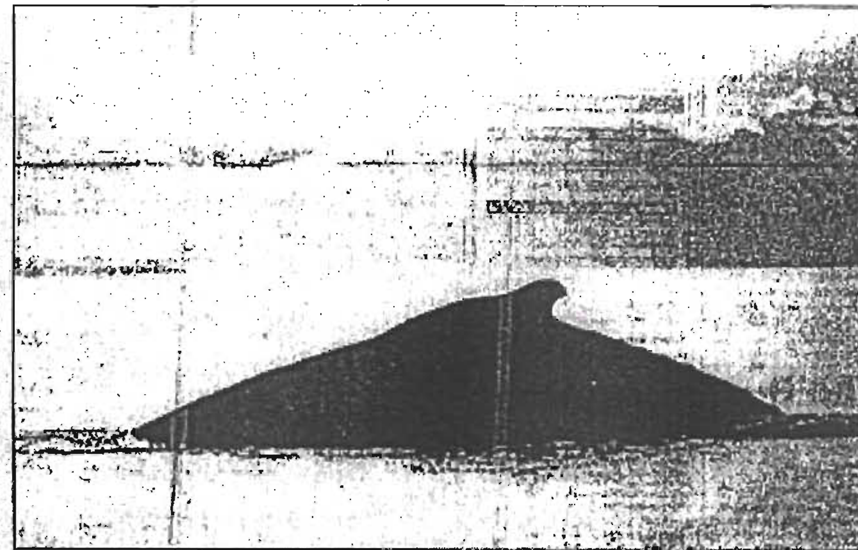
By [illegible]

The plight of whales — the docile giants hunted nearly to extinction by roving factory ships — captured the public's attention several decades ago. The public outcry that followed resulted in a whaling ban in the United States and around the world. International treaties signed in [illegible] prohibit whale hunting on the high seas, although some countries — such as Japan — continue to hunt the mammals for what they call "research."

The limits on hunting have led to increased numbers of whales and a heightened public desire to see them up close. But the whales' celebrity status has become a double-edged sword. It may have saved them from extinction, but out of it has sprung an industry — whale watching — that has some ecologists concerned about crowding in key habitats. Scientists have noted changes in whale migration patterns that they attribute to the number of boats seeking contact with the animals, and the National Marine Fisheries Service (NMFS) plans to propose regulations to combat the problem.

Nowhere is the debate more hotly contested than at Glacier Bay National Park. Designated a national monument in 1925 and a national park in 1980, the park encompasses three million acres of marine and terrestrial wilderness accessible only by sea and

Please see Page F-5, WHALES



Humpback whales surface and dive in Prince William Sound. The whales are seasonal visitors to Alaska waters.

WHALES: Glacier Bay at center of debate

Appendix C.
Juneau Empire Article Announcing NOAA Fisheries' Proposed Rule
(June 26, 2000)

Rule to help humpbacks

■ *Proposal comes as tour traffic mushrooms*

By ERIC FRY
THE JUNEAU EMPIRE

No one would be able to approach within 200 yards of a humpback whale in Alaska, under a federal rule proposed today.

The proposal follows explosive growth in the whale-watching and charter-fishing industries in Southeast Alaska and the Kenai Peninsula.

It would supplement what now are simply voluntary guidelines for watching marine mammals, which recommend that people stay at least 100 yards from marine mammals and watch them for no more than a half-hour.

The proposal is intended to give mariners a clear rule to follow when they come across the endangered whales, which feed in waters off Alaska from spring to fall, fisheries service officials said.

It's the only time all year the whales feed, so it's important not to disrupt them or the schooling fish they prey upon, said National Marine Fisheries Service enforcement agent Ron Antaya in Juneau.

"If they don't get all the chow they need in Alaska, they may not make it back next year," he said.

The only exception to the proposed new rule would be some commercial fishermen while they're actively fishing, Antaya said.

Please see Whales, Page 8

JUNEAU EMPIRE, MONDAY, JUNE 26, 2000

Whales...

Continued from Page 1

Larry Dupler of Orca Enterprises, which runs one whale-watching boat in Juneau, supports the proposed rule and said it wouldn't hurt the visitor industry. A lot of tour boats already watch whales from a few hundred yards away, he said.

And Dupler said the rule could help the industry. He said he's seen humpbacks leave the area apparently in reaction to boats. A cow and a calf moved out of a secluded cove near Juneau when boats discovered them, he said.

"If we keep crowding these guys, there's a good chance they may move away from us here," he said.

The fisheries service considered other restrictions, such as speed limits or limits on whale-watching time, but the agency rejected those as unenforceable.

Regulators said the problem with the current guidelines is that they aren't always followed and they aren't enforceable.

"We couldn't do anything about people not adhering to guidelines," said Kaja Brix, a fisheries service wildlife biologist in Juneau.

Mariners will still be subject to the Marine Mammal Protection Act, which prohibits "taking" — defined as hunting, capturing, collecting, killing or harassing, or attempting to do so. Violators can be fined or even imprisoned in extreme cases.

The problem, Antaya said, is that harassment is hard to define for the public and hard to prosecute. Many times federal attorneys decided not to prosecute cases because the law is so vague, he said.

The proposed rule would prohibit anyone from approaching within 200 yards of a humpback whale in Alaska. That includes what's called interception — when a boat places itself in the path of a whale so that it surfaces.

The rule doesn't require vessels to leave if a whale surfaces nearby or approaches a boat. That's because quickly moving away may be more disruptive than staying quietly in place, Antaya said.

Regulators don't have firm figures on how many boats could be affected. But they and tour industry members agree the number of charter-fishing and whale-watching boats has jumped in recent years. The rules also affect private boats, including kayaks.

The penalty hasn't been determined yet, but it probably would be a fine, Antaya said. The fisheries service expects to be able to enforce the rule with readings from range finders from its own boats, or with testimony, range-finder readings and photographs from witnesses.

The fisheries service is taking public comment on the proposed rule until Aug. 10. Send comments to Mike Payne, National Marine Fisheries Service, P.O. Box 21668, Juneau, Alaska 99802-1668, or by fax to 907-586-7012. The proposed rule is on the Internet at www.fakr.noaa.gov.

Appendix D.
Fairbanks Daily News-Miner Article Describing NOAA Fisheries' Proposal (July 19, 2000)

Do not harass the humpbacks

Feds propose safety zones for whales

The Associated Press

KENAI—The federal government is proposing some new rules designed to protect humpback whales from harassment.

Scientists with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service are concerned that the growth in whale-watching could be harmful to the large mammals and dangerous to boaters.

Under the new regulations, it would be unlawful to approach a humpback whale from less than 200 yards.

"Two-hundred yards is a good distance for humpback whales," said the agency's Carol Tocco. "They feed continuously in the same areas and fall when they migrate south. If they don't feed here, they won't retain their health, so that's why it's important to make sure they're not disturbed."

A set of voluntary guidelines for viewing marine mammals was developed in 1996.

"The whale-watching industry has pretty much already followed the voluntary guidelines," Tocco told the Peninsula Clarion. "It's the occasional deliberate approach we're trying to eliminate."

While the National Marine Fisheries Service has not prosecuted any incidents of whale harassment, the new regulations will help prevent such occurrences, she said.

"Right now we have to prove someone has actually harmed an animal," Tocco said.

Fairbanks Daily News-Miner, Wednesday, July 19, 2000

Appendix E.

Juneau Empire Article on Controversy of NOAA Fisheries' Proposal (October 17, 2000)

Operators, scientists question whale plan

■ *Proposal stirs debate over protecting whales*

By ERIC FRY
THE JUNEAU EMPIRE

A proposed federal rule to keep boats 200 yards away from humpback whales in Alaska would harm tour companies, some boat owners told regulators. A whale research institute said the proposed rule wouldn't help the whales, either.

But other boat operators and conservation groups said the rule, as well as other requirements, is needed to keep the whales from being harassed or struck.

National Marine Fisheries Service officials have said they proposed the 200-yard rule as a simple way to protect the endangered whales – which feed with their calves in Alaska in the summer – from being chased off their feeding grounds.

Whales are thought to be sensitive to engine noise and pursuit by boats. And the closer the boats are to whales, the greater the possibility of a collision. Although there are no hard figures, the fisheries service said the number of tour boats, fishing charters and private boats in Southeast and Southcentral Alaska is growing.

> "If we are forced to view whales from a minimum 200-yard distance, even the more understanding of our customers will be significantly disappointed."
>
> —Rob Allen, Allen Marine Tours

* Heather Peterson, a graduate student at Duke University's environmental school, told the fisheries service it was common to see up to 13 boats watching a single humpback over 90-minute sampling periods near Juneau this summer. She has seen eight boats closely following a whale while 20 other boats were traveling nearby and 20 others were trolling within a half-mile, she said.

Federal law prohibits harassing or harming endangered species and marine mammals in general, but the law is hard to prosecute, officials have said. And voluntary guidelines for watching marine mammals aren't always followed, they said. Those guidelines ask mariners to stay 100 yards away and

Continued from Page 1

watch the animals for no more than 30 minutes.

The 200-yard limit wouldn't please tour passengers, who already complain about the 100-yard distance, Rob Allen, president of Allen Marine Tours, told the fisheries service in written comments. The company served more than 100,000 passengers in Juneau, Sitka and Seward last summer, he said.

"If we are forced to view whales from a minimum 200-yard distance, even the more understanding of our customers will be significantly disappointed and it will result in serious damage to our business," Allen said.

Allen also said the rule would be hard to enforce and would give an unfair advantage to companies that broke the rule.

Like other commenters, Allen asked the fisheries service to turn the current guidelines into formal rules and enforce them, along with a requirement that boats slow down near whales to avoid collisions.

Even commenters who supported the 200-yard limit, such as the Marine Mammal Commission and the Center for Marine Conservation, often asked for additional protection such as vessel speed limits.

The Whale Center of New England, a research and education organization in Gloucester, Mass., opposed the 200-yard limit, saying it wasn't based on science. The center's director and chief scientist, Mason Weinrich, said if whales react to anything, they react to sound, not the nearness of vessels, and he called for speed limits to avoid collisions.

He called the proposed rule "an easily enforceable but ultimately meaningless regulation."

Enforcement agents have said speed limits are particularly hard to enforce. Speed is hard to measure on the water because the patrol vessel and the target vessel may be pushed in different directions and at different speeds by separate currents, said special agent Ron Antaya in the fisheries service's Juneau office.

The fisheries service will review the public comments and reconsider its proposed rule as it prepares a final draft, possibly before next tour season, officials said. The proposed rule does not apply to commercial fishing vessels while they're fishing. And it doesn't require vessels to move away from whales if they surface near a boat.

JUNEAU EMPIRE
TUESDAY, OCTOBER 17, 2000

Appendix F.
Humpback Whale Behaviors of Interest

Behavior	Definition
Blow	Whale exhales above water surface
Underwater Blow	Whale exhales below water surface
Trumpet Blow	Whale exhales with accompanying loud vocalization
No Blow Rise	Whale surfaces with no exhalation
Fluke-Up Dive	Whale submerges and lifts flukes clear of water surface so that tail's ventral surface is exposed
Fluke-Down Dive	Whale submerges and lifts flukes clear of water surface, but tail's ventral side is not exposed
Peduncle Arch	Whale submerges so that most of the tail stock, but not the flukes, is exposed above water surface
Slip Under	Whale submerges without arching its back or exposing its flukes
Roll	Whale spins on its long axis at water surface; movement is not accompanied by pectoral fin slaps
Spyhop	Whale rises vertically out of the water, rostrum first. Eyes may or may not be exposed above water surface.
Breach	Whale jumps so that ¾ of its body clears water surface, twists 180° through air, and lands on its back
Half Breach	Whale jumps so that less than ¾ of its body clears water surface and may or may not twist
Peduncle Throw	Whale strikes water surface with lateral side of tail stock
Tail Swish	Whale rapidly moves tail through water in a sideways movement
Tail Cartwheel	Whale waves tail side-to-side in an arc-like motion above water surface
Tail Slap	Whale strikes water surface with tail's ventral side
Pectoral Fin Slap	Whale strikes water surface with its pectoral fin
Head Slap	Whale strikes water surface with its head
Head Lunge	Whale rapidly moves head forward above water surface at an angle $<45°$
Lunge Feed	Whale emerges abruptly through water surface with mouth open, ready to engulf prey
Bubblenet Feed	Whale releases a discrete sequence of bubbles underwater that form a ring at water surface; feed is contained here as whale emerges with open mouth
Feeding Call	Whale vocalizes audibly while engaging in feeding behavior

Appendix G.
Humpback Whale Behavioral State Descriptions

Code	Name	Definition
R	RESTING	A whale is *resting* if he lies horizontal and motionless at the surface in the same location for fifteen seconds or more.
M	MILLING	A whale is *milling* if he swims with no obvious orientation (non-directional movement). A milling whale often circles, changes direction and speed frequently, exhibits no surface activity, and is not feeding.
T	TRAVELING	A whale is *traveling* if he swims with an obvious orientation (directional movement). A traveling whale exhibits no surface activity and is not feeding.
F	FEEDING	A whale is *feeding* if he surfaces and dives with consistent dive times, and in the same general location. Sometimes there are obvious signs of feeding, including a whale lunging at the surface, building a bubblenet, or vocalizing an audible feeding call. Additionally, sometimes there are diving seabirds and/or prey boiling at the surface near the whale.
SA	SURFACE ACTIVE	A whale is *surface active* if he exhibits aerial behavior that creates a conspicuous splash (including head slapping, tail slapping, pectoral fin slapping, and breaching).

Appendix H.
Codes for Vessel Activity Data

VESSEL TYPE

Commercial [Tour] Vessels

AM = Allen Marine Tours vessel (jet engine)
JB = Dolphin Jet Boat Tours vessel (jet engine)
OR = Orca Enterprises vessel (jet engine)
WT = M/V *Whale Tale* (outboard engine)
JS = Juneau Sportfishing vessel (I/O engine)
AB = Auke Bay Sportfishing vessel (I/O engine)
AK = Alaska State Ferry
CS = Cruise ship
EX = Excursion vessel (multiple-day tour boat)

Non-Commercial Vessels

REC = Recreational boat
REC O = Rec. boat w/ outboard engine
REC < [+/- O] = Rec. boat < 7 m long
REC > [+/- O] = Rec. boat > 7 m long
FISH = Commercial fishing vessel
GC = Greens Creek Mine crew vessel
K = Kayak
TC = Thrill craft (jet ski, wave-runner)

VESSEL ACTIVITY

Speed

0 = Not moving forward (engine not on or engine in neutral)
1 = Slow/idle (1-2 km/hr. and no wake)
2 = Medium (3-7 km/hr. and small wake)
3 = Fast (>7 km/hr. and large wake)

Movement (may use combination of descriptors)

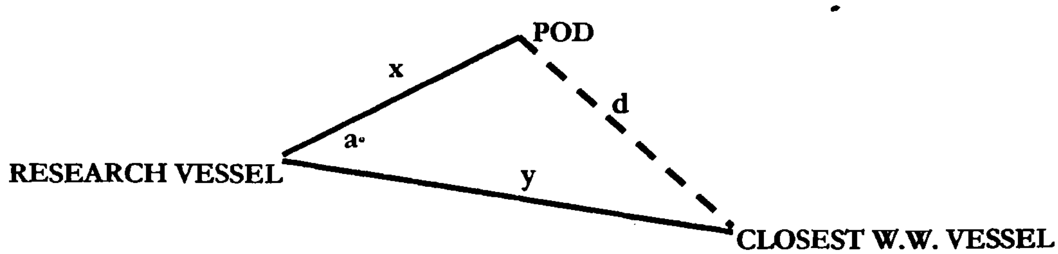
+ = Perpendicular to pod movement
// = Parallel to pod movement
f = Moving towards front of pod
b = Moving towards rear of pod
lf = Leapfrogging (intercepting pod's forward movement)

**Note if all whale watching vessels are on one side of pod, encircling pod, or trapping pod against shore. If possible, also note how all vessels (w.w. and non-w.w. boats) are oriented towards one another.

VESSEL PROXIMITY

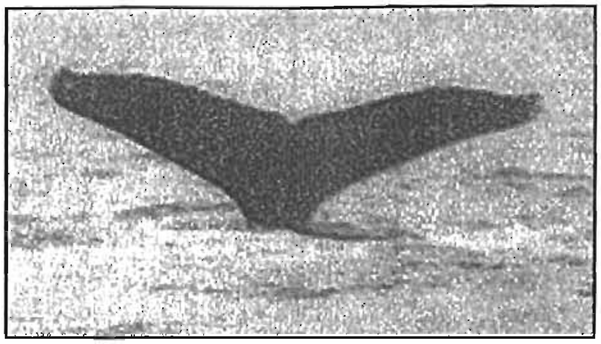
Using a laser range finder, determine distance from research vessel to pod (x) and distance from research vessel to boat closest to pod (y) for a particular whale surfacing. Determine the angle between pod and closest vessel (a°, using research vessel as angle's vertex) with a protractor. Calculate distance between pod and closest vessel (d) using above distance values and angle (Law of Cosines).

Law of Cosines: $d = SQRT[\ x^2 + y^2 - 2 * x * y * \cos(a^{\circ})]$



Appendix I.
Sighting Histories of Nine Photo-Identified Humpback Whales

SCAR

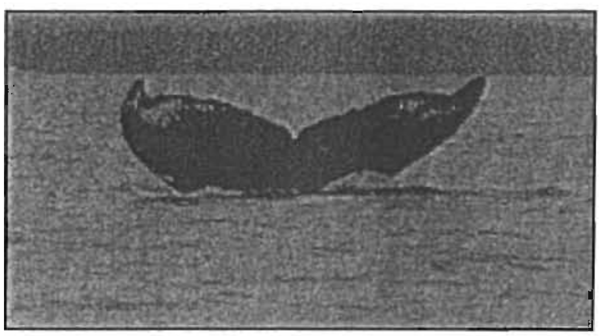


Pod 77A: Southwest Shelter Island/Portland Island (singleton)
Pod 721A: Saginaw Channel/SW Shelter Island (singleton)
Pod 724A: Saginaw Channel/SW Shelter Island (singleton)
Pod 85A: Southwest Shelter Island (singleton)
Pod 813B: Young Bay (with Sharkfin)
Pod 818A: Southwest Shelter Island (singleton)
Pod 819A: Favorite Reef/Southwest Shelter Island (singleton)
Pod 820A: Southwest Shelter Island (singleton)
Pod 823A: Southwest Shelter Island/Portland Island (singleton)

#0994 in SE Alaska Fluke Catalog

*sighted in Sitka Sound, Falls 1991, 1998

SHARKFIN



Pod 718A: Southwest Shelter Island (singleton)
Pod 812A: Young Bay (singleton)
Pod 813A: Young Bay (singleton)
Pod 813B: Young Bay (with Scar)
Pod 816B: Young Bay (singleton)

Not found in Straley and Gabriele's SE Alaska Fluke Catalog

Appendix I.
Sighting Histories of Nine Photo-Identified Humpback Whales

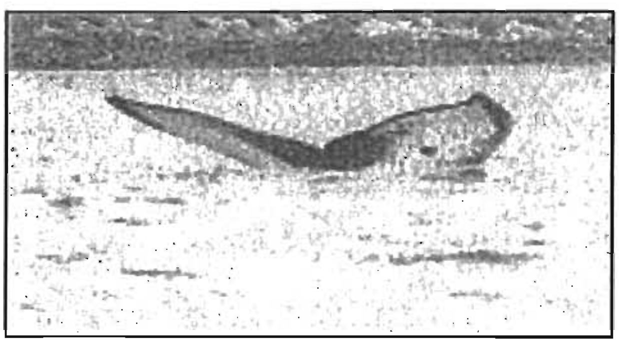
SPARTACUS

Pod 85B: Saginaw Channel/SW Shelter I. (singleton)
Pod 86A: North Pass (singleton)
Pod 817B: North Pass (with Spot and Slash)
Pod 819B: North Pass (with Spot and Slash)
Pod 823B: North Pass (with Slash)

#1211 in SE Alaska Fluke Catalog
* sighted in Sitka Sound, Fall 1992

Photo: Chris Howard

SPOT

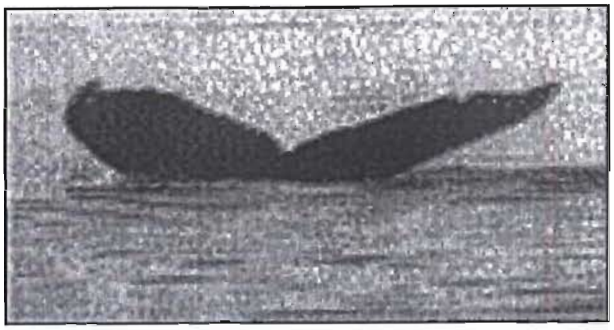


Pod 88A: North Pass (singleton)
Pod 812B: North Pass (singleton)
Pod 817B: North Pass (with Slash and Spartacus)
Pod 819B: North Pass (with Slash and Spartacus)

#1434 in SE Alaska Fluke Catalog
* sighted in Frederick Sound, Summers 1994, 1998
* born in 1994 to #581 (Frederick Sound)

Appendix I.
Sighting Histories of Nine Photo-Identified Humpback Whales

SLASH



Pod 817B: North Pass (with Spot and Spartacus)

Pod 819B: North Pass (with Spot and Spartacus)

Pod 823B: North Pass (with Spartacus)

#1306 in SE Alaska Fluke Catalog

* sighted in Glacier Bay/Icy Strait, June-July 2000
* sighted in Glacier Bay/Icy Strait, Summers 1992, 1996, 1997, 1998
* sighted in Frederick Sound, Summer 1995
* born in 1992 to #193 (Glacier Bay)

STEALTHY

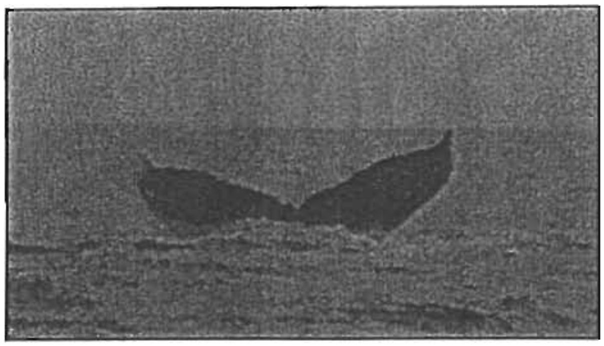
Pod 816A: Benjamin Island

singleton
traveling

Not found in Straley and Gabriele's SE Alaska Fluke Catalog

Appendix I.
Sighting Histories of Nine Photo-Identified Humpback Whales

RALEY



Pod 76A: North Pass/Ralston Island

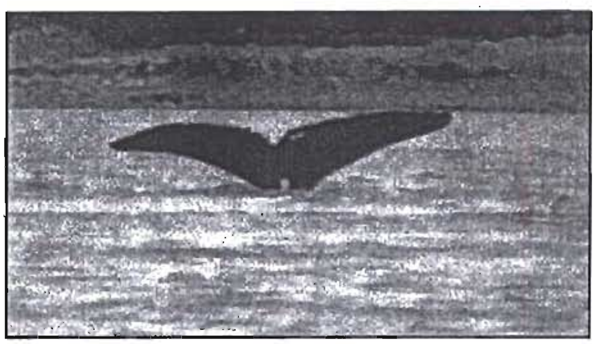
part of pod of 12 whales
traveling and surface active

Photo: Rachel Cartwright

#0252 in SE Alaska Fluke Catalog

* sighted in Frederick Sound, Chatham Strait, and Seymour Canal, Summers 1989-1997
* sighted in Chatham Strait in mid-1980s as part of a large lunge-feeding group
* calf in 1993 (Frederick Sound)

MOUSIE



Pod 76A: North Pass/Ralston Island

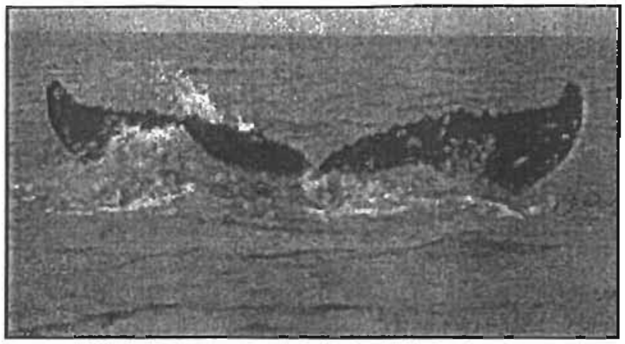
part of pod of 12 whales
traveling and surface active

Not found in Straley and Gabriele's SE Alaska Fluke Catalog

Photo: Rachel Cartwright

Appendix I.
Sighting Histories of Nine Photo-Identified Humpback Whales

JITTER



Pod 76A: North Pass/Ralston Island

Not found in Straley and Gabriele's SE Alaska Fluke Catalog

part of pod of 12 whales
traveling and surface active

Photo: Rachel Cartwright

Appendix J.

Raw Data: Whale Focal Follows with No Whale Watching Vessels Present

NO WHALE WATCHING VESSEL SAMPLES [11 samples, 972 minutes, 16.2 hours]

POD #	POD COMP.	SAMPLE LENGTH	SURFACE INTERVALS	INDIVIDUAL(S)	LOCATION	TIDAL STATE	TRANSIT.	TRASIT./MIN	TROLLERS	TROLL./MIN.
77B	singleton	16 min.	2	Who?	Portland I.	HTF	2	0.13/min.	0	0
715A	singleton	50 min.	10	Who?	Saginaw Channel	LTE	10	0.20/min.	1	0.02/min.
85A	singleton	74 min.	13	Scar	S. Shelter I.	HTF	12	0.16/min.	5	0.07/min.
818A	singleton	111 min.	18	Scar	S. Shelter I.	HT E	**52	0.50/min.	**17	0.15/min.
819A	singleton	90 min.	15	Scar	Favorite Reef	LTF	**54	0.60/min.	**59	0.7/min.
820A	singleton	98 min.	18	Scar	SW Shelter I.	LTF	**32	0.33/min.	**24	0.24/min.
813B	pair	103 min.	32	Scar/Sharkfin	Young Bay	LTF	5	0.05/min.	0	0
812A	singleton	141 min.	15	Sharkfin	Young Bay	HT E	4	0.03/min.	3	0.02/min.
813A	singleton	86 min.	14	Sharkfin	Young Bay	HT E	5	0.06/min.	3	0.03/min.
812B	singleton	101 min.	13	Spot	North Pass	L	9	0.09/min.	11	0.11/min.
819B	trio/pair (50/50)	102 min.	41	Spot, Spa., Sl.	North Pass	HTF	**27	0.26/min.	**87	0.85/min.

**Salmon Derby

Appendix K.

Raw Data: Whale Behavior with No Whale Watching Vessels Present

NO WHALE WATCHING VESSEL SAMPLES [191 total surface intervals]

POD #	n=14 S.I.	n=14 D.D.	n=13 #BLOWS	n=13 BLOW INT.	n=14 SU	n=14 PA	n=14 FU	n=14 FD	n=14 TRAVEL	n=14 MILL	n=14 REST	n=14 S.A.	n=14 FEED
77B	1.015	8			0.5	0	0.5	0	0.5	0.5	0	0	0
715A	0.992222	5	3.7777778	21.04	0.2	0.6	0.2	0	0.7	0.3	0	0	0
85A	0.851818	5.181818	4.9090909	12.8809524	0	0.0909	0.9091	0	0.4167	0.5833	0	0	0
812A	2.082667	3.714286	5.5333333	27.3043478	0.6	0.4	0	0	0.6	0.4	0	0	0
812B	0.738462	6.916667	2.9230769	22.5416667	0.08	0	0.92	0	0.4615	0.3846	0	0	0.1539
813A	1.286429	5.384615	4	25.6428571	0.5	0.43	0.07	0	0.2143	0.6428	0.1429	0	0
813B SH	1.186875	4.533333	4.25	21.1346154	0.3889	0.3333	0.2778	0	0.6471	0.3529	0	0	0
813B SC	1.000625	4.6	4.5	18.0178571	0.375	0.3125	0.3125	0	0.6	0.4	0	0	0
818A	0.947222	5.176471	5.1666667	13.7361111	0	0.1667	0.8333	0	0.8889	0.1111	0	0	0
819A	1.112667	5.071429	6.2	12.8461538	0	0	1	0	0.7333	0.2667	0	0	0
819B SPA	1.69	8	5.2	21.15	0.1667	0.3333	0.5	0	0.5	0.3333	0	0	0.1667
819B SP	0.817333	5.133333	3.4	17.4054054	0.3529	0.1765	0.4706	0	0.1765	0.2941	0	0.0588	0.4706
819B SL	0.887059	4.625	3.0588235	23.4857143	0.2778	0.1667	0.5556	0	0.2222	0.2778	0	0	0.5
820A	0.941176	4.5625	5.4705882	13.8648649	0	0	1	0	0.5	0.5	0	0	0
MEAN	1.110682	5.421389	4.491489	19.3115805	0.245807	0.214993	0.539207	0	0.511464	0.3819	0.010207	0.0042	0.092229
STDEV	0.36684	1.294531	1.025039	4.92215597	0.211564	0.190671	0.344932	0	0.207057	0.139297	0.038192	0.015715	0.176254

Appendix L.
Raw Data: Whale Focal Follows with Whale Watching Vessels Present

WHALE WATCHING VESSEL SAMPLES [16 samples, 1404 minutes, 23.4 hours]

POD #	POD COMP.	SAMPLE	SLs	INDIVID.	LOCATION	TIDAL ST.	TRANSIT.	TRA/MIN.	TROLLERS	TROLL/MIN.	W. ALONE	W/ BOAT	% W/ BOAT	#BOATS	1 BOAT	2 BOATS	3 BOATS	4 BOATS	5 BOATS	TIMES <200m	> 30 min.	NOT NEAR	TRAPPED?	CPA	NOTES
716A	singleton	67 min.	9	Who?	S. Shelter I.	HT E	14	0.21/min.	0	0	7 min.	60 min.	90%	4	33 min.	27 min.	N/A	N/A	N/A	0	1 boat	1	N/A	377m	full breach!
716B	singleton	38 min.	8	Who?	S. Shelter I.	LTE	2	0.05/min.	2	0.05/min.	0	38 min.	100%	2	16 min.	22 min.	N/A	N/A	N/A	0	1 boat	0	N/A	approx. >300m	need to calculate CPA
718A	singleton	60 min.	10	Sharkfin	S. Shelter I.	H	11	0.18/min.	6	0.10/min.	44 min.	16 min.	27%	2	16 min.	N/A	N/A	N/A	N/A	1	0	1	N/A	approx. 190m	need to calculate CPA
721A	singleton	112 min.	13	Scar	Saginaw Ch.	HTF	21	0.20/min.	5	0.04/min.	88 min.	24 min.	20%	3	22 min.	2 min.	N/A	N/A	N/A	1	0	1	N/A	approx. 190m	need to calculate CPA
724A	singleton	136 min.	23	Scar	Saginaw Ch.	L	4	0.03/min.	22	0.16/min.	48 min.	88 min.	65%	13	17 min.	39 min.	2 min.	11 min.	19 min.	4	2 boats	0	yes-5	<100m	need to calculate CPA
85B	singleton	59 min.	7	Spartacus	Saginaw Ch.	HT E	23	0.40/min.	0	0	35 min.	24 min.	41%	1	24 min.	N/A	N/A	N/A	N/A	0	0	0	N/A	approx. 400m	need to calculate CPA
823A	singleton	20 min.	3	Scar	Portland I.	LTE	0	0	0	0	0	17 min.	100%	2	14 min.	3 min.	N/A	N/A	N/A	0	0	0	N/A	approx. 300m	giant circling behavior
77A	singleton	60 min.	8	Scar	Portland I.	HTF	6	0.10/min.	0	0	9 min.	51 min.	85%	3	29 min.	22 min.	N/A	N/A	N/A	0	1 boat	0	N/A	approx. 300m	giant circling behavior
78A	12 whales	155 min.	35	Raley, etc.	Ralston I.	HTF	8	0.05/min.	5	0.03/min.	34 min.	121 min.	78%	6	77 min.	9 min.	28 min.	7 min.	N/A	1w/1	5 boats	1	yes-4	<200m (w), ~400m	a lot of surface behaviors
86A	singleton	87 min.	18	Spartacus	North Pass	HTF	8	0.09/min.	11	0.13/min.	4 min.	83 min.	95%	8	51 min.	13 min.	19 min.	N/A	N/A	1w/3	1 boat	1	yes-3	<200m (w),<100m	need to calculate CPA
88A	singleton	121 min.	12	Spot	North Pass	L	12	0.10/min.	14	0.12/min.	32 min.	89 min.	74%	2	89 min.	N/A	N/A	N/A	N/A	3w/3	2 boats	0	N/A	<200m (w),~350m	need to calculate CPA
817A	singleton	32 min.	4	Who?	North Pass	LTF	4	0.13/min.	1	0.03/min.	8 min.	24 min.	75%	2	12 min.	12 min.	N/A	N/A	N/A	0	0	1	N/A	approx. 250m	frequent slip unders
817B	pair/trio	122 min.	54	Sp., Sl., Spa.	North Pass	H	13	0.11/min.	13	0.11/min.	42 min.	80 min.	66%	8	2 min.	16 min.	27 min.	21 min.	14 min.	0	5 boats	2	yes-5	approx. 200m	need to calculate CPA
823B	pair	25 min.	7	Sl./Spa.	North Pass	LTE	4	0.16/min.	6	0.24/min.	0	25 min.	100%	4	0	10 min.	15 min.	N/A	N/A	3w/3	0	0	yes-3	<100m (w), 300m	encircled b/c ww & no ww
816A	singleton	160 min.	27	Stealthy	Lincoln I.	LTE	1	0.01/min.	1	0.01/min.	71 min.	88 min.	55%	4	79 min.	9 min.	N/A	N/A	N/A	2	0	0	N/A	approx. 180m	need to calculate CPA
816B	singleton	150 min.	23	Sharkfin	Young Bay	H	4	0.03/min.	0	0	54 min.	96 min.	64%	3	90 min.	6 min.	N/A	N/A	N/A	4w/6	2 boats	0	N/A	<100m (w), ~190m	need to calculate CPA

Appendix M.

Raw Data: Whale Behavior with Whale Watching Vessels Present

WHALE WATCHING VESSEL SAMPLES [261 total surface intervals]

	n=17	n=17	n=16	n=16	n=17	n=17	n=17	n=17	n=17	n=17	n=17	n=17	n=17
POD #	S.I.	D.D.	#BLOWS	BLOW INT.	SU	PA	FU	FD	TRAVEL	MILL	REST	S.A.	FEED
77A	0.87125	7.1666667			0	0	1	0	0.5	0.5	0	0	0
716A	2.1744444	5.5	5	27.05714286	0.2222	0.4444	0.2222	0.1112	0.4444	0.5556	0	0	0
718A	1.67	4.4444444	5.7	20.76595745	0	0.8	0.1	0.1	0.7	0.3	0	0	0
721A	1.6516667	7.6363636	7.16666667	16.06756757	0.0833	0.75	0.1667	0	0.4167	0.5833	0	0	0
724A	0.7573913	4.9545455	3.56521739	17.16949153	0.0434	0.087	0.8696	0	0.5217	0.4783	0	0	0
85B	1.438	7	4.8	23	0.1429	0	0.8571	0	0.8571	0.1429	0	0	0
86A	0.4977273	3.6666667	1.86363636	31.68421053	0.2353	0	0.7647	0	0.3043	0.2174	0	0.4348	0.0435
88A	0.63	7.5	2.55555556	23.92857143	0.3333	0	0.6667	0	0.5556	0.3333	0	0	0.1111
816A	0.4377778	2.8421053	2.14285714	17.2173913	0.6429	0.3571	0	0	0.2963	0.5185	0.1852	0	0
816B	1.4054545	4.4761905	4.13636364	25.75714286	0.381	0.4762	0.0476	0.0952	0.0435	0.9565	0	0	0
817A	0.39333	9.6666667	2	22.33333333	0.5	0	0.5	0	0.5	0.5	0	0	0
817B SP	0.3923077	4	2.15384615	19.83870968	0.7692	0.0385	0.1963	0	0.1154	0	0	0.7308	0.1538
817B SL	0.4708333	3.5454545	2.20833333	22.51724138	0.7083	0.25	0.0417	0	0.0417	0	0	0.7917	0.1667
817B SPA	1.53	4.6666667	6	17.63157895	0.5	0.5	0	0	0	0	0	0	1
823A	1.2533333	5.5	6	13	0.3333	0	0.3333	0.3334	1	0	0	0	0
823B SL	0.735	7.6666667	4.25	14.38461538	0.25	0	0.75	0	0.25	0.75	0	0	0
823B SPA	2.225	9	6.5	25.45454545	0	0	1	0	0.3333	0.6667	0	0	0
MEAN	1.0902068	5.8372022	4.12765477	21.11296873	0.302653	0.217835	0.442112	0.037635	0.40470588	0.3826	0.010894	0.115135	0.08677059
STDEV	0.6217306	2.0250695	1.81723195	5.056939884	0.251659	0.28164	0.357753	0.086061	0.28097662	0.290473	0.044918	0.265113	0.24208515

Appendix N.

Raw Data: Sightings of Individual Whales with and without Whale Watching Vessels

INDIVIDUAL WHALES (9 photo-identified individuals)

NAME	POD#	W/ WW	W/O WW	LOCATION	NOTES	TOTALS
Scar	77A	X		Portland I.		4 WW
Scar	721A	X		Saginaw Ch.		
Scar	724A	X		S. Shelter I.		
Scar	823A	X		Portland I.		
Scar	85A		X	S. Shelter I.		5 NO WW
Scar	813B		X	Young Bay	w/ Sharkfin	
Scar	818A		X	S. Shelter I.		
Scar	819A		X	Favorite Reef		
Scar	820A		X	SW Shelter I.		
Spartacus	85B	X		Saginaw Ch.		4 WW
Spartacus	86A	X		North Pass		
Spartacus	817B	X		North Pass	w/ Spot & Slash	
Spartacus	823B	X		North Pass	w/ Slash	
Spartacus	819B		X	North Pass	w/ Spot & Slash	1 NO WW
Sharkfin	718A	X		S. Shelter I.		2 WW
Sharkfin	816B	X		Young Bay		
Sharkfin	812A		X	Young Bay		3 NO WW
Sharkfin	813A		X	Young Bay		
Sharkfin	813B		X	Young Bay	w/ Scar	
Slash	817B	X		North Pass	w/ Spot & Spartacus	2 WW
Slash	823B	X		North Pass	w/ Spartacus	
Slash	819B		X	North Pass	w/ Spot & Spartacus	1 NO WW
Spot	88A	X		North Pass		2 WW
Spot	817B	X		North Pass	w/ Slash & Spartacus	
Spot	812B		X	North Pass		2 NO WW
Spot	819B		X	North Pass	w/ Slash & Spartacus	
Stealthy	816A	X		Benjamin I.		1 WW
Raley	76A	X		Little I.	w/ 11 Others	1 WW
Mousie	76A	X		Little I.	w/ 11 Others	1 WW
Jitter	76A	X		Little I.	w/ 11 Others	1 WW
Unknown	716A	X		Saginaw Ch.		3 WW
Unknown	716B	X		S. Shelter I.		
Unknown	817A	X		North Pass		
Unknown	77B		X	Portland I.		2 WW
Unknown	715A		X	SW Shelter I.		

Appendix O.
Raw Data: Vessel Activity in Three Key Areas

VESSEL ACTIVITY IN THREE KEY AREAS

S. SHELTER	WW BOATS	TRANSIT.	TROLL.	TOTAL WW.	MEAN WW.	MEAN STAY	>30 MIN%	MEAN PROP.	CPA	<200 m	NOT REAR.	TRAPPED?	TOTAL TRA.	MEAN TRA.	TRA/MIN.	MEAN TRA/M.	TOTAL TRO.	MEAN TRO.	TRO/MIN.	MEAN TRO/M.
77B	0	2	0	67	4.19	25 min.	20 boats/30%	71%	<100m	12w/24	8	5/5 >3 boats	348/**183	12.89/**7.96	0.13	0.16/**0.11	296/**109	10.96/**4.74	0	0.12/**0.06
715A	0	10	1	30	3.75	18 min.	1/6=17%	66%	<100m	6	3	5: 724A (Sig)	244/**106	17.42/9.64	0.2	0.22/0.15	141/**41	10.07/3.73	0.02	0.11/0.04
85A	0	12	5	34	4.86	28 min.	13/34=38%	78%	<100m	8w/12	5	4: 76A(NP)	86/**59	9.56/7.38	0.16	0.11/0.09	149/**62	16.56/7.75	0.07	0.18/0.10
818A	0	**52	**17	3	3	34 min.	2/3=66%	64%	~190m	4w/6	0	3: 86A (NP)	18	4.5	**0.5	0.04	6	1.5	**0.15	0.01
819A	0	**54	**59		1-33 boats	11-59 min.		27%-100%	<100-400 m			5: 817B (NP)		0-54/**23	**0.6	0-0.60/**0.40		0-87/**22	**0.70	0-0.85/**0.24
820A	0	**32	**24		n=16	n=64	n=67	n=16	n=16	n=7	n=7	3: 823B (NP)	n=27/**23	n=27/**23	**0.33	n=27/**23	n=27/**23	n=27/**23	**0.24	n=27/**23
716A	4	14	0									n=16			0.21				0	
716B	2	2	2												0.05				0.05	
718A	2	11	6												0.18				0.1	
721A	3	22	5												0.2				0.04	
724A	13	4	22												0.03				0.16	
85B	1	23	0												0.4				0	
823A	2	0	0												0				0	
77A	3	6	0			540 total min.									0.1				0	
TOTALS	30	244/**106	141/**41	30	3.75	18 min.	1/6=17%	66%	<100m	6	3	1		17.42/**9.64	3.09/min.	0.22/**0.16		10.07**/3.73	1.53/min.	0.11/**0.04
NORTH PASS																				
812B	0	9	11												0.09				0.11	
819B	0	**27	**87												**0.26				**0.85	
78A	6	8	5												0.05				0.03	
86A	8	8	11												0.09				0.13	
88A	2	12	14												0.1				0.12	
817A	2	4	1												0.13				0.03	
817B	8	13	13												0.11				0.11	
823B	4	4	6												0.16				0.24	
816A	4	1	1			952 total min.									0.01				0.01	
TOTALS	34	86/**69	149/**62	34	4.86	25 min.	13/34=38%	78%	<100m	8w/12	5	4		9.56/**7.38	1/min.	0.11/**0.09		16.56/**7.75	1.63/min.	0.18/**0.10
YOUNG BAY																				
813B	0	5	0												0.05				0	
812A	0	4	3												0.03				0.02	
813A	0	5	3												0.06				0.03	
816B	3	4	0			102 total min.									0.03				0	
TOTALS	3	18	6	3	3	34 min.	2/3=66%	64%	~190m	4w/6	0	0		4.5	0.17/min.	0.04		1.5	0.05/min.	0.01

** w/o Salmon Derby Samples