Incidental Take and Interactions of Marine Mammals and Birds in the Yakutat Salmon Setnet Fishery, 2007 and 2008

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Table of Contents

Summary

- The Marine Mammal Protection Act directs the Secretary of Commerce to monitor marine mammal mortality and serious injury occurring incidentally to commercial fishing, and to monitor the progress of commercial fisheries in reducing these incidental takes to insignificant levels. The procedures used by the National Marine Fisheries Service to obtain these outcomes are summarized.

- The Alaska Marine Mammal Observer Program (AMMOP) was set up in 1990 to obtain reliable estimates of the levels of serious injury and mortality of marine mammals and birds, assess the reliability of injury and mortality reports by vessel owners and operators, identify new methods and technology for reducing incidental takes, collect relevant biological samples, and record data on bycatch and discard levels of all species. The program for the rotational surveys of fisheries for the estimation of incidental take rates is described, with the Yakutat setnet fishery observed in the summers of 2007 and 2008.

- The Yakutat setnet fishery in Southeast Alaska is divided into two management areas by the Alaska Department of Fish and Game, with the Yakataga District in the east and the Yakutat District in the west of the fishery. There are approximately 170 permit holders in the fishery, which is currently categorized as a Category II fishery by the National Marine Fisheries Service (occasional incidental mortality and serious injury to marine mammals), because of documented interactions with grey whales and harbor seals. The status of these marine mammal populations is described, and marine birds that may interact with the fishery are listed.

- For sampling purposes in 2007 and 2008 the fishery was divided into four regions labeled Y1 (the Alsek River area), Y2 (the Situk area), Y3 (the Yakutat Bay area), and Y4 (the Kaliakh River and Tsiu River area). These regions were sampled separately. The planned observer cover of each region was at least 5% of the total fishing effort based on considerations of the accuracy of estimation expected for the total fishery take numbers of marine mammals and birds.

- The method for measuring the total fishing effort and the observed fishing effort is based on the total hours fished by permit holders and the observed hours fished. In 2007 this measure gives the observer coverage of the fishery to be 3.2%, 5.1%, 6.2% and 5.9%, for regions Y1, Y2, Y3 and Y4, respectively, with an overall 5.3% coverage. In 2008 the coverage was higher at 7.4%, 7.6%, 7.3% and 10.6% for sampling regions Y1, Y2, Y3 and Y4, respectively, with an overall 7.6% coverage. These percentages agree fairly well with the percentages of the total salmon catch recorded by the observers.

- There were two reports of strandings for marine mammals in the Yakutat area in 2007 (a Steller sea lion and a harbor porpoise, both with advanced decomposure), and five

reports of strandings in 2008 (an unknown cetacean with advanced decomposure, three dead harbor porpoises, and a moderately decomposed Steller sea lion).

- There was one self-report of a marine mammal take in the Yakutat setnet fishery in 2007 for a harbor porpoise, and another in 2008, again for a harbor porpoise.

- In 2007 the AMMOP observers recorded one harbor porpoise that interacted with nets and was released dead in sampling area Y3. A total of 23 birds were also observed to be taken, with nine species (a double crested cormorant, a pigeon guillemot, a glaucus winged gull, a Pacific loon, a red throated loon, four common murres, 11 marbled murrelets, two white winged scoters, and a wandering tattler). Only four of the 23 birds were released alive. All of the takes of the birds were in sampling regions Y2 (the Situk area) and Y3 (the Yakutat Bay area).

- In 2008 the AMMOP observers recorded three harbor porpoises and one harbor seal take while on set and haul watches, while one northern Steller sea lion was seen to interacted with nets between two soak watches. Of these, one harbor porpoise, the harbor seal and the sea lion were released alive while the other two harbor porpoises were released dead. All of the marine mammal takes were in sampling region Y3. A total of 12 birds were also observed to interact with nets (a Kittlitz's murrelet, four marbled murrelets, a murrelet of unknown species, an Arctic loon, two red-throated loons, a common murre, and two Long-tailed duck ducks). Only two of the birds were released alive. The two Long-tailed duck ducks were taken in sampling region Y1 (the Alsek River area), one marbled murrelet was taken in sampling region Y2, and the remainder of the birds were taken in sampling region Y3.

- Based on ratio estimation it is estimated that the total serious injury or mortality (SI/M) take of harbor porpoises in the Yakutat setnet fishery in 2007 was 16.1, with a standard error (SE) of 15.4 and a coefficient of variation (CV) of 96.1%. The SI/M total take of birds in the fishery in that year is estimated to be 305.3 with a SE of 90.0 and a CV of 29.5%. In 2008 it is estimated that the total SI/M take of harbor porpoises in the fishery was 27.5, with a SE of 18.8 and a CV of 64.4%, while the total SI/M take of birds in the fishery in that year is estimated to be 136.5 with a SE standard error of 48.8 and a CV of 35.7%.

- It is possible to calculate the binomial probability that no take was observed for a species or group of species in a sampling region in 2007 or 2008, assuming that the hauls with takes of these species or groups of species occurred independently of each other at random. This probability is equal to $(1 - p)^N$ if N hauls with takes actually occurred, and p is the observer coverage as a proportion of the total fishing time. This allows an upper 95% confidence limit for N to be determined as the value such that if the actual number of hauls with takes equaled this limit or more then the probability of observing no take is 0.05 or less. These calculations give upper limits for the amount of takes that might have occurred but not been observed for a species or group of species ranging from 28 in region Y4 in 2008, to 93 in region Y1 in 2007.

- Confidence intervals for true total take and SI/M take numbers are calculated for all birds, murrelets, all marine mammals, and harbor porpoises. For all birds and murrelets the usual approximate 95% confidence limits from ratio estimation were used, giving limits for SI/M takes of 125 to 485 for all birds in 2007, 26 to 328 for murrelets in 2007, 39 to 234 for all birds in 2008, and 5 to 137 for murrelets in 2008. For all marine mammals and harbor porpoises a different approach for finding 95% confidence limits was used based on the binomial distribution because of the small number of hauls with takes. This gives limits for SI/M takes of 1 to 74 for all marine mammals and harbor porpoises in 2007, based on the one observed SI/M harbor porpoise take. In 2008 the 95% confidence limits for total SI/M takes are 4 to 96 for all marine mammals and harbor porpoises based on the observed SI/M takes of two harbor porpoises.

- The binomial distribution method was also used to obtain 95% confidence limits for the total number of Kittlitz's murrelet SI/M takes in 2008 based on one observed take because this was listed as a candidate species under the Endangered Species Act in 2004. These limits are 1 to 63.

- A total of 15 variables and factors are identified as possibly being related to the probability of a take being observed on a set and haul. These and factors include the fishing effort in hours, the sampling region, the day in the fishing season, the time of day at the middle of the set and haul period, the depth of the net, the visibility of the net, the nature of the fishing location, the stage of the tide, the type of land the net was set from, air and water temperatures, and the hook shape, mesh size, material and color of the net. It is noted that these variables and factors had different distributions in the different sampling regions.

- Take numbers on hauls for all mammals, all birds, harbor porpoises, and murrelets are plotted against the 15 variables and factors to see if this gives any indication of takes being related to any of these variables and factors.

- Randomization tests were carried out to better evaluate any relationships between takes and the 15 variables and factors, with the fishing year added as another factor. For all marine mammal takes compared to hauls in all fishing regions there were six variables and factors with significant results. However, all marine mammal takes occurred in sampling region Y3 and when the randomization tests were based only on hauls in this region the only significant result was for the time of day midway between the start of the set and the end of the haul (with more takes on hauls with mid-times between midnight and 6am). Hence the tests based on hauls from all regions were probably mainly just detecting differences between the hauls in region Y3 and the hauls in other regions.

- When the randomization tests were carried out with hauls with harbor porpoise takes compared with hauls in all sampling regions there were five significant effect for variables and factors, but when the hauls with takes were only compared with other hauls in sampling region Y3 only the sampling effort had a significant effect. Again this is probably because the first tests were mainly detecting differences between the nature of hauls in region Y3 and the hauls in other regions.

- When the 17 hauls with bird takes were compared with the other hauls in all sampling regions there were eight significant results for variables and factors. However, 22 of the hauls with takes were in sampling region Y3. The randomization tests were therefore also ran just using the hauls with and without takes in region Y3. There were then only three significant results, for the sampling effort, the day in the fishing season (the mean day for takes being later than the mean for all hauls), and the time midway between the start of the set and the end of the haul (with more takes with a mid-time from midnight to 6am). Again some of the significant results for the tests using hauls from all regions seem to be due to differences between the nature of hauls in sampling region Y3 and the hauls in other regions.

- For the randomization tests comparing hauls with murrelet takes with other hauls in all sampling regions there are significant results for 11 of the variables and factors. However, only one of the 14 hauls with murrelet takes was outside sampling region Y3. The tests were therefore run again just using the hauls in sampling region Y3. There were then only two significant results, for the effect of fishing effort (the probability of take increasing with the fishing effort), and the time midway between the start of the set and the end of the haul (most takes with a mid-time between midnight and 6am). again the tests based on hauls from all regions seem to be detecting differences between the hauls in sampling region Y3 and the hauls in other regions.

- Most takes were in the ADF&G statistical area 183-10 in sampling region Y3. Chi-squared test shows that there were significantly more hauls with takes in this statistical area than in the other statistical areas in region Y3 for all birds. For all mammals, harbor porpoises, and murrelets a similar test gives insignificant results.

- For the takes of all bird species there is sufficient data for a logistic regression analysis of the effects of more than one of the variables and factors at the same time on the probability of a haul having a take of at least one bird. This analysis was carried out based on the 27 hauls with bird takes and the 2190 hauls without bird takes in sampling regions Y1, Y2 and Y3 because there were no hauls with bird takes in region Y4. This resulted in an equation including very significant effects for the fishing effort and the sampling region, a significant quadratic effect for the day in the fishing season, and a significant effect for the net material. According to the final equation the probability of a bird take increased with the fishing effort (as expected), was lower in sampling regions Y1 and Y2 than in region Y3, was higher at the start and end of the fishing season than in the middle of the fishing season, and was lower with six-strand and mono-strand nylon nets than with the nets of other materials.

- A logistic regression analysis was also carried out using the hauls with and without murrelet takes in sampling region Y3 because there was only one haul with a murrelet take outside this region. This resulted in an equation that just included the effect of the fishing effort.

- The interactions of marine mammals with the fishery are discussed. Before the 2007 and 2008 AMMOP sampling in Yakutat there were documented interactions with the fishery for grey whales, harbor seals and humpback whales. However, there were no grey whale or humpback whale interactions observed in 2007 and 2008, and the one harbor seal that interacted with nets only had a momentary snag with nets and then released itself alive and uninjured. Therefore the AMMOP sampling provided no evidence of mortalities or serious injuries to grey whales, humpback whales or harbor seals due to interactions with the Yakutat setnet fishery.

- One Steller sea lion was observed to interact with nets while an observer was between two set watches. As the sea lion released itself unharmed this also provides no evidence of interactions with Steller sea lions leading to mortalities or serious injuries.

- The situation is different for harbor porpoises. In 2007 one interaction with nets was observed leading to the death of the harbor porpoise, while in 2008 three harbor porpoises were observed to interact with nets, leading to two dead animals. As a result it is estimated that in 2007 there were 16 harbor porpoises SI/M takes with a 95% confidence interval of from 1 to 74, and in 2008 there were 28 SI/M harbor porpoise takes with a 95% confidence interval from 4 to 96. The Southeast Alaska stock of harbor porpoises is not listed as depleted under the Marine Mammal Protection Act, or listed as threatened or endangered under the Endangered Species Act. Also, the PBR of the Southeast Alaska stock of harbor porpoises is currently undetermined because the estimate of the total population size is out of date. However, based on a 1997 estimate of the population size the PBR is only 91. An estimated average SI/M take of 21.8 harbor porpoises a year in the Yakutat setnet fishery is therefore of concern, particularly because there are two other commercial salmon fisheries in Southeast Alaska that may also be interacting with harbor porpoises.

- The take of a Kittlitz's murrelet resulting in its death in 2008 is also of concern because Kittlitz's murrelets are listed as a candidate species under the Endangered Species Act because of documented declines in numbers in Alaska. The one observed take in the Yakutat Bay area leads to an estimated total SI/M take of 14 Kittlitz's murrelets in that region in 2008, with a 95% confidence interval of 1 to 63 birds.

- The effect of different variables and factors on the probability of hauls with takes of marine mammals as determined from randomization tests is discussed. For marine mammals in general, and harbor porpoises in particular it is concluded that the most important factors influencing the probability of a take occurring are the fishing time, and the sampling region (because all hauls with takes were in sampling region Y3).

- For all birds and murrelets randomization tests and logistic regressions indicate that the probability of a take occurring increases with the fishing effort as expected, and is highest in sampling region Y3. In addition, it appears that for all birds the probability of a take is higher at the start and end of the fishing season than in the middle, and that apparently the net material used affects the probability of a take.

1. Introduction

The Marine Mammal Protection Act (MMPA) prohibits take (to hunt, harass, capture or kill) of all marine mammals in United States waters and by United States citizens on the high seas, but includes an exemption from this prohibition for marine mammals taken incidentally in commercial fisheries. The MMPA also directs the Secretary of Commerce to monitor marine mammal serious injuries and mortalities (SI/M) occurring incidentally to commercial fishing, and to monitor the progress of commercial fisheries in reducing these SI/M takes to insignificant levels approaching a zero mortality rate goal (ZMRG). The National Marine Fishery Service (NMFS) currently uses a value of 10% of the stock's potential biological removal (PBR, Wade and Angliss, 1997) as a criterion to evaluate whether the incidental take of a stock is at an insignificant level approaching the ZMRG.

The PBR is defined to be

$$(N_{min})(0.5\ r_{max})(F_R),$$

where N_{min} is the minimum estimate of the population size for the stock, r_{max} is the maximum yearly rate of increase of the stock, and F_R is a recovery factor between 0.1 and 1.0. The PBR is considered to be the maximum number of animals (not including natural mortality) that may be removed from a stock while still allowing that stock to reach its optimum sustainable population size.

Under the MMPA, the NMFS classifies each U.S. commercial fishery (state and federal) into one of three categories, based on the level of incidental SI/M takes of marine mammals that occurs in the fishery. Each fishery is classified through a two-tiered analysis which assesses the potential impact of fisheries on each marine mammal stock by comparing serious injury and mortality levels to the stock's PBR.

The Tier 1 analysis proceeds as follows. For each marine mammal stock, SI/M takes from all commercial U.S. fisheries are totaled. If the total is less than or equal to 10% of the PBR of that stock, then all fisheries interacting with this stock are placed in Category III. This process is repeated for each stock. A fishery remains in Category III unless it interacts with a stock for which the SI/M takes exceed 10% of the PBR. All fisheries that interact with a stock for which the SI/M takes exceed 10% of the PBR are subject to a Tier 2 analysis. Fisheries with no SI/M takes of any marine mammal stocks are placed in Category III.

If a Tier 2 analysis is required then this proceeds as follows. For each fishery, the annual SI/M take for each marine mammal stock is evaluated relative to the PBR of that stock. The fishery is categorized as Category I if the SI/M take exceeds 50% of the PBR, as Category II if the SI/M take is greater than 1% and less than 50% of the PBR, and as Category III if the SI/M take is less than or equal to 1% of the PBR.

The NMFS relies on observer data in the analyses, but also evaluates other factors such as fishing techniques, the gear, the methods used to deter marine mammals, the seasons and the areas fished.

The Alaska Scientific Review Group (ASRG) was set up in 1994 to review the science used as the basis for marine mammal management. This group reviews stock assessment reports on the marine mammals in the regions and advises the NMFS on the status and trends in each population, and on the research and management needs to reduce incidental fisheries mortality if this is necessary.

In Alaska logbook programs were used from 1990 to 1993, and fisher self-reporting programs from 1995 to 2001 in an attempt to estimate the fishing related mortality of marine mammals. However, this was unsuccessful as logbook data were found to under-estimate mortality rates in comparison to more reliable observer data (Credle *et al.*, 1994), and there were almost no self-reports of injuries or mortalities. As a result, the ASRG directed the NMFS not to use self-reporting data for producing estimates of fishing related mortality (ASRG, 1998), leading to many Alaskan fisheries being categorized as II or III using a combination of data five to ten years old, stranding reports, and their similarity to other fisheries.

The Alaska Marine Mammal Observer Program

The Alaska Marine Mammal Observer Program (AMMOP) was set up in 1990 to:

(a) obtain reliable estimates of the level of incidental serious injury and mortality of marine mammals during fishing operations;

(b) determine the reliability of reports submitted by vessel owners and operators;

(c) identify changes in fishing methods or technology that may increase or decrease incidental serious injury and mortality;

(d) collect biological samples that may otherwise be unobtainable for scientific studies; and

(e) record data on incidental take and discard levels of all species.

Although the collection of data on the incidental injury and mortality of marine birds during fishing operations is not part of these goals, the collection of such data is fully supported and considered to be an important secondary benefit from the program.

As part of this program, the NMFS places observers in Alaskan fisheries on a rotational basis, to gather data to monitor the level and nature of incidental mortalities and serious injuries. These data are also used to place Alaska federal and state commercial fisheries into the appropriate Fisheries category, as required under the Marine Mammal Protection Act. There are currently no Category I fisheries (frequent serious injuries and mortalities) in Alaska, and Category II fisheries (occasional serious injuries and mortalities) have priority for observer coverage. Category III fisheries are not required to accommodate observers and therefore unlikely to be covered by the AMMOP.

The AMMOP began observer coverage in 1990 and 1991 on the Prince William Sound setnet and driftnet fisheries, and the Aleutian Peninsula driftnet fisheries (Wynne *et al*., 1991, 1992). It continued with the Cook Inlet salmon setnet and driftnet fisheries in 1999 and 2000 (Manly, 2006a), and covered the Kodiak Island salmon setnet fishery in 2002 and 2005 (Manly, 2007a), and the Yakutat salmon setnet fishery in 2007 and 2008. The present report covers the 2007 and 2008 AMMOP surveys of the Yakutat salmon setnet fishery. More information about the AMMOP program including the manual used by observers and copies of earlier reports on the fisheries that have been observed are available at the website (www.fakr.noaa.gov/protectedresources/observers/mmop.htm).

2. The Yakutat Setnet Fishery

Figure 2.1 shows the area covered by the Yakutat setnet fishery. The more detailed Alaska Department of Fish and Game (ADF&G) map of statistical areas is provided in Appendix A. The ADF&G manages the fishery with two management districts. The Yakataga District is between Cape Suckling in the west to Icy Cape, while the Yakutat District is between Icy Cape and Cape Fairweather in the east. The permit holders in the Yakutat District mainly target sockeye and coho salmon, although other species are also harvested, and the permit holders in the Yakataga District target coho salmon.

There are about 170 commercial setnet permits in use in the Yakutat fishery. The permit holders do not have fixed sites and may fish in any open fishing area as long as they do not fish in more than one area at a time. There are 25 ADF&G fishing areas in the fishery but most of the salmon harvest each year comes from the Akwe River, the Alsek River, the Situk-Ahrnklin Inlet, the Tsiu River and Yakutat Bay. The fishery is managed by adjusting fishing times and areas in response to in-season assessments of run strength to allow adequate spawning escapements and the harvest of salmon that are surplus to escapement goals (Woods, 2007).

Interactions With Marine Mammals Documented Before 2007

Before the AMMOP in 2007 and 2008 the marine mammals that were documented to interact with the Yakutat setnet fishery are grey whales (*Eschrichtius robustus*), harbor seals (*Phoca vitulina richardsi*) and humpback whales (*Megaptera novaeangliae*) based on fisher's logbooks and reported strandings with some evidence of an interaction with the fishery (Angliss and Outlaw, 2007).

The grey whales in the Yakutat fishery area are from the Eastern North Pacific stock. This stock has been increasing in recent years and was removed from the list of endangered and threatened species under the Endangered Species Act in 1994. The estimated population size based on two surveys taken in the period 2000 to 2002 is 18,813 animals with a coefficient of variation (CV) of 6.9%, with a PBR of 417, and an estimated annual mortality of more than 6.7 due to interactions with commercial fisheries (Angliss and Allen, 2009, pp. 151-9).

Currently harbor seals in Alaska are considered to consist of three stocks in Southeast Alaska, the Gulf of Alaska, and the Bering Sea, although this is being reassessed. The Yakutat harbor seals are part of the Southeast Alaska stock, with an estimated population size of 112,391with a CV of 4.0%, and a PBR of 3,260 animals, but with a possibly declining population in Yakutat Bay. At present the annual level of human-induced mortality is not known to exceed the PBR and harbor seals are not listed as depleted under the Marine Mammal Protection Act, or as threatened or endangered under the Endangered Species Act (Angliss and Allen, 2009, pp. 30-34).

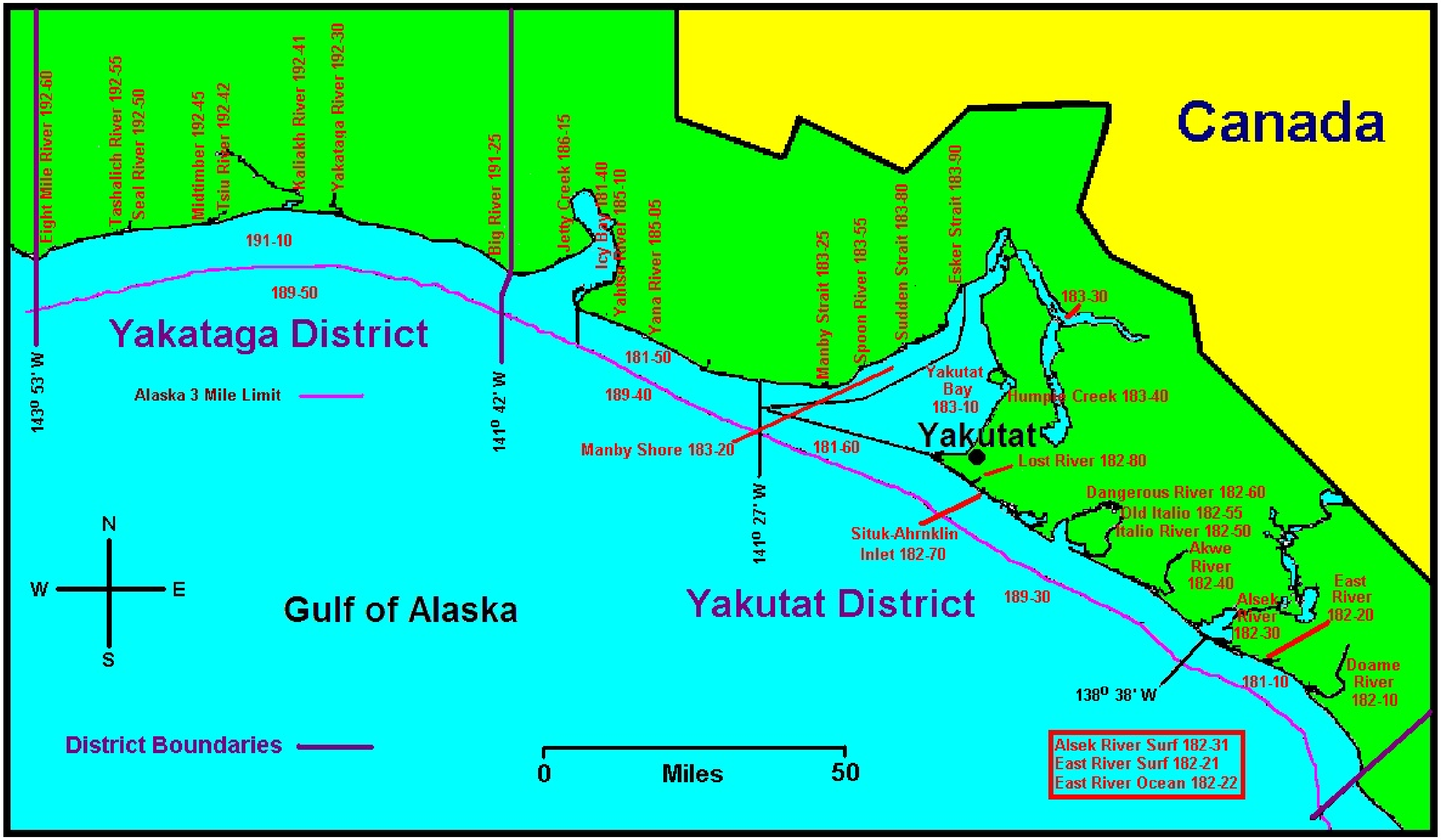

Figure 2.1 The Yakutat setnet fishery with the two ADF&G management districts shown (the Yakataga District to the west of 141° 42' W, and the Yakutat District to the east of this line, and the town of Yakutat by Yakutat Bay. ADF&G fishing areas are also shown, from Eight Mile River (192-60) in the west to Doame River (182-10) in the east.

Currently three stocks of humpback whales are recognized in the north Pacific. Of these, the Central North Pacific stock are present offshore in the Gulf of Alaska, Bering Sea, and above the Bering Strait, but with little interchange between whales using the southeast Alaska feeding area and those using other feeding areas. A 1993 estimated population size of the entire Central North Pacific stock is 4005 with a CV of 9.5%, while the estimated population size in Southeast Alaska is 961 with a CV of 12.0% based on data from 1994 to 2000. The estimate of 961 for Southeast Alaska is substantially higher than estimates from earlier years although a trend in the population size cannot be determined because of differences in the methods used for estimation and the areas covered. The PBR of the Southeast Alaska portion of the population is considered undetermined because the abundance estimate is older than eight years, but is 3.0 based on the abundance estimate of 961. There is one reported mortality associated with the Yakutat set gillnet fishery in 2001, and an overall minimum estimate of SI/M takes from commercial fisheries of 3.2 humpback whales per year. The humpback whale is listed as endangered under the Endangered Species Act and depleted under the Marine Mammal Protection Act. As a result the Central North Pacific stock is classified as a strategic stock (Angliss and Allen, 2009, pp. 169-80).

Marine Birds and Mammals in the Yakutat Area

A U.S Fish and Wildlife survey of the marine birds and mammals in the vicinity of the town of Yakutat (Yakutat Bay, Disenchantment Bay, Russell Fiord, and Nunatak Fiord) was made between 16 and 19 June, 2000 (Stephensen and Andres, 2001). Table 2.1 shows the bird species that they recorded in the order of the abundance of those species for transect surveys in the bays and fiords. Marbled murrelets, mew gulls, Arctic terns, harlequin ducks, Bonaparte's gulls, black-legged kittiwakes, Glaucous-winged gull, and Canadian geese were the most common species, each seen more than 200 times. Kittlitz's murrelets were also recorded 120 times in the surveys. This species is of particular interest as it was listed as a candidate species under the Endangered Species Act by the U.S. Fish and Wildlife Service in May 2004 because of documented population declines in other parts of Alaska. Stephensen and Andres also recorded marine mammal sightings during their transect surveys, with 134 harbor seals, 13 sea otters and 10 harbor porpoises recorded.

More recently surveys of *Brachyramphus* murrelets and other marine species have been conducted from Icy Bay to the west of Yakutat Bay to past the East River, excluding Yakutat Bay itself (Kissling *et al.*, 2007). It was found that marbled murrelets and Kittlitz's murrelets were well distributed throughout the sampled areas from Icy Bay to the East River. Other bird species seen in large numbers during these surveys were mew gulls, herring gulls, glaucous winged gulls, black legged kittiwakes, surf scoters, white winged scoters, common mergansers, Pacific loons, pelagic cormorants, pigeon guillemots, red necked phalaropes, and bald eagles. During the surveys marine mammal sightings were made to the east of Yakutat Bay. River otters, sea otters, Steller sea lions, harbor seals, humpback whales, a killer whale, Dall's porpoises, and harbor porpoises were recorded in this area. In addition, there are eight documented sightings of Beluga whales in the Yakutat Bay area from surveys carried out from 1976 to 2000 (Laidre *et al.*, 2000).

Table 2.1 Common names, scientific names, 4-letter codes, and counts of marine birds and mammals observed on transects of Yakutat Bay, Disenchantment Bay, Russell Fiord, and Nunatak Fiord, Alaska in June 2000 (Stephensen and Andres, 2001). These counts indicate the relative abundance of different bird species.

Common Name	Scientific Name	Code	Count	Common Name	Scientific Name	Code	Count
Marbled murrelet	*Brachyramphus marmoratus*	MAMU	760	Barrow's goldeneye	*Bucephala islandica*	BAGO	13
Mew gull	*Larus canus*	MEGU	613	Red-throated loon	*Gavia stellata*	RTLO	13
Arctic tern	*Sterna paradisaea*	ARTE	549	Unidentified loon	*Gavia spp.*	UNLO	12
Harlequin duck	*Histrionicus histrionicus*	HARD	543	Pacific loon	*Gavia pacifica*	PALO	9
Bonaparte's gull	*Larus philadelphia*	BOGU	366	Yellow-billed loon	*Gavia adamsii*	YBLO	8
Black-legged kittiwake	*Rissa tridactyla*	BLKI	244	Whimbrel	*Numenius phaeopus*	WHIM	8
Glaucous-winged gull	*Larus glaucescens*	GWGU	233	Gadwall	*Anas strepera*	GADW	7
Canada goose	*Branta canadensis*	CAGO	222	Double-crested cormorant	*Phalacrocorax auritus*	DCCO	6
Common merganser	*Mergus merganser*	COME	170	Pelagic cormorant	*Phalacrocorax pelagicus*	PECO	6
Surf scoter	*Melanitta perspicillata*	SUSC	134	Great blue heron	*Ardea herodias*	GBHE	5
Pigeon guillemot	*Cepphus columba*	PIGU	131	Common raven	*Corvus cryptoleucus*	CORA	4
Mallard	*Anas platyrynchos*	MALL	126	Long-tailed duck	*Clangula hyemalis*	LTDU	4
Kittlitz's murrelet	*Brachyramphus brevirostris*	KIMU	120	Fork-tailed storm-petrel	*Oceanodroma furcata*	FTSP	4
Brachyramphus murrelet	*Brachyramphus spp.*	BRMU	107	Brant	*Branta bernicla*	BRAN	3
Northwestern crow	*Corvus caurinus*	NOCR	106	Common murre	*Uria aalgae*	COMU	3
Common loon	*Gavia immer*	COLO	70	Common goldeneye	*Bucephala clangula*	COGO	3
Northern shoveler	*Anas clypeata*	NOSH	66	Unidentified shorebird		UNSB	3
Bald eagle	*Haliaeetus leucocephalus*	BAEA	60	Caspian tern	*Sterna caspia*	CATE	2
Black oystercatcher	*Haematopus bachmani*	BLOY	53	Belted kingfisher	*Ceryle alcyon*	BEKI	2
Black scoter	*Melanitta nigra*	BLSC	47	Unidentified falcon		UNFA	1
Red-breasted merganser	*Mergus serrator*	RBME	34	Long-tailed jaeger	*Stercorarius longicaudus*	LTJA	1
Herring gull	*Larus argentatus*	HEGU	33	Unidentified murrelet		UNMR	1
Northern fulmar	*Fulmarus glacialis*	NOFU	29	Unidentified scoter	*Melanitta spp.*	UNSC	1
Aleutian tern	*Sterna aleutica*	ALTE	28	Unidentified diving duck		UNDD	1
White-winged scoter	*Melanitta fusca*	WWSC	27	Spotted sandpiper	*Actitis macularia*	SPSA	1
Parasitic jaeger	*Stercorarius parasiticus*	PAJA	22	Unidentified merganser	*Mergus spp.*	UNME	1

3. Sampling Methods

This section gives an outline of the sampling and data collection methods used in Yakutat. More details about these methods are available in Appendix B of this report.

Sampling Strata

The ADF&G divides the Yakutat setnet fishery into two management districts but a further subdivision was made for AMMOP sampling purposes. Four sampling regions (strata) were defined, with separate random sampling of each of these. Table 3.1 shows the fishing areas for each of the regions Y1 to Y4, and Figure 3.1 shows the location of each of these strata.

Table 3.1 The sampling regions used for the Yakutat setnet fishery in 2007, with the ADF&G statistical areas. Fishing did not occur in all of the ADF&G fishing areas within the regions.

Region	Fishing Areas
Y1	East Alsek River (182-20), East Alsek River surf (182-20), East River ocean (182-20), Alsek River (182-30), Alsek River surf (182-30).
Y2	Situk-Lost River ocean (182-70), Situk-Ahrnklin Inlet (182-70), Lost River (182-80).
Y3	Ocean Cape and Yakutat Bay (183-10), Manby Shore (183-20), Manby Stream(183-25), Akwe River (182-40), Italio River (182-50), Mid-Italio River (182-52), Old Italio River (182-55), Dangerous River (182-60), Spoon River (183-55) Sudden Stream (183-80), Esker Creek (183-90)..
Y4	Kaliakh River (192-41), Tsiu River (192-42).

Tracking of Fishing Effort

Lead observers were responsible for tracking the fishing effort by all the permit holders in their areas on a daily basis because this information was needed to quantify the total fishing effort in the fishery for the whole of the 2007 and 2008 fishing seasons. Where possible information was collected for each permit holder, on each fishery open day, in each of the four sampling regions, on the number of hours that nets were in the water and fishing (i.e., not tied up), the location of each net, and the permit number. More details of the procedure used are provided in Appendix B.

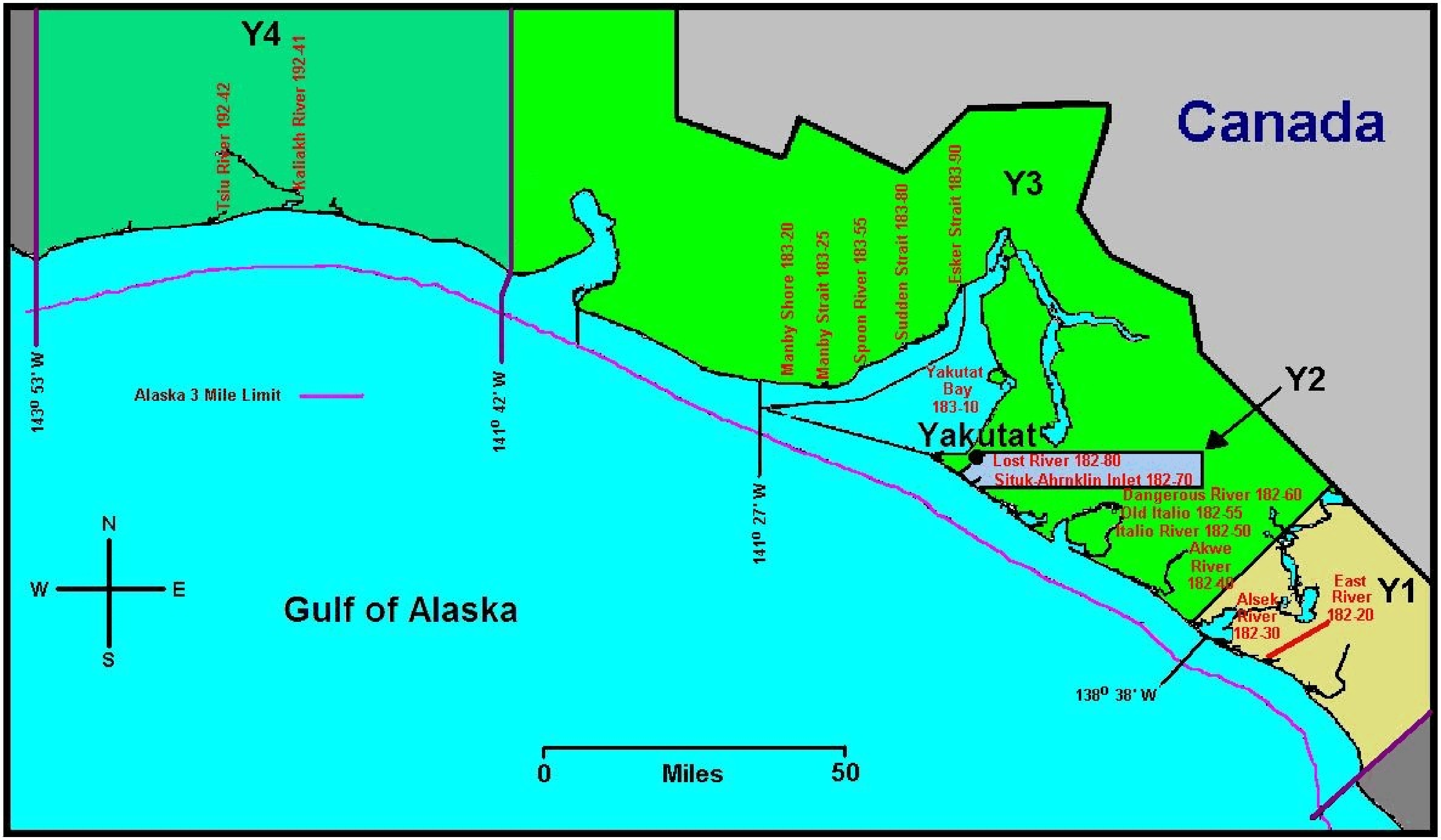

Figure 3.1 The four regions (strata) Y1, Y2, Y3 and Y4 used for the AMMOP sampling in 2007 and 2008. Sampling region Y2 just consists of the ADF&G fishing areas 182-70 and 182-80 that are surrounded by fishing areas in region Y3.

Sample Selection

The fishing areas had different opening times in June 2007. For this reason each of the strata had a separate list of permit holders for the month of June, with the permit holders on each list in a random order. The permit holders on each list were then completely sampled in the order on the list unless they were not fishing. If all the permit holders on a list were sampled once and all inactive permits positively identified, a new random list was constructed, including all inactive permits in case they became active while the list was being sampled. The sampling of the new list was then started immediately.

Starting with the first fishing week in July, when all sampling areas were open for the season, the sampling of permits was conducted in the same way except that one master list of permit holders was used instead of separate lists for each of the four strata. This was done because it was expected that some permit holders would move their fishing area from one region to another. Care was taken to ensure that if a permit holder was sampled in one area and then moved to another area then they were not resampled until all active permit holders were sampled and a new random list was generated.

In 2008 a slightly different procedure was used. One list was generated for the entire fishery before the first opener, and active permit holders were sampled in the list order. When all active permit holders were sampled a new random master list was then generated for further sampling. This change was made to avoid the perception by permit holders of uneven sampling in different regions of the fishery.

Sometimes a permit holder (A, say) could not be sampled when their name was reached on a list because they were not fishing or could not be reached for some reason such as the weather conditions. In that case the next name on the list (B, say) was used instead. However, the permit holder A was left on the list and was the top priority for sampling on the next open fishing day. This continued until permit holder A was sampled.

When a permit holder was selected for sampling it sometimes happened that they were fishing together with another permit holder. When that occurred the second permit holder was also sampled and their name crossed off the sampling list. This was done to avoid a potential problem of determining the observed fishing effort for each of two permit holders working together, and to ensure that the second permit holder was not sampled again until a new list was made up.

Data Recorded

The sampling of one or more permits on one calendar day is called a trip. On a trip the observers attempted to record data for all hauls during the sample day, where a haul (also sometimes called a pick) is the process of examining a net and removing any fish that were caught. A note was made of any hauls that could not be observed for any reason, such as bad weather. Set and soak observations were also made when the time and weather allowed, where this refers to watching a net in the water for any interactions with marine mammals and birds when the net is being set, or is in the water fishing.

Throughout a trip AMMOP observers recorded all entanglements and deaths of marine mammals and birds related to the fishing gear. During the sample day they also recorded data on environmental variables such as the water depth and temperature, weather and tidal conditions, and gear characteristics such as the mesh size, the net length and the net configuration. A list of the variables recorded by observers on AMMOP forms is provided in Appendix C, with copies of these forms shown in Appendix D.

Planned Observer Coverage

At the start of the 2007 fishing season the intention was that for each of the strata Y1 to Y4 the observed fishing effort should be at least 5% of the total fishing effort. To achieve this, during the fishing season an attempt was made to sample slightly more than 5% of the permits fishing on any open day.

The target of at least 5% of the total fishing effort should be covered was based on the consideration of the expected accuracy of estimation of the total bycatch numbers for different species and the cost of the sampling program. Manly (2007b) has discussed the observer coverage levels that are desirable for the 11 category II fisheries that may be observed by the AMMOP. In that report it is shown that the minimal observer cover for the Yakutat fishery is 0.5%, based on the Wade (1999) method (to give a probability of 0.95 of observing some bycatch of gray whales if the total bycatch of this species equals a PBR of 575), while a more realistic observer cover is 2.7% (based on obtaining a coefficient of variation of 25% for the estimated total bycatch of grey whales if the true total bycatch is equal to the PBR of 575). Based on these results, the target of at least 5% cover for the fishery used in 2007 was very reasonable.

In 2008 the plan was to exceed 5% cover by more than in 2007 because it turned out for various reasons that the target of at least 5% cover was not achieved for strata Y1 in 2007. This was successful, and all of the coverage levels in 2008 were well above 5%.

4. Fishing Effort and Observer Coverage

Determining the observer coverage of the fishery required that the total effort for the whole fishery was defined and measured, and that the amount of effort observed on trips was also defined and measured. Data for determining the total effort in the whole fishery had to be collected separately from the data collected on trips because the effort on unobserved days had to be known, whereas the observer data could only be used to determine the observed effort.

There is more than one way to define fishing effort. The simplest is in terms of permit days, where this is one permit fished during an open day. In that case the total fishing effort is the sum of the permit days for all open days during the season, and the observed effort is the number of permit days observed. This is the definition that was used when assigning observers to trips, with the intention of sampling somewhat more than 5% of the permits on each open day for each of the sampling strata defined in Table 3.1.

For allocating fishing effort this measure of effort is the only one that can be used in practice. However, it is not really satisfactory for measuring the true effort in the fishery. This is because the total effort in permit days does not take into account the fact that some permit holders may only fish for part of an open day, while the observed effort on a trip may be less than the total fishing effort because the observer was only present at the fishing site for part of the open day. Hence the permit day measure of effort is expected to over-estimate both the total effort and the observed effort by unknown amounts.

To overcome this problem a different measure of fishing effort was defined, based on the number of hours fished by permit holders and the number of those hours effectively observed. For the purpose of estimating bird and mammal take rates and total take numbers the measurements of the total effort and cover were made separately for the four sampling regions Y1 to Y4 as defined in Table 3.1. Also, separate estimates are provided for all takes and takes involving serious injury or mortality (SI/M).

Fishing Effort Based on Hours Fished

For this measure of fishing effort the total fishing effort is the sum of the hours fished for all of the openers and all of the permit holders that fished in a sampling region, where the hours fished is defined as the hours when nets are in the water actively fishing (rather than out of the water, or tied up). This total fishing effort was determined by the lead observers, as explained in Section 2 and Appendix B of this report. The observed effort for a trip is then the effort in hours, taking into account the number of permit holders observed, the effective fishing time observed, and the fraction of observed hauls observed, while the total observed effort in a region is the sum of the observed hours for all the trips in the region.

The equation used for measuring the effort for a trip takes the form

$$\text{Effort} = (\text{Fishing Time})\times(\text{Permits Fishing})\times(\text{Average \% of Net Observed}/100). \quad (4.1)$$

Here the fishing time effectively observed includes the soak times for nets. For example, if a net was set at 10pm the day before an observed trip and the net was hauled ending at 6am on the observed day then the soak plus haul time of eight hours is considered to be effectively observed on the assumption that any overnight bird or mammal takes should still be in the net and available to be observed during the haul. In practice to calculate the fishing time for a trip using equation (4.1) the time that the soak began is found for each observed haul during the trip and the earliest of these times is considered to be the start of the effectively observed fishing period. The end of this period is then the time when the last observed haul for the trip ends. The number of permits observed was either one or two. If it is two then it is assumed that both permits had the same effective fishing time.

The last factor on the right-hand side of equation (4.1) allows for the fact that for various reasons observers may not be able to observe all of the hauls made by permit holders. For each observed haul the percentage of the net pulled is recorded, and also the percentage of the net observed. The percentage of the haul observed is 100% if all of the pulled net is observed, or is otherwise the amount observed as a percentage of the amount pulled. The last factor in equation (4.1) is then the average of the percentages observed for all hauls observed.

For some trips there may have been hauls that were unobserved because they ended before the observer arrived or after the observer left for the day. These are not taken into account in the last factor of equation (4.1) but are assumed to be allowed for by the effective fishing time being less that the time fished by the permit holder on the day of the trip.

Having calculated the total number of hours fished in a region and the number of those hours observed for each trip, the percentage cover for the region is the sum of the hours observed for all trips as given by equation (4.1), expressed as a percentage of the total fishing effort in hours.

Observer Coverage Levels for Hours Fished

Table 4.1 shows the observer cover based on the number of permit days observed and the effort based on hours, for 2007 and 2008. The coverage levels are highest when based on the permit days observed, which does not take into account days that were not completely fished and days that were not fully observed.

The target observer coverage of at least 5% was met in 2007 for effort based on hours for strata Y2, Y3 and Y4, but not for region Y1, which only had 3.2% coverage. However, overall in 2007 the coverage was 5.3%, and in 2008 it was 7.6%, which is satisfactory. For both years the overall coverage was also satisfactory at 6.3%.

Table 4.1 Observer coverage calculated based on the number of permit days observed and the fishing effort in hours. The coverage is not the same for these two measures of effort because the total fishing effort based on permit days does not allow for the fact that permit holders did not always fish for the whole day, and the observed effort based on permit days does not allow for the fact that observers did not always observe all of the fishing that took place on a permit day.

2007						
	Effort Based on Permit Days		%	Effort Based on Hours		%
Region	Total	Obs	Cover	Total	Obs	Cover
Y1	692	41	5.9	10279	331	3.2
Y2	2214	157	7.1	25491	1295	5.1
Y3	1393	96	6.9	25414	1582	6.2
Y4	146	10	6.8	1875	111	5.9
Total	4445	304	6.8	63059	3320	5.3

2008						
	Effort Based on Permit Days		%	Effort Based on Hours		%
Region	Total	Obs	Cover	Total	Obs	Cover
Y1	367	30	8.2	4786	354	7.4
Y2	2203	191	8.7	22251	1698	7.6
Y3	1043	93	8.9	18290	1332	7.3
Y4	184	26	14.1	1818	192	10.6
Total	3797	340	9.0	47145	3576	7.6

Both Years						
	Effort Based on Permit Days		%	Effort Based on Hours		%
Region	Total	Obs	Cover	Total	Obs	Cover
Y1	1059	71	6.7	15065	685	4.5
Y2	4417	348	7.9	47743	2994	6.3
Y3	2436	189	7.8	43704	2914	6.7
Y4	330	36	10.9	3693	304	8.2
Total	8242	644	7.8	110204	6896	6.3

Observer Coverage and the Salmon Catch Observed

The observer coverage level should approximately correspond to the total number and weight of the salmon caught in the fishery, as recorded by the ADF&G. This then gives some check on the observer coverage levels shown in Table 4.1 to see if they are reasonable from this point of view.

Table 4.2 shows the total catches recorded by ADF&G and the catches recorded by the observers for the four sampling strata used for the observer program, for 2007 and 2008. Overall in 2007 the percentage of the salmon catch recorded by observers was

4.9% based on fish numbers or fish weights. This is slightly less than the 5.3% observer cover calculated based on the hours observed for that year, but the agreement is quite good. The agreement for the sampling strata is also reasonably good in 2007 except in region Y3 where the observers recorded about 4.5% of the salmon catch but observed 6.2% of the fishing effort based on hours. Overall in 2008 the observers recorded 7.3% of the salmon catch based on the numbers of fish and 6.9% based on the weight. These percentages are again slightly less that the overall 7.6% coverage based on the hours observed, but the agreement is still quite good. However the agreement is not so good for the individual strata.

Table 4.2 The total catches of fish by numbers and weight as recorded by ADF&G and the AMMOP observers in 2007 and 2008, with coverage rates to compare with the coverage rates based on the hours observed from Table 4.1.

		2007						
		Number of Fish Caught			Weight of Fish (lbs)			Cover Based on Hours
Region	Species	Total	Obs	%	Total	Obs	%	%
Y1	Chinook	760	3		13728	60		
	Chum	1256	53		11356	231		
	Coho	190	93		1332	407		
	Pink	203	1		859	5		
	Sockeye	83242	3034		577745	20494		
	Unknown	0	0		0	0		
	Total	85651	3184	3.7	605020	21197	3.5	3.2
Y2	Chinook	83	3		0	34		
	Chum	415	20		3187	91		
	Coho	41900	2085		332675	18114		
	Pink	61591	3057		255833	12344		
	Sockeye	61846	4056		389063	21855		
	Unknown	0	86		0	353		
	Total	165835	9307	5.6	980758	52791	5.4	5.1
Y3	Chinook	1053	43		16569	869		
	Chum	1111	21		8865	126		
	Coho	8580	557		68200	4582		
	Pink	26203	851		108378	3301		
	Sockeye	91561	4230		591198	27106		
	Unknown	0	24		0	159		
	Total	128508	5726	4.5	793210	36143	4.6	6.2
Y4	Chinook	0	0		0	0		
	Chum	0	0		0	0		
	Coho	25880	1622		204184	16220		
	Pink	0	0		0	0		
	Sockeye	7	0		56	0		
	Unknown	0	0		0	0		
	Total	25887	1622	6.3	204240	16220	7.9	5.9
	All	405881	19839	4.9	2583228	126352	4.9	5.3

Table 4.2, Continued.

		2008						
		Number of Fish Caught			Weight of Fish (lbs)			Cover Based on Hours
Region	Species	Total	Obs	%	Total	Obs	%	%
Y1	Chinook	593	10		12917	108		
	Chum	2	10		20	59		
	Coho	2833	176		25247	1380		
	Pink	0	2		0	8		
	Sockeye	2871	139		16480	853		
	Unknown	0	2		0	4		
	Total	6299	339	5.4	54664	2412	4.4	7.4
Y2	Chinook	91	38		0	420		
	Chum	166	10		1402	75		
	Coho	95874	4764		949730	43743		
	Pink	43250	2779		184013	12301		
	Sockeye	10625	793		55017	4488		
	Unknown	0	2080		0	9950		
	Total	150006	10464	7.0	1190162	70976	6.0	7.6
Y3	Chinook	625	41		10176	592		
	Chum	378	19		3036	133		
	Coho	5465	332		53051	3086		
	Pink	21976	743		81363	3243		
	Sockeye	21781	1709		135780	10885		
	Unknown	0	4		0	31		
	Total	50225	2848	5.7	283406	17970	6.3	7.3
Y4	Chinook	0	0		0	0		
	Chum	0	0		0	0		
	Coho	49522	4984		476556	46664		
	Pink	1	115		3	625		
	Sockeye	5	0		27	0		
	Unknown	0	0		0	0		
	Total	49528	5099	10.3	476586	47289	9.9	10.6
	All	256058	18750	7.3	2004818	138648	6.9	7.6

5. Strandings and Self-Reporting of Takes

There were a number of reports of strandings of marine mammals in the Yakutat area in 2007 and 2008. These were: (1) on June 10, 2007 a Steller sea lion with advanced decomposure was reported by an AMMOP observer, (2) on August 29, 2007 a harbor porpoise with advanced decomposure was reported by an AMMOP observer, (3) on about June 8, 2008 an unknown cetacean with advanced decomposure was reported by a Stranding Network member, (4) on June 17, 2008 a dead harbor porpoise was found floating by a NMFS enforcement officer, (5) on June 30, 2008 a freshly dead harbor porpoise was reported by an AMMOP observer, (6) on July 23, 2008 a freshly dead harbor porpoise was reported by a Stranding Network member, and (7) on October 4, 2008 a moderately decomposed Steller sea lion was reported by a Stranding Network member.

The Marine Mammal Authorization Program allows commercial fishing even though takes of marine mammals may occur. It is required, however, that commercial fishers should report all incidental mortalities and injuries of marine mammals within 48 hours after the end of the fishing trip, or within 48 hours of the occurrence of a mortality or injury. Mortality/Injury Reporting Forms were mailed to all Yakutat setnet permit holders for this purpose. In 2007 there was one self-report of a marine mammal take. This was for a dead harbor porpoise that was also the observed harbor porpoise take that is shown in Table 6.1 below. In 2008 there was also a self-report for one of the two dead harbor porpoises shown in Table 6.1.

6. Ratio Estimation of Total Takes

A major objective of the AMMOP program is to estimate the total number of yearly takes of different species of marine mammals and birds in fisheries, and also the number of SI/M (serious injury or mortality) takes. For the present report the estimation of these total take numbers for the Yakutat set gillnet fishery is based on ratio estimation, with separate estimates for each of the four sampling regions shown in Table 3.1 (Y1, the Alsek River region, Y2, the Situk region, Y3, the Yakutat Bay region, and Y4, Kaliakh and Tsiu River region). Basically the observer data for a region is used to calculate the take of a species per observed hour of fishing. This take per hour is then multiplied by the total number of hours of fishing by permit holders for the whole season in the region to get the estimated total take.

As noted in Section 4, it is not appropriate to measure the observer effort just based on the number of trips made because this does not take into account that there are some trips where all of the fishing carried out by a permit holder could not be observed because, for example, the permit holder began fishing before the observer arrived. For this reason the estimates of take rates and numbers are based on the effort in terms of the hours fished, as discussed in Section 4. Then the total fishing effort in a region is the sum of all of the hours fished in the region, for all of the openers and all of the permit holders in the region, where the hours fished is defined as the hours when nets were in the water actively fishing rather than out of the water or tied up. This total effort is denoted here by t_e, and is assumed to have been determined by lead observers with a negligible error.

The observed effort for a trip is determined based on the observer records. This involves taking into account the fishing time observed, the number of permits fishing, and unobserved hauls or parts of hauls, using equation (4.1). The total sample effort in a region is the sum of the observed effort for all trips made in a region. It is denoted here by t_s, and this is again assumed to have a negligible error. Columns 5 and 6 of Table 4.1 show the values for t_e and t_s determined for the four sampling regions based on these definitions, for 2007 and 2008.

Within a sampling region let the observed total take of a marine mammal or bird species be denoted by t_c, where this is either all of the takes or just the SI/M takes. Then the take rate per fishing hour for the species in question is estimated to be

$$r = t_c / t_s, \tag{6.1}$$

and an obvious estimate of the total take in the sampling region is this hourly take rate multiplied by the total fishing hours in the region, or

$$T = r.t_e. \tag{6.2}$$

Equation (6.2) is a ratio estimator. Standard theory (Sheaffer *et al*., 1990, p. 155) provides an equation for estimating the variance of r, which is

$$Var(r) = [\sum (c_i - r\,e_i)^2 /(n - 1)]\,(1 / \bar{e}^2)\,(1 / n)\,(1 - n / N). \qquad (6.3)$$

Here N is the total number of trips that could have been made in the region by the observers, n is the number of trips actually made, c_i is the observed take on the ith trip for the species being considered, e_i is the sampling effort on the ith trip, $\bar{e}$ is the mean sampling effort per trip, and the summation is over the n trips.

Because the total sampling effort T_e is assumed to be known with a negligible error the variance of the estimator of total take from equation (6.2) is simply

$$Var(T) = Var(r)\,t_e^2\,. \qquad (6.4)$$

Hence the estimated percentage coefficient of variation is

$$CV(T) = 100xSE(T) / T, \qquad (6.5)$$

where SE(T) is the standard error of T, which is the square root of Var(T). Finally, an approximate 95% confidence interval for the true total take is given by

$$T - 2\,SE(T) \text{ to } T + 2\,SE(T) \qquad (6.6)$$

(Sheaffer *et al*., 1990, p. 155). This interval may be very approximate when the take rate is low.

The equations (6.1) to (6.6) apply to the take within one region. For all regions combined the estimated total take is the sum of the estimates for each of the regions. As the estimates for the regions are independent of each other, the variance of the estimated total number of takes for all regions is the sum of the variances for the individual regions. Equations (6.5) and (6.6) can also be applied with the estimated total for all regions.

Marine Mammal and Bird Takes

Table 6.1 lists the marine mammal and bird takes recorded by the AMMOP observers in 2007 and 2008. In 2007 one harbor porpoise was observed to be taken and was released dead. A total of 23 birds were observed to be taken, with nine species (a double crested cormorant, a pigeon guillemot, a glaucus winged gull, a Pacific loon, a red throated loon, four common murres, 11 marbled murrelets, two white winged scoters, and a wandering tattler). Only four of the 23 birds were released alive with no visible external injuries. All of the takes were in sampling regions Y2 (the Situk area) and Y3 (the Yakutat Bay area).

In 2008 there were five marine mammal interactions with the fishery. A harbor seal, a northern Steller sea lion (seen between two soak watches), and a harbor porpoise released themselves alive with no visible external injuries, while two harbor porpoises were released dead. A total of 12 birds were also observed to be taken (a Kittlitz's murrelet, four marbled murrelets, one murrelet of unknown species, one Arctic loon, two red-throated loons, a common murre, and two long-tailed duck ducks). Only two of the birds were released alive with no visible external injuries. The two ducks were taken in sampling region Y1 (the Alsek River area), one marbled murrelet was taken in sampling region Y2 (the Situk area), and the remainder of the takes were in sampling region Y3 (the Yakutat Bay area).

Table 6.2 summarizes the results obtained for the estimation of the total take, species by species for 2007 and 2008, both for all takes and for SI/M takes only. In 2007 takes were only observed in the regions Y2 and Y3, with most takes observed in Y3. For these regions the table shows the number of hauls for which takes occurred, the number of each species observed to be taken, the observed take rate per 24 hour fishing period, the estimated total take, the estimated standard error for the total take, and the CV. It is estimated for this year that there were a total of 16 harbor porpoise takes in the fishery in sampling region Y3, with a CV of 96%, and a total take of 380 birds, with a CV of 26%. All of the estimated harbor porpoise takes are estimated to be SI/M takes, while 305 of the bird takes are estimated to be SI/M takes, with a CV of 30%.

In 2008 most takes were in region Y3, as was the case in 2007. There were three harbor porpoises and one harbor seal observed to be taken in sampling region Y3, with two of the harbor porpoises released dead. This leads to a total estimated take of 41 harbor porpoises, with a CV of 56%, and 14 harbor seals, with a CV of 96%. Table 6.2 does not include the Steller sea lion listed in Table 6.1 because this was not observed during a watch period. There were observed takes of 12 birds in 2008, leading to an estimated total take for the whole fishery of 164 birds with a CV of 34%. This is less than half of the estimated total take of 380 birds in 2007, which can be partly but not completely accounted for by the fact that the total fishing effort in hours in 2008 was only about 75% of the effort in 2007 (Table 4.1). In 2008 there is an estimated total SI/M take of 28 harbor porpoises with a CV of 68%, no estimated SI/M take of harbor porpoises, and an estimated SI/M take of 137 birds, with a CV of 36%.

Table 6.1 The marine mammal and bird takes recorded by AMMOP observers in 2007 and 2008, with the dates of the takes, the sampling region, the species, the method of release from nets, the horizontal and vertical positions in the nets, and the final condition of the animal.

2007 Takes									
Date	Region	Species	Disentanglement	Horizontal Location	Vertical Location	Condition	Injury	Age Class	Sex
22-Aug	Y3	Harbor porpoise	Removal by untangling	First third of net	Top third of net	Dead	Small lacerations	Adult	Male
12-Jun	Y3	Common murre	Removal by untangling	First third of net	Top third of net	Dead	Small lacerations & missing plumage	Adult	Male
26-Jun	Y3	Common murre	Removal by untangling	Final third of net	Middle third of net	Dead	No external injury & unresponsive	Adult	Male
02-Jul	Y3	Marbled murrelet	Removal by untangling	Unknown	Unknown	Dead	No external injury & unresponsive	Adult	Female
02-Jul	Y3	Marbled murrelet	Removal by untangling	Middle third of net	Unknown	Dead	No external injury & unresponsive	Adult	Female
02-Jul	Y3	Marbled murrelet	Removal by untangling	Unknown	Unknown	Dead	No external injury & unresponsive	Adult	Female
02-Jul	Y3	Marbled murrelet	Removal by untangling	Unknown	Unknown	Dead	No external injury & unresponsive	Adult	Male
08-Jul	Y3	Marbled murrelet	Removal by untangling	Final third of net	Middle third of net	Dead	No external injury & unresponsive	Adult	Male
10-Aug	Y3	Common murre	Removal by untangling	Middle third of net	Middle third of net	Dead	No external injury & unresponsive	Juvenile (hatch-year)	Male
10-Aug	Y3	Common murre	Removal by untangling	First third of net	Middle third of net	Dead	No external injury & unresponsive	Juvenile (hatch-year)	Male
14-Aug	Y3	Marbled murrelet	Removal by untangling	Middle third of net	Middle third of net	Dead	No external injury & unresponsive	Juvenile (hatch-year)	Unknown
14-Aug	Y3	Marbled murrelet	Removal by untangling	First third of net	Top third of net	Dead	No external injury & unresponsive	Adult	Female
21-Aug	Y3	Marbled murrelet	Removal by untangling	Final third of net	Top third of net	Dead	Saturated wet plumage or oiled	Juvenile (hatch-year)	Unknown
22-Aug	Y3	Marbled murrelet	Dislodged once out of water	Middle third of net	At water surface	Dead	Broken appendages	Adult	Male
26-Aug	Y3	Glaucus-winged gull	Momentary snag with self release	First third of net	At water surface	Alive	No external injury & responsive	Adult	Unknown
26-Aug	Y3	Pigeon guillemot	Dislodged once out of water	Middle third of net	Top third of net	Dead	No external injury & unresponsive	Juvenile (hatch-year)	Male
28-Aug	Y3	Marbled murrelet	Removal by untangling	Final third of net	At water surface	Dead	No external injury & unresponsive	Juvenile (hatch-year)	Female
03-Sep	Y2	Wandering tattler	Other	First third of net	Top third of net	Alive	No external injury & responsive	Adult	Unknown
10-Sep	Y3	Red-throated loon	Removal by untangling	Middle third of net	Top third of net	Dead	No external injury & unresponsive	Unknown	Male
24-Sep	Y3	White-winged scoter	Removal by untangling	Final third of net	Top third of net	Dead	Saturated wet plumage or oiled	Unknown	Female
30-Sep	Y3	Marbled murrelet	Removal by untangling	Middle third of net	Top third of net	Dead	No external injury & unresponsive	Juvenile (hatch-year)	Male
01-Oct	Y3	White-winged scoter	Dislodged once out of water	Middle third of net	Unknown	Dead	No external injury & unresponsive	Unknown	Female
01-Oct	Y2	Pacific loon	Momentary snag with self release	Middle third of net	At water surface	Alive	No external injury & responsive	Unknown	Unknown
02-Oct	Y2	Double-crested comorant	Removal by untangling	Middle third of net	At water surface	Alive	Unknown	Unknown	Unknown

Table 6.1, Continued

2008 Takes									
Date	Region	Species	Disentanglement	Horizontal Location	Vertical Location	Condition	Injury	Age Class	Sex
30-Jun	Y3	Harbor porpoise	Dislodged under water	Final third of net	Bottom third of net	Dead	Unknown	Unknown	Unknown
06-Jul	Y3	Harbor seal	Momentary snag with self release	First third of net	Top third of net	Alive	No external injury & responsive	Adult	Unknown
06-Jul	Y3	Northern Steller sea lion*	Momentary snag with self release	First third of net	Middle third of net	Alive	No external injury & responsive	Unknown	Unknown
10-Aug	Y3	Harbor porpoise	Momentary snag with self release	First third of net	Unknown	Alive	Unknown	Adult	Unknown
20-Aug	Y3	Harbor porpoise	Removal by untangling	Final third of net	Middle third of net	Dead	Small lacerations	Unknown	Male
01-Jun	Y1	Long-tailed duck duck	Removal by untangling	First third of net	At water surface	Alive	Unknown	Unknown	Male
01-Jun	Y1	Long-tailed duck duck	Removal by untangling	Middle third of net	Top third of net	Dead	No external injury & unresponsive	Adult	Female
08-Jun	Y3	Arctic loon	Dislodged once out of water	First third of net	Top third of net	Dead	Small lacerations & missing plumage	Adult	Female
16-Jun	Y3	Common murre	Dislodged once out of water	Final third of net	Top third of net	Dead	No external injury & unresponsive	Adult	Male
17-Jun	Y3	Red-throated loon	Removal by untangling	First third of net	Unknown	Dead	No external injury & unresponsive	Adult	Male
17-Jun	Y3	Red-throated loon	Removal by untangling	First third of net	Unknown	Dead	No external injury & unresponsive	Adult	Female
17-Jun	Y3	Kittlitz's murrelet	Removal by untangling	First third of net	Unknown	Dead	No external injury & unresponsive	Adult	Male
30-Jun	Y3	Marbled murrelet	Dislodged once out of water	First third of net	Top third of net	Dead	No external injury & unresponsive	Adult	Male
30-Jun	Y3	Marbled murrelet	Dislodged once out of water	Middle third of net	Top third of net	Dead	No external injury & unresponsive	Adult	Male
20-Jul	Y3	Unknown murrelet	Other	First third of net	Top third of net	Alive	No external injury & responsive	Unknown	Unknown
12-Aug	Y3	Marbled murrelet	Dislodged once out of water	Final third of net	Middle third of net	Dead	Saturated wet plumage or oiled	Juvenile (hatch-year)	Male
26-Aug	Y2	Marbled murrelet	Removal by untangling	First third of net	Middle third of net	Dead	Broken appendages	Juvenile (hatch-year)	Female

*The Steller sea lion was observed off-watch (when the observer was between two soak watches).

Table 6.2 The number of hauls with take of the mammal or bird (HWT), observed take numbers (Obs Take), observed take rates per 24 fishing hours (Take Rate), estimated total takes for the whole fishery (Est Take) with the standard error (SE) and percentage coefficient of variation (CV %) for the estimated total takes. Results are provided separately for 2007 and 2008, and separately for serious injury and mortality (SI/M) takes.

Results From the 2007 Observer program (All Takes)

Region	Total Hauls		Harbor Porpoise	Double Crested Cormorant	Pigeon Guillemot	Glaucus Winged Gull	Pacific Loon	Red Throated Loon	Common Murre	Marbled Murrelet	White Winged Scoter	Wandering Tattler	All Birds
Y1	181						No take observed						
Y2	678	HWT	0	1	0	0	1	0	0	0	0	1	3
		ObsTake	0	1	0	0	1	0	0	0	0	1	3
		Take Rate	0.000	0.019	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.019	0.056
		Est Take	0.0	19.7	0.0	0.0	19.7	0.0	0.0	0.0	0.0	19.7	59.0
		SE	0.0	19.3	0.0	0.0	19.4	0.0	0.0	0.0	0.0	19.2	33.5
		CV %		98.3			98.4					97.8	56.7
Y3	302	HWT	1	0	1	1	0	1	3	8	2	0	15
		Obs Take	1	0	1	1	0	1	4	11	2	0	20
		Take Rate	0.015	0.000	0.015	0.015	0.000	0.015	0.061	0.167	0.030	0.000	0.303
		Est Take	16.1	0.0	16.0	16.1	0.0	16.1	64.3	176.7	32.1	0.0	321.3
		SE	15.4	0.0	15.6	15.7	0.0	15.6	37.9	75.5	21.9	0.0	91.4
		CV %	96.1		97.3	97.4		97.1	59.0	42.7	68.3		28.4
Y4	50						No take observed						
All	1211	HWT	1	1	1	1	1	1	3	8	2	1	18
Regions		Obs Take	1	1	1	1	1	1	4	11	2	1	23
		Take Rate	0.015	0.019	0.015	0.015	0.019	0.015	0.061	0.167	0.030	0.019	0.359
		Est Take	16.1	19.7	16.0	16.1	19.7	16.1	64.3	176.7	32.1	19.7	380.4
		SE	15.4	19.3	15.6	15.7	19.4	15.6	37.9	75.5	21.9	19.2	97.3
		CV %	96.1	98.3	97.3	97.4	98.4	97.1	59.0	42.7	68.3	97.8	25.6

Results From the 2007 Observer program (SI/M Takes Only)

Region	Total Hauls		Harbor Porpoise	Double Crested Cormorant	Pigeon Guillemot	Glaucus Winged Gull	Pacific Loon	Red Throated Loon	Common Murre	Marbled Murrelet	White Winged Scoter	Wandering Tattler	All Birds
Y1	181	No SI/M Take Observed											
Y2	678	No SI/M Take Observed											
Y3	302	HWT	1	0	1	0	0	1	3	8	2	0	15
		Obs Take	1	0	1	0	0	1	4	11	2	0	19
		Take Rate	0.015	0.000	0.015	0.000	0.000	0.015	0.061	0.167	0.030	0.000	0.288
		Est Take	16.1	0.0	16.1	0.0	0.0	16.1	64.3	176.7	32.1	0.0	305.3
		SE	15.4	0.0	15.7	0.0	0.0	15.6	37.9	75.5	21.9	0.0	90.0
		CV (%)	96.1		97.4			97.1	59.0	42.7	68.3		29.5
Y4	50	No SI/M Take Observed											
All Regions	1211	HWT	1	0	1	0	0	1	3	8	2	0	15
		Obs Take	1	0	1	0	0	1	4	11	2	0	19
		Take Rate	0.015	0.000	0.015	0.000	0.000	0.015	0.061	0.167	0.030	0.000	0.288
		Est Take	16.1	0.0	16.1	0.0	0.0	16.1	64.3	176.7	32.1	0.0	305.3
		SE	15.4	0.0	15.7	0.0	0.0	15.6	37.9	75.5	21.9	0.0	90.0
		CV (%)	96.1		97.4			97.1	59.0	42.7	68.3		29.5

Results From the 2008 Observer Program (All Takes)

Region	Total Hauls		Harbor Porpoise	Harbor Seal	Long-Tailed Duck	Arctic Loon	Red Throated Loon	Common Murre	Kittlitz's Murrelet	Marbled Murrelet	Unknown Murrelet	All Birds
Y1	196	HWT	0	0	1	0	0	0	0	0	0	1
		Take	0	0	2	0	0	0	0	0	0	2
		Take Rate	0.000	0.000	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.136
		Est Take	0.0	0.0	27.1	0.0	0.0	0.0	0.0	0.0	0.0	27.1
		SE	0.0	0.0	26.2	0.0	0.0	0.0	0.0	0.0	0.0	26.2
		CV %			96.9							96.9
Y2	603	HWT	0	0	0	0	0	0	0	1	0	1
		Take	0	0	0	0	0	0	0	1	0	1
		Take Rate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.014
		Est Take	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.1	0.0	13.1
		SE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	0.0	12.4
		CV %								94.4		94.4
Y3	257	HWT	3	1	0	1	1	1	1	3	1	7
		Take	3	1	0	1	2	1	1	3	1	9
		Take Rate	0.054	0.018	0.000	0.018	0.036	0.018	0.018	0.054	0.018	0.162
		Est Take	41.2	13.7	0.0	13.7	27.5	13.7	13.7	41.2	13.7	123.6
		SE	23.1	13.2	0.0	13.3	25.8	13.2	12.9	29.4	13.0	47.1
		CV %	56.2	96.2		97.0	94.1	96.1	94.1	71.5	95.0	38.1
Y4	63						No take observed					
All Regions	1119	HWT	3	1	1	1	1	1	1	4	1	9
		Take	3	1	2	1	2	1	1	4	1	12
		Take Rate	0.054	0.018	0.136	0.018	0.036	0.018	0.018	0.068	0.018	0.312
		Est Take	41.2	13.7	27.1	13.7	27.5	13.7	13.7	54.3	13.7	163.8
		SE	23.1	13.2	26.2	13.3	25.8	13.2	12.9	31.9	13.0	55.3
		CV (%)	56.2	96.2	96.9	97.0	94.1	96.1	94.1	58.8	95.0	33.8

Results From the 2008 Observer Program (SI/M Takes)

Region	Total Hauls		Harbor Porpoise	Harbor Seal	Long Tailed Duck	Arctic Loon	Red Throated Loon	Common Murre	Kittlitz's Murrelet	Marbled Murrelet	Unknown Murrelet	All Birds
Y1	196	HWT	0	0	1	0	0	0	0	0	0	1
		Obs Take	0	0	1	0	0	0	0	0	0	1
		Take Rate	0.000	0.000	0.068	0.000	0.000	0.000	0.000	0.000	0.000	0.068
		Est Take	0.0	0.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	13.5
		SE	0.0	0.0	13.1	0.0	0.0	0.0	0.0	0.0	0.0	13.1
		CV (%)			96.9							96.9
Y2	603	HWT	0	0	0	0	0	0	0	1	0	1
		Obs Take	0	0	0	0	0	0	0	1	0	1
		Take Rate	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.014
		Est Take	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.1	0.0	13.1
		SE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	0.0	12.4
		CV (%)								94.4		94.4
Y3	257	HWT	2	0	0	1	1	1	1	3	0	7
		Obs Take	2	0	0	1	2	1	1	3	0	8
		Take Rate	0.036	0.000	0.000	0.018	0.036	0.018	0.018	0.054	0.000	0.144
		Est Take	27.5	0.0	0.0	13.7	27.5	13.7	13.7	41.2	0.0	109.9
		SE	18.8	0.0	0.0	13.3	25.8	13.2	12.9	29.4	0.0	45.3
		CV (%)	68.4			97.0	94.1	96.1	94.1	71.5		41.2
Y4	63					No SI/M take observed						
All Regions	1119	HWT	2	0	1	1	1	1	1	4	0	8
		Obs Take	2	0	1	1	2	1	1	4	0	10
		Take Rate	0.036	0.000	0.068	0.018	0.036	0.018	0.018	0.068	0.000	0.226
		Est Take	27.5	0.0	13.5	13.7	27.5	13.7	13.7	54.3	0.0	136.5
		SE	18.8	0.0	13.1	13.3	25.8	13.2	12.9	31.9	0.0	48.8
		CV (%)	68.4		96.9	97.0	94.1	96.1	94.1	58.8		35.7

7. Further Calculations on Take Estimates

Regions With No Observed Bycatch

No take of marine mammals and birds was observed in the sampling region Y1 (the Alsek River area) in 2007, but that does not mean that no take occurred. Based on measuring the fishing effort by hours the observer coverage of the region was 3.2%. This means that if a take occurred in this region to a random permit holder at a random fishing time then the probability of this being observed was 0.032, while the probability of it not being observed was 1.000 - 0.032 = 0.968. Assuming that the takes of a species or a group of species occur independently to random permit holders it then follows that if there are N take incidents then the probability of none of them being observed is

$$P(0) = (1 - 0.032)^N = 0.968^N.$$

More generally, based on this argument if the proportion of the fishing effort covered is p, then the probability of observing none of N takes of a particular type is

$$P(0) = (1 - p)^N \qquad (7.1)$$

(Wade, 1999). Table 7.1 shows these probabilities for the coverage levels in each of the sampling regions, for 2007 and 2008. It shows, for example, that if there was one haul with a marine mammal take in sampling region Y1 in 2007 then the probability of this not being observed was 0.968, while if there were 10 hauls with marine mammal takes then the probability of none of these takes being observed was 0.722. It is clear from the table that when no take was observed for a region in a year there is a possibility that some take actually occurred.

Table 7.1 also shows a type of 95% confidence limit for the maximum number of takes that may have occurred. This is the smallest value of N that makes the probability of seeing no take equal to 0.05 or less because there is then a probability of at least 0.95 of seeing some bycatch if the number of incidents is N or more. This limit is found by solving the equation $0.05 = (1 - p)^N$, so that

$$N = \text{Log}(0.05)/\text{Log}(1 - p), \qquad (7.2)$$

where p is the observer coverage expressed as a proportion. The 95% confidence limit is then the smallest integer larger than N. The table shows, for example, that the number of take incidents in Y1 in 2007 might have been as high as 93, even though no incidents were observed.

Table 7.1 Probabilities of observing no take incidents of a particular kind in sampling regions Y1 to Y4 in 2007 and 2008 when the true number of incidents was equal to N, with 95% confidence limits for the total number of take incidents that might have occurred. A take incident involves one or more animals being taken on one haul.

Year	2007	2007	2007	2007	2008	2008	2008	2008
Region	Y1	Y2	Y3	Y4	Y1	Y2	Y3	Y4
	Cover							
N	3.2%	5.1%	6.2%	5.9%	7.4%	7.6%	7.3%	10.6%
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	0.968	0.949	0.938	0.941	0.926	0.924	0.927	0.894
5	0.850	0.770	0.726	0.738	0.681	0.674	0.685	0.571
10	0.722	0.592	0.527	0.544	0.464	0.454	0.469	0.326
20	0.522	0.351	0.278	0.296	0.215	0.206	0.220	0.106
50	0.197	0.073	0.041	0.048	0.021	0.019	0.023	0.004
100	0.039	0.005	0.002	0.002	0.000	0.000	0.001	0.000
200	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
95% Limit	93	58	48	50	40	39	41	28

Confidence Intervals for Species With Bycatch

As noted in Section 6, the 95% confidence limits given by equation (6.6) may be very approximate when the take rate is low. For this reason, the limits from this equation are provided here only for the total take and SI/M take for all birds and all murrelets in 2007 and 2008.

For the cases with a small number of takes in one sampling region an alternative approach for determining confidence limits can be used, using the same type of idea as was used to produce Table 7.1. Thus suppose that the observer coverage in the sampling region as a proportion of the total fishing effort is p, and that this is therefore the probability of observing a take event of a certain type (e.g, the take of one or more murrelet birds at the same time). Suppose, also, that there are actually N take events in the sampling region during the whole fishing season. Then the probability of observing exactly n take events is given by the binomial distribution to be

$$P(n) = {}^{N}C_{n}\, p^{n}\, (1-p)^{N-n}. \qquad (7.3)$$

Based on this idea 95% confidence limits for the value of N based on the n observed takes can be calculated, noting that a take event may involve the take of more than one animal so that the confidence interval is for the total number of take events, which may be less than the total number of animals taken. The confidence limits are found by solving the two equations

$$P(0) + P(1) + \ldots P(n) \approx 0.025 \qquad (7.4)$$

and

$$P(n) + P(n+1) + ... P(N) \approx 0.025 \qquad (7.5)$$

for N. Solving the first equation gives an upper limit N_U for N such that if the true value of N exceeds N_U then the probability of observing n or less take events is less than 0.025, while solving the second equation for N gives a lower limit N_L for N such that if the true value of N is less than N_L then the probability of observing n or more take events is less than 0.025.

If there is only one observed take event then equation (7.5) becomes $P(1) + P(2) + ... +P(N) = 1 - P(0) = 1 - (1 - p)^N \approx 0.025$. This then does not have a good approximate solution. For example, there was one observer Kittlitz's murrelet take in region Y3 in 2008, where the coverage level was p = 0.073. Taking N = 1 gives $1 - (1 - p)^1 = p = 0.073$, which is much larger than 0.025. Taking N = 2 gives $1 - (1 - 0.073)^2 = 0.140$, which is worse, and taking larger values gives even poorer solutions. For this reason, the 95% confidence limits can be changed when there is only one observed take event. The lower limit can be set at $N_L = 1$ because it is certain that at least one take event occurred, while the upper limit can be obtained by solving the equation

$$P(0) + P(1) \approx 0.05. \qquad (7.6)$$

If the solution of equation (7.6) is the upper limit $N = N_U$ then if the true total number of take events is larger than N_U the probability of observing only one or zero events is less than 0.05.

Table 7.2 shows the 95% confidence limits calculated for all birds, murrelets, Kittlitz's murrelet, all mammals, and harbor porpoises using either equation (6.6) or the equations (7.4) to (7.6). Limits for Kittlitz's murrelets are provided because it was listed as a candidate species under the Endangered Species Act by the U.S. Fish and Wildlife Service in 2004.

Table 7.2 The observed takes (Obs Take), and estimated total takes with standard errors (SE) and 95% confidence limits for the total take in the years and sampling regions indicated, and for all takes and serious injury and mortality (SI/M) takes. The equation or equations used to calculate the confidence limits are also shown.

Type of Take	Species	Year	Regions	Obs Take	Total Takes Estimate	SE	Lower Limit	Upper Limit	Equations Used
All	All Birds	2007	Y2, Y3	23	380.4	97.3	186	575	(6.6)
	Murrelets	2007	Y3	11	176.7	75.5	26	328	(6.6)
SI/M	All Birds	2007	Y3	19	305.3	90.0	125	485	(6.6)
	Murrelets	2007	Y3	11	176.7	75.5	26	328	(6.6)
All	All Birds	2008	Y1, Y2, Y3	12	163.8	55.3	53	274	(6.6)
	Murrelets	2008	Y2, Y3	6	81.7	36.8	8	155	(6.6)
SI/M	All Birds	2008	Y1, Y2, Y3	10	136.5	48.8	39	234	(6.6)
	Murrelets	2008	Y2, Y3	5	68.0	34.4	5	137	(6.6)
All	Kittlitz's Murrelet	2008	Y3	1	13.7	12.9	1	63	(7.6)
SI/M	Kittlitz's Murrelet	2008	Y3	1	13.7	12.9	1	63	(7.6)
All	Marine Mammals	2007	Y3	1	16.1	15.4	1	74	(7.6)
	Harbor Porpoises	2007	Y3	1	16.1	15.4	1	74	(7.6)
SI/M	Marine Mammals	2007	Y3	1	16.1	15.4	1	74	(7.6)
	Harbor Porpoises	2007	Y3	1	16.1	15.4	1	74	(7.6)
All	Marine Mammals	2008	Y3	4	54.9	26.6	16	137	(7.4), (7.5)
	Harbor Porpoises	2008	Y3	3	41.2	23.1	9	117	(7.4), (7.5)
SI/M	Marine Mammals	2008	Y3	2	27.5	18.8	4	96	(7.4), (7.5)
	Harbor Porpoises	2008	Y3	2	27.5	18.8	4	96	(7.4), (7.5)

8. Analysis of Factors Affecting Take

The following variables and factors have been investigated in terms of a possible association with the take of birds or mammals, where a variable is something that was measured and a factor represents different conditions. For example, the air temperature is a measured variable and the sampling region is a factor at four levels (Y1, Y2, Y3 and Y4). The abbreviated names shown below are used for the remainder of this section of the report. In some cases there were missing data values. These were handled in different ways for different variables, as explained below.

Effort — A variable for the observed fishing effort involved in a single haul. This is calculated as (soak and haul duration in minutes/1440) x (% of the haul observed for the net/100). This is related to the fishing effort calculation described Section 4 for a full trip. The first factor takes into account the soak and haul duration in minutes as a fraction of the total number of minutes in a day (24 x 60 =1440), while the second factor takes into account the fact that in some cases observers were only present for a part of the time when a haul took place.

Region — A factor for the fishing region as defined in Section 3: Y1, the Alsek River area, Y2, the Situk area, Y3, the Yakutat Bay area, and Y4, the Kaliakh River and Tsiu River area.

Day — A variable for the observation day number in the fishing season, with June 1 as day 1. In 2007 the maximum value for Day was 131, while in 2008 the maximum was 129.

MTCode — A factor that represents the time of day half way between the start of the soak and the end of the haul, from 0 to 24 hours. Because values close to 0 and 24 represent similar mid-fishing times the variable was classified for analysis purposes into the four classes: (1) midnight to 6am, (2) 6am to midday, (3) midday to 6pm, and (4) 6pm to midnight.

Depth — A variable for the average of the depth (fathoms) at the start and end of the haul. The depths were not recorded for about 6% of hauls in 2007 and about 3% in 2008. The missing values in a year were replaced by the average depth recorded of all observed hauls in that year (2.26 fathoms in 2007 and 1.78 fathoms in 2008).

NVRank — A factor for the net view ranking: (1) clear view, (2) at least 1/3 view, (3) no underwater view, (4) distance/glare/obstruction, (5) other.

FzCode — A factor for the fishing zone code: (1) open water, (2) inside large bay, (3) inside sheltered bay, (4) river, (5) channel or canal (6) river mouth/estuary, (7) river mouth/open water, and (8), other.

TdCode A factor for the tide code: (1) ebb tide, (2) flood tide, (3) high slack, (4) low slack, and (5) other. There were about 2% of codes missing in 2007 that were replaced by 0. There were no missing values in 2008.

LdCode A factor for the land code: (1) mainland shoreline, (2) peninsula or island (3) sand bar, (4) rocky reef, (5) submerged land, (6) not set from land), and (7) other.

AirTemp A variable for the air temperature (°C). The air temperature was not recorded for about 2% of the hauls in 2007 and 2008. These missing values were replaced by the temperature measured at about the same time of day on the same trip, if possible. Otherwise the temperature measured in the same sampling region on another trip on the same day was used. In a few cases the temperature in the same region at about the same time of day was used but a few days earlier or later.

WtrTemp A variable for the water temperature (°C). The water temperature was not recorded for about 3% of the hauls in 2007 and about 4% of the hauls in 2008. These missing values were replaced by the temperature measured at about the same time of day on the same trip, if possible. Otherwise the temperature measured in the same sampling region on another trip on the same day was used. In a few cases the temperature in the same region at about the same time of day was used but a few days earlier or later, while in a few other cases the air temperature was used.

HSCode A factor for the hook shape code: (1) none, (2) V-shaped, (3) arrowhead, and (4) other.

MshSz A variable for the average of the minimum and maximum net mesh size (inches), which were usually the same. There were about 4% of values missing in 2007 and about 7% missing in 2008. If only one value was missing then the available value was used. Otherwise missing mesh sizes were replaced with the average recorded size for the year (5.38" in 2007 and 5.62" in 2008). There were three hauls where the maximum mesh size was recorded by observers as 1" while the minimum mesh size was stated to be larger than this. In these cases the upper mesh size was treated as missing for the graphs and analyzes considered here.

NMCode A factor for the net material code: (1) monofilament nylon, (2) multifilament nylon, (3) six strand mono, (4) multi-strand-mono, and (5) other. Net material (1) was recorded as used by some permit holders, although in fact it is illegal. The evidence suggests that this material was probably not used but sometimes recorded by mistake when permit holders were not sure what net material they were using. For this reason all codes of (1) have been re-coded as (5) because the true net material is unknown.

NCCode A factor for the net color code: (1) unknown, (2) clear, (3) white, (4) gray, (5) green, (6) blue, (7) yellow, (8) tan/brown, (9) combination, (10) clear green or blue-green, (11) clear green, tan, blue, green or gray, and (12) other.

It important when considering any effects that these variables and factors may have on the takes of mammals and birds to allow for potential confounding between these factors and regional differences in take rates. This is because the variables and factors have different distributions in the four fishing regions Y1 to Y4 (as shown in Table 8.1), but there may also be differences between regions because the abundance of mammals and birds is not the same in all regions. This is an issue when considering the Yakutat observer data because all of the marine mammal takes and most of the bird takes occurred in Y3 (the Yakutat Bay area). There is therefore uncertainty about the extent to which this is due to the fishing methods used in this region rather than because there were more marine mammals and birds in that region than there were elsewhere.

Graphical Analysis

Data on the above variables and factors are available for 1211 hauls in 2007 and 1119 hauls in 2008. For these hauls Figure 8.1 shows the take numbers for marine mammals plotted against the values for the variables and the factor levels. Thus each point on the graph represents one haul, where the take was zero, one or two mammals. Figure 8.2 is similar but is for all birds, with the take ranging from zero to three birds taken on one haul. Figures 8.3 and 8.4 are similar again, but are for harbor porpoises (four of the six marine mammal takes) and murrelets (17 of the 35 bird takes). In all of the plots the plotted points have been jiggered slightly in the vertical direction to show the distributions more clearly.

When examining the plots in Figures 8.1 to 8.4 it should be kept in mind that take only occurred for a small fraction of hauls, and that an apparent relationship between a variable and take may really be due to many hauls having taken place when a variable was within a small range of values or a factor was at one particular level. In that case the probability of take may have been the same for all values of the variable or factor level, but still most of the take occurred with the variable within the small range or the factor at the one level. For example, considering the plot of mammal takes against the depth in Figure 8.1, it can be seen that all of the take occurred for low water depths, probably because most fishing took place with low water depths.

Table 8.1 Comparisons between the distributions of variables and codes for hauls in the different sampling regions Y1 to Y4. For example, the mean fishing effort observed per haul in region Y2 was 0.08, while it was 0.21 in region Y3. Similarly, the percentage of hauls with MTcode 1 was 3.3% in region Y2 and 17.8% in region Y1. This table shows that there is considerable variation among the regions in the variables and factors that describe the fishing conditions.

Means and Standard Deviations of Quantitative Variables

		Fishing Effort		Day in Season		Depth (Fathoms)		Air Temp (°C)	
Region	N	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	377	0.18	0.17	46.1	30.5	1.5	1.4	12.5	4.1
2	1281	0.08	0.12	69.9	34.0	1.5	1.0	12.6	2.9
3	559	0.21	0.21	47.0	29.3	4.0	4.3	12.6	2.7
4	113	0.10	0.12	103.6	14.9	0.5	0.5	11.3	2.9

		Water Temp (°C)		Mesh Size (inches)	
Region	N	Mean	SD	Mean	SD
1	377	6.9	4.2	5.6	0.3
2	1281	12.5	2.3	5.5	0.4
3	559	12.3	2.3	5.3	0.3
4	113	11.5	3.0	6.0	0.5

Distributions of Codes (%)

		Mean Time Code (MTCode)				Net View Rank (NVRank)				
Region	N	1	2	3	4	1	2	3	4	5
1	377	17.8	23.6	45.9	12.7	0.5	3.4	58.1	37.9	0.0
2	1281	3.3	42.6	44.3	9.8	1.4	5.2	65.4	19.4	8.6
3	559	16.1	34.7	39.2	10.0	5.2	34.7	48.8	7.0	4.3
4	113	5.3	32.7	52.2	9.7	3.5	35.4	34.5	11.5	15.0

		Fishing Zone Code (FZCode)							
Region	N	1	2	3	4	5	6	7	8
1	377	0.5	5.8	0.0	82.0	0.0	0.0	10.1	1.6
2	1281	0.3	0.2	0.9	48.6	1.1	34.7	11.2	3.0
3	559	15.0	51.2	15.0	18.8	0.0	0.0	0.0	0.0
4	113	0.0	0.0	0.0	97.3	0.0	0.0	2.7	0.0

		Tide Code (TdCode)						Hook Shape Code (HSCode)			
Region	N	0	1	2	3	4	5	1	2	3	4
1	377	0.0	24.4	43.0	5.3	8.0	19.4	100.0	0.0	0.0	0.0
2	1281	0.0	30.7	50.7	5.9	12.6	0.2	100.0	0.0	0.0	0.0
3	559	0.0	26.7	37.6	14.7	15.9	5.2	96.8	2.1	0.4	0.7
4	113	18.6	31.9	37.2	8.0	4.4	0.0	100.0	0.0	0.0	0.0

Table 8.1, Continued

		Net Material Code (NMCode)			
Region	N	2	3	4	5
1	377	14.1	17.8	32.9	35.3
2	1281	41.6	12.1	29.3	17.0
3	559	51.2	18.6	16.1	14.1
4	113	70.8	0.0	29.2	0.0

		Net Color Code (NCCode)											
Region		1	2	3	4	5	6	7	8	9	10	11	12
1	377	0.0	0.0	12.7	9.5	39.3	6.9	0.0	0.0	0.0	18.3	3.4	9.8
2	1281	0.3	0.2	0.0	1.2	51.0	12.3	1.7	11.6	0.3	7.8	1.9	11.7
3	559	0.0	0.0	0.5	2.5	38.6	16.1	0.0	0.4	20.8	9.3	0.2	11.6
4	113	0.0	3.5	15.0	0.0	47.8	0.0	0.0	26.5	0.9	4.4	0.0	1.8

Figure 8.1 shows that the six marine mammal takes (four harbor porpoises, one harbor seal, and one Steller sea lion) occurred for hauls with moderate effort, in sampling region Y3, on days in the early to middle part of the fishing season, with set and haul mid-times at various times of the day (MTCode), with fairly low fishing depths, with good to fair net visibility ranks (NVRank), inside large or sheltered bays (FZCode), with a range of tide conditions (TdCode), on the mainland shoreline or not set from land (LdCode), with narrow ranges for the air and water temperatures, with none or V-shape hooks (HSCode), with a narrow range of mesh sizes, with a range of net materials (NMCode), and a range of net colors (NCCode). The take of two was for the harbor seal and Steller sea lion, which were both taken during the same set and haul.

Figure 8.2 shows that the 35 bird takes occurred with moderate effort, in all sampling regions except Y4, throughout the fishing season, forsets and hauls with mid-times at all times of the day except the evening (MTCode), with low to moderate fishing depths, with all except the clearest net visibility (NVRank), in most fishing zones (FZCode), in most tide conditions (TdCode), in a range of fishing locations (LdCode), at low to moderate air and water temperatures, with no fishing hooks (HSCode), with moderate mesh sizes, and with a range of net materials (NMCode) and colors (NCCode).

Figure 8.3 shows the results for the four harbor porpoise takes. The graphs are generally similar to those for all mammals because there were only two other marine mammal takes. The harbor porpoise takes occurred with moderate effort, only in sampling region Y3, in the early to middle part of the fishing season, with set and haul mid-times in the early morning and early afternoon (MTCode), at low fishing depths, with fair observer visibility (NVRank), inside large or sheltered bays (FzCode), at a range of tide conditions (TdCode), on the mainland shoreline or not set from land (LdCode), with narrow ranges of air and water temperatures, only on nets with no hooks (HSCode), with a narrow range of mesh sizes, and with a range of net materials (NMCode) and colors (NCCode).

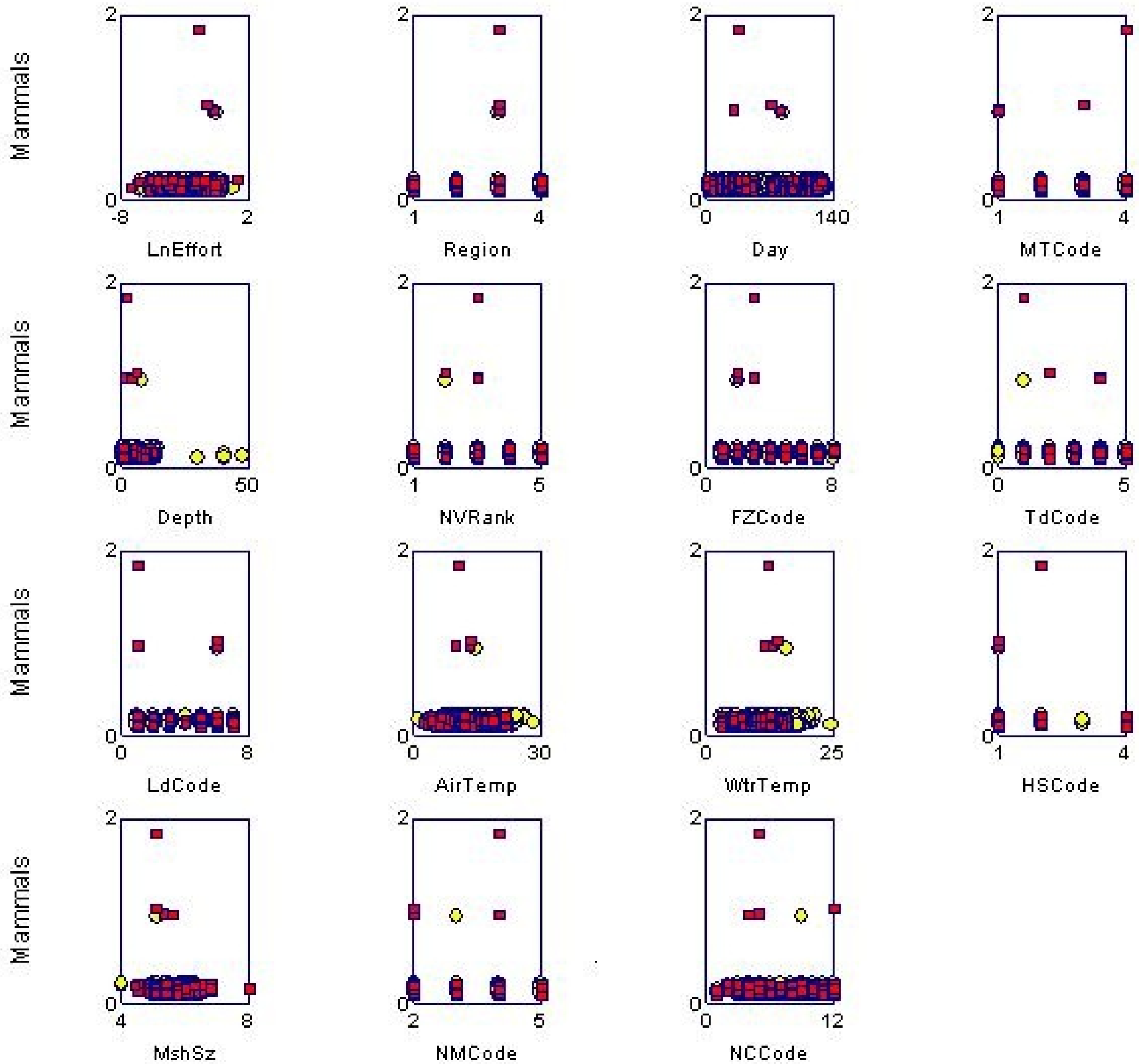

Figure 8.1 Take numbers in hauls for all mammals plotted against 15 variables describing the conditions for the haul involved, with different symbols for 2007 (●) and 2008 (■). The variables are defined in the text. There were six marine mammals caught in nets altogether, including one Steller sea lion observed to interact with a net while the observer was off watch. The sea lion result is included in these plots. The plotted points have been jiggered vertically. The natural logarithm of fishing effort is plotted rather than the effort because of the wide range of efforts associated with individual hauls.

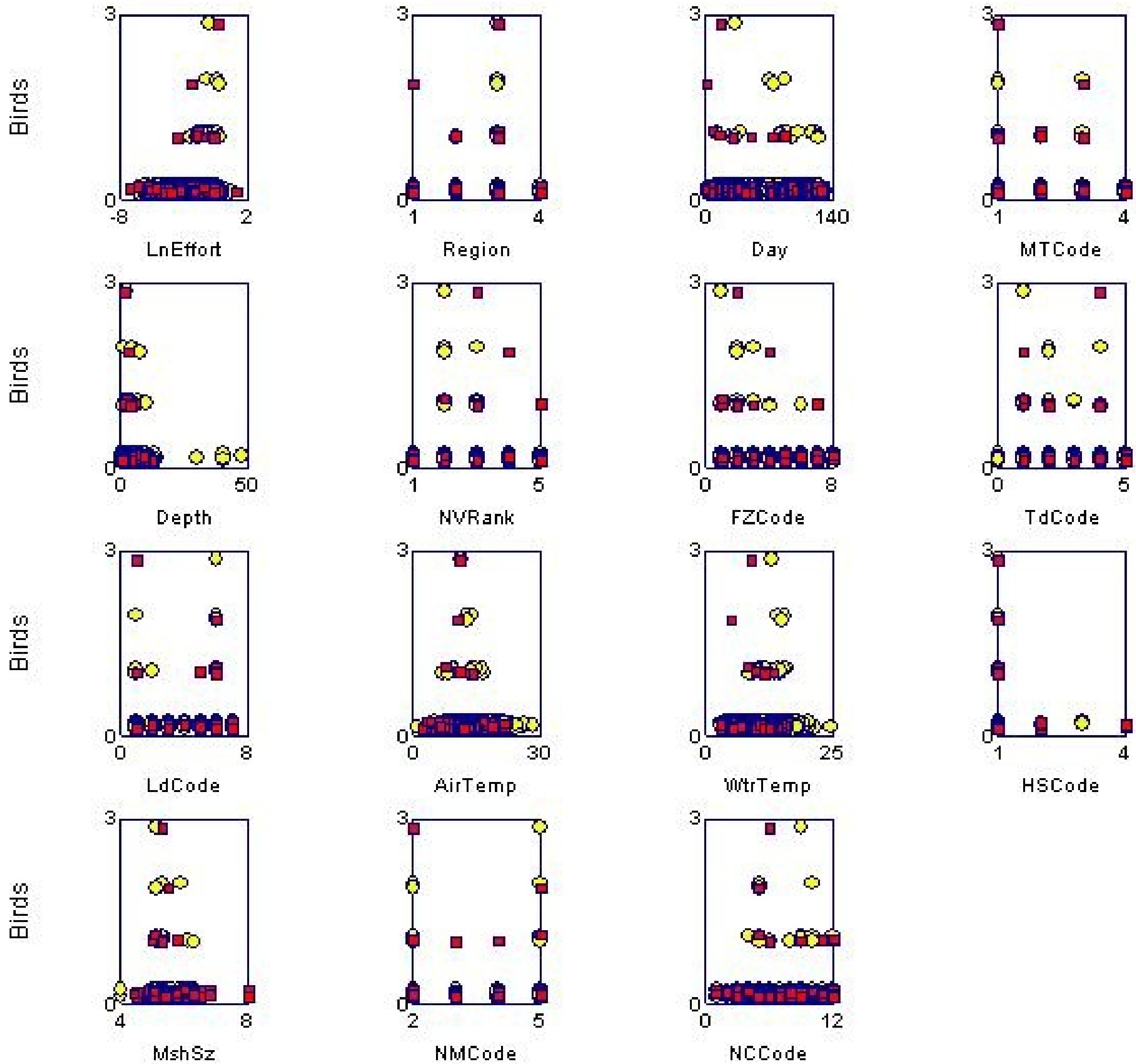

Figure 8.2 Take numbers in hauls for all birds plotted against 15 variables describing the conditions for the haul involved, with different symbols for 2007 (●) and 2008 (■). The variables are defined in the text. There were 35 birds caught in nets altogether. The plotted points have been jiggered vertically. The natural logarithm of fishing effort is plotted rather than the effort because of the wide range of efforts associated with individual hauls.

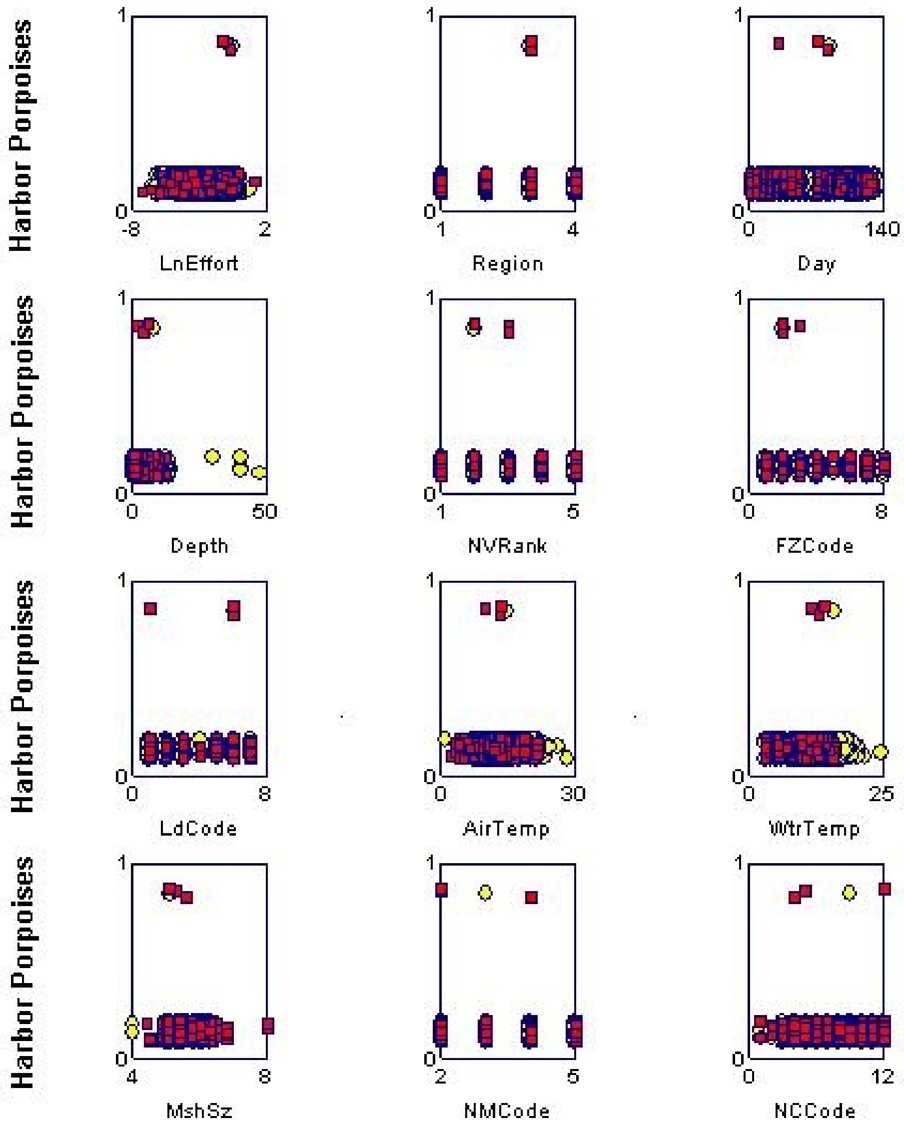

Figure 8.3 Take numbers in hauls for harbor porpoises plotted against 15 variables describing the conditions for the haul involved, with different symbols for 2007 (●) and 2008 (■). The variables are defined in the text. There were four harbor porpoises caught in nets altogether. The plotted points have been jiggered vertically. The natural logarithm of fishing effort is plotted rather than the effort because of the wide range of efforts associated with individual hauls.

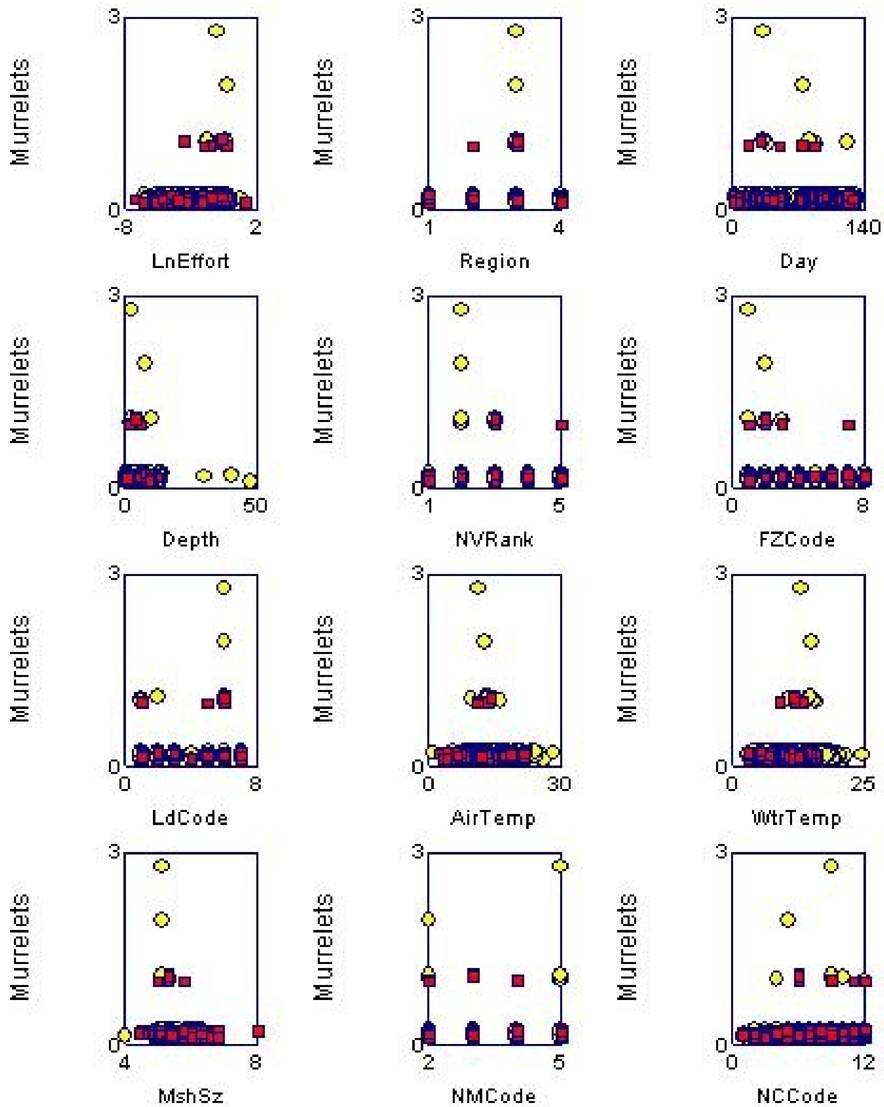

Figure 8.4 Take numbers in hauls for murrelets plotted against 15 variables describing the conditions for the haul involved, with different symbols for 2007 (●) and 2008 (■). The variables are defined in the text. There were 17 murrelets caught in nets altogether, one with an unknown species and the others marbled murrelets. The plotted points have been jiggered vertically. The natural logarithm of fishing effort is plotted rather than the effort because of the wide range of efforts associated with individual hauls.

Finally, Figure 8.4 shows the results for 17 murrelets takes (15 marbled murrelets, one Kittlitz's murrelet and one murrelet with an unknown species), where these were about half of the total bird takes. The takes occurred for hauls with moderate fishing effort, in sampling regions Y2 and Y4, on days throughout the fishing season, on set and haul mid-times during the morning and afternoon (MTCode), at low to moderate fishing depths, with fair to poor net visibility (NVRank), in a range of fishing locations (FZCode), and a range of tide conditions (TdCode), on a range of land conditions (LdCode), with narrow ranges for air and water temperatures, with no net hooks (HSCode), with a narrow range of mesh sizes, and with a range of net materials (NMCode) and net colors (NCCode).

Randomization Tests

The Figures 8.1 to 8.4 suggest that the observed mammal and bird takes may be associated with various fishing conditions, but as noted above, the apparent associations need further consideration and may just be due to chance. This was examined first using randomization tests (Manly, 2006b, Chapter 1). Randomization tests were used for two reasons. First, the standard theory for tests using a parametric method like logistic regression is questionable when most observations have a zero take. Second, some of the factors to be examined have more levels than the number of hauls with takes, which means that a standard parametric test cannot be carried out. For example the net color code (NCCode) has 12 levels but there were only five hauls with marine mammal takes.

Logistic regression cannot be used with the data on mammal takes because of the small number of hauls with takes. However, there are many more hauls with bird takes. Logistic regression analyses of the bird take data is therefore considered after the randomization test results.

With the variables such as the air temperature the test statistics used were the absolute value of the difference between mean of the variable for the hauls with takes minus the mean for the hauls without takes, and also the absolute value of the standard deviation for the hauls with takes minus the standard deviation for the hauls without takes, i.e.,

$$T_1 = \text{Abs}(\text{Mean of hauls with takes - Mean of hauls without takes}), \qquad (8.1)$$

and

$$T_2 = \text{Abs}(\text{SD of hauls with takes - SD of hauls without takes}). \qquad (8.2)$$

The second statistic is included with the idea that the hauls with takes may show more or less variation in the variable than the hauls without takes.

For the factors a test statistic is needed that compares the distribution over the factor levels for hauls with takes with the distribution for hauls without takes. For this purpose the statistic

$$T_3 = \sum |P_{1i} - P_{2i}|/2$$

was chosen where P_{1i} is the proportion of hauls with takes that have factor level i, and P_{2i} is the proportion of hauls without takes that have factor level i, with the summation being over all of the possible factor levels. The value of this statistic is zero if the factor level proportions are the same for hauls with and without takes, and takes a maximum value of one if there is no overlap between the codes with and without takes (i.e., the codes that occur for the hauls with take do not occur for the hauls without take). Thus T_3 is a general measure of the similarity of the factor level proportions for the hauls with an without takes.

The randomization tests carried out compare the values of the statistics T_1, T_2 and T_3 for the real data with the distributions for these statistics generated by randomly allocating the observed takes to all of the hauls. This allows the estimation of the probability of obtaining a test statistic as large as an observed statistic when the probability of take occurring is completely unrelated to variables and factors being considered.

For example, consider the test for whether the probability of a marine mammal take on a haul is related to the fishing effort in hours. In this case there are five hauls in 2007 and 2008 with marine mammal takes (four hauls with single harbor porpoise takes, and one haul with a harbor seal and a Steller sea lion take). The mean and standard deviation of the effort for these five hauls are 0.37 and 0.17, respectively. There are 2325 hauls without marine mammal takes, and for these the mean and standard deviation of effort are 0.13 and 0.16, respectively. Hence the test statistics are $T_1 = 0.24$ and $T_2 = 0.01$. These statistics are compared with the distributions obtained when five hauls are randomly chosen from the full set of 2330 hauls to be the ones with the marine mammal takes, in order to estimate the probability of getting a value of 0.24 or more for T_1 by chance, and the probability of getting a value of 0.01 or more for T_2 by chance.

Test Results for All Marine Mammals

All randomization tests used 5,000 randomized sets of data. For mammals the results of the tests are shown in Table 8.2 when hauls for all of the sampling regions Y1 to Y4 were included in the randomization. The significant effects are shown to be (a) there was significantly high fishing effort on hauls with mammal takes, (b) it is very unlikely that all takes would have occurred in region Y3 (the Yakutat Bay area) by chance alone, (c) there were more takes than expected when the mid-time for the set and haul was from midnight to 6am (possibly because the nets were in water overnight), (d) takes tended to occur at deeper depths than for most hauls, (e) all takes were in large or sheltered bays, and (f) one of the five hauls with takes was with a net with an uncommon V-shaped hook.

Table 8.2 Summary of the randomization test results when the five hauls with marine mammal takes are compared with the other 2325 hauls from sampling in regions Y1 to Y4. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.64	0.208	No significant year effect
Effort	Mean fishing effort	T1	0.24	0.006	Significantly higher mean effort on hauls with take
	SD of fishing effort	T2	0.01	0.973	Not significant
Region	Sampling region	T3	0.76	0.001	All takes in region Y3 highly unlikely to have occurred by chance
Day	Mean day in fishing season	T1	1.99	0.900	Not significant
	SD of day in season	T2	9.56	0.298	Not significant
MTCode	Mid-time of set and haul	T3	0.61	0.013	More takes than expected from midnight to 6am
Depth	Mean depth	T1	2.33	0.027	Takes tended to occur at deeper depths
	SD of depth	T2	14.00	0.980	Not significant
NVRank	Net visibility rank	T3	0.28	0.456	Not significant
FZCode	Fishing zone code	T3	0.83	0.000	All takes were in large bays or sheltered bays
TdCode	Tide code	T3	0.39	0.334	Not significant
LdCode	Land code	T3	0.40	0.238	Not significant
AirTemp	Mean air temperature	T1	0.24	0.862	Not significant
	SD of air temperature	T2	1.08	0.458	Not significant
WtrTemp	Mean water temperature	T1	1.78	0.240	Not significant
	SD of water temperature	T2	1.80	0.168	Not significant
HSCode	Hook shape code	T3	0.20	0.037	There was one take with a very uncommon V-shaped hook
MshSz	Mean net mesh size	T1	0.26	0.191	Not significant
	SD of net mesh size	T2	0.20	0.197	Not significant
NMCode	Net material code	T3	0.19	0.858	Not significant
NCCode	Net color code	T3	0.41	0.581	Not significant

Because all of the marine mammal takes occurred in region Y3 the randomization tests were repeated just using the haul data from this region. This then shows whether the significant effects are still significant for hauls made in this region. Table 8.3 shows the results obtained when this restriction is applied. The mean fishing effort is still higher for the hauls with takes, but the test result is no longer significant at the 5% level. The other significant effects shown in Table 8.2 are also no longer significant except for the MTCode. The test for this effect is still indicating that there were more marine mammal takes than expected with hauls where the middle of the set and haul time was between midnight and 6am.

Table 8.3 Summary of the randomization test results when the five hauls with marine mammal takes are compared with the other 554 hauls from sampling in regions Y3 only. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.34	0.187	No significant year effect
Effort	Mean fishing effort	T1	0.16	0.065	Higher mean effort on hauls with take but not quite significant
	SD of fishing effort	T2	0.04	0.688	Not significant
Region	Sampling region	T3	0.00	1.000	All hauls now in region Y3
Day	Mean day in fishing season	T1	13.29	0.322	Not significant
	SD of day in season	T2	4.04	0.744	Not significant
MTCode	Mid-time of set and haul	T3	0.54	0.042	More takes than expected from midnight to 6am
Depth	Mean depth	T1	0.32	0.827	No longer significant
	SD of depth	T2	14.00	0.660	Not significant
NVRank	Net visibility rank	T3	0.17	1.000	Not significant
FZCode	Fishing zone code	T3	0.34	0.338	No longer significant
TdCode	Tide code	T3	0.38	0.396	Not significant
LdCode	Land code	T3	0.09	1.000	Not significant
AirTemp	Mean air temperature	T1	0.33	0.769	Not significant
	SD of air temperature	T2	0.65	0.614	Not significant
WtrTemp	Mean water temperature	T1	0.97	0.347	Not significant
	SD of water temperature	T2	0.73	0.408	Not significant
HSCode	Hook shape code	T3	0.18	0.153	No longer significant
MshSz	Mean net mesh size	T1	0.03	0.842	Not significant
	SD of net mesh size	T2	0.09	0.933	Not significant
NMCode	Net material code	T3	0.26	0.711	Not significant
NCCode	Net color code	T3	0.28	0.776	Not significant

Test Results for Harbor Porpoises

Four of the five hauls with marine mammal takes had takes of single harbor porpoises. The randomization tests were carried out to compare the conditions for these four hauls with the conditions in the other hauls. This was done first with the four hauls compared with the other 2326 hauls for sampling in all areas, and then with the four hauls compared with the other 555 hauls that took place in sampling region Y3.

Table 8.4 shows the randomization test results for the hauls with harbor porpoise takes compared with the other hauls in all sampling areas. The significant effects are (a) there was significantly high fishing effort on hauls with takes, (b) it is unlikely that all takes would have occurred in region Y3 (the Yakutat Bay area) by chance alone, (c) there were more takes than expected when the mid-time for set and haul was from midnight to 6am, (d) takes tended to occur at deeper depths than for most hauls, and (e) all takes were in large or sheltered bays. These are essentially the same as the results for all marine mammals except that the result is now not significant for the hook shape code because the unusual

V-shaped hook occurred for the haul with marine mammal takes that were not harbor porpoises.

Table 8.4 Summary of the randomization test results when the four hauls with harbor porpoise takes are compared with the other 2326 hauls from sampling in regions Y1 to Y4. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.27	0.357	No significant year effect
Effort	Mean fishing effort	T1	0.29	0.005	Significantly higher mean effort on hauls with take
	SD of fishing effort	T2	0.03	0.843	Not significant
Region	Sampling region	T3	0.76	0.005	All takes in region Y3 unlikely to have occurred by chance
Day	Mean day in fishing season	T1	4.07	0.818	Not significant
	SD of day in season	T2	10.16	0.360	Not significant
MTCode	Mid-time of haul	T3	0.66	0.004	More takes than expected from midnight to 6am
Depth	Mean depth	T1	2.92	0.021	Takes tended to occur at deeper depths
	SD of depth	T2	0.07	0.983	Not significant
NVRank	Net visibility rank	T3	0.37	0.369	Not significant
FZCode	Fishing zone code	T3	0.83	0.003	All takes were in large bays or sheltered bays
TdCode	Tide code	T3	0.38	0.456	Not significant
LdCode	Land code	T3	0.54	0.074	Not significant
AirTemp	Mean air temperature	T1	0.18	0.901	Not significant
	SD of air temperature	T2	1.03	0.540	Not significant
WtrTemp	Mean water temperature	T1	2.04	0.222	Not significant
	SD of water temperature	T2	1.69	0.281	Not significant
HSCode	Hook shape code	T3	0.01	1.000	Not significant
MshSz	Mean net mesh size	T1	0.22	0.337	Not significant
	SD of net mesh size	T2	0.18	0.303	Not significant
NMCode	Net material code	T3	0.20	0.795	Not significant
NCCode	Net color code	T3	0.56	0.185	Not significant

Table 8.5 shows the results of the randomization tests using just the hauls in sampling region Y3. The mean fishing effort is still significantly higher for the hauls with take than for the other hauls, but no other effects are significant at the 5% level. Apparently, therefore, the other significant effects shown in Table 8.2 were due to differences between the haul conditions in region Y3 and the conditions in the other regions.

Table 8.5 Summary of the randomization test results when the four hauls with harbor porpoise takes are compared with the other 555 hauls from sampling in regions Y3 only. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.29	0.334	No significant year effect
Effort	Mean fishing effort	T1	0.22	0.031	Significantly higher mean effort on hauls with take
	SD of fishing effort	T2	0.08	0.476	Not significant
Region	Sampling region	T3	0.00	1.000	All hauls now in region Y3
Day	Mean day in fishing season	T1	19.36	0.197	Not significant
	SD of day in season	T2	4.62	0.744	Not significant
MTCode	Mid-time of haul	T3	0.59	0.059	No longer significant
Depth	Mean depth	T1	0.91	0.571	No longer significant
	SD of depth	T2	1.70	0.664	Not significant
NVRank	Net visibility rank	T3	0.17	1.000	Not significant
FZCode	Fishing zone code	T3	0.34	0.537	No longer significant
TdCode	Tide code	T3	0.34	0.601	Not significant
LdCode	Land code	T3	0.16	1.000	Not significant
AirTemp	Mean air temperature	T1	0.09	0.946	Not significant
	SD of air temperature	T2	0.61	0.697	Not significant
WtrTemp	Mean water temperature	T1	1.24	0.275	Not significant
	SD of water temperature	T2	0.62	0.552	Not significant
HSCode	Hook shape code	T3	0.03	1.000	Not significant
MshSz	Mean net mesh size	T1	0.01	0.929	Not significant
	SD of net mesh size	T2	0.07	0.954	Not significant
NMCode	Net material code	T3	0.15	0.748	Not significant
NCCode	Net color code	T3	0.40	0.624	Not significant

Test Results for All Birds

Table 8.6 shows the results of the randomization tests for takes of all birds in all of the sampling regions. The significant effects in this case are (a) the mean fishing effort is significantly higher on hauls with bird takes than for hauls without takes, (b) there are more hauls with takes than expected in sampling region Y3, (c) there are more takes than expected for hauls where the mid-time of the set and haul is between midnight and 6am, (d) hauls with takes had a mean depth that was deeper than for the hauls without takes, (e) there were more hauls with takes than expected with a net visibility rank of 2 (at least a 1/3 view), (f) there were more hauls with takes than expected in open water, large bays and sheltered bays, (g) there were more hauls with takes than expected when the nets were not set from land, and (h) there were more hauls with takes than expected with monofilament nylon, multifilament nylon and the other category of net material.

Table 8.6 Summary of the randomization test results when the 27 hauls with bird takes are compared with the other 2303 hauls from sampling in regions Y1 to Y4. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.15	0.176	No significant year effect
Effort	Mean fishing effort	T1	0.21	0.000	Significantly higher mean effort on hauls with take
	SD of fishing effort	T2	0.07	0.140	Not significant
Region	Sampling region	T3	0.58	0.000	More takes than expected in sampling region Y3
Day	Mean day in fishing season	T1	2.43	0.722	Not significant
	SD of day in season	T2	5.69	0.062	Not significant
MTCode	Mid-time of haul	T3	0.32	0.001	More takes than expected from midnight to 6am
Depth	Mean depth	T1	1.66	0.015	Takes tended to occur at deeper depths
	SD of depth	T2	14.00	0.836	Not significant
NVRank	Net visibility rank	T3	0.24	0.034	More takes than expected with code 2 (at least 1/3 view)
FZCode	Fishing zone code	T3	0.61	0.000	More takes than expected in open water, large bays and sheltered bays
TdCode	Tide code	T3	0.18	0.240	Not significant
LdCode	Land code	T3	0.40	0.000	More takes than expected when the nets were not set from land
AirTemp	Mean air temperature	T1	0.60	0.301	Not significant
	SD of air temperature	T2	0.50	0.407	Not significant
WtrTemp	Mean water temperature	T1	0.62	0.339	Not significant
	SD of water temperature	T2	0.80	0.110	Not significant
HSCode	Hook shape code	T3	0.01	1.000	Not significant
MshSz	Mean net mesh size	T1	0.13	0.122	Not significant
	SD of net mesh size	T2	0.08	0.140	Not significant
NMCode	Net material code	T3	0.30	0.014	More take than expected with multifilament nylon and other net materials
NCCode	Net color code	T3	0.25	0.149	Not significant

Of the 27 hauls with bird takes there was one in sampling region Y1, four in sampling region Y2, 22 in sampling Y3, and none in sampling region Y4. Therefore the majority of these hauls with takes were in sampling region Y3 (the Yakutat Bay area). In fact, only 23% of all hauls were in region Y3, but 81% of the hauls with takes were in this region. For this reason it was appropriate to repeat the randomization tests but just with hauls from region Y3. This then involved comparing the conditions for the 22 hauls with bird takes in this region with the conditions for the other 537 hauls in the region.

The results of these randomization tests are shown in Table 8.7. The only significant results for the reduced data are for the mean fishing effort, which is higher for the hauls with takes than for those without takes, the average day for hauls with take was later in the fishing season than expected, with more variation than for the other hauls, and there were more hauls with takes than expected with a mid-time between midnight and 6am.

Table 8.7 Summary of the randomization test results when the 22 hauls with bird takes are compared with the other 537 hauls from sampling in regions Y3 only. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.15	0.199	No significant year effect
Effort	Mean fishing effort	T1	0.19	0.000	Significantly higher mean effort on hauls with take
	SD of fishing effort	T2	0.02	0.654	Not significant
Region	Sampling region	T3	0.00	1.000	All hauls now in region Y3
Day	Mean day in fishing season	T1	13.22	0.036	Takes are significantly late in the fishing season
	SD of day in season	T2	8.73	0.051	Not quite significant, but more variation for hauls with takes
MTCode	Mid-time of haul	T3	0.35	0.002	More takes than expected from midnight to 6am
Depth	Mean depth	T1	0.07	0.928	No longer significant
	SD of depth	T2	14.00	0.361	Not significant
NVRank	Net visibility rank	T3	0.17	0.304	No longer significant
FZCode	Fishing zone code	T3	0.20	0.189	No longer significant
TdCode	Tide code	T3	0.17	0.420	Not significant
LdCode	Land code	T3	0.12	0.539	No longer significant
AirTemp	Mean air temperature	T1	0.40	0.477	Not significant
	SD of air temperature	T2	0.38	0.562	Not significant
WtrTemp	Mean water temperature	T1	0.38	0.468	Not significant
	SD of water temperature	T2	0.18	0.742	Not significant
HSCode	Hook shape code	T3	0.03	0.763	Not significant
MshSz	Mean net mesh size	T1	0.03	0.618	Not significant
	SD of net mesh size	T2	0.14	0.337	Not significant
NMCode	Net material code	T3	0.22	0.121	No longer significant
NCCode	Net color code	T3	0.16	0.724	Not significant

Test Results for Murrelets

There were 35 birds taken during fishing operations in 2007 and 2008. Of these, 17 were murrelets (15 marbled murrelets, one Kittlitz's murrelet and one murrelet with the species unknown). Given this relatively large number of murrelets it is interesting to see the results of randomization tests for the takes of murrelets only.

Table 8.8 shows the results for the hauls in all sampling regions. The significant effects are (a) there was higher mean effort on the hauls with takes than with the other hauls, (b) there were more hauls with takes than expected in sampling region Y3, (c) there were more hauls with takes than expected with a haul and set mid-time between midnight and 6am, (d) hauls with takes had a higher mean depth than hauls without takes, (e) there were more hauls with takes than expected with a net visibility of at least a 1/3 view, (f) there were more hauls with takes than expected in open water and large or sheltered bays,

(g) there were more hauls with takes than expected when the net was not set from land, (h) the standard deviation of the water temperature was lower than expected for hauls with takes, the mean and standard deviation of the net mesh size were lower than expected for hauls with takes, and (i) there were more hauls with takes than expected for orange nets.

Table 8.8 Summary of the randomization test results when the 14 hauls with murrelet takes are compared with the other 2316 hauls from sampling in regions Y1 to Y4. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.05	0.786	No significant year effect
Effort	Mean fishing effort	T1	0.22	0.001	Significantly higher mean effort on hauls with take
	SD of fishing effort	T2	0.07	0.284	Not significant
Region	Sampling region	T3	0.69	0.000	More takes than expected in sampling region Y3
Day	Mean day in fishing season	T1	2.20	0.824	Not significant
	SD of day in season	T2	3.74	0.408	Not significant
MTCode	Mid-time of haul	T3	0.34	0.023	More takes than expected from midnight to 6am
Depth	Mean depth	T1	2.09	0.026	Takes tended to occur at deeper depths
	SD of depth	T2	14.00	0.997	Not significant
NVRank	Net visibility rank	T3	0.30	0.061	More takes than expected with code 2 (at least 1/3 view) but not quite significant
FZCode	Fishing zone code	T3	0.72	0.000	More takes than expected in open water, large bays and sheltered bays
TdCode	Tide code	T3	0.23	0.337	Not significant
LdCode	Land code	T3	0.41	0.006	More takes than expected when the nets were not set from land
AirTemp	Mean air temperature	T1	0.41	0.615	Not significant
	SD of air temperature	T2	1.35	0.065	The SD for hauls with takes is lower than expected, but not quite significant
WtrTemp	Mean water temperature	T1	1.53	0.094	Not significant
	SD of water temperature	T2	1.42	0.048	The SD for hauls with takes is lower than expected
HSCode	Hook shape code	T3	0.01	1.000	Not significant
MshSz	Mean net mesh size	T1	0.26	0.023	Mean mesh size lower than expected
	SD of net mesh size	T2	0.23	0.020	SD of mesh size lower than expected
NMCode	Net material code	T3	0.20	0.316	Not significant
NCCode	Net color code	T3	0.54	0.002	More takes than expected with orange nets

There were 14 hauls with murrelet takes. Of these, 13 were in the sampling region Y3. As before, it is therefore of interest to run the randomization tests just using the hauls made in region Y3. Table 8.9 shows the results obtained when this was done. Most of the significant effects shown in Table 8.8 are no longer significant. All that remains significant is the higher mean effort for hauls with murrelet takes, and the higher than expected number of hauls with takes with a set and haul mid-time between midnight and 6am.

Table 8.9 Summary of the randomization test results when the 13 hauls with murrelet takes are compared with the other 546 hauls from sampling in regions Y3 only. There were 5,000 randomizations used.

Variable or Factor	Description	Test Statistic	Value	P-value	Comment
Year	Year difference	T3	0.08	0.788	No significant year effect
Effort	Mean fishing effort	T1	0.16	0.008	Significantly higher mean effort on hauls with take
	SD of fishing effort	T2	0.03	0.619	Not significant
Region	Sampling region	T3	0.00	1.000	All hauls now in region Y3
Day	Mean day in fishing season	T1	11.15	0.180	Not significant
	SD of day in season	T2	2.13	0.731	Not significant
MTCode	Mid-time of haul	T3	0.38	0.018	More takes than expected from midnight to 6am
Depth	Mean depth	T1	0.27	0.784	No longer significant
	SD of depth	T2	14.00	0.562	Not significant
NVRank	Net visibility rank	T3	0.17	0.555	No longer significant
FZCode	Fishing zone code	T3	0.19	0.385	No longer significant
TdCode	Tide code	T3	0.21	0.497	Not significant
LdCode	Land code	T3	0.08	0.968	No longer significant
AirTemp	Mean air temperature	T1	0.47	0.527	Not significant
	SD of air temperature	T2	0.96	0.215	No longer nearly significant
WtrTemp	Mean water temperature	T1	0.82	0.204	Not significant
	SD of water temperature	T2	0.30	0.651	No longer significant
HSCode	Hook shape code	T3	0.03	1.000	Not significant
MshSz	Mean net mesh size	T1	0.07	0.390	No longer significant
	SD of net mesh size	T2	0.20	0.125	No longer significant
NMCode	Net material code	T3	0.17	0.527	Not significant
NCCode	Net color code	T3	0.34	0.102	No longer significant

Conclusions from the Randomization Tests

When hauls with marine mammal takes are compared with hauls without these takes over all sampling regions in the fishery then there are significant differences for six of the 16 effects considered according to the randomization tests. However, all of the marine mammal takes occurred in sampling region Y3, and if the randomization tests are restricted to hauls in this region then the only significant effect at the 5% level is that hauls with a mid-time for the set and haul between midnight and 6am had takes more often than expected. Therefore, the effects that were significant with all hauls but became insignificant with hauls in region Y3 only can be interpreted as due to the hauls in region Y3 tending to have different characteristics than hauls in the other sampling regions, as shown in Table 8.1. Also, the significance of the mid-time effect is due to three of the five hauls with takes ended in the morning after soaks that were overnight.

Four of the five hauls with marine mammal takes were of harbor porpoise takes. For these there were five significant effects from the randomization tests comparing these hauls with hauls from all of the sampling areas, but the only significant effect when the four hauls with takes were compared with hauls in sampling region Y3 was for the fishing effort. Therefore, again this can be interpreted as due to the hauls in sampling region Y3 tending to have different characteristics than the hauls in other regions. Also, the four hauls with takes were all first hauls of the day, with fishing durations from seven to 14 hours, which accounts for the significant result on the randomization test for the fishing effort variable.

There were 27 hauls with bird takes, with 22 of these in sampling region Y3. In this case the randomization tests comparing these hauls with hauls from all sampling regions resulted in eight results significant at the 5% level, with a very highly significant regional effect because most hauls with takes were in region Y3. This reduced to four significant or nearly significant results when the randomization tests were repeated using only takes from sampling region Y3, again presumably because the hauls in region Y3 tended to have different characteristics from the hauls in other regions. For the tests based on hauls in region Y3 only the significant effects were for the mean fishing effort (with higher takes associated with higher effort, which is as expected), takes were significantly late in the fishing season, and there were more hauls with takes than expected with a mid-time for the set and haul from midnight to 6am. Also, the standard deviation for the fishing day was nearly significantly large, indicating that the fishing day for hauls with takes was more variable than expected.

There were 14 hauls with murrelet takes (one Kittlitz's murrelet, 15 marbled murrelets, and one murrelet with an unknown species. The randomization tests comparing these hauls with hauls from all regions gives 11 significant effects and one nearly significant effect. However, 13 of these hauls were in sampling region Y3 and if the randomization tests are only carried out using hauls from this region then there are only two significant effects. These are for the mean fishing effort (with higher takes associated with higher effort, which is as expected), and there were more hauls with takes than expected with a mid-fishing time from midnight to 6am.

The region effect is very significant for the randomization tests using hauls from all sampling regions because all of the hauls with marine mammal takes and most of the hauls with bird takes occurred in sampling region Y3. Within this sampling region all of the hauls with marine mammal takes and most of the hauls with bird takes were in the ADF&G statistical area 183-10 (outside Ocean Cape, the main Yakutat Bay area, and the Yakutat Bay inner harbor). To some extent this is because most of the hauls in sampling region Y3 were in area 183-10. In 2007 there were 302 hauls in region Y3, with 252 of these in statistical area 183-10, while in 2008 there were 257 hauls in region Y3, with 176 of these in statistical area 183-10. However, for birds there is evidence that hauls were more likely to have takes in statistical area 183-10 than in the other parts of sampling region Y3.

Table 8.10 shows the number of hauls with takes and without takes for statistical area 183-10, and for the other areas in region Y3. For all marine mammals, harbor porpoises, all birds and murrelets there are more hauls with takes than expected in statistical area 183-10, but it is only for all birds that the effect is significant at the 5% level.

Table 8.10 The number of hauls with and without takes of marine mammals, harbor porpoises, birds and murrelets in ADF&G statistical area 183-10, and in the other statistical areas in sampling region Y3. For example, there were 428 hauls in statistical are 183-10, of which five had mammal takes and 423 had no mammal takes, while there were 131 hauls in other statistical areas in sampling region Y3 with no mammal takes. The chi-squared values are from standard 2 x 2 contingency table tests. P-value 1 is from the chi-squared distribution with one degree of freedom, and P-value 2 is from a randomization test with 5,000 random allocations of the takes to the hauls. Randomization tests were used because the small number of hauls with takes makes the usual chi-squared significance level questionable, particularly for all mammals and harbor porpoises.

	Hauls with Mammal		Hauls with Harbor Porpoise		Hauls with Bird		Hauls with Murrelet	
Statistical Area	Take	No Take	Take	No Take	Take	No Take	Take	No Take
183-10	5	423	4	424	21	407	12	416
Other Areas	0	131	0	131	1	130	1	130
Total	5	554	4	555	22	537	13	546
Chi-squared		1.54		1.23		4.55		1.84
P-value 1		0.214		0.267		0.033		0.175
P-value 2		0.347		0.565		0.037		0.215

Logistic Regression Analysis for Bird Takes

With logistic regression it is assumed that the probability of take being observed during a set and haul is given by an equation like

$$P(\text{Take}) = \frac{\text{Exp}\{\beta_0 + \beta_1 X_1 + ... + \beta_p X_p\}}{1 + \text{Exp}\{\beta_0 + \beta_1 X_1 + ... + \beta_p X_p\}}, \tag{8.3}$$

where X_1 to X_p are variables describing the conditions during the haul being considered, and β_0 to β_p are regression coefficients to be estimated from the data. This model can be used to assess the effects of haul conditions on the probability of a bird take having occurred, and it has the advantage over the randomization tests of allowing the effects of several factors to be considered together. This is not possible with mammal takes because of the small number of takes observed.

Under certain conditions the effort may have a special role in this equation. In general the take probabilities are low and may be approximately proportional to the fishing effort. This occurs if equation (8.3) takes the form

$$P(\text{Take}) = \frac{(\text{Effort})\text{Exp}\{\beta_0 + \beta_1 X_1 + ... + \beta_p X_p\}}{1 + (\text{Effort})\text{Exp}\{\beta_0 + \beta_1 X_1 + ... + \beta_p X_p\}}$$

and the term $Exp(\beta_0 + \beta_1 X_1 + ... + \beta_p X_p)$ is close to zero. The equation can then be rewritten as

$$P(Take) = \frac{Exp\{Ln(Effort) + \beta_0 + \beta_1 X_1 + ... + \beta_p X_p\}}{1 + Exp\{Ln(Effort) + \beta_0 + \beta_1 X_1 + ... + \beta_p X_p)\}},$$

where Ln(Effort) is the natural logarithm of the effort variable. In practice the equation can be made a little more flexible if necessary by treating Ln(Effort) as just another variable describing the conditions for a haul and estimating a regression coefficient for this variable in the same way as for the other variables. This then gives an equation of the form

$$P(Take) = \frac{Exp\{\beta_0 + \beta_1 Ln(Effort) + \beta_2 X_2 + ... + \beta_p X_p\}}{1 + Exp\{\beta_0 + \beta_1 Ln(Effort) + \beta_2 X_2 + ... + \beta_p X_p\}} \quad (8.4)$$

where X_2 to X_p allow for effects in addition to the effect of effort.

Model fitting was carried out using the logistic regression option in GenStat version 11 (VSN International Ltd., 2009), assuming that the probability of a take on a haul is a binomial variable with a probability given by a logistic regression equation, and whether or not a take is observed is independent of whether there is a take or not on all other hauls. These are the standard assumptions for logistic regression.

There are 27 hauls with bird takes and 2303 hauls without bird takes in sampling regions Y1, Y2 and Y3. These hauls provide the data for a logistic regression analysis to assess the effects of the variables Year, Effort, Region, Day, MTCode, Depth, NVRank, FZCode, TdCode, LdCode, AirTemp, WtrTemp, HSCode, MshSz, NMCode and NCCode that the randomization tests were applied with. Data from region Y4 was not considered because no bird takes were observed in this region.

The approach used was to start with by fitting model (8.4) to the data, and then add the effect of the sampling region to ensure that this is significant. It was expected that both the effort effect and the region effect would be very significant. The other variables and factors were then examined to see which gives the most improvement to the equation in terms of accounting for as much as possible of the variation in the take data. If this improvement was significant then the variable of factor was added into the equation, and consideration was given to adding another variable or factor into the equation. This continued until no additional variables or factors gave a significant improvement to the equation at the 5% level. Also, if a variable like depth was added into the equation then the square of this was also added if this had a significant effect at the 5% level.

Once a final equation was found using this procedure then a randomization test was carried out to ensure that this equation accounts for a significant amount of the variation in the data. This variation is measured by the deviance accounted for, which is analogous to the regression sum of squares in ordinary multiple regression. The deviance for the final equation is compared with the distribution of the deviance obtained when the observed takes are randomly reassigned to the hauls, to find the probability of a deviance as large as the one for the final equation occurring by chance if the probability of a take occurring is not related to any of the variables and factors in the logistic regression equation.

The result of this procedure was that Ln(Effort) has a very highly significant relationship with the occurrence of a take ($p < 0.001$), as does the sampling region. In addition, the day in the fishing season and the square of this day were added into the equation, plus the net material code (NMCode). No additional effects were significant at the 5% level, and the final equation accounts for a very significant amount of the variation in the data either using the usual F test for logistic regression ($F = 9.92$ with 8 and 2208 df, $p < 0.001$) or from a randomization test ($p = 0.001$ with 1,000 randomizations). Table 8.11 shows details of the final equation.

Table 8.11 Estimated regression parameters for the logistic regression equation for the probability of a bird take on hauls in sampling regions Y1, Y2 and Y3. Region Y3 and net material code 1 are the standard codes that others are compared to. The parameters for these codes are therefore zero, with zero standard errors. The effect of Day and Day2 are together significant at the 5% level even though the coefficient of Day is not significant at this level.

Parameter	Est	SE	t	Sig
Constant	-1.0640	0.738		
LnEffort	0.8772	0.2488	3.53	0.000
Region Y1	-2.4552	1.0461	-2.35	0.019
Region Y2	-2.2824	0.6751	-3.38	0.001
Region Y3	0.000	0.000		
Day	-0.0459	0.0240	-1.91	0.057
Day^2	0.00046	0.00018	2.51	0.012
NMCode 2	0.0000	0.0000		
NMCode 3	-0.7948	0.7907	-1.01	0.315
NMCode 4	-2.0624	1.0765	-1.92	0.056
NMCode 5	0.7906	0.4615	1.71	0.087

According to the final equation the probability of a bird take increased with the fishing effort (as expected), was lower in sampling regions Y1 and Y2 than in sampling region Y3, is higher at the start and end of the fishing season than in the middle of the fishing season, and was lower for nets with six strand mono and multi-strand mono material than for the other materials.

The sampling region effects in the equation are mainly due to most of the hauls with bird takes being in region Y3 rather than the other regions. The day in the season effect is due to the percentage of hauls with bird takes being higher for the first and last five weeks of the fishing seasons (1.5% and 1.3%, respectively) than for the middle nine weeks (0.6%), and the net material effect is due to the proportion of hauls with takes varying considerably with the net material. Table 8.12 shows how the number of bird takes varied with the net material while Figure 8.5 shows the estimated probabilities of takes for different days in the season and different net materials based on the logistic regression equation. Figure 8.5 shows that the highest estimated probability of a set and haul lasting for one day having had a bird take (about 0.8) is for nets with the "other" code in sampling region Y3 at the end of the fishing season. As the nature of the nets with the "other" code is not known this is not a useful observation. However, the relatively low estimated catch rates for the six strand mono and multi-strand mono nets is of interest.

Table 8.12 The hauls with takes and the total number of hauls for nets of different materials.

	Multifilament nylon	Six strand mono	Multi-strand mono	Other
Hauls with Takes	15	2	1	9
Total Hauls	952	326	622	430
% of Hauls with Takes	1.6	0.6	0.2	2.1

The logistic regression analysis was repeated for the hauls with murrelet takes, but just using the hauls in sampling region Y3 because all but one of the murrelet takes was in this region. In this case no region effect was considered because all hauls were in the same region. The variable Ln(effort) has a highly significant effect, as expected, but none of the other effects were significant at the 5% level.

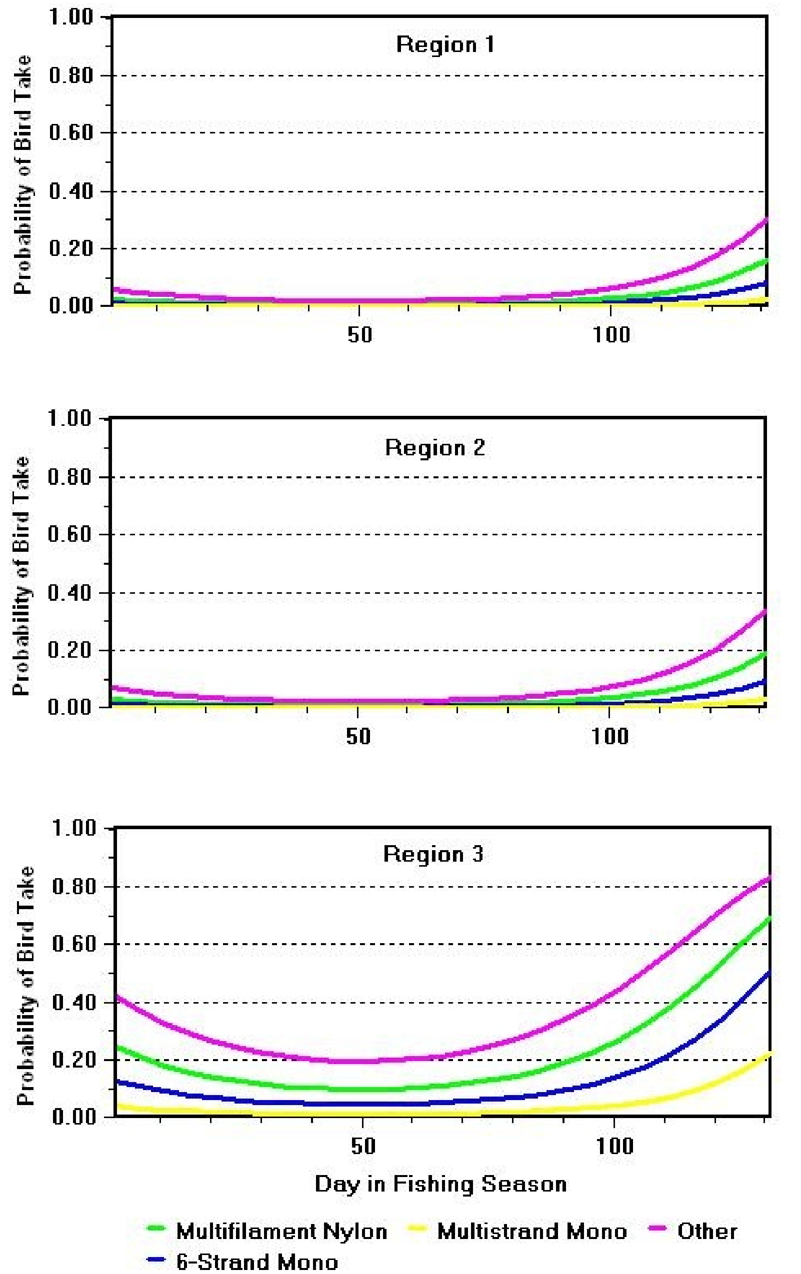

Figure 8.5 The estimated probabilities of bird takes from the logistic regression equation in sampling regions Y1, Y2 and Y3, for different days in the fishing season, and for different net materials,, with a fishing effort of one day. Sampling region Y4 is not included because there were no observed bird takes in that region. The observed probability of a take (●) is the proportion of hauls with takes from nets of all materials in the sampling region considered, for a week centered on the fishing day shown.

9. Discussion

Marine Mammal and Bird Interactions with the Fishery

As noted in Section 2, before the 2007 and 2008 AMMOP sampling the documented interactions of marine mammals with the Yakutat setnet fishery were for grey whales (*Eschrichtius robustus*), harbor seals (*Phoca vitulina richardsi*) and humpback whales (*Magaptera novaeangliae*). However, the results of the observer program suggest that there should be more concern about interactions with harbor porpoises (*Phocoena phocoena*). Also, the AMMOP observers saw an interaction with a northern Steller sea lion (*Eumetopias jubatus*) between two set watches in 2008.

There were no takes of grey whales observed in 2007 and 2008 and therefore no evidence of grey whale interactions was obtained from the sampling in these two years. The earlier documented interaction was from a stranding report (Anglis and Allen, 2009, Appendix 4), so that overall there is little indication of significant grey whale interactions with the Yakutat setnet fishery.

There was an observed interaction of a harbor seal in with the fishery in 2008, leading to an estimate of 14 total takes for this species in the fishery in 2008, with a standard error of 13. However, the harbor seal only had a momentary snag with nets and released itself alive and without serious injuries. Therefore the AMMOP sampling in 2007 and 2008 provides no evidence of mortalities or serious injuries for harbor seals due to interactions with the Yakutat setnet fishery.

The Steller sea lion observed to interact with nets in 2008 had a momentary snag and then released itself alive and without serious injuries. Therefore, the AMMOP sampling in 2007 and 2008 again provides no evidence of mortalities or serious injuries for this species due to interactions with the Yakutat setnet fishery. However, the eastern U.S. stock of Steller sea lions, which includes those in the Yakutat area, is currently listed as threatened under the Endangered Species Act, and therefore as depleted under the Marine Mammal Protection Act. The observed interaction is therefore important in this regard.

There were no documented interactions between harbor porpoises and the Yakutat setnet fishery before the AMMOP sampling in 2007 and 2008. In 2007 one interaction was observed, resulting in the death of the harbor porpoise, while in 2008 there were three interactions observed, resulting in two deaths. Based on these observations it is estimated that there were a total of 16 serious injury and mortality (SI/M) interactions with harbor porpoises in 2007 and 28 SI/M interactions in 2008, with 95% confidence limits for the total SI/M take numbers of 1 to 74 in 2007 and 4 to 96 in 2008. This gives an estimated yearly average of 21.8 SI/M takes, with a CV of 56%.

At present there are three stocks of harbor porpoises recognized in Alaska, with those in the area of the Yakutat fishery being part of the Southeast Alaska stock (Angliss and Allen, 2009). The estimated total abundance for this stock from 1997 surveys is 11,146 with a coefficient of variation of 24.2%. The potential biological removal (PBR) for the stock is currently considered as undetermined because the latest estimated population size is more than eight years old. However, using the 1997 estimate of the population size gives a PBR of 91.

Harbor porpoises are currently not listed as depleted under the Marine Mammal Protection Act, or listed as threatened or endangered under the Endangered Species Act, and the estimated minimum annual mortality incidental to commercial fisheries in Alaska is zero. From this point of view, if the PBR of 91 is approximately correct then there must be concern about an average estimated SI/M take of 21.8 harbor porpoises a year in the Yakutat fishery, particularly because the Yakutat setnet fishery is only one of the three commercial salmon fisheries in Southeast Alaska and there may be harbor porpoise takes in the other two fisheries as well.

The Kittlitz's murrelet was listed as a candidate species under the Endangered Species Act in May 2004 because of documented declines in numbers in other parts of Alaska. Also, the ADF&G received a petition to list the species under Alaska's endangered species statutes in March 2009. The petition to the ADF&G was denied because of lack of evidence, but the observed SI/M take of a Kittlitz's murrelet in sampling region Y3 (the Yakutat Bay area) in 2008 leads to an estimated total SI/M take of 14 Kittlitz's murrelets in that region for the whole year, with a 95% confidence interval of from 1 to 63. This suggests that the number of Kittlitz's murrelets taken by the fishery may be quite high.

Factors That Affect the Probability of a Take Occurring

The assessment of variables and factors that may influence the probability of a take occurring during a set and haul is complicated by the fact that all marine mammal takes and most of the marine birds occurred in sampling region Y3 where the environmental and fishing conditions differ from the conditions in other regions. Therefore, it is difficult to separate regional effects due to differing local abundances of mammals and birds from the effects due to the environmental and fishing conditions in the different regions.

For all marine mammals randomization tests to compare the conditions for hauls with takes with the conditions for hauls without takes in all sampling regions give many significant effects. However, all but one of these effects become non-significant when the tests are carried out only using hauls in sampling region Y3. The only significant result is for the period of the day midway between the start of the set and the end of the haul, with more hauls with takes than expected for this mid-time from midnight to 6am. The fishing effort in terms of the time fished is also nearly significant, with higher mean effort of hauls with take than on hauls without take. However, in fact the mid-time effect and the effort effect are related because the mean three of the five sets and hauls with marine mammal takes had overnight fishing with high effort as a result. Also, overall the sets and hauls with a mid-time between midnight to 6am had much higher average effort than hauls with other mid-times (6am to noon, noon to 6pm and 6pm to midnight). Essentially, therefore, it seems that the main factor influencing the probability of observing a marine mammal take was the fishing time for the set and haul being observed.

For harbor porpoises there are also many significant effects when the conditions for hauls with takes are compared to the condition for hauls without takes in all sampling regions using randomization tests. However, when the tests are just carried out using hauls in sampling region Y3 the only effect is for the fishing effort, with hauls with take having a significantly higher mean fishing time than hauls without take. It appears, therefore, that for marine mammals in general, and harbor porpoises in particular, that the most important factor influencing the probability of a take occurring is the fishing time, which is hardly surprising.

For all birds there were again many significant results when the conditions for hauls with takes are compared to the conditions for hauls without takes using randomization tests, with far fewer results if only hauls in sampling region Y3 are considered. For the tests only using the hauls in sampling region Y3 there are significant results for the fishing effort (hauls with takes have a higher mean effort than hauls without takes), the day in the fishing season (hauls with takes tend to be later in the season than other hauls), and the mid-time of fishing (more takes for sets plus hauls with a mid-time from midnight to 6am than those with other mid-times, which is expected because the mean effort is highest for hauls with a mid-time from midnight to 6am).

For randomization tests comparing hauls with and without murrelet takes in all sampling regions there were again many significant results, but when only hauls in sampling region Y3 were considered the only significant results were for the fishing effort (hauls with takes have a higher mean effort than hauls without takes) and the mid-time of fishing (more takes for sets plus hauls with a mid-time from midnight to 6am than those with other mid-times, which is expected because the mean effort is highest for hauls with a mid-time from midnight to 6am).

These effects were further explored for all birds using logistic regression because there is enough data for this type of analysis, which allows effects to be examined for several variables and factors at the same time. Only hauls in sampling regions Y1, Y2 and Y3 were used for this purpose because no bird takes were observed in sampling region Y4. The logistic regression gave significant results for the fishing effort (more effort giving a higher probability of take, as expected), the region (higher probabilities of take in region Y3 than in other regions, as expected), the day in the fishing season (higher take probabilities at the start and end of the fishing season than in the middle of the season), and the net material (lower take probabilities for six strand mono and multi-strand mono than the multifilament nylon and other materials).

Logistic regression was also tried to compare hauls with and without murrelet takes. This was only done for hauls in sampling region Y3 because there was only one haul with murrelet takes outside this region. The only significant effect in this case was for the fishing effort (more effort giving a higher probability of take, as expected).

Overall the randomization tests and logistic regressions for all birds and murrelets indicate that the probability of a take occurring increases with the fishing effort as expected, and is highest in sampling region Y3. In addition, it appears that for all birds the probability of a take is higher at the start and end of the fishing season than in the middle, and that the net material used affects the probability of a take.

Acknowledgments

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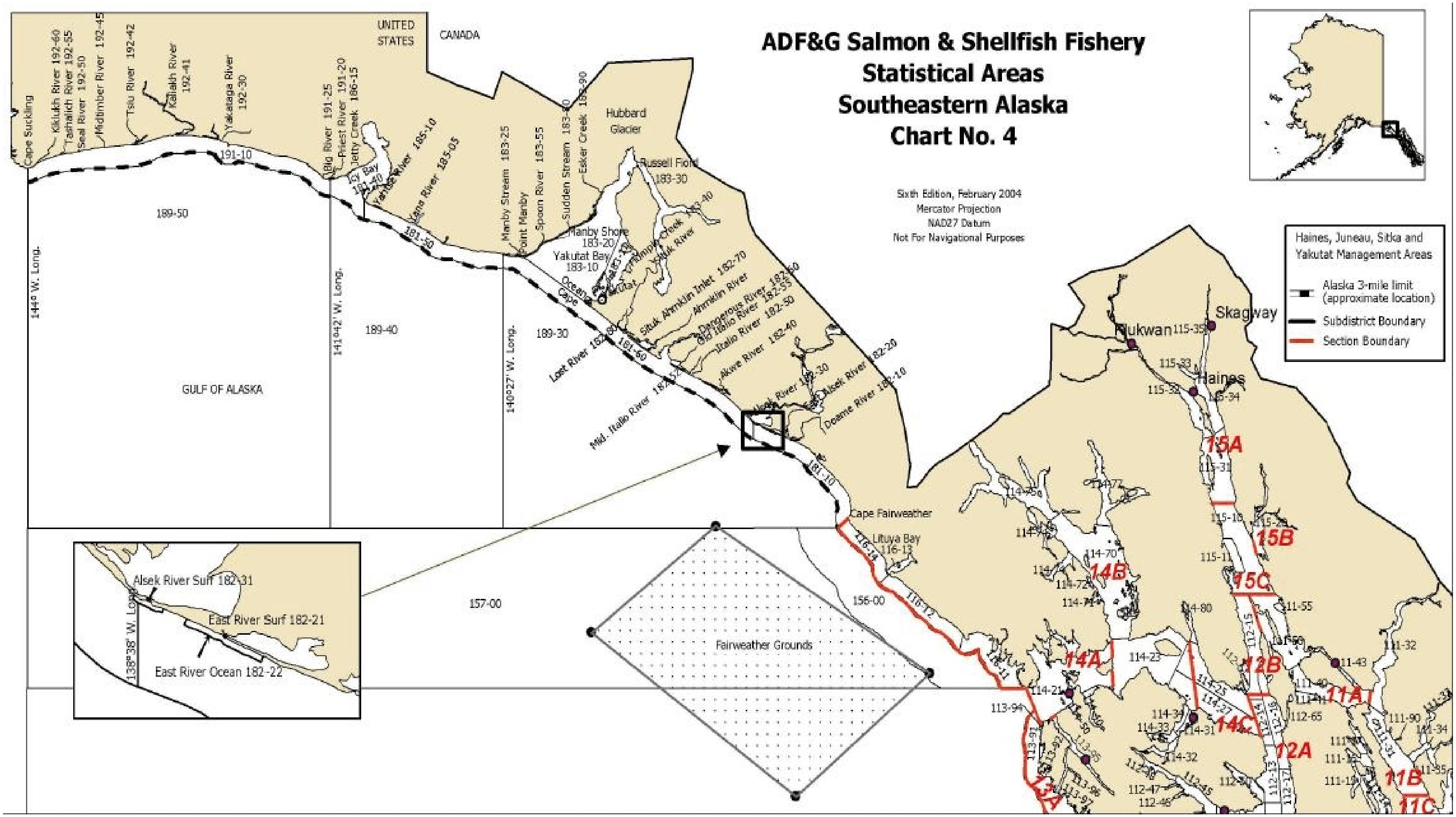
Appendix A: ADF&G Map of Statistical Areas in Southeast Alaska



Appendix B: Operations in the Yakutat Setnet Fishery 2007-8

This Appendix provides a copy of Section 3 in the AMMOP Manual for 2008. There were only a few changes from what was in the 2007 Manual.

Observer operations include a suite of many and varied details and protocols. All are critical components to the success of the program. Each element plays an important role in the ultimate analysis of the data collected, and the instructions given should be followed carefully. There may be situations, however, where the observer is the first to recognize new or unforeseen activities in fishery operations that confound existing AMMOP operational protocols. In these cases, it is incumbent on the observer to bring such situations to the attention of Saltwater and the AMMOP leadership, so that appropriate adjustments can be made.

1. Sampling Protocol

AMMOP sampling for marine mammal interactions in the Yakutat set gillnet fishery will follow a sampling approach similar to sampling protocols followed in the Kodiak set gillnet fishery in 2002 and 2005. Adjustments have been made to the sampling protocol to accommodates specific characteristics of the Yakutat set gillnet fishery.

Optimal observer coverage effort for a sample unit, or "permit sample", is considered to be: the observation of all retrievals, picks, or hauls (with a minimum of one retrieval, pick or haul observed) during a 24 hour period during which permitted fishing gear is submerged and fishing during an ADF&G fishing opener. It is understood that factors such as weather, changes to fishing operations, and other unforeseen circumstances may interfere with observer effort and is taken into consideration in program design and data analysis.

The level of observer coverage for this fishery is set initially at 300 permit sample, based on an analysis of past effort in the Yakutat set gillnet fishery, to achieve a target CV of 20%. This level may change as fishing effort changes throughout the season. Sampling is designed to be conducted in a random stratified sampling scheme, with observer coverage in each stratum to be proportional to the overall fishing effort in that stratum over time.

Observer effort will be calibrated over each bi-weekly period, or two openers for each area, and the overall area. If observer effort is high or low in the early or middle period of that two week period, the last couple of days of that period can be used to adjust the coverage to close in on the target level.

Yakutat Set Gillnet Sampling Strata

For the purposes of the 2007 and 2008 Yakutat study, the geographic sampling strata include ADF&G statistical areas and corresponding geographical areas as follows:

Y1-Alsek Area

Alsek River	18230
East Alsek River	18220
Italio River	18250
Mid-Italio River	18252
Old Italio River	18255

Y2-Situk Area

Situk Ahrnklin Inlet	18270
Lost River	18280
Situk-Lost River Ocean	18270

Y3-Yakutat Bay Area	
Ocean Cape	18310
Yakutat Bay	18310
Manby Shore	18320
Esker Creek	18390
Sudden Stream	18380
Spoon River	18355
Manby Stream	18325
Dangerous River	18260
Akwe River	18240
Y4-Tsiu Area	
Tsiu River	19242
Kaliakh River	19241

Tracking Fishing Effort

Accurate fishing effort tracking on a real-time basis is one of the biggest challenges in this sampling scheme and is one of the most critical elements in conducting the post-season analysis of the data collected. Achieving accurate tracking of the fishing effort will help ensure that sampling efforts meet the target levels. To achieve this, a fishing effort tracking system will be implemented and modified in-season as needed.

The lead observer will coordinate tracking the fishing effort for their area and all leads will coordinate to track effort across all areas, especially for those permit holders moving from one area to another. Separate effort tracking methods will be employed for fishers in areas not typically covered on a daily basis. Lead observers may enlist observers to augment the effort tracking and will instruct observers accordingly.

At the start of the season, a list of all the permit holders in the fishery will be checked for fishing status of each participant. This will be accomplished through various means, including ADF&G and direct contact with fishers. The first day of the first opener of the season for each area will be the trickiest day for sampling, since it will be difficult to really know who is fishing where, until they actually begin. Lead observers in the areas where effort is expected can conduct area-wide surveys by actually speaking to individual permit holders asking them where they expect to fish for that opener.

Thereafter throughout the season, fishing effort must be tracked through daily contact with fishers, most likely at their set net sites or at the seafood buying station in the area, if there is one. A fishing effort tracking form will be provided to leads and must be filled out for each permit holder each day.

Permit Sample Selection

Once effort has generally been established, the sampling scheme will be followed:

- A random master list will be generated of all permits issued for entire fishery without regard to AMMOP Yakutat sampling areas. This list will be completely sampled (all permit holders sampled if they are actually fishing) in the order the permit numbers appear on the list. Once all permit numbers have been sampled once and crossed off the list, and all inactive permits positively identified, a new random list will be generated (including all assumed inactive permits, in case they become active during the period this list is sampled from). Sampling with this list will begin immediately.

- For each AMMOP area Y1- Y4, the number of permit samples needed for the opener will be determined according to the sampling target.

- The permits to be sampled for a given day or opener are chosen from the top of the current list in use. The permits will be sampled in the order that they appear on the list. It is critical that the master list of permits be updated daily regarding the permits already sampled, so that a permit holder, who was sampled in one area and moves to another area, is not sampled again until the list is completely sampled and a new list is generated. If a permit on the top of the list is not able to be sampled on the day for which it was chosen (due to weather, mechanical failure, etc), the observer will sample the next name on the list for their area. However, that unsampled permit number stays at the top of the list and is the top priority for observation on the next open fishing day. Such permits will remain at the top of the list until sampled.

- If not enough information is available on "who is fishing where" at the start of the first opener, alternate methods of permit selection may be employed for the first day of sampling.

Watch Types

Once a permit is selected and the observer deploys for the set net site, the observer's data collection duties commence. Each type of sampling is conducted during a period called a "watch." The following summary of data to be collected, if events conflict in area or time, are described and prioritized. However, the order in which they occur will vary on a given permit sample day (trip).

Haul Watch

Highest Priority: The observer's first sampling priority is to observe the entire pick of a net, and a haul watch is conducted while the vessel is picking fishing gear. The haul watch provides information on the fishing operations, marine mammal interactions, and marine mammals that are in the vicinity of the gear during fishing operations when the net is actively picked. Detailed instructions on how to conduct a haul watch are found in Section 4 of this manual. Detailed haul data are recorded on the Haul Form and associated data forms. Any incidental takes will be recorded and necessary sampling conducted and recorded as directed in Section 4 of this manual. Additional documentation of the haul watch is recorded on the Sighting Form as directed in Section 4 of the AMMOP 2008 Manual under Marine Mammal Sighting Watches.

Additional Watches

In addition to watching and recording data during periods when the net is actively picked, the observer will conduct additional marine mammal sighting watches as described below. Specific instructions for conducting these watches and recording data can be found in Section 4 of the AMMOP 2008 Manual under Marine Mammal Sighting Watches. The priorities for conducting these watches are determined by the on-going fishing activities.

Soak Watch

Soak watches should be conducted to the maximum extent possible as conditions and fishing operations allow. The standard soak watch period is 60 minutes. However, observers may conduct a soak watch anytime during the trip if he or she can expect an uninterrupted period of at least 30 minutes. Therefore, soak watches should never be shorter than 30 minutes or longer than 60 minutes. If a soak watch is less than 60 minutes, the observer should document the reason for not achieving the 60 minute duration. Observers may conduct several soak watches in a row if the net soaks longer than 60 minutes. However, a 15 minute break must be taken between soak watches to rest the observer's eyes and renew his or her ability to concentrate. If a soak watch is begun with the anticipation that the observer will be able to complete a 30 minute watch, but the permit holder unexpectedly picks the net, the observer should so note this in comments on the soak form.

Set Watch

A set watch is conducted while the vessel is setting out fishing gear. This information is used to assess possible interactions and associations of marine mammals with this aspect of the fishing activity. Set watches are a lower priority if the observer is working up samples, preparing for the haul/pick, or needs to take a break. In the set gillnet fishery, sets may be rarely observed and are of limited importance. A set watch can be conducted during every set, regardless of weather conditions.

Transit Watch

A transit watch is conducted while traveling over water to or from the fishing grounds and between fishing sites when transit is likely to be 15 minutes or more. Transit watches are conducted when the Beaufort sea state is 5 or less. The Beaufort Scale defines a Force 5 as 17 to 21 knot wind speed, 6 to 8 foot waves, many white caps, and some spray. Each transit watch is maintained without break for a minimum of 15 minutes and a maximum of 60 minutes, followed by a 15 minute break.

Beaufort Scale Sampling Reduction Plan

Weather can potentially affect all observations and could bias observer coverage of more exposed sites. Many of the sites may receive extreme weather. The contractor will ensure that observer coverage at exposed sites is in proportion to other sites in a region based on fishing effort. Weather will also reduce the quality of observations during soak watches due to wave action and sampling platform movement. Moderate weather will reduce visibility and obscure interactions, while strong winds and heavy seas will cause serious safety concerns.

Lead observers will use a combination of National Weather Service forecasts, USCG weather reports, local mariners, and information provided by area radio contacts. Lead observers will attempt to establish the weather at sites before deploying observers. If the weather begins to worsen, observers will relay information to the lead observer, or other appropriate parties and a determination to change sampling protocols appropriately will be made. Avoidance of placing observer/skiff operator teams in danger during severe weather conditions is paramount. For these reasons, the contractor will deploy observers based on sea-state and implement a Beaufort Scale Sampling Reduction Plan as follows.

- Beaufort 0-3 (wind 0-10 knots; seas 0 - 3.5 ft): All sampling will occur as scheduled.

- Beaufort 4 (wind 11 to 16 knots; seas 3.5-5 ft): All skiff-based soak watches will be suspended. At Beaufort 4, frequent white caps and waves begin to limit visibility, affecting the dependability of soak watch data. Anchoring a skiff to a buoy becomes quite dangerous in four-foot seas. Observer effort will focus on observing picks.

- Beaufort 5 (wind 17-21 knots; seas 6-8 ft): Lead observers may direct observer-skiff operator teams to use alternate sites. Lead observers will restrict deployment of skiffs during Beaufort 5 weather. Leads will determine if a skiff can safely be deployed during picks only.

- Beaufort 6 and higher (wind 22+ knots; seas 9.5 ft +): All skiff-based observations will be suspended. Ten-foot white-capped waves with scattered spray will reduce visibility beyond acceptable observation levels. Observers may establish if the net is fishing and try to contact the permit holder to determine if the site will be picked that day.

2. Observer Deployments

Observers will be deployed at the direction of the observer provider. Remote sampling locations, such as the Tsiu, the Alsek, East Alsek, and other locations will require transportation via small plane or boat. Remote camps will be self-sufficient and will be in daily communications with the main camp in Yakutat. The contracted observer provider will coordinate all logistics for travel and living accommodations, including lodging and food.

3. Observer Gear

Observers will be issued NMFS-furnished gear, which will consist of sampling and safety equipment. Observers are expected to provide their own personal needs, including footwear and outerwear, though NMFS will provide rain jackets and bibs, as well as full body Mustang suits. A full complement of sampling and safety gear for each observer will be provided by NMFS to the contracted observer provider, who will then issue it to the observer. The observer will be responsible for keeping track of their gear, conducting required in-season maintenance and testing of certain items, and returning the gear in clean, useable condition at the end of the season. Some sampling and safety gear will be checked out to the skiff drivers and kept aboard the skiffs to minimize observers lugging extra weight around unnecessarily. A list of gear for observers and skiff drivers can be found in the Appendices to the AMMOP 2008 Manual..

4. Field Communications

The Yakutat set gillnet fishery is about as remote as it gets. There are numerous logistical requirements to get the job done that require on-going teamwork, and safety is an ever-present concern. Good field communications are essential to this program. As with any observer program, and particularly in a new fishery, there will be a daily need to adjust to changes and new circumstances arise or information comes to light. Ensuring an effective communications network will minimize confusion and create a reliable transfer of information. This will help keep everyone in the program safer and will provide a better chance for success of the program.

Daily Communication Protocols

Mandatory float plans will be filed daily for each observer/skiff driver pair who deploys to the field from a base camp (overnight trips may have multiple day float plans). Daily radio check protocols between field camp and the observer/skiff driver team will be included in each float plan prior to each deployment. Guidelines for establishing those daily protocols can be found in the Float Plan instructions in Section 5 of this manual. These radio checks are mandatory and failure to check in or respond to a check in will initiate the appropriate pre-designated response specified in the float plan instructions.

Saltwater and lead observers will establish general daily communication protocols between the Base camp in Yakutat and the remote camps in the Alsek Area (Y1) and the Tsiu Area (Y4), as well as for other areas remote areas to which observers may temporarily deploy.

The Yakutat base camp and each remote camp will have a satellite phone for voice communication and data transfer, as well as VHF radios. Each observer and each skiff driver will be issued a handheld VHF radio and each skiff will be equipped with a VHF radio and antenna. Improperly working communications equipment must be reported as soon as possible, so that repair or replacement can be made immediately.

AMMOP Website

A password-protected AMMOP intranet site, accessible by observers, skiff drivers and program managers, will be established to allow for a central posting site for information on the program, particularly for updates on sampling protocols, answering questions, etc. This will help ensure that all field personnel receive the same information and in a timely manner.

Internet service is provided for the purpose of official AMMOP business. Any personal use of these services by observers or skiff drivers may not interfere with this official use in any way, including by limiting access to these services.

General Communications with Saltwater and NMFS

Observers and skiff drivers should follow the established chain of communication regarding needs, concerns or problems. However, if there is no response at the field level, or the response appears to be ineffectual, the observer or skiff driver should consider whether the issue is of a nature that requires direct communication to the observer contractor operations manager or NMFS. These lines of communication will always be open.

Bridget Mansfield, AMMOP coordinator, can be reached M-F 7am - 3:30 pm at (907) 586-7642. A cell phone number and home number will be provided during training. She can be called 7 days a week, 24 hours a day. Saltwater, Inc. will provide 24 hour contact information during training.

Emergency Communications

Emergency communications are covered in a separate Emergency Action Plan.

5. Communications with Permit Holders

Good communication with fishermen is the backbone of the program. A courteous and respectful manner must be observed at all times when speaking with fishermen. The AMMOP wants to foster a good working relationship with fishermen for several reasons. Although NMFS and your contractor have done pre-season outreach to try to explain the goals and objectives of the AMMOP, many fishermen will still have questions about the program. Many may be concerned about additional government oversight and worried that any data collected could have a negative impact on their fishery. The perception may be that NMFS is entering their workplace with what could be perceived as an intrusive program. We want to try to dispel these worries to the degree possible.

While this is a mandatory program and fishermen are required by law to provide information and access to the needed data, we want to ensure that fishermen understand we respect their livelihood and that we would like to work cooperatively with them. The information that they can provide us will be critical in getting an accurate picture of the levels of marine mammal interactions.

6. Field Logistics

Observers and skiff drivers will work together as a team. Detailed specifics on sampling protocols are found in Section 4 of the AMMOP 2008 Manual. However, the logistics required to ensure the data is able to be collected require additional planning. Each sampling day, the observer and skiff driver will coordinate on all pre-trip logistics, travel together to the set net site, work in tandem to achieve the day's sampling goals, return safely to base camp after the day's sampling, and wrap up the details of the day.

Observer Minimum Responsibilities

- Understand AMMOP goals and needs and present the program in a professional manner.
- Interact with permit holders in a professional and courteous manner.
- Collect and record accurate and precise data according to training and manual sampling protocols.
- Collect and record biological samples in accordance with training and manual protocols.
- Review and edit data to ensure data quality.
- Maintain conduct standards and safety protocols.
- Care for assigned gear, including recording maintenance, problems, and disposition.
- Work with all program staff in a cooperative manner to ensure a successful program.

Night before a sampling day

- Determine what permit he or she is to sample the next day.
- Coordinate with the lead observer to ensure the permit holder was notified the day before sampling and ascertain: 1) set net site location, and 2) estimated time of the first pick of the day.
- Communicate with the skiff driver on the next day's sampling logistics, including permit number, location, and estimated time of departure from the camp and arrival at the set net site.
- Establish radio check procedures with the lead observer and the skiff driver.
- Ensure personal and sampling gear is clean, ready, and working.

Sampling day

- Prior to departure: Coordinate with the skiff driver on the weather and route to the set net site, ensure all needed gear is loaded on the skiff or ATV for transport; review radio check protocols with skiff driver and lead observer.
- Prior to departure: Double check that the skiff driver filed the float plan with the lead observer or base camp in Yakutat.
- Arrive at the set net site at least 30 minutes prior to the first pick of the day.
- Introduce yourself to the permit holder. When appropriate, initiate permit holder interview to understand the general fishing plan for the day and gain information for data collection.
- Begin data collection and recording on appropriate data forms. Conduct data collection according to sampling protocols throughout the day.
- Conduct radio checks with base camp according to radio check protocols.
- Return to camp.
- Remove gear from skiff; clean as appropriate.
- Complete paperwork for the day and turn it in to the lead observer.
- Submit any biological samples to the lead observer.
- Consult with lead observer, if appropriate, on any pressing concerns.

Skiff Driver Minimum Responsibilities

- Understand AMMOP goals and needs and present the program in a professional manner.
- Interact with permit holders in a professional and courteous manner.
- Maintain safe operation of skiff at all times.
- Maintain conduct standards and safety protocols.
- Care for assigned gear, including recording maintenance, problems, and disposition.
- Work with all program staff in a cooperative manner to ensure a successful program.

Night before a sampling day

- ommunicate with the observer on the next day's sampling logistics, including permit number, location, and estimated time of departure from the camp and arrival at the set net site.
- Check the weather forecast.
- Establish radio check procedures with the lead observer and the skiff driver.

Sampling day

- Check weather forecast to/at set net site.
- Coordinate with the observer on the weather and route to the set net site, ensure all needed gear is loaded on the skiff or ATV for transport; review radio check protocols.
- File float plan.
- Complete skiff departure checklist.
- Begin skiff log entry; if sampling on land, so note in log.
- Leave the dock in a timely manner to arrive at the intended permit sample site at least 30 minutes prior to the expected first pick of the day.
- If on land for the sampling day, maintain vigilant bear look out.
- Maintain skiff operations in a manner that ensures the safety of the vessel and people aboard, as well as nearby vessels and crew.
- Operate vessel in a safe, professional manner that allows the observer to successfully complete his/her duties.
- Conduct radio checks with base camp according to radio check protocols.
- Return to camp.
- Remove gear from skiff as appropriate, secure skiff for the evening.
- Close Float Plan.
- Complete Skiff Return checklist.
- Complete daily logbook entry.

7. Debriefing and Data Editing

One of the most critical elements in data quality control is the in-season debriefing of an observer who has collected data in the field. In-season debriefing of the observer ensures that the data are complete and as accurate as possible before data entry. During the 2008 field season, observers will debrief with the area lead observer on a weekly basis, after each opener.

The lead observer will review the data and conduct a positive and private, face-to-face discussion with the observer on the previous week's data. During the debriefing, two-way communication between the observer and the lead should focus on data quality, logistical issues related to the trips made, sampling protocols that need to be examined, and any safety issues that may arise. The lead observer will courteously explain all concerns or errors and suggest appropriate ways to make corrections.

Observers should note that in many cases the lead cannot offer a simple answer, because he or she was not present during the data collection. The lead may offer guidance based on sampling protocols set out by the program, which the observer must use to make a judgment call on how to report and record the data. The observer will be expected to make all needed corrections to the data at the time of the debriefing. The lead will complete a debriefing form for each debriefing, and discrepancies or errors in collecting or recording data will be noted, with suggestions for improvement discussed. Data collection methods will be discussed and documented before the data is transmitted.

Observers will provide feedback to the lead observer on data sampling protocols or other issues or concerns, such as logistical questions or comments and any interactions with fishermen that are noteworthy. Any safety concerns must be discussed as soon as they are noted. If a serious concern arises, the lead should be notified immediately, without waiting for the weekly debriefing. Lead observers will ensure that all concerns and suggestions are discussed in a professional manner and that observers are provided with appropriate and professional responses to their concerns.

A final debriefing with AMMOP staff is required for each observer at the end of the fishing season. The final debriefing will focus on a review of any outstanding data problems, the observer's performance throughout the fishing season, writing of any necessary affidavits or reports, turning in any biological samples, gear, and equipment to NMFS, and a general review of the observer's experience during the summer. The observer provider is responsible for making any changes or corrections requested by NMFS prior to final acceptance of the data and reports from each observer for the season, as well as return of all issued gear, unless other arrangements are made in the case of missing or damaged gear.

Data Entry

The observer provider is not responsible for the bulk of the data entry into electronic format, but observers will perform some data entry of information pertaining to their work. The bulk of the collected data will be scanned as a backup and the original paper forms will be sent to NMFS on a biweekly basis for data entry. The contractor will maintain a data tracking system for the observer data as they are collected and corrected. The contractor will complete quality-assurance processes of observer-collected data, and make any necessary corrections before sending data to NMFS.

NMFS has provided the computers and equipment necessary to support the data needs in each field office where observers are regularly debriefed. NMFS will develop and maintain the data entry and database system.

8. Regulatory Compliance

Trip Refusals

The Alaska Marine Mammal Observer Program is providing observer coverage of Category I and II fisheries in Alaska under the authority of the Marine Mammal Protection Act of 1972. Vessel or permit owners and operators selected for observer coverage are responsible for complying with regulations set forth by the Marine Mammal Protection Act (50 CFR § 229.7) and the Magnuson-Stevens Act (50 CFR § 600.746).

If asked, a fisherman must allow an observer access to fishing operations for the collection of data critical to this program. A refusal occurs when an observer informs a fisherman that they have been selected for observer coverage and the fishermen refuses to cooperate with the observer. The observer must clearly communicate that the permit or vessel has been selected for coverage and confirm that the skipper is denying the observer access to properly observe the operations or to information required to be collected.

Trip refusals are documented in observer logbooks and immediately reported to the contracted Program Manager and the NMFS Program Coordinator. The observer will note in their log all dialogue that occurred between the parties, including dates and times, weather conditions, fishing conditions, trip logistics, and safety issues. The notes must be complete and factual and may be used to write an affidavit if warranted. The reasons for refusing an observer will be clearly reported and evaluated on a case by case basis. A refusal based on principle (a fixed or predetermined policy or mode of action) is not a legitimate reason to not comply with observer requirements.

The observer requirements for participants in Category I and II fisheries are [from 50 CFR § 229.7(c)] that:

1. If requested by NMFS or by a designated contractor providing observer services to NMFS, a vessel owner/operator must take aboard an observer to accompany the vessel on fishing trips. For set net fisheries, the observer must have access to the fishing operations to collect the needed data. This may be visual access from an independent observation platform.

2. After being notified by NMFS, or by a designated contractor providing observer services to NMFS, that the vessel or permit holder is required to have their fishing operations observed, the vessel owner/operator (permit holder) must comply with the notification by providing information requested within the specified time on scheduled or anticipated fishing trips.

3. NMFS, or a designated contractor providing observer services to NMFS, may waive the observer requirement based on a finding that the facilities for housing the observer or for carrying out observer functions are so inadequate or unsafe that the health or safety of the observer or the safe operation of the vessel would be jeopardized.

4. The vessel owner/operator and crew must cooperate with the observer in the performance of the observer's duties including:

   i. Providing, at no cost to the observer, the United States government, or the designated observer provider, food, toilet, bathing, sleeping accommodations, and other amenities that are equivalent to those provided to the crew, unless other arrangements are approved in advance by the Regional Administrator;

   ii Allowing for the embarking and debarking of the observer as specified by NMFS personnel or designated contractors. The operator of a vessel must ensure that transfers of observers at sea are accomplished in a safe manner, via small boat or raft, during daylight hours if feasible, as weather and sea conditions allow, and with the agreement of the observer involved;

iii. Allowing the observer access to all areas of the vessel necessary to conduct observer duties;

iv. Allowing the observer access to communications equipment and navigation equipment, when available on the vessel, as necessary to perform observer duties;

v. Providing true vessel locations by latitude and longitude, accurate to the minute, or by loran coordinates, upon request by the observer;

vi. Sampling, retaining, and storing of marine mammal specimens, other protected species specimens, or target or non-target catch specimens, upon request by NMFS personnel, designated contractors, or the observer, if adequate facilities are available and if feasible;

vii. Notifying the observer in a timely fashion of when all commercial fishing operations are to begin and end;

viii. Not impairing or in any way interfering with the research or observations being carried out; and

ix. Complying with other guidelines or regulations that NMFS may develop to ensure the effective deployment and use of observers.

It is unlawful to fail to take an assigned observer on a fishing trip [50 CFR § 229.7(c)(1)]. It is unlawful for any person to assault, harm, harass (including sexual harassment), oppose, impede, intimidate, impair, or in any way influence or interfere with an observer, or to attempt the same. This includes any action which has the purpose or effect of interfering with the observer's responsibilities, or which creates an intimidating, hostile, or offensive environment [50 CFR § 229.3(b)].

The general prohibitions listed under the Magnuson-Stevens Act (50 CFR § 600.746) are applicable to any fishing vessel required to carry an observer under any U.S. law and include, but are not limited to:

Failure to submit to a USCG safety examination when required by NMFS pursuant to Sec. 600.746.
Fish without an observer when the vessel is required to carry an observer.
Assault, oppose, impede, intimidate, or interfere with a NMFS-approved observer aboard a vessel.

Prohibit or bar by command, impediment, threat, coercion, or refusal of reasonable assistance, an observer from conducting his or her duties aboard a vessel.

Violations of the MMPA may result in sanctions on Authorization Certificates, civil penalties of up to $12,000 and criminal penalties. A complete list of MMPA prohibitions can be found at 50 CFR § 229.3.

Marine Mammal Authorization Certificate

All participants in Category I and II fisheries are required to have a Marine Mammal Authorization Certificate in their possession while they are fishing or accessible at the set net site. The Marine Mammal Authorization Certificate allows for lawful incidental serious injury and mortality of marine mammals during the course of fishing. If a person is operating in one of these fisheries and has not received a certificate, they may contact Rhonda McMichael, National Marine Fisheries Service, Alaska Regional Office, Protected Resources, P.O. Box 21668, Juneau, Alaska 99802, at (907) 586-7236. A copy of the certificate can be found in the Appendix of the AMMOP 2008 manual.

It is not the job of the observer to enforce this (or any) provision of the MMPA. This information is provided in the manual to inform the observers in case a permit holder asks about this.

Injury and Mortality Reporting Requirements

Operators in all commercial fisheries must report all incidental injuries and mortalities of marine mammals that have occurred as a result of their fishing operations on a NMFS Marine Mammal Injury/Mortality Report Form. This report must be submitted regardless of whether there was an observer observing the fishing operations or present at the site. The report must be sent by mail or fax within 48 hours of the end of the fishing trip (or within 48 hours of an occurrence of a take in the case of a set net fishery) in which the injury or mortality occurred [50 CFR § 229.6(a)]. Failure to report all injuries and mortalities within 48 hours may result in suspension, revocation, or denial of a marine mammal authorization certificate [50 CFR § 229.10(e)].

Copies of the Injury/Mortality Report Form may be provided by observers to permit holders. For additional copies, contact Rhonda McMichael, National Marine Fisheries Service, Alaska Regional Office, Protected Resources, P.O. Box 21668, Juneau, Alaska 99802 or (907) 586-7236. The Injury/Mortality Report Form is also available on the internet at the site www.fakr.noaa.gov/protectedresources /observers/mmapform.pdf.

When an observer witnesses an incidental take, the observer will record the information as appropriate on the AMMOP data forms. The observer may want to offer to the fisherman the information that a the report must also be made to NMFS.

Safety Requirements

On May 18, 1998, NMFS published regulations under the Magnuson-Stevens Fishery Conservation and Management Act that address the health and safety of observers stationed aboard commercial fishing vessels. Under these regulations, observers may not depart on a fishing trip aboard a vessel which does not comply with United States Coast Guard (USCG) safety requirements or that does not display a current Commercial Fishing Vessel Safety Examination decal [50 CFR § 600.746(c)(1)].

All vessels required to carry an observer must meet USCG safety requirements and display a current safety decal (issued within the previous two years). Vessels that do not meet these requirements are deemed unsafe for purposes of carrying an observer and must correct noted deficiencies prior to departing port [50 CFR § 600.746(d)(2)].

The vessel owner operator must allow an observer, NMFS, or NMFS-appointed-contractor to visually inspect any safety or accommodation requirement if requested [50 CFR § 600.746(c)(2)]. Observers are required to complete a pre-trip safety check of the emergency equipment and are encouraged to review emergency instructions with the operator prior to the vessel departing port. Fishermen can schedule a free dockside examination to obtain a current safety decal by contacting the nearest US Coast Guard Marine Safety Office Dockside Examiner.

Section 5 of the AMMOP 2008 Manual provides a more in-depth review of safety issues.

Observer Guidelines for Preparing an Affidavit

An affidavit is a written declaration made under oath before an official, such as a notary public. In the case of a possible regulatory violation, any follow-up must begin with the observer preparing a written affidavit. The observer must be prepared to provide evidence or testimony as needed. An affidavit should be a detailed, non-inflammatory, concise, and factual description of the events that led up to and including the violation(s).

The first paragraph should be an introduction of yourself; your name, who you work for, what position you hold, relevant experience, your education, and any other pertinent background information that would support your credibility.

Example: I, (First/Last Name), was employed by (Contractor) to serve as a marine mammal observer for the National Marine Fisheries Service (NMFS). I have served as a NMFS fisheries observer on (number of) deployments, and on this trip served aboard the (vessel name) fishing in the (fishery name) with permit (permit number) from (embark to disembark date), where I witnessed several incidents of (state suspected violation). I received a (highest schooling degree) from the (school name) in (year of graduation). I have successfully completed certifications in C.P.R., vessel safety, and NMFS fisheries observer courses.

Referring to your logbook and forms, detail the event addressing the following questions: Who committed the violation? What was the violation? When did it occur? Where did it occur? Why did it occur? How did it occur?

- Define crucial information (names, dates, times, locations).
- Outline the issues with the debriefer.
- Detail events in chronological order as they occur.
- Do not summarize or minimize events.
- Identify each time an event occurred.
- Maintain objectivity, do not use personal opinions.
- Use complete sentences in a narrative, not outline form.
- Write in the first person, active tense.
- Should be written on plain paper and may be handwritten or typed.

Confirm that the information in the heading of the report is correct, including:

- Observer's name.
- Violation(s) type.
- Trip identification number.
- Vessel/permit name or number.
- Vessel/permit operator.
- Number and date of violation(s)

You should close the affidavit with the following and sign and date:

I certify that, to the best of my knowledge, the above statement is true.
Signature______________________ Date _____________

9. Data Confidentiality

Permit holders should be assured that all data collected by AMMOP observers will be considered confidential and will never be released in a form that can identify an individual permit holder's catch information. Data released to the public will be aggregated according to NMFS policy. For further information on NOAA data confidentiality requirements, please refer to NAO 216-100.

All Federal or State of Alaska personnel with a direct need for AMMOP data access, AMMOP Observers, Saltwater staff, and other individuals contracted by AMMOP to fulfill programmatic needs through access to the data are required to read and sign a data confidentiality agreement that states the terms of data access authorization.

Appendix C: Net and Haul Variables Recorded by Observers

The following list of variables does not include all of the variables on the various forms. it does include those that are considered to possibly be related to the bycatch rate for marine mammals and birds.

Set Gillnet Gear Characteristics Form

- Lead length, depth, twine size, lead material, minimum and maximum mesh size, and color.
- Net length, depth, twine size, net material, number of strands, minimum and maximum mesh size, and color.
- Hang ratio, dropline use, dropline height, floatline use, floatline material, weedline use, weedline material, leadline use, leadline weight, number of floats, float type, float color, float distance, float length, number of anchors, anchor type, hook shape, and number of buoys.
- Pinger use, brand, number, percent operating, and frequency.
- Light use and number, alarm use and number.

Set Gillnet Haul Form

- Zone, land, tide, statistical area, pressure washer use.
- Water temperature, water clarity, and air temperature.
- Minimum and maximum distance to shore.
- Begin and end haul time, location and bottom depth.
- Fish and soak durations, and primary species sought.
- Percent net run, pulled and observed.
- Gear damaged, observation quality, and occurrence of incidental take.
- Skiff size, number of skiffs used, and number of crew per skiff.
- Weight and number of individuals and type for weight and numbers caught by species, disposition (kept or discarded), condition (alive or dead), and disposition reason.

Incidental Take Form (Mammal and Bird Bycatch)

- Trip, haul, photos, disentanglement description, horizontal location, vertical location, animal condition, injury description, age class, sex, and whether it was sampled.

Marine Mammal Sample Form

- Trip, haul, species, tag number, standard length, girth, flipper length, flipper width, dorsal fin height, fluke width, blubber thickness, samples taken.

Marine Bird Sample Form

- Trip, haul, species, tag number, plumage description (phase and feather condition), weight, head-bill length, culmen length, tarsus length, wing chord, brood patch description, fat index, samples taken.

Marine Mammal Sighting Form

- Trip and/or day, observer code, event type (watch type, scan type, sighting, other), platform, time, latitude and longitude, weather, beaufort, wave height.

- Sighting species or vessel type, number, animal behavior, distance to gear, distance to vessel.

Appendix D: Forms Used by the Observers

The forms used by the AMMOP observers in Yakutat are as follows, with an indication of whether the forms are included in this Appendix. In some cases there were minor changes between 2007 and 2008.

- The Trip Information Form (included here).
- Set Gillnet Gear Characteristic Form (included here).
- Set Gillnet Haul Form (included here).
- Incidental Take Form (included here).
- Marine Mammal Sample Form (included here).
- Marine Bird Sample Form (included here).
- Marine Mammal Sighting Form (included here).
- Photo Form (for each roll of film shows the picture taken on an incidental take, large fish, unusual bird, etc.).
- Marine Mammal Stranding Report (gives information on the location and condition of each marine mammal found stranded by observers).
- Biological Chain of Custody Form (gives information about when a sample was taken from the carcass of a marine mammal or bird, the type of sample and its initial condition, and a record of who collected the sample, and all subsequent custodians).
- Fisher's Comment Form (included here).

NOAA Fisheries Alaska Marine Mammal Observer Program

Trip Information Form

Year	Month	Trip ID #	Fishery name & code	Geographical Region & Code
Trip Begin Date	Trip Begin Time	Trip End Date	Trip End Time	Trip Type 1 fully observed 2 partially observed 3 arrested 9 other
Fishing Permit #	Permit Selection Type 1 Primary 4 Secondary 9 Other	Ownership Status 0 Original Owner 1 Unknown 2 Permanent Transfer¶ 3 Temporary Transfer 9 Other	Operation Type 1 Single operator 2 Joint venture 3 Co-operative 9 Other 0 Unknown	Vessel Registration #
			Leased Net Y N	
			Length of Net Leased (Fm) + –	

Additional Trip Research:	1 none	2 marine bird sampling	3 shark tagging	4¶ fish sampling	5 stranding	9 other

Expected # Hauls	# Nets Fishing	# Skiffs Used	Primary Species Landed (name & code)	# Primary Species Landed

Dealer (name & code)	Delivery Location

# Marine Mammals Taken	# Marine Birds Taken	# Nets Observed	# Hauls / Picks Observed

Comments (continued on back: Y N)

Tracking	Debriefed	Received by NMFS	Reviewed by NMFS	Data Entered
Date				
Initials				

Form AMMOP 001-05 Page 1 of ¶

Set Gillnet Gear Characteristics Form

Year	Month	Trip ID #	Net ID #s

Lead Used	Net Combo	Hang Ratio	# Strands	Leadline Used
YES / NO	YES / NO			YES / NO

Lead Length (fm)	Net Length (fm)	Dropline Used	Leadline Weight (lbs/100 fm)
		YES / NO	

Lead Depth (mesh count)	Net Depth (mesh count)	Dropline Height (")	# Bouys
min max avg	min max avg		

Lead Twine Size	Net Twine Size	Weedline Used	Floatline Used
		YES / NO	YES / NO

Lead Material	Net Material	Weedline Material	Floatline Material
1=poly 2=nylon 8=combination 9=other (comment) 0=unknown	1=monofilament nylon 2=multi-filament nylon 3=six-strand mono 4=multi-strand mono 8=combination 9=other (comment)	1=twisted poly 2=braided poly 9=other (comment) 0=unknown	1=floating (w/poly core) 2=twisted poly 3=braided nylon 9=other 0=unknown

Lead Mesh Size Min (0.1")	Net Mesh Size Min (0.1")	Float Combination	Float Length (")	Anchors Used
		YES / NO		YES / NO

Lead Mesh Size Max (0.1")	Net Mesh Size Max (0.1")	# Floats	Float Distance (")	# Anchors

Lead Color	Net Color	Float Color	Float Shape / Hook Shape	Anchor Type
1=clear 2=white 3=black 4=gray 5=green 6=blue 7=red 8=pink 9=orange 10=yellow 11=purple 12=tan 13=combination 20=blue/green 22=blue/green/tan/gray 99=other	1=clear 2=white 3=black 4=gray 5=green 6=blue 7=red 8=pink 9=orange 10=yellow 11=purple 12=tan 13=combination 20=blue/green 22=blue/green/tan/gray 99=other	1=clear 2=white 3=black 4=gray 5=green 6=blue 7=red 8=pink 9=orange 10=yellow 11=purple 12=tan 13=combination 99=other	Float Shape: 1=sphere/ball 2=disk/donut/cylinder 3=oval/football 4=3D rectangle/rhombus 5=square or cube 8=combination (comment) 9=other (comment) Hook Shape: 1=L- shaped 2=V - shaped 3=J - shaped 4=Umbrella 5=Arrowhead 6=Flag 7=Diamond 8=Box 9=Zig Zag 1 =None 11=Pennant 99=Other (comment)	1=Danforth 2=Kedge 3=Manta 4=Bruce 5=Claw 6=Grapnel 7=Mushroom 8=Quick set 9=Screw 10=Scrap metal 11=Tied to vessel 12=Combo 99=Other 0=Unknown

Pingers Used	Pinger Brand	Alarms Used	Lights Used
YES / NO	1= Dukane 9= Other(comments 0=Unknown	YES / NO	YES / NO
# Pingers		# Alarms	# Lights

% Pinger Operating	Pinger Frequency (kHz)	Comments (Cont'd on back Y N)

Form AMMOP 002-07

Page ______ of ______

Set Gillnet Haul Form

Year	Month	Trip ID #	Haul #	Net ID #
Zone 1=Open water 2=Large bay 3=Sheltered bay 4=River 5=Channel or canal 6=River mouth/estuary 7=River mouth/open water 9=Other (comment)	Land 1=Main shoreline 2=peninsula /small island 3=sand bar 4=rocky reef 5=submerged land 8=not set from land 9=other (comment)	Tide 1=Ebb 2=Flood 3=High slack 4=Low slack 9=Other (comment)	Statistical Area Water Clarity (0.0m)	Water Temp (0.0 C) Air Temp (0.0 C)
Min Shore Distance (m)	Max Shore Distance (m)	Hydraulic Pump Used? Y N	# Skiffs	# Crew per Skiff
Skiff Size (ft)	Fishing Duration (hh.mm)	Soak Duration (hh.mm)	Primary target species (& code)	

	Date (mmddyy)	Time (24 hr)	Latitude (ddhh.m)	Longitude (dddhh.m)	Depth (fm)
Begin Haul					
End Haul					

Gear Damage	% Net Ran	% Net Pulled	% Net Observed	Incidental Take
1=no damage 2=<5% of net torn 3=5% < net torn < 25%				YES NO
4=25%< net torn < 50% 5=net torn > 50% 6=obstructed by debris < 50% 7=obstructed by debris > 50% 8=net totally balled up 9=other (comments)	Observation Quality 1=Excellent 2=Good 3=Fair 4=Poor 9=Other (comment)	CODES: Number & Weight Type A=Actual E=Estimated F=Fisherman's L=Landing/Fish Ticket	CODES: Animal Condition A=Alive D=Dead R=Recovering Tank U=Unknown	CODES: Disposition K=Kept D=Discarded

Species	Code	Number	Number Type	Weight (0.0 kg)	Weight Type	Disposition	Animal Condition	Reason (see codes)

COMMENTS: (Cont'd on back: Y N)

FORM AMMOP 003-07

NOAA Fisheries Alaska Marine Mammal Observer Program

INCIDENTAL TAKE FORM

YEAR	MONTH	TRIP IDENTIFICATION #	HAUL #

ID #	SPECIES (& CODE)	TAG #	TAG TYPE	TAG STATUS	DISENTANGLEMENT	HORIZONTAL LOCATION	VERTICAL LOCATION	ANIMAL CONDITION	INJURY	AGE CLASS	SEX (M, F, U)	PHOTOS (Y / N)	SAMPLE (Y / N)

Tag Type Codes

0=No tag
1=Cattle ear tag
2=Brand
3=Bleach, dye, or ink
4=Flipper tag
5=Dorsal fin tag
6=Metal leg tag
7=Plastic color leg band
8=Nasal tag
9=Spaghetti tag
10=Coded wire tag
11=Stomach tag
99=Other (comment)

Tag Status Codes

0=No tag
1=Applied by observer
2=Already on; left on by observer
3=Already on; removed by observer
9=Other (comment)

Disentanglement Codes

0=Unknown
1=Momentary snag; self-release
2=Released from net; unknown location
3=Released from net underwater
4=Released from net out of water
5=Released with gear damage
6=Released with cut to animal
7=Release required untangling
9=Other (comment)

Horizontal Location Codes

0=Unknown
1=Animal in first 1/3 of net
2=Animal in middle 1/3 of net
3=Animal in final 1/3 of net

Vertical Location Codes

0=Unknown
1=At water surface
2=Top 1/3 of net
3=Middle 1/3 of net
4=Bottom 1/3 of net

Animal Condition Codes

A=Alive
D=Dead
R=Recovering; comatose
U=Unknown

Injury Codes

0=Unknown
1=No external injury; responsive
2=No external injury; unresponsive
3=Wet plumage or oiled
4=Small Lacerations; missing plumage
5=Large wounds; excessive bleeding
6=Broken appendages
7=Ingested gear
8=Gear remained on the animal
9=Moderate decomposition
10=Severe decomposition

Age Class Codes

0=Unknown
1=Calf; pup; juvenile (hatch year)
2=immature
3=Adult

Comments
(include animal I D#; Cont'd on back? Y___ N ___)

Form AMMOP 004-07

Page _______ of _______

Year	Month	Trip Identification Number	Haul Number	*NMFS Alaska Marine Mammal Observer Program* **MARINE MAMMAL SAMPLE FORM** Page Number ____ of ____

Tag Number	Species (& code)	Standard Length (cm)	Girth (cm)	Flipper Length (cm)	*Flipper Width (cm)*	*Dorsal Fin Height (cm)*	*Fluke Width (cm)*	Blubber Thickness (mm)	Skin (Y;N)	Retained Whole (Y;N)	Jaw or Teeth (Y;N)	Stomach (Y;N)	# Other Samples

Comments (include the tag number of the referenced animal)
(Continued on Back: Y ___ N ___)

2002

Year	Month	Trip Identification Number	Haul Number	*NMFS Alaska Marine Mammal Observer Program* **MARINE BIRD SAMPLE FORM** Page Number _____ of _____

Tag Number (or Id #)	Species (& code)	Plumage		Body Measurements					Condition		Retained Samples			
		Phase	Feather	Weight (g)	Head-Bill (mm)	Culmen Length (mm)	Tarsus Length (mm)	Wing Chord (cm)	Brood Patch	Fat Index	Whole (Y;N)	Head Feet (Y;N)	Stomach (Y;N)	# Other Samples

Phase Codes
S = Summer (breeding) plumage
T = Transitional (molt in progress)
W = Winter (basic) plumage
J = Juvenile plumage
U = Unknown / can't tell

Feather Codes
1 = No missing feathers
2 = One or more primary flight feathers missing
3 = One or more secondary flight feathers missing
4 = One or more tail feathers missing
5 = Missing feathers in wings and tail
6 = Other missing feathers (body, head)
0 = Not checked, or can't tell

Fat Index Codes
1 = Skin very thin, feather ends obvious; no fat along keel or around heart; emaciated
2 = Skin moderately smooth with fat; little fat along keel but none around heart; not emaciated
3 = Skin has moderate fat; fat evident along keel, with some traces around heart
4 = Skin smooth with fat; fat deposits along keel and around heart
5 = Skin thick with fat, feather points barely visible; heavy fat along keel and heart, and spots of fat in interstitials
0 = Unknown or unable to check

Brood Patch Codes
1 = No defeathering
2 = Loss of down and some contour feathers
3 = Loss of down & most contour feathers; vasc. beginning
4 = Loss of feathers & heavy vascularization
5 = Regression beginning, down appearing
6 = Downy, feathers beginning to break sheath
7 = Partial or near-complete regression
0 = Didn't check, or carcass too degraded

Comments (include the tag number of the referenced animal)
(Continued on Back: Y ___ N ___)

2002

NOAA Fisheries Alaska Marine Mammal Observer Program

Year	Month	Trip ID #	Observer ID #	Date (DD/MM/YY)	**Marine Mammal Sighting Form**

Event #	Event Type	Platform	Time (hh:mm) 24 hr	Latitude (ddhh.m)	Longitude (dddhh.m)	Weather	Beaufort Sea State	Wave Height (0.1 m)	Species Name and Code	Number	Animal Behavior	Distance to Gear (m)	Distance to Vessel (m)

Event Type Codes
1=Begin haul watch
2=End haul watch
3=Begin transit watch
4=End transit watch
5=Begin set watch
6=End set watch
7=Begin soak watch
8=End soak watch
9=Horizon scan
10=Net scan
11=sighting; on watch
12=sighting; off watch
99=other (comment)

Platform Codes
1=Observer skiff
2=fishing skiff/vessel
3=Research vessel
4=Shore, beach
5=shore, cliff/hill
6=shore, dock
7=aerial
9=other (comment)

Weather Codes
1=Clear (<10% cloud cover)
2=Partly cloudy (10-50% cloud cover)
3=Cloudy (51-90% cloud cover)
4=Overcast (>90% cloud cover)
5=Drizzle
6=Rain
7=Fog
8=Sleet or snow
0=unknown

Beaufort Wind /Sea State Codes
Code = Wind Speed & ea State
0=< 1 kt & mirror-like surface
1=1-3 kt & ripples/no foam crests
2=4-6 kt & small wavelets/crests glassy – not breaking
3=7-10 kt & large wavelets / breaking crests / scattered whitecaps
4=11-16 kt & small waves/numerous whitecaps
5=17-21 kt & moderate waves/many whitecaps/some spray
6=22-27 kt & large waves/whitecaps everywhere
7=28-33 kt & sea heaps up/streaks of foam
8=34-40 kt & moderate high waves/sprindrifts/blowing foam

Animal Behavior Codes
1=Swimming
2=Milling/circling
3=Sounding
4=Porpoising
5=Bow riding
6=Breaching
7=Thrashing
8=In flight
9=Taking flight
10=Landing on water
11=Feeding on catch
12=Foraging on other prey
13=Floating on surface
14=Vessel avoidance
15=Bird avoidance
16=On land
99=Other (comment)

Comments: (include Event # and time; cont'd on back Y____ N____)

Form AMMOP 006-05

Page ______ of _______

FISHER'S COMMENT FORM

Year	Month	Trip Identification Number	Fishery Name (& code)

Vessel Name	Vessel Number	Fishing Permit Number

Today's Date	Fisher's First Name	Fisher's Last Name

Comments (Continued on Back: Y ___ N ___)

2002