# Harbour Porpoise Interactions with the 2001 Selective Salmon Fisheries in Southern British Columbia and License Holder Reported Small Cetacean By-Catch

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## Executive Summary

We estimated the incidental mortality of harbour porpoise (*Phocoena phocoena*) in selective salmon fisheries in southern British Columbia from reports received from federal fisheries observers (2001) and license holders (1997 - 2001).

Data sheets were developed to record prevailing conditions at the time of a harbour porpoise entanglement event. These were incorporated into the existing Federal Fisheries Observer Program. Data collection occurred throughout the 2001 - commercial salmon fishing season in the coastal waters of southern British Columbia.

Neither the seine net, nor the troll salmon fisheries reported entanglements in 2001. All observer reported entanglements of small cetaceans were phocoenids and all were caught in gill nets. In total, four porpoises were incidentally caught – each in a different statistical licensing area (licensing areas 12, 21, 25, 121). Two of these four (50%), were released alive. The two by-caught harbour porpoises that could not be released alive, died in the gill nets before either the observer or the vessel's crew were aware of the collision. When mitigative actions were effected, live release resulted. At a minimum, the porpoises sustained superficial lacerations from the rescue efforts and the gill net collision. Morphometric and scan zone data indicated that the by-caught harbour porpoise were likely solitary juveniles.

A total of 979 gill and seine net license holders were sent a questionnaire regarding their knowledge and experiences with harbour porpoise. Of these, 27.6% returned their completed questionnaires: 250 were used in the final analysis. Respondents had an average of 33.5 years fishing experience, with two-thirds of them reporting a multi-gear career. Respondents expressed a keen willingness to participate and provided details of their harbour porpoise experiences, as well as information about other small cetacean encounters.

Respondents reported a total of 14 incidents, involving 19 harbour porpoise incidentally caught between 1997 and 2001. All were with gill nets and most involved single animals. The license holders reported a 52.6% overall release rate, with a 100% release rate for those found alive. Damage to gear was usually caused by the rescue efforts, rather than by the entangled porpoises.

Human intervention was required, as none of the phocoenids were able to disentangle themselves. Porpoises appeared to respond well to human intervention and handling, as indicated by the few reports of mortality occurring during a rescue (ancillary reports prior to the 1997 - 2001 focus period). The license holder's responses indicated that most of the incidental catch events occurred in Salmon Statistical Licensing Areas 4, 8, 12, 21 and 22.

Based on the number of by-caught porpoises reported through the observer program, the total theoretical mortality for southern BC (Statistical Areas D and E) is 20 animals per 810 boat days fished, or 80 porpoises for the 2001 fishing effort. Given that harbour porpoise accounted for all observer reported phocoenid mortality, this translates to an estimated mortality of 80 harbour porpoise for the 2001 effort. Poisson distribution 95% confidence levels determined annual phocoenid mortality between 11 and 102 animals for southern BC (salmon licensing

areas D and E). It is likely that the proportions of harbour to Dall's porpoise killed annually are variable based on differential overlap of gill net fisheries with phocoenid spatial and temporal distribution.

This estimate was based on a very small sample size and assumed that catch rates were the same across all statistical areas. However, this assumption is questionable given that harbour porpoise and fishing effort have heterogeneous distributions.

A second estimate derived from the province-wide career experiences of license holders (1997 - 2001) yielded an estimated incidental catch of 14.1 harbour porpoise per year, with an annual mortality of 6.6 animals and Poisson distribution 95% confidence levels of 23 - 61 porpoises killed annually.

Our estimates suggest that fewer than 100 harbour porpoise are killed each year by commercial salmon gill net fisheries. However, the biological significance of our estimates of mortality is unknown due to a lack of information about numbers and rates of birth, and natural mortality of BC harbour porpoise. What we do know is that fishery caused mortality of harbour porpoise continues throughout the province, including trans-boundary areas with Washington State, even in times of reduced fishing effort. This has special significance for any populations that are at risk of gear entanglement in both US and Canadian waters, and to any populations, which are small or have restricted ranges.

The fact that mortality occurs in a highly regulated fishery raises the possibility that considerably higher mortality may have occurred in times of more permissive fisheries. If so, reduced fishery related mortality today, may mean the recovery of harbour porpoise populations historically diminished by fisheries. This in turn, underlines the need for further monitoring in southern BC and implementation of standardized reporting of harbour porpoise by-catch from central and northern regions.

Approximately half of the observer and license holder reported incidentally caught porpoises were released alive. This speaks well to the efforts of gill net fishermen in British Columbia. Further efforts to reduce harbour porpoise by-catch and increase live release rates must be practical to a commercial fishing situation and must consider the effects to the efficiency of the target species fisheries.

A number of recommendations stem from our study to reduce incidental catch and increase live release rates. These include further investigation into selective gill net fishery modifications, improving observer training specific to marine mammals, rescue and release protocols and augmenting harbour porpoise biological research.

Time or area restrictions and the introduction of acoustic net alarms do not appear to be appropriate management tools at this time, due to the uncertainty associated with the estimates of mortality, the lack of knowledge about harbour porpoise biology and the apparent rarity of occurrence per boat day fished or per respondent license holder.

## Introduction

Many populations of harbour porpoise (*Phocoena phocoena*) appear to be decreasing throughout the species range (Gaskin 1984). In many cases, this decline has been attributed to interactions with fisheries. According to the International Union for the Conservation of Nature, the single most important action that must be accomplished to protect the harbour porpoise is to reduce incidental take in gill nets and other fishing gear (Klinowska 1991).

Harbour porpoise populations are threatened by incidental mortality, due to their mostly inshore distribution and dietary preference for commercially important prey. Many populations are either depleted or have disappeared, probably due to these interactions (Gaskin 1984, 1992). Harbour porpoise have virtually disappeared from the Baltic (Andersen 1972, Kinze 1985) and the Black Seas (IWC 1982, 1983) and are thought to be declining in the southern North Sea and the English Channel (Evans 1987, van Kreveld 1987). In 1990, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) accorded a threatened status to the Northwest Atlantic harbour porpoise population of Canada, as a result of the substantial population declines caused by incidental catches in the gill net fishery (Gaskin 1991). A designation by COSEWIC on the status of the western Canadian (Northeastern Pacific) population is pending.

Barlow *et al*. (1994) reviewed cetacean and pinniped mortality in coastal North Pacific fisheries and determined a larger effort is required to determine the number of animals killed in fisheries and to evaluate the significance of this mortality to the populations. Barlow *et al*. (1994) also suggest that some level of direct observation seems necessary to accurately estimate the by-catch in the salmon drift gillnet fisheries of BC, as use of indirect methods alone are likely to result in a mortality underestimate.

The potential impact of commercial fisheries on harbour porpoise in British Columbia is of interest for the long-term conservation of this species. Some reports indicate the harbour porpoise numbers in Puget Sound, WA and around southern Vancouver Island, BC are reduced from several decades ago (Flaherty and Stark 1982, Gaskin 1984, Cowan 1988, Calambokidis and Baird 1994). The unknown extent to which harbour porpoise interact with fisheries in this region is compounded by the sparse biological knowledge available for this population.

Seasonal abundance, distribution and habitat use are not understood for the harbour porpoise population(s) of British Columbia. Nor is it known, if individuals or groups of individuals maintain any degree of site fidelity or to what extent they move throughout the trans-boundary regions of southern BC and northwestern Washington State. Such basic biological information is of primary consequence if the impact of fisheries interactions to the population is to be fully comprehended.

Although scientific assessment is not available for BC waters, there are some data from US waters that provide insight into this issue. The estimated level of incidental mortality for the Inland Washington State harbour porpoise stock is near the calculated Potential Biological Removal (PBR) (NMFS 2000). According to the National Marine Fisheries Service (NMFS) calculations, only one additional observed incidental harbour porpoise mortality or injury is required to exceed the

PBR. This calculation does not account for incidental mortality that may occur in British Columbia, or any movement of animals between American and Canadian waters. The question is not whether fishery related mortality occurs in British Columbia, but rather, to what extent and where it occurs, and what the biological ramifications might be given that entanglement in gill nets and other fishing gear has long been known to cause small cetacean mortality in BC and Washington (Scheffer and Slipp 1948).

Our study was undertaken to determine the level of harbour porpoise incidental mortality during the 2001-fishing season in selective salmon fisheries, with focus on the commercial gill and seine net operations in southern British Columbia. We begin with a brief overview of harbour porpoise biology before outlining our direct and indirect sampling methods that emphasize by-catch location and gear type.

Complementary to the fisheries interactions research, we conducted a 12-month line transect survey to determine trends in harbour porpoise seasonal abundance and depth distribution in southern Vancouver Island waters to gain greater understanding of this species annual habitat use. In concert, these components provide the first comprehensive, systematic survey for harbour porpoise in this region, and furthers our understanding of harbour porpoise ecology and interactions with commercial net fisheries. This report will address only the fishery related mortality component of the project.

Harbour Porpoise Biology

The harbour porpoise has a Northern Hemisphere, circumpolar distribution inhabiting the cold-temperate, sub-arctic waters of North America, the Russian Federation and Eurasia; as well as some mid North Atlantic landmasses, such as the Faeroe Islands, Greenland and Iceland. Three major isolated populations exist: the North Pacific, the North Atlantic and the Black Sea-Sea of Azov (Gaskin 1992).

Harbour porpoise reach lengths of 1.5 to 1.8 meters (4.9 - 5.9 feet) and are relatively short lived, with an expected lifespan of less than 20 years (Read 1990, Read *et al*. 1997). Females sexually mature between 3 and 4 years of age, producing a single annual calf (Read 1990). Calf survival rates and female senesce are unknown.

Harbour porpoise prey upon commercially important fish and squid species, relying heavily upon herring, eulachon, walleye pollock, hake, sandlance and market squid (Recchia and Read 1989, Smith and Gaskin 1974, Scheffer 1953, Wilke and Kenyon 1952, Fontaine *et al*. 1994, Walker *et al*. 1998). Harbour porpoise are primarily a coastal water inhabitant, although there have been sightings up to 37 kilometers offshore in California (Scheffer and Slipp 1948, Pike and MacAskie 1969, Everitt *et al*. 1980).

Harbour porpoise are one of the world's smallest odontocetes and are often most difficult to observe. Dorsally they are gray-brown, with lighter lateral undersides, which become white on the most ventral surface. A distinctive lateral dark grey stripe extends from the corner of the mouth to the anterior insertion of the pectoral flipper on both sides of this small mammal. The width and pigmentation of this stripe varies among individuals. However, it is rarely visible on wild, healthy animals. Harbour porpoise exhibit the characteristic spade-shaped teeth of the Phocoenidae family, which are often worn to the jawbone or are missing in older individuals and are not yet erupted in very young calves. Slight sexual dimorphism exists within this species, with females approximately one kilogram heavier than males at the same age and length (Yasui and Gaskin 1986).

Harbour porpoise break the surface with little disturbance and rarely breach or display. Sea conditions greater than Beaufort 2 greatly reduce the possibility of sighting this species, as the dorsal fin is approximately 15 - 20 centimeters (6 - 8 inches) in height and has no distinctive pigmentation patterns. However, in calm conditions, the dorsal fin of the harbour porpoise can be easily identified as it breaks the ocean surface with a smooth forward rolling motion, almost as if it were attached to a submersed wheel. In some regions of the Pacific Ocean, the distribution of harbour porpoise and Dall's porpoise (*Phocoenoides dalli*) overlap, as is the case in the inshore regions of British Columbia. In these areas, the two species are discernable based on pigmentation patterns, dorsal fin shape and behaviour. The leading edge of the harbour porpoise dorsal fin is longer than the trailing edge, which is the exact opposite of the black and white Dall's porpoise. Harbour porpoise also rarely approach moving vessels, unlike Dall's porpoise which commonly bowride. The behaviour of harbour porpoise combined with their small size and counter-colouration contributes to a most cryptic existence, even though this species inhabits regions that are often proximal to populated areas.

## Methods

Observer Data Collection

A three-page data form was distributed to observers that were aboard selective salmon fishery vessels during the 2001 season to provide a cursory examination of the small cetacean by-catch in gill and seine nets throughout southern British Columbia. Our primary focus was on harbour porpoise interactions with fisheries by gear type and location. However, we included all other marine mammals to yield as much information as possible about fishery interactions. Coastal areas of British Columbia, open to commercial selective salmon fisheries, defined the study area (Figure 1). For more information regarding the 2001 commercial salmon fishery, please see Fisheries and Oceans Canada 2002 summary report.

All data were collected by commercial fishery observers on a per day fished basis. Data collection was divided into 3 parts (Appendix 1):

- Part A - general marine mammal by-catch
- Part B - small cetacean by-catch
- Part C - marine mammal/vessel abundance.

General by-catch data were collected for all marine mammals in Part A to determine which species became entangled. Observers were asked to report the time of day and gear type used when the by-catch event occurred. For gill nets, the position within the net was also documented. Ancillary information collected included whether the entangled animal was brought on board or if it dropped out of the net during net retrieval, and whether mitigative efforts were exercised to deter entanglement. Observers were asked to define these efforts (examples were provided).

Figure 1. British Columbia Salmon Statistical Licensing Areas as Defined by Fisheries and Oceans Canada

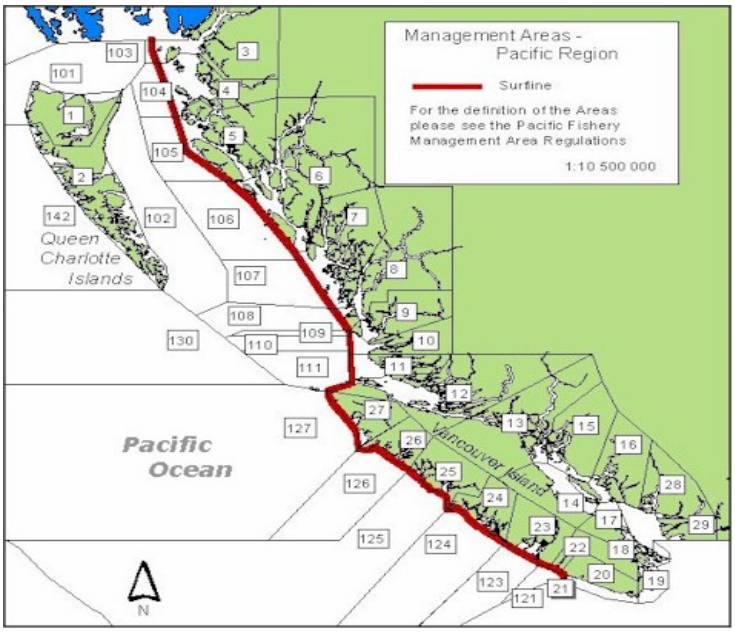


Image from Fisheries and Oceans website:
http://www.pac.dfo-mpo.gc.ca/ops/fm/Areas/areamap.htm

Observers were requested to complete Part B *only* if a small cetacean was incidentally caught. This consisted of a 1-page questionnaire intended to gain insight into the by-catch event. The form was divided into four sections and was designed to be simple and quick to complete, while yielding sufficient information to allow comprehensive analysis.

The first section required a reference to Part A for continuity and inquired into whether the by-catch event was signaled by any surface indications. The second section consisted of nine questions directly related to the entanglement. To allow for efficiency at sea, observers were simply required to circle the correct answer or fill in the blanks. Requested morphometric and biological data of dead porpoises included length, girth, weight, sex, distinguishing marks and presence or absence of blood or foam in the mouth or blowhole.

The purpose of this data collection was to determine whether any particular size or sex was more prone to fisheries interactions. Finally, the observers were asked to provide any additional information relevant to the entanglement event. Again examples were provided.

Part C was designed to document the general physical conditions observed during fishing activities. Observers were asked to report all marine mammals and vessels observed per fishing day within two scan zones of the gear. Scan Zone 1 was designated as within 50 meters of the gear and Scan Zone 2 was any distance beyond Scan Zone 1.

Physical data collected in Part C included the set number, gear type, statistical area, location, time of sighting, sea state and the number of other vessels in the area. Biological data collection consisted of the number and species of marine mammals observed in the presence of selective salmon fisheries gear. As in Part B, an observer comments section was provided.

The observer data forms were accompanied by a four-page explanatory form designed to guide observers through the data collection process, and answer questions they may have had regarding the goal of the study (Appendix 2). This document included a brief description of each data entry requirement, as well as a species identification guide for the three most common small cetaceans of British Columbia; harbour porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*) and Pacific White-sided Dolphins (*Lagenorhynchus obliquidens*). As identification of these three can be quite difficult, physical descriptions of each were provided on the explanatory form with a picture. In addition to this, species-specific surface behaviours were included to aid in correct identification.

We emphasized that these three species are not the only small cetaceans found in British Columbia, and that observers would have to consult the marine mammal identification guide provided in their observer package to correctly identify other species.

Diagrams were included to assist observers in measuring and sexing by-caught, decked animals. A statement of caution was incorporated reminding observers that live caught animals must be handled carefully, with minimum human contact and

that *estimates* of length, girth and weight would suffice. In this situation, successful release with minimal disturbance or stress to the animal was the priority.

A written explanation of desired data was included for Part C - Marine Mammal and Vessel Abundance. The explanatory form finished with a table of the Beaufort scale including maximum wave heights and wind speed in knots. The sea state conditions described as a Beaufort number allowed for quick standardized data collection. Finally, observers were reminded to include their full name, written clearly, on the data forms if they wished to be acknowledged in the final report.

To further reduce any ambiguity in the data collection format, a sample of the three-part data form was provided to each observer for clarity (Appendix 3).

The data, explanatory and sample forms (Appendices 1, 2 and 3) were distributed to the southern British Columbia fisheries observers through the Observer Program with the assistance of Mr. Leroy Hop Wo and Mr. Lee Keary. Upon the return of the data sheets, Mr. Ian Wrohan compiled the data in Microsoft Excel 2000 for analysis.

License Holder Questionnaire

The second component of the by-catch assessment involved sending a "request-for-information-questionnaire" to all British Columbia commercial gill net and seine net license holders (n=979) (Appendix 4). This request was prefaced with an introductory letter explaining the focus and the purpose of the project. We kept the questionnaire to two pages in length and stated that completion should only take about 10 minutes. We also included a self addressed, stamped envelope to minimize the effort on the part of the license holder and to further enhance the likelihood of the questionnaire being completed and returned. This letter also stated that the participant's identity would remain confidential and included phone numbers for both the University of British Columbia's Office of Research Services and the Marine Mammal Research Unit, if the license holder had any questions or concerns. We thanked the participants in advance for their assistance and offered to send a report summary when complete. It was made clear that the license holder's experiences were valuable in understanding the interactions between small cetaceans and commercial fishing gear.

The questionnaire began with a picture of a harbour porpoise to reduce potential confusion for respondents between this and other common small cetacean species in inshore British Columbia. Questions focused on the past 5 years of fishing (1997 - 2001) and pertained to any incidents that may have occurred between the license holder and harbour porpoise. Only recent events were focused on, as the nature of BC commercial salmon fisheries changed in 1997 in response to Coho salmon (*Oncorhynchus kisutch*) conservation concerns. We asked for information about gear type, gear damage, the animal's condition and whether or not the animal was released alive. Participants were also asked to recall the location and time of year of particular incidents.

Questions to ascertain the participant's experience included number of years fished, gear types used, regions fished and whether or not they participated in the 2001 season. The license holder was also asked to recall any other small cetacean by-catch that had occurred during their career.

To conclude the survey, the license holder was asked to add any further information they thought may be important to the study. Again, we thanked the license holders for their assistance and requested that the completed questionnaire be returned by January 31, 2002.

We distributed the questionnaire via Canada Post to all regular license (A-Tab) gill and seine net holders and 8 F-tab Seine license vessel owners on December 24 and December 26, 2001. Only one questionnaire was sent to each address, to avoid sending multiple copies to multi-license individuals or companies. The Northern Native Fishing Corporation, NNFC, (N-Tab) and most DFO ATP licenses (F-Tab) were excluded from this survey because we felt that disseminating the information through the NNFC or a Native Band would be difficult to achieve within our allotted time frame.

The University of British Columbia's Behavioural Research Ethics Board and Animal Care Committee approved research permits for the methods described herein.

## Results

Observer Data Collection

Species sightings and gear entanglements were reported by observers based on gill net (n=48), seine net (n=11) and troll vessels (n=15). Single species incidents accounted for 72 of the 74 entries. Two incidents were of two species simultaneously observed (gill net, n=1; troll, n=1). The southern British Columbia 2001 commercial data were collected by observers from 18 June to 15 November for the salmon gill net fishery, 6 August to 27 October for the salmon seine net fishery and from 27 July to 9 October for the salmon troll fishery. Troll fishery data will not be further discussed, as all entries were observations only. No marine mammal by-catch was reported in the 2001 salmon troll fishery.

Of the 60 reported species interactions with gill and seine nets, observers documented that 80.0% (n=48) were pinnipeds, 15.0% (n=9) were cetaceans and 5.0% (n=3) were mustelids. Killer whales (*Orcinus orca*), porpoises (species undetermined) and sea lions (species undetermined) were reported to have interacted with both gear types. Porpoises were only reported as observed near gear once (from a seine vessel) when no entanglement occurred. All other porpoise data stems for gear collisions.

Table 1 summarizes the frequency of occurrence, not the number of individuals, to avoid numerical biases in the group size estimation by different observers. In several instances, the group size was recorded as "multiple" rather than a whole number making tabulation of the exact number of animals involved impossible.

Table 1. Total Observer Reported Marine Mammal Interactions with Gill Net (GN) and Seine Net (SN) Fishing Gear

| Observed Species | Number of Observations | Gear | Number of Entanglement Incidents | Gear |
|---|---|---|---|---|
| **Cetacean Species** | | | | |
| Harbour Porpoise | 0 | -- | 2 | GN |
| Dall's Porpoise | 0 | -- | 1 | GN |
| Unknown Species - Porpoise | 1 | SN | 1 | GN |
| Pacific White-sided Dolphin | 1 | SN | 0 | -- |
| Gray Whale | 1 | GN | 0 | -- |
| Killer Whale | 2 | GN-1, SN-1 | 0 | -- |
| **Total** | **5** | **GN-2, SN-3** | **4** | **GN-4** |
| | | | | |
| **Pinniped Species** | | | | |
| Harbour Seal | 0 | -- | 1 | GN |
| Unknown Species - Seal | 6 | GN | 0 | -- |
| California Sea Lion | 1 | GN | 0 | -- |
| Steller Sea Lion | 1 | GN | 0 | -- |
| Unknown Species - Sea Lion | 34 | GN-28, SN-6 | 5 | GN-3, SN-2 |
| **Total** | **42** | **GN-36, SN-6** | **6** | **GN-4, SN-2** |
| | | | | |
| **Mustelid Species** | | | | |
| Sea Otter | **3** | GN | **0** | -- |

Figure 2. Marine Mammal Interactions with Gill Net and Seine Net Fisheries by Statistical Area

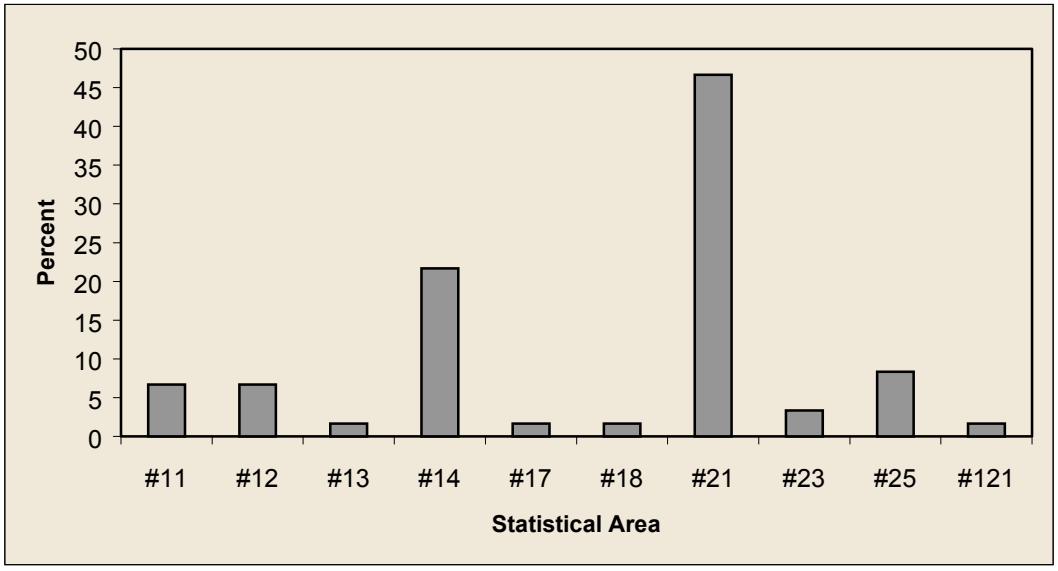


Figure 2 presents the proportion of reported marine mammal interactions by salmon statistical licensing area. More than two-thirds (68%) of the observer data were reported from statistical areas 14 and 21. Cetacean and pinniped species accounted for 2 and 38 of the reported 41 interactions, respectively, in these areas. One mustelid interaction was reported in Area 21.

Compilation of the 2001 - pinniped and mustelid fishery interactions, as well as a comprehensive account of historical mammal and bird reports are in progress (Ian Wrohan, Pacific Biological Station, pers. comm.). Neither mustelid, nor pinniped interactions will be further discussed in this report.

Cetaceans were encountered in five statistical areas as follows: Area 11 (n=1), Area 12 (n=4), Area 21 (n=2), Area 25 (n=1) and Area 121 (n=1). Again, the number of interactions, not the number of individuals, was tabulated and a species classification by statistical area is presented in Table 12 (Appendix 5). The statistical significance of the observed differences between statistical areas could not be ascertained because of the small per area sample sizes.

Observer reported cetacean interactions, which resulted in a net collision, are summarized in Table 2. All involved gill nets and single phocoenids. It is unknown whether the animals which were entangled and released alive, survived.

Codes presented in Table 2 were assigned to ensure continuity with entanglement and physical details and are used herein to identify individuals, rather than species common names.

Table 2. Observer Reported Phocoenid Gill Net Entanglement and Mortality

| Species Common Names | Number | Gear | Result | Mammal Code |
|---|---|---|---|---|
| Harbour porpoise | 1 | Gill net | Dead | 01M2 |
| Harbour porpoise | 1 | Gill net | Dead | 01M33 |
| Dall's porpoise | 1 | Gill net | Released Alive | 01M4 |
| Unknown species - porpoise | 1 | Gill net | Released Alive | 01M28 |

Table 3. Entanglement Event Physical Conditions

| Code | Date | Stat. Area | Sub-area or Zone | Location | Set Number | Time | Sea State | Wind Speed, kts |
|---|---|---|---|---|---|---|---|---|
| 01M2 | 25-Oct-01 | 21 | -- | 2 km NW of Carmanah Light | 2 | 13:06 | Chop | 10-12 |
| 01M33 | 4-Oct-01 | 12 | 8 | Malcolm Island | -- | 15:10 | 0 | 0 |
| 01M4 | 24-Oct-01 | 121 | -- | 1/2 mile from Carmanah | -- | 10:15 | -- | -- |
| 01M28 | 25-Sep-01 | 25 | 6 | 1 mile south of Boston Point | 6 | 18:05 | 0 | 0 |

All phocoenid by-catch occurred within one month from 25 September to 25 October. Each event transpired in a different area: salmon statistical licensing areas 12, 21, 25 and 121. However, statistical areas 21 and 121 are adjacent to one another, as indicated by the location identifiers (Table 3). A different observer reported each porpoise event (sighting or entanglement).

In the waters off Carmanah, one harbour porpoise and one Dall's porpoise (01M2, 01M4) were entangled in gill nets on consecutive days, within a 27-hour period (Table 3). Although 01M33 and 01M28 were caught within 10 days of each other (Table 3), 01M33 was entangled near Johnstone Strait (Area 12) and 01M28 in Nootka Sound (Area 25), which are geographically distinct regions (Figure 1). Both reported incidentally caught harbour porpoise (01M2 and 01M33) died in the gill nets.

No other marine mammals or fishing vessels were sighted in either scan zone, prior to or during each entanglement event (Table 4). By-catch event 01M2, occurred during wind speeds of 10 -12 knots (Table 3), when sea conditions would have reduced the likelihood of seeing other marine mammals. This translates to Beaufort number 3 - 4, which corresponds to approximately a 1.2-meter (4 ft.) wave height (Appendix 2). The sea conditions were recorded as calm (Beaufort 0) for the entanglement events of 01M33 and 01M28 (Table 3). No physical conditions were recorded for the 01M4 event.

There was no reported surface indication of net encounter for 01M2, due perhaps to the reported sea conditions (Table 4). No mitigative actions were taken, although 01M2 was recovered from the top one-third of the net (Table 4). Harbour porpoise 01M2 reportedly had small lacerations on its dorsal fin and dorsal surface, just anterior of the fin. This animal was found completely entangled, at the very end of the net, likely the cause of the facial bleeding (Table 5). The observer surmised that the cause of death was drowning - probably the most parsimonious explanation for the expiration of this phocoenids life. Mortality occurred within 60 minutes (Table 5) of the commencement of the second set (Table 3).

Both 01M33 and 01M4 were caught in the middle one-third of the net (Table 4). No surface indication of the entanglement was observed for the former and no mitigative action thus occurred. No blood was observed, but the porpoise was reported as "quite stiff when landed". Perhaps indicating the onset of *rigor mortis*. In the case of 01M4, seal bombs were unsuccessfully used to prevent entanglement (Table 4). Refer to Appendix 1 for mitigative effort codes. A rescue was initiated by cutting 01M4 out of the gill net and releasing it alive. 01M4 was reported by the observer as "bleeding but vigorous at the time of release". No additional information was reported for 01M4.

01M28 was caught during the sixth set (Table 3) and became entangled in the top one-third of the net, very near the surface. Both observation of the phocoenid and net movement prompted mitigative actions. The observer described a statement made to the skipper that a "dead porpoise was *not* an option". The rescue ensued and a live release occurred within 10 - 12 minutes (Table 5). The observer reported that the release occurred with "minimum trauma" and that the animal's skin was very delicate and susceptible to laceration. 01M28 had two small cuts on the side of its left tail fluke, which the observer presumed were from the net. This porpoise was reported to be making “loud audible vocalizations”, interpreted by the observer as distress calls.

Entanglement events in which mitigative actions were exercised resulted in live releases (01M4, 01M28) (Table 4). None of the entangled phocoenids were able to disentangle themselves. For ease on the part of the observers reporting, mitigative efforts were described with numerical codes presented in Part A of the data collection forms (Appendix 1). Porpoises were only decked post-mortem.

Observers provided physical details for animals 01M2, 01M33 and 01M28, excluding sex, which was either recorded as "uncertain" or omitted from data collection. Standard length was reported for harbour porpoise 01M2 and 01M33, at 137.4 cm (4.51ft) and 91.4 cm (3.48ft), respectively (Table 5). 01M33 was much smaller, at about one-third the weight and girth of 01M2, at 27.2 kg (60 lbs) and 27.9 cm (0.92 ft), respectively (Table 5).

The unidentified species of porpoise (01M28) was a medium size, compared to either of the harbour porpoise, at a standard length of 111.8 cm (3.67 ft) and an approximate weight of 65 kg (143.3 lbs) (Table 5). All weights were estimates, as were the length and girth measurements reported for 01M33, since no measuring tape was available. No morphometric data were provided for 01M4 (Dall's porpoise), as live release was identified as the priority over measurements.

Table 4. Capture Details

| Code | Scan Zone 1 | Scan Zone 2 | Mitigative Efforts | Position in Net | Decked | Observer Reported Surface Indication | Alive | Released |
|---|---|---|---|---|---|---|---|---|
| 01M2 | 1 porpoise in net | -- | 1 | Top 1/3 | Yes | No indication | No | N/A |
| 01M33 | -- | -- | -- | Middle 1/3 | Yes | No indication | No | N/A |
| 01M4 | -- | -- | 3 | Middle 1/3 | No | -- | Yes | Yes |
| 01M28 | 1 porpoise in net | -- | 4 | Top 1/3 | No | Animal visible, net moving | Yes | Yes |

Table 5. Incidentally Caught Porpoise Morphometric Data

| Code | Time Between Catch and Release | Time in Net Prior to Expiry | Length, cm | Girth, cm | Weight, kg | Bleeding |
|---|---|---|---|---|---|---|
| 01M2 | -- | Up to 1 hour | 137.4 | 84.0 | 75.0 | A little around the mouth |
| 01M33 | -- | Unknown | 91.4 | 27.9 | 27.2 | No |
| 01M4 | -- | -- | -- | -- | -- | -- |
| 01M28 | 10-12 min | -- | 111.8 | -- | 65.0 | 2 small net cuts, leading edge of tail fin, left side |

License Holder Questionnaire Results

Of the 979 questionnaires mailed in December 2001, 269 license holders responded either through return of the questionnaire (n=263), phone conversations (n=2), letter (n=1) and email (n=3): five were returned as undeliverable, yielding a total return rate of 27.6% (269/974). Of the returned questionnaires, 19 were excluded from the final data set for either answering in regard to harbour seals (n=1), expressing hostility (n=2), answering less than 4 questions (n=9), providing inconsistent answers (n=1) or responding more than two months after the specified deadline (n=6). The final data set consisted of responses from 250 license holders. Sample sizes are indicated for questions with less than 100% response.

A total of 145 respondents (53.9%) requested a report summary and the Fishing Vessels Owners Association (FVOA) requested an executive summary for their newsletter.

Observations of harbour porpoise during fishing activities within the last five years were reported by almost half of all respondents (n=120, 48.0%) (Table 6). However, only 11.7% (n=14) of those reported a gear collision (Table 6). Gill net license holders reported all entanglement events, although both gill net and seine net fishermen reported observations of the species.

Single incidents were recounted by 11 of the 14 respondents (Table 6), of which nine involved single animals and two reported pairs. Three respondents reported multiple by-catch events, with each of these reporting two events of single animals. A total of 19 harbour porpoise were reported incidentally caught since 1997 (Table 7), with 78.9% (n=15) colliding with the gear as single animals (Table 6).

The condition at the time of discovery of the by-caught phocoenids is summarized in Table 7 from license holder comments. Vigilance on the part of the fishermen resulted in over half (n=10, 52.6%) entangled harbour porpoise being found alive, and of those, 100% were reported successfully rescued and released (Table 7). To facilitate this, gill nets were cut in four of the 10 rescues, resulting in substantial damage to the gear. This accounted for four of the five reports of substantial gear damage (Table 7). The fifth involved a carcass removal, which resulted in a one-meter hole in the web.

Table 6. License Holder Reported Harbour Porpoise Observations and Gill Net Collisions in Last Five Years

| | Observed in last 5 years | Collisions with gear | Single Incident | Multiple Incidents | Single Animal | Pair |
|---|---|---|---|---|---|---|
| **Reported** | 120 | 14 | 11 | 3 | 15 | 2 |

In most of the license holder reported by-catch incidents (n=14, 73.7%), the entangled porpoises caused little to no damage to the gill net; however 57.1% (n=8) of those were found dead. Six were rescued and released alive. Survival was not related to the number of individuals caught per incident, as of the four harbour porpoise caught in pairs, only one was released alive. One incidentally caught porpoise was reported as a juvenile and none were reported to expire during disentanglement.

Gear was generally reported as either "gill net" or "salmon gill net". Six respondents specified using gear with 4" - 6 1/4" mesh and two specified the net as either tooth/tangle or Alaska twist. These two respondents accounted for 30% of the live releases (n=3), although this cannot be confirmed or rejected as statistically significant with this sample size.

The majority of reported incidental catch events occurred in salmon statistical areas 4, 8 and 12 at 47.7% (n=9), 21.1% (n=4) and 15.8% (n=3), respectively (Table 8). No other areas were reported except those in Table 8. Areas 4, 8 and 12 accounted for 88.9%(n=8) of the total reported harbour porpoise mortality and 80.0% (n=8) of all reported live releases.

All by-catch reported from Areas 3, 4, 8 and two from Area 12 (north and central coast) occurred in June, July or August. The third reported incident from Area 12 and the one from Area 25 (Nootka Sound) occurred in October. It was not specified when the Area 22 porpoise was caught. The by-caught pairs from Areas 8 and 12 were reported in June and August, respectively.

Table 7. Total Harbour Porpoise Incidental Catch, Mortality and Relative Gear Damage

| | Total Number Caught | Alive | Dead | Released Alive | Minimal Damage | Substantial Damage |
|---|---|---|---|---|---|---|
| **Reported** | 19 | 10 | 9 | 10 | 14 | 5 |

Table 8. Statistical Area Summary of Harbour Porpoise Gill Net Incidental Catch Since 1997

| | Area 3 | Area 4 | Area 8 | Area 12 | Area 22 | Area 25 |
|---|---|---|---|---|---|---|
| **Total** | **1** | **9** | **4** | **3** | **1** | **1** |
| **Alive** | 0 | 6 | 2 | 0 | 1 | 1 |
| **Dead** | 1 | 3 | 2 | 3 | 0 | 0 |

Respondents reached no consensus regarding regions of British Columbia where harbour porpoise entanglement was more likely. Only 122 of the returned questionnaires completed this question, and of those, 81.1% (n=99) reported no region posed greater risk, 12 of which had reported by-catch within the last five years.

Specific regions identified by 14 respondents are as follows:

- Cape Caution to Prince Rupert (Areas 3-11)
- Nass and Skeena River mouths (Area 3 & 4)
- Cousin's Inlet (Area 8)
- Fitz Hugh Sound (Area 8)
- Johnstone Strait (Area 12)
- Knight Inlet (Area 12)
- Blackney Pass (Area 12)
- Port Hardy (Area 12)
- Hope Island (Area 12)
- Malcolm Island (Area 12)
- San Juan/Nitnat (Area 22)
- Imperial Eagle Channel (Area 23)

A similar response was observed regarding gear types. 85.6% (n=214) either did not answer this question or reported no gear type was more prone to harbour porpoise entanglement (Table 9). Gill and seine nets were reported almost equally (Table 9). Other gear types reported, included mid-water and bottom trawl (n=2), troll (n=1), offshore driftnets (n=1), nets in general (n=3) and deep-sea tuna fishing or high seas foreign fleets (n=2). Six either reported that they did not know or that the question was "Not Applicable".

Of the 14 respondents who reported by-catch experience within the last five years, nine reported no gear type posed a greater risk, one failed to respond, one replied "Not Applicable" and again there was an almost equal response for gill and seine nets (Table 9).

Table 9. License Holders Gear Type Evaluation

| | Not Answered | None | Gill Net | Seine Net | Other |
|---|---|---|---|---|---|
| **All** | 124 | 90 | 10 | 11 | 9 |
| **Experienced** | 1 | 9 | 1 | 2 | 1 |

Table 10. Reported Gear Type Experience

| | Gill Net | Gill Net only | Seine Net | Seine Net only | Troll | Longline | Trawl | Trap/Pot |
|---|---|---|---|---|---|---|---|---|
| **All** | 227 | 84 | 84 | 16 | 94 | 53 | 27 | 10 |
| **Experienced** | 19 | 1 | 4 | 0 | 11 | 6 | 0 | 1 |

Over half of the respondents had more than three decades of multi-gear experience, with single gear experience reported by only 100 respondents (Table 10). All but one of the by-catch experienced respondents had multi-gear experience (Table 10).

The mean number of years fished by respondents (n=248) was 33.5 years, with a range of 4 to 80 years. The median number was 33.0 years with a mode of 30.0 years. The experience of those who reported by-catch in the last five years was similar: mean 33.1 years; range 12 to 50 years; median 34.5 years; mode 35.0 years.

License holders were asked whether they commercially fished the 2001 season. Three respondents did not answer (n=247), while 88.3% (n=218) did fish the 2001 season and 29 did not (of which seven commented that the lack of participation was due to area closures).

Regions fished by respondents were classified according to Fisheries and Oceans Canada salmon statistical area licensing as follows:

Seine Net
- Area A (Stat. Areas 1-10)
- Area B (Stat. Areas 11-29 & 121)

Gill Net
- Area C (Stat. Areas 1-10)
- Area D (Stat. Areas 11-15 & 23-27)
- Area E (Stat. Areas 16-22, 28, 29 &121)

Troll
- Area F (Stat. Areas 1-10, 101-110, 130 & 142)
- Area G (Stat. Areas 11, 20-27, 111, 121, 123-127 & sub-areas 12-5 &12-16)
- Area H (Stat. Areas 12-19, 28 & 29)

Table 11 summarizes the reported and relative experience, by salmon licensing statistical areas of all respondents (n=250). A simple chi-squared analysis indicated that significant differences existed between gear types and areas (Table 13, Appendix 6).

Significantly more respondents had gill net experience, with the greatest proportion having experience in Area C (North Coast) (Table 11). See Figure 1 for area locations and Tables 14 -17 (Appendix 6) for Chi-Squared values.

Table 11. Reported and Relative License Holder Experience by Salmon Statistical Area

| Statistical Area | Reported Experience | Relative Experience, % |
|---|---|---|
| A | 49 | 8.54 |
| B | 48 | 8.36 |
| C | 144 | 25.09 |
| D | 102 | 17.77 |
| E | 101 | 17.60 |
| F | 51 | 8.89 |
| G | 36 | 6.27 |
| H | 43 | 7.49 |

License holders were invited to recount any other dolphin or porpoise incidental catch experienced during their career. 58 reported having had cetacean by-catch before 1997, 54 of which provided details. Six of the 58 had also reported incidental catch in the 1997 - 2001 focus period. Four did not respond and 188 reported no by-catch. The details of reported incidents were summarized by species.

Harbour Porpoise

Nineteen harbour porpoise were reported caught. Four were dead and eight were released alive (two were bleeding when released and one was described as "tired but alive"). The remaining seven reports did not comment on the animal's condition. All were caught in gill nets.

Twelve were single animals, three were pairs and one was a group of three. One respondent commented that the entanglement occurred "because of the young". The earliest report was dated from the 1960's. Locations of 11 of the events were as follows:

- Skeena River - Chatham Sound area (n=2) (Area 4)
- Milbanke Sound (Area 7)
- Ontario Point, Namu (Area 8)
- Roller Bay (n=2) (Area 11)
- Johnstone Strait (n=3) (Area 12)
- Robson Bight (Area 12)
- Nitnat Lake entrance in Straits of San Juan (Area 22)

Dall's Porpoise

Only 12 respondents reported having caught Dall's porpoise during their career. Fewer details were provided than for the by-caught harbour porpoise. Three simply stated that they had caught the species, and one reported that the Dall's porpoise was "encircled but not entangled and was successfully released", indicating the incident involved a seine net. No other gear details were provided.

A minimum of 14 Dall's porpoise were reported by-caught, with seven released alive. Three reports did not state the number of animals involved.

Three incidents involved mothers with calves, one of two adults and a calf, and the remaining eight involved single animals. In events involving calves, it was the calves that were reported as initially entangled. In one report, the entanglement was said to occur because the calf "panicked" and swam into the bunt end of the seine net and the adults followed. The license holder and his crew decked all three animals to facilitate a rescue. The adults became so agitated during the calf disentanglement that one adult started thrashing its tail and cut the snout of the other adult with its flukes.

One mother-calf pair was reported caught on a "very windy night" (successfully released) and a single Dall's porpoise became entangled in a "heavy plankton bloom at night". The fate of this animal was not stated.

The earliest report was dated 1958. Locations of some of these events were reported as follows:

- Yugoslav Bay (Area 6)

- Cape Caution, Hope Island area (Area 11)
- Johnstone Strait (Area 12)
- Port Hardy (Area 12)
- Sheringham Point (Area 20)

Pacific White-sided Dolphin

There were only eight reports of Pacific White-sided Dolphins incidentally caught in fishing gear. These involved a minimum of seven animals, with one described as juvenile. Four records did not specify the number of animals involved. Little detail was provided for these encounters.

Two were reported dead and four were released alive. One animal became entangled while being pursued by killer whales. These reports date to the 1980's. Locations of some of the events were specified as:

- Milbanke Sound (Area 7)
- Kwatna Inlet (Area 8)
- Johnstone Strait (Area 12)
- Port Hardy (Area 12)
- Goletas Channel (Area 12)
- Cape Lazo (Area 14)

Unidentified porpoise or dolphin species

There were 25 reports of 46 animals, either reported as porpoise or dolphins. One specified a longline (animal dropped off line alive), while all others identified "nets" as the gear.

Of the 45 reported net entangled animals, 21 were reported as released alive or unharmed, 10 were found dead, three died during a rescue and the condition of the remaining 11 animals was unspecified.

Twenty single animals (one was reported to be a calf), two mother calf pairs (again the events were reported as triggered by calf entanglement) and three groups of two or more animals (not specified as mother-calf pairs) were reported incidentally caught. Two reports did not specify the number involved.

Night fishing accounted for five animals: 2 dead, 2 live, 1 unknown condition. One dolphin caught about 15 years ago was reported to have a large lateral laceration. The respondent theorized it was either from a propeller or a whale, and one porpoise was reportedly pregnant when caught and too heavy to lift. She died in the net.

One respondent reported three animals caught in one set (2 juveniles, 1 adult). The two small animals were reported to hyperventilate and die. The respondent theorized that heart attacks were the cause of death. The adult died in the net during the rescue attempt.

The earliest dated report was 1966. Locations of some these events were specified as follows:

- Prince Rupert (Area 4)
- Milbanke Sound (Area 7)
- Hakai Pass (Area 8)

- Namu (Area 8)
- Smiths Inlet (Area 10)
- Queen Charlotte Sound (Area 11)
- Malcolm Island area (Area 12)
- Juan de Fuca Strait (Area 20)
- San Juan (Area 22)
- Barkley Sound (Area 23)
- Imperial Eagle Channel (Area 23)
- Gulf of Georgia (Area 29)

Other Species

One bluenose, one bottlenose dolphin (dead) and six accounts of whales were reported as colliding with fishing gear. Three of the reports specified killer whales, one as a finback and two as simply "whales". The earliest dated report was from the 1950's.

Pre-1997 By-Catch Summary

Anecdotal by-catch events reported by license holders totaled a minimum of 87 small cetaceans incidentally caught with 41 released alive. This is a release rate of 47.1% (41/87). No whales were reported as entangled, but rather, that they either swam through the gear or were encircled.

Other Comments

The last section of the questionnaire provided a location for license holders to provide details or opinions they thought may be important to the project. This proved to be most interesting.

121 respondents included comments in this section, 120 of which were supportive and useful. Only one respondent questioned the project motive. The topics of the other 120 comments were summarized as follows:

- Career observations and experiences.
- Anecdotal reports of historical porpoise by-catch.
- Gear information.
- Ecosystem pollution and effect on marine mammals.
- High-speed vessel pressure on marine wildlife.
- Fish farm predator controls and subsequent damage to cetacean sonar and/or hearing.
- Loss of porpoise feeding habitat areas due to coastal construction.
- Distrust of DFO may reduce the response rate.
- By-catch information including:
    - Only sick, injured or immature porpoises are caught.
    - Porpoise by-catch is not a problem.
    - Porpoise and dolphin numbers have increased in recent years.
    - Dolphins and porpoise sonar allows net avoidance.
    - Prohibition of night fishing equals reduced porpoise by-catch risk.
    - Reduced fishing means reduced by-catch.
- Offers of further assistance, project encouragement and interest in final report.

Synthesis

Although pinnipeds accounted for the majority of marine mammals observed in the vicinity of fishing gear, cetaceans accounted for nearly half of the entanglement events in the 2001 commercial season. All observer reported net entangled cetaceans were single phocoenids, caught within a one-month period in salmon licensing areas D and E. All were caught in gill nets. Two harbour porpoise, one Dall's porpoise and one unidentified species of porpoise collided with gear. Harbour porpoise accounted for all incidental mortality.

No other porpoises were reported in either Scan Zone 1 or 2, indicating that the by-caught animals were probably solitary. All phocoenids became entangled in the top two-thirds of the gill net and were unable to free themselves. In situations where the crew and/or observer had knowledge of the collision, mitigative actions were taken and successful rescues resulted in the release of live porpoises. This occurred in two of the four net collisions. At a minimum, porpoises were reported to sustain superficial lacerations from gill net encounters and rescue efforts.

The request to license holders yielded a 27.6% return rate. A total of 14 incidents, involving 19 harbour porpoise, were reported incidentally caught within the last five years (1997 - 2001), from respondents with an average of 33.1 years of commercial fishing experience. Almost two-thirds of the respondents reported a multi-gear career.

All incidental catch events occurred in gill nets and most involved single animals. Almost equal proportions were found dead and alive, with a 100% release rate for those harbour porpoise found alive. Porpoise rescue resulted in substantial damage to the gear in 40% of the reported events. The majority of animals were caught in Areas 4, 8, and 12 during the summer months (84.2%, n=16) from June to August.

Contrary to license holder opinions, the pooled data sets identified regions in which small cetacean by-catch was repeatedly described: Area 4 (Skeena River mouth), Area 8 (Bella Coola, Namu), Area 12 (Johnstone Strait, Malcolm Island) and Areas 21 and 22 (Nitnat). Area 121 should also be included as it is adjacent to Area 21 and as indicated by the 2001 observer data, two of the four by-caught porpoises, although each in a different statistical licensing area, were proximal to one other.

The additional information provided by the license holders illustrated the respondents overall concern for the marine environment including factors, which both directly and indirectly influenced their commercial industry. Their willingness to assist exceeded simply completing the questionnaire and provided greater insight into the by-catch events experienced during their professional fishing careers, with entanglement events recalled dating to the 1950's.

## Conclusions

2001 Incidental Catch

From the observer and license holder surveys, we concluded that the gill net salmon fishery has a higher rate of incidental catch of phocoenids, than do other selective fisheries, with single animals and cow-calf pairs being the most susceptible.

Human intervention is required for survival, as no phocoenid was able to disentangle itself. Porpoises appeared to respond well to human intervention, as indicated by the few reports of mortality during rescue (ancillary reports prior to the 1997 - 2001 focus period). Gill net fisheries in Areas 4, 8, 12, 21 and 22 reported the most frequent gear collisions. Damage to gear was usually due to the porpoise rescue efforts, rather than to the entangled animal's struggling.

The biological significance of the observer reported harbour porpoise mortality, to the population, is difficult to establish because of uncertainty over whether the two incidentally caught harbour porpoise belonged to the same population. Additional uncertainty is due to each licensing area (D & E) having only had observers on 5% of the gill and seine net vessels.

Areas D and E reported 2426 and 810 boat days fished, respectively. A simple extrapolation of the data, yields an estimate of the minimum theoretical phocoenid by-catch of 40 porpoises incidentally caught per area per 810 boat days fished, assuming the 5% observer coverage accurately represented the entire gill net salmon fishery. This translates to a theoretical estimated mortality of 79.9 porpoises in Areas D and E, for the 2001 effort. Based on the 2001 observer data, this yields an estimated harbour porpoise mortality of 80 individuals for the 2001 fishing effort in Areas D and E.

However, a more encompassing estimate can be derived independent of the exact number of boat days fished, based on the premise of high fishing effort and low probability of a porpoise entanglement. On the assumptions that the observers are placed randomly and irrespective of porpoise by-catch, and that probabilities of porpoise entanglement were equal throughout the fleet, the four observed entanglements could be set as a single observation from a Poisson distribution. This yields 95% confidence levels of 1.09 to 10.24 porpoises/random sample of boats within the 5% observer coverage or between 21.8 and 204.8 porpoises entangled for the entire fleet. Mortality is estimated to be 50% of the total entanglement, based on the observer reported live release rate. Therefore, for Areas D and E, the total annual phocoenid mortality is estimated with 95% confidence levels, to range between 10.9 and 102.4 animals. It is likely that the proportions of harbour to Dall's porpoise killed annually are variable based on differential overlap of gill net fisheries with phocoenid spatial and temporal distributions.

Examination of the license holder reported mortality indicates that actual annual by-catch is probably closer to the lower confidence level, given that porpoise by-catch was reported as an infrequent event per license holder, so much so, that individual by-catch events were recalled in great detail.

An estimate of harbour porpoise mortality based on the license holder's province-wide by-catch reports from 1997-2001, yielded an annual theoretical incidental catch of 14.1 porpoises. The license holders reported an average harbour porpoise live release rate of 52.6%, yielding an annual mortality of 6.6, assuming all areas have equal entanglement and release rates.

To provide a more encompassing range from this data, a Poisson distribution is again useful. The probability of entanglement was low compared with the fishing effort of respondents, and under the assumption that the respondents accurately represented all license holders (P=19/250=0.076); the 95% confidence levels, for total entanglement (1997 - 2001) are 44.6 to 115.6 porpoises. Therefore, the total annual province-wide harbour porpoise mortality is predicted to range between 23.4 and 60.8 animals, based on the 52.6% reported live release rate.

The estimated annual phocoenid mortality is likely between 11 and 102 animals based on the Poisson approximations with variable annual species proportions. It is interesting to note that the license holders reported a higher probability of porpoise entanglement (P=0.076), than the observer data yielded (P=0.0247).

Although there is considerable uncertainty in the actual numbers of porpoise killed annually and therefore the cumulative ecological effect, our study undeniably confirms that by-catch of small cetaceans is a province-wide phenomenon with mortality reported occurring from the Skeena River to Sheringham. Therefore, by-catch of small cetaceans, even at regionally low levels, is an issue to be addressed by British Columbia gill net fisheries.

Efforts to assess population size, habitat use and stock boundaries are paramount to understanding the reported and estimated by-catch level significance. Also, trans-boundary seasonal stock movements must be addressed. If the harbour porpoise, reported as by-catch in the 2001 selective salmon fisheries, belong to a trans-boundary population, then the PBR (Potential Biological Removal) calculations of the National Marine Fisheries Service must be readdressed to include this mortality. If the present US fishery related mortality were unchanged from the 2000 estimate, then the addition of our data would exceed the calculated PBR (NMFS 2000) and assign new significance to fisheries interactions for a trans-boundary population.

Extrapolation of the observer reported by-catch must be exercised with caution based on the small area sample sizes and the assumption that by-catch is solely dependent upon fishing effort. This information should be viewed in a precautionary manner and used as a basis for expanded enquiry rather than for immediate or sweeping management action. It is clear that a by-catch database with broader spatial and temporal frames is required to more accurately calculate phocoenid by-catch.

It is difficult to know whether gill nets selectively caught a particular age class, as no body length to age relationship exists for BC harbour porpoise. However, relationships are available for Atlantic and Baltic harbour porpoise populations, and considerable variation exists between regions and among sexes.

It is generally accepted that harbour porpoise, which are smaller than 100 cm in length, are less than one year of age (Gaskin *et al*. 1984, Kastelein *et al*.1997). If this is applicable to BC harbour porpoise, then 01M33 (91.4 cm) was in its first year of life at the time of mortality.

To determine the age of 01M2 is more difficult, as a harbour porpoise of standard length 137.4 cm, according to Gaskin *et al*. (1984) would fall between the ages of 2 - 5 years, depending on sex and origin. Age of sexual maturity occurs between ages 3 - 6 years, and varies by sex and origin.

Limited stranding data from southern Vancouver Island indicates that adult males and females are in the range of 136.0 cm (±9.93 CI) and 172.3 cm (±9.17 CI), respectively (Hall, unpublished data). From this, it can be surmised that 01M2 was either a mature or near maturing male, or a juvenile female.

Although 01M28 was not species-specified, it was likely one to two years old according to Gaskin *et al*. (1984) regardless of whether it was a harbour or a Dall's porpoise, male or female, at a standard length of 111.8 cm.

Based on all the uncertainties associated with BC harbour porpoise and the small samples sizes currently available for length to age relationships, the survey data should be viewed as preliminary until larger, more encompassing sample sizes are available. However, the theory of juvenile porpoise susceptibility to entanglement was supported by accounts provided by several license holders.

The observation of two single porpoises, incidentally caught at about one year of age has implications for social development of these animals. This may indicate that young porpoises undergo an exploratory learning phase during maturation. It is generally thought that harbour porpoise and Dall's porpoise become independent of their mothers at early ages (Gaskin *et al*. 1984, Kastelein *et al*. 1997). If this holds true for BC phocoenids, then the animals caught in the observer monitored gill net fishery would have only recently gained their independence. If the BC gill net fishery poses greater risk to immature animals, then population viability studies of harbour porpoise in this region must include a juvenile mortality rate that is related to regional gill net fishing effort.

Based on the fact that gill net fishing in BC is presently under more regulatory control than in the past, it is probable that the significant damage to the BC harbour porpoise population has already occurred and a recovery may be in progress. For this reason alone, continued monitoring of the relationship between gill net fisheries and harbour porpoise by-catch should be encouraged. The long-term effects of extensive incidental mortality may include altered sex ratios or suppressed population sizes, which could affect reproductive parameters, such as the age of sexual maturation or neonate size. This, therefore, could affect not only the survival of the individual but also the long-term viability of a population.

Approximately half of all reported entangled harbour porpoise caught between 1997 and 2001 were released alive. This is to the credit of the BC gill net fishermen. Mitigative efforts aimed at reducing or eliminating harbour porpoise by-catch should be directed at the salmon gill net fishery for maximum gain at minimum cost. However, it is imperative that efforts to reduce harbour porpoise (or other small

cetacean) incidental catch and release rate improvement do not significantly impair the target species fishing efficiency, while allowing for maximum survival of the entangled odontocete.

Recommendations

The following recommendations are based on the harbour porpoise incidental catch data provided by our study and the apparent complete lack of biological data regarding British Columbia harbour porpoise biology and ecology.

For simplicity the recommendations have been classified into four categories: gill net fishery, observer program, rescue and release protocol and biological research.

Gill Net Fishery

- Further investigation into the shorter sets and smaller nets successfully tested in Area 4 in 2001.
- Experimental monitoring of entanglement events while vessel engine is engaged compared to by-catch events while vessel is at drift.
- Include in the monitoring program the entanglement and release rates with different selective net types such as tooth/tangle or Alaska twist nets.
- Collaboration with license holders coast-wide to develop a harbour porpoise/small cetacean monitoring program. A simple, but effective waterproof guide could be given to interested license holders to aid in species identification and by-catch reporting.
- Cooperation with commercial license holders to retrieve any by-caught porpoise/dolphin carcasses for measurement and examination.

Observer Program

- Increase observer coverage, especially in Areas 4, 8, 12, 21, 22 and 121.
- Expand fisheries interaction data collection to central and northern BC.
- Continue current data collection in southern BC for identification of spatial and temporal variations.
- During observer training include threats to marine mammals, especially small cetaceans, stressing the importance of accurate and complete recording, avoiding terms such as "multiple".
- Train observers in small cetacean identification, measurement and sexing to reduce misidentification of species thereby reducing bias and error.
- Update data collection forms to include information on animal's position in net, i.e., which body part, contacted the net leading to the catch, to gain understanding of the dynamics of net encounters.

Rescue and Release Protocol

- Collaborate with commercial fishermen to develop a gill net release protocol based on their professional experiences and the protocols used in the Bay of Fundy Weir Release Program developed by the Grand Manan Research Station.

Biological Research

- Collaborate with existing commercial fishing associations to retrieve by-caught phocoenids for complete morphometric measurement and reproductive status assessment.
- Determine a length-age relationship for British Columbia harbour porpoise.
- Stock boundary assessment.
- Population(s) estimates.

Coast-wide harbour porpoise by-catch events are likely rare and until such time that the population(s) boundaries are established and the biological significance of fishery related mortality is understood; time or area restrictions to the gill net salmon fishery are not considered appropriate management options. The experimental use of acoustic net alarms is also not encouraged due to the rarity of encounters per boat day fished, the cost of equipping the commercial gillnet fleet as no localized regions were identified as higher-risk and the risk to marine mammals by increased environmental sound production.

Mitigative efforts which expand on the fishers knowledge of local species, fishing practice alteration (i.e. avoidance and frequent net running) and refinement of rescue protocols already in use in eastern Canada appear the most promising for a province-wide reduction in harbour porpoise incidental mortality.

**Summary**

Harbour porpoise (*Phocoena phocoena*) are incidentally caught throughout their range by commercial net fisheries in part due to their inshore distribution and reliance on commercially important prey species. In British Columbia (BC), few quantitative studies have been undertaken to understand this species biology, ecology or fisheries interactions. The goal of our study was to determine the level of incidental mortality of harbour porpoise in the 2001-selective salmon fisheries of southern BC. Incidental catch data were collected directly and indirectly through the Federal Fisheries Observer Program and a license holder questionnaire. Observers, in two licensing areas (5% per area), reported four single phocoenids incidentally caught in gill nets, within a one-month period. Mortality was 50%. Requests for by-catch information to 979 license holders yielded a 27.6% return rate. Harbour porpoise were reported observed near fishing gear by almost half of all respondents, with 11.7% (n=14) reporting harbour porpoise incidentally caught from 1997 - 2001. Ten of the 19 harbour porpoise reported caught in this period were alive and successfully released. Estimates of annual gill net fishery related porpoise mortality ranged from 11 - 102 individuals, with variable annual species proportions. Recommendations to reduce incidental catch and increase live release rates were classified in four categories - gill net fishery modifications, observer training, rescue and release protocol and biological research. Area closures or implementation of acoustic net alarms were not recommended due to the poor understanding of harbour porpoise ecology and biology. Mitigative efforts based on license holder collaboration and existing selective fishing experimental techniques, were deemed the most promising for a province-wide reduction of harbour porpoise incidental mortality.

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## Appendix 1

**Marine Mammal By-Catch Data Forms**



**Part A. Marine Mammals - Please complete for each set sampled.**

1. Name of Observer: _____ **4. Stat. Area** _____

2. Date: _____

3. If no marine mammals caught, please circle: **NO MARINE MAMMALS CAUGHT** and go to Part C. Marine Mammal Scans

If marine mammals are caught, complete Table 1.

**Mitigative Efforts Options for Table 1.**

1. None
2. Pingers
3. Seal Bombs
4. Boat run along net
5. Other - Please specify:

**Table 1. General By-Catch Data**

| Record Number | Species (common name) *refer to guide | Time of By-Catch | Gillnet: Position in Net (1/3) Top | Middle | Bottom | Other Gear: Please specify | Decked | Lost | Mitigative Efforts | Location (Lat and Long.) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
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| 10 | | | | | | | | | | |

**Part B. Small Cetacean By-Catch Questionnaire** **Page 2 of 3**

This form is *only* to be completed for dolphins or porpoises caught in fishing gear. Date: _____

Please Note: Only one form per by-caught animal.

1. General Catch Data (Table 1, Part A) Record Number: _____
2. Small Cetacean Species Caught (common name) _____
3. Surface Indication of by-catch, please circle: **No Indication**
   **Animal Visible from Surface**
   **Net Moving**
   **Other - Specify** _____

**Circle appropriate choice for 4, 8 & 11.**

4. Did the animal disentangle itself and swim away? **YES NO**
5. Was the animal brought on board the vessel? **YES NO**
6. Was the animal alive or dead? **ALIVE DEAD**
7. If alive, was the animal released? **YES NO**
8. What was the animal's condition? **Apparently Healthy Visibly Injured**
9. How much time elapsed between catch and release? _____
10. If dead, how long was animal in net prior to expiry? _____
11. If dead, was the animal retrieved or discarded? **RETRIEVED DISCARDED**
12. If retrieved, where was it sent? _____

**Measurements and Sex**

1. Length (tip of snout to fluke notch, straight line) _____cm
2. Girth at Flipper Insertion _____cm
3. Weight_____kg
4. Sex: **MALE, FEMALE, UNCERTAIN**: Please circle appropriate choice.
5. Any distinguishing marks on body: _____
6. Is it bleeding: circle **NO**, **YES**. If **YES**, specify from where? _____
7. Is there any foam in the **MOUTH** or **BLOWHOLE**, **NO FOAM**?

**Observer Comments**

Please provide any additional information you feel is relevant to the by-caught specimen.

_____

_____

_____

_____

## Part C. Marine Mammal/Vessel Abundance Information

**Date:** _____ 

Please complete for each day's fishing activities. **Gear Type:** _____ **Observer Name:** _____

| Instructions: Record all marine mammals sighted during fishing activities. | | | | | | | **Scan Zone I** Within 50 meters of gear | | | | **Scan Zone II** 50+ meters from gear | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Set # (Seine or Gillnet) | Stat. Area | Location | Time | Sea State | Wind Speed and Direction | Species* refer to small cetacean explanatory form | No. | Spatial Distribution | No. Boats | | No. | Spatial Distribution | No. Boats | Observer Comments |
| | | | | | | | | | | | | | | |
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## Appendix 2

**2001 Salmon Selective Fisheries**
**Observer Explanatory Form for Small Cetacean By-Catch Data Sheet**
This form is to help in small cetacean species identification and to assist in completing the marine mammal by-catch data sheets. The purpose of this data collection is to gain insight into marine mammal by-catch in British Columbia's selective salmon fisheries, with special emphasis on small cetaceans (dolphins and porpoises). It is anticipated this data collection will contribute to understanding any temporal or spatial relationships involved in the by-catch of small cetaceans, especially the harbour porpoise. The data sheets are simple and will only take a few minutes to complete; however accuracy is extremely important. Your input into all aspects of this data collection is valuable; please include your own comments and additional information in the Observer Comments section. This program is part of a larger project which is entitled *Harbour Porpoise Seasonal Abundance Fluctuations and Interactions with Selective Fisheries for Southern British Columbia.* All responses will remain confidential and your participation is voluntary. Consent to utilize your information will be determined by the return of the completed form. Please return the forms with your by-catch data sheet package to Mr. Leroy Hop Wo and/or Mr. Lee Keary at the Department of Fisheries and Oceans either by mail or email.
Thank you for your attention to detail and participation in this program.

Anna Hall
Marine Mammal Research Unit
University of British Columbia
6248 Biological Sciences Road
Vancouver, BC
V6T 1Z4, (604) 822-8181
***Important:***
**Part A and Part C are for <u>all marine mammals</u> and are to be completed for <u>each</u> set sampled.**
**Part B is <u>only</u> for when dolphins or porpoises are caught.**
**<u>Part A. General Catch Data</u>**

Please complete questions 1, 2, 3 and 4.
Please complete Table 1, if by-catch occurs.
**Table 1. General By-Catch Data** is similar to that used for the seabird by-catch data collection and is for **<u>ALL</u>** marine mammals caught.
**Species (common names)** - use the names in your observer package marine mammal identification guide. Small cetaceans can be difficult to identify, so an additional form has been provided (page 2) to assist you with this for the by-catch and scans data sheets.
**Time of By-Catch** - Record the time at which you first observe the entangled animal using the 24-hour system (i.e. 1630 hrs, instead of 430pm).
**Gillnet: Position in Net (1/3)** - Same format as the seabird by-catch forms.
**Other Gear**: Specify gear types other than gillnet.
**Decked and Lost Columns** - Did the animal land on the deck of the boat (**Decked**) or did it drop out of the net, back into the water (**Lost**). Check appropriate box.
**Mitigative Efforts** - Record the number from the list above Table 1. If you record #5, please specify actions taken.

**<u>Part B. Small Cetacean By-Catch Questionnaire</u>**
This form is to be completed for **<u>only</u>** small cetaceans (i.e. dolphins and porpoises).
Each question has an explanation below.
**Record Number** - This is simply the corresponding number (1-10) from Column 1, Table 1.
**Small Cetacean Species Caught** - common name, from Column 2, Table 1.

**Surface Indication of By-Catch** - were you aware of the by-catch before the gear was hauled in, if not, circle "**No Indication**".
**For questions 4-8 & 11, circle the appropriate answer**.
**Question 8**: if no injuries are visible, assume the animal is healthy
**Question 9**: if an exact time is not known make an estimate of length of time from entanglement to live release.
**Questions 10 -12** refers to animals brought on board dead. If animals are released alive, do not answer questions 10-12. For question 12, record as much information as possible to provide detail on the location of the animal.
For questions which do not apply to your particular situation (i.e. questions about live animals, if the by-catch was dead when brought on board, mark such questions **N/A** (Not Applicable).

**Species Identification - Physical and Behavioural Description**
These are not all the small cetaceans of BC, if you encounter an animal, which is not on this page, please refer to the marine mammal identification guide provided in your observer package. These three have been identified here because they are difficult to identify, even for experienced observers. Pay close attention to the dorsal fins of these three, easily confused animals.

### Harbour Porpoise, *Phocoena phocoena*

**Physical Description**: A small animal to about 1.8 meters and about 90kg, at maturity. This animal is grey/brown above and white below with a stripe extending from the tip of the mouth to the front flipper. There is no prominent forehead and the beak is very short and indistinct.
**Surface Description**: Fin appears to be on a wheel with a slow forward rolling motion. Does not bowride, does not create a splash, and usually occurs in small groups of 1 to 10 animals. This is a shy, elusive animal.

### Dall's Porpoise, *Phocoenoides dalli*

**Physical Description**: A larger porpoise than the harbour, growing to about 2.2 meters in length and weighing approximately 200 kg at maturity. This animal has a distinctive white flank patch on each side, a white fin tip and white trailing edges on the tail flukes. This is a stocky animal with a pronounced keel on the tailstock.
**Surface Description**: This is a fast swimming animal but does not jump out of the water. When rolling at the surface, it can be easily confused with harbour porpoise, pay special attention to the fin and tail stock bulge. These animals will bowride and create a rooster-tail spray at the surface. Usually occurs in groups of 1 to 20.

### Pacific White-sided Dolphin, *Lagenorhynchus obliquidens*

**Physical Description**: The largest of BC's common small cetaceans. At maturity PWSD are about 2.5 meters long and weigh up to 180 kg. This animal has a black back with light grey sides and a white belly. On each side there is light grey or white stripe from the head to the tail. These "suspenders" are easily seen when the animal bowrides. The dorsal fin is bi-coloured: the forward one-third is black and the rear two-thirds is white/light grey.
**Surface Description**: Easily identified at sea as often travels in large groups of up to 200. A gregarious species which frequently bowrides and jumps out of the water. PWSD are often noticeable from a distance as they also create a roostertail splash.

**Note:**
If another small cetacean is encountered, please record the species name based on the marine mammal information provided in your observer package.

## Measurements and Sex

**Important: Live animals are to be handled as little as possible, *do not* try to measure live animals, make estimates only.**

1. **Length** - is measured in a straight line from the tip of the snout to the fluke notch. See Figure 1 A and B. *Do not* adjust for curvature of the body.
2. **Girth at Flipper Insertion** - Measure around the animal's body (the curvature of the body will be accounted for) at the rear of the pectoral flipper. See Figure 1A.
3. **Weight** - measure if you have a scale, if not approximate, but write "est." if weight is estimated.
   **Sex** - easily determined by examination of the urogenital slits. See Figure 2. The distance between the genital and anal slits should be examined and the location of the mammary slits.

Figure 1. Standard length from snout to fluke notch and girth at flipper insertion

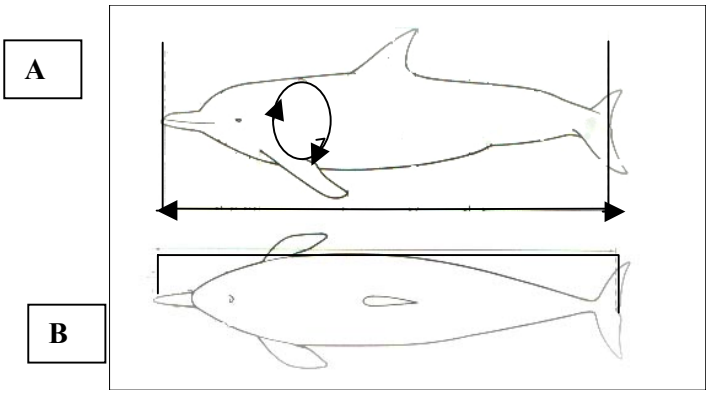
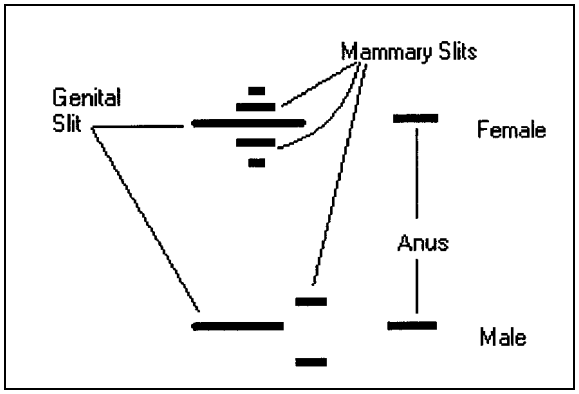



Figure 2. Odontocete Sex Determination




4. **Distinguishing marks** – describe any scars, wounds or nicks.
5. **Bleeding** - please be specific about source of blood. Supply all relevant information.
6. Foam in the mouth or blowhole - bubbly, yellowish/clear liquid, (not Styrofoam) simply look in the mouth and the blowhole.
7. Observer comments - anything you feel is relevant or interesting to the data collection. Please feel free to continue on the backside of the data form if required.

## Part C. Marine Mammal and Vessel Abundance Information

This section will be used to interpret the conditions during fishing activities to understand the potential for a by-catch (or no by-catch) by location, time of day and date. Please record **all** marine mammals sighted during fishing activities by their common names. Sometimes it is impossible to distinguish the species, although the type of animal is known. For instance, you may see it is a dolphin, but because of glare cannot determine what type it is, in this situation simply record "unknown dolphin". Also record the time at which you see the animals, estimate if you cannot count an exact number, ex. 4-6.

It is also important to record the gear type, set number, statistical area, and location. Two observational scan zones have been delineated: within 50 meters of the gear and any sighting at a distance greater than 50 meters from the gear. For each marine mammal sighting please record: the number of each species, the animals' spatial distribution and the number of other vessels within the scan zone.

Spatial distribution refers to the animals orientation to one another, simply record whether the animals are single, a pair or in clusters. If in clusters, then record group sizes and if clusters are side-by-side or spaced apart. It is also important to record anything else you feel is relevant to the description of what you see, please include your own comments in the "**Observer Comments**" section. This may include dolphins bow-riding with your vessel, or animals resting at the surface or actively lunge feeding.

To keep sea state descriptions simple, please just record the Beaufort Number from the table below. The sea state, wind speed and direction are important to determine the ability to sight marine mammals. Record wind speed in knots and direction as N, S, E, W, SW, NE etc.

Please use "**N/A**" (Not Applicable) for data, which do not apply to your current situation.

**Sea State Descriptions**
Use the following table and describe by Beaufort Number for Part C, Marine Mammal Scans information. The Beaufort Number is often referred to as “Force”, ex. Force 5 winds.

| **Beaufort Number** | **Description** | **Max. Height of Waves** (feet) | **Wind Speed** knots |
|---|---|---|---|
| **0** | Calm | 0 | less than 1 |
| **1** | Light Air | 0 - 1 | 1-3 |
| **2** | Light Breeze | 1 - 2 | 4-7 |
| **3** | Gentle Breeze | 2 - 4 | 7-10 |
| **4** | Moderate Breeze | 4 - 8 | 11-16 |
| **5** | Fresh Breeze | 8 - 13 | 17-21 |
| **6** | Strong Breeze | 13 - 20 | 22-27 |
| **7** | Moderate Gale | 20 - 30 | 28-33 |
| **8** | Fresh Gale | 30 - 45 | 34-40 |
| **9** | Strong Gale | Over 45 | 41-47 |
| **10** | Whole Gale | N/A | 48-55 |
| **11** | Storm | N/A | 55-65 |
| **12** | Hurricane | N/A | above 65 |

Thank you very much for your assistance with this project, please do not forget to include your full name if you would like to be acknowledged in the final report.

**Appendix 3**

**Marine Mammal By-Catch Data Forms** 

**Part A. Marine Mammals - Please complete for each set sampled.**

1. Name of Observer: Peter Smith

2. Date: June 25, 2000 **4. Stat. Area: 19**

3. If no marine mammals caught, please circle: **NO MARINE MAMMALS CAUGHT** and go to Part C. Marine Mammal Scans

If marine mammals are caught, complete Table 1.

**Mitigative Efforts Options for Table 1.**

1. None
2. Pingers
3. Seal Bombs
4. Boat run along net
5. Other - Please specify:

**Table 1. General By-Catch Data**

| Record Number | Species (common name) *refer to guide | Time of By-Catch | Gillnet: Position in Net (1/3) | | | Other Gear: Please specify | Decked | Lost | Mitigative Efforts |
|---|---|---|---|---|---|---|---|---|---|
| | | | Top | Middle | Bottom | | | | |
| 1 | harbour seal | 9:00 | | | X | N/A | | X | 3 |
| 2 | Dall's porpoise | 16:40 | X | | | N/A | X | | 1 |
| 3 | harbour seal | 17:20 | | X | | seine net | | X | 4 |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

**Part B. Small Cetacean By-Catch Questionnaire** **Page 2 of 3**

This form is *only* to be completed for dolphins or porpoises caught in fishing gear. Date: **June 25, 2000**

Please Note: Only one form per by-caught animal.

1. General Catch Data (Table 1, Part A) Record Number: **2**
2. Small Cetacean Species Caught (common name) **Dall's Porpoise**
3. Surface Indication of by-catch, please circle:
   **No Indication**
   **Animal Visible from Surface**
   **(Net Moving)**
   **Other - Specify** _____

**Circle appropriate choice for 4, 8 & 11.**

4. Did the animal disentangle itself and swim away? **YES (NO)**
5. Was the animal brought on board the vessel? **(YES) NO**
6. Was the animal alive or dead? **(ALIVE) DEAD**
7. If alive, was the animal released? **(YES) NO**
8. What was the animal's condition? **(Apparently Healthy) Visibly Injured**
9. How much time elapsed between catch and release? **30 minutes**
10. If dead, how long was animal in net prior to expiry? **N/A**
11. If dead, was the animal retrieved or discarded? **RETRIEVED DISCARDED**
12. If retrieved, where was it sent? _____

**Measurements and Sex**

8. Length (tip of snout to fluke notch, straight line) **2.2 meters** cm
9. Girth at Flipper Insertion **84** cm
10. Weight **150 est.** kg
11. Sex: **(MALE,) FEMALE, UNCERTAIN**: Please circle appropriate choice.
12. Any distinguishing marks on body: **parallel scars on back behind fin**
13. Is it bleeding: circle **(NO)**, **YES**. If **YES**, specify from where? _____
14. Is there any foam in the **MOUTH** or **BLOWHOLE**, **(NO FOAM)**?

**Observer Comments**

Please provide any additional information you feel is relevant to the by-caught specimen.
Example:

- Photographs taken of Dall's porpoise.
- Lots of herring visible at the surface.

**Part C. Marine Mammal/Vessel Abundance Information** **Date:** June 25, 2000 

Please complete for each day's fishing activities. **Gear Type: Gillnet** **Observer Name:**

| Instructions: Record all marine mammals sighted during fishing activities. | | | | | | | **Scan Zone I** Within 50 meters of gear | | | **Scan Zone II** 50+ meters from gear | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Set # (Seine or Gillnet) | Stat. Area | Location | Time | Sea State | Wind Speed (kts) and Direction | Species* refer to small cetacean explanatory form | No. | Spatial Distribution | No. Boats | No. | Spatial Distribution | No. Boats | Observer Comments |
| 1 | 19 | Latitude and Longitude | 1145 | 0 | no wind | Harbour porpoise | 2 | pair | 0 | 0 | N/A | 3 | Lots of herring observed in the water near the nets during fishing operations. |
| same | same | same | 1230 | 1 | W 1 -2 kts | Steller sea lion | 0 | N/A | 1 | 3 | in a cluster, all swimming together | 2 | Herring seemed to disappear half way through fishing (after 12:00). |
| 2 | 19 | Latitude and Longitude | 1343 | 2 | W 5kts | Grey whale | 0 | N/A | 1 | 2 | pair | 1 | Looks like it may be a mother and calf |
| 3 | 20 | Latitude and Longitude | 1545 | 3 | NW 9kts | Killer whales | 3 | cluster, all traveling together | 0 | 0 | N/A | 5 | Didn't see marine mammals after killer whale sighting. |
| 4 | 20 | Latitude and Longitude | 1750 | 2 | NW 7kts | Harbour seal | 5 | two groups: one of 3, one of 2 | 0 | 2 | pair | 2 | Nothing to add. |
| 5 | 20 | Latitude and Longitude | 1900 | 2 | NW 7kts | None | 0 | N/A | 2 | 0 | N/A | 1 | No marine mammals sighted. |
| | | | | | | | | | | | | | |
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## Appendix 4

THE UNIVERSITY OF BRITISH COLUMBIA

**Fisheries Centre**
2204 Main Mall
Vancouver, B.C. Canada V6T 1Z4
Director: Professor Tony J. Pitcher
Tel: 604-822-2731 Fax: 604-822-8934
E-Mail: office@fisheries.ubc.ca

**REQUEST FOR INFORMATION ON HARBOUR PORPOISE INTERACTIONS WITH FISHING GEAR IN BRITISH COLUMBIA**

Dear Sir or Madam:

Harbour porpoise are found throughout British Columbia, however very little is known about these small marine animals and it has become apparent that almost every spring (April-May), an unusual number are found dead from Port Renfrew to Parksville. Rarely is a cause of death found. The animals generally do not have evidence of entanglement in fishing gear and from discussions with local fishermen this type of interaction appears to be rare in British Columbia. To better understand the significance of this mortality, I am conducting a study entitled *Harbour Porpoise Seasonal Abundance Fluctuations and Interactions with Selective Fisheries for Southern British Columbia* and am hoping you are willing to share your experiences with me.

I have included a short 2-page questionnaire with this letter, which will only take about 10 minutes to complete. Please return it in the enclosed postage-paid, addressed envelope. It appears the harbour porpoise population is healthy and numerous calves have been observed in southern BC this year. Information collected in this survey will be used to better understand the porpoise's biology and ecology. Please return by January 31, 2002 as the results of this study will be presented in Seattle at a meeting of the American Cetacean Society in the spring of 2002. This research is being undertaken through the University of British Columbia with funding from Fisheries and Oceans Canada.

Please complete and return the questionnaire even if you have never encountered a harbour porpoise during your career. Knowing where they are not, is just as important as knowing where they are. All responses will remain confidential, and no personal information will be released in any presentation or written report. Please be assured that your participation is purely voluntary and you may refuse to participate or withdraw at any time. Consent to utilize your information will be determined by the return of the completed form. If you have any concerns regarding your rights or treatment in this program please contact the Director of the UBC Office of Research Services at 604-822-8598.

Any information you can provide regarding gear interactions with harbour porpoise or other dolphins and porpoises is sincerely appreciated. Thank you very much for your participation and cooperation. If you would like to receive a summary of the results please fill in your name and address below and return with the questionnaire. If you have any questions regarding this project please contact Anna Hall or Dr. Andrew Trites (Principal Investigator) at (604) 822-8181.

Sincerely,

Anna Hall, M.Sc. Candidate
UBC Marine Mammal Research Unit
Room 18, Hut B-3, 6248 Biological Sciences Road, Vancouver, B.C. V6T 1Z4
Telephone: (604) 822-8181

Name:_____ Phone Number:_____
Address:_____
_____
_____

*Thank you very much for your help.*

**HARBOUR PORPOISE QUESTIONNAIRE**

Harbour Porpoise, *Phocoena phocoena*

**Please circle the appropriate answer and fill in the blanks. Please provide as much detail as you can. *Please feel free to add additional pages if you require.***

1. Have you encountered harbour porpoise during fishing activities in the last 5 years?
   **YES** **NO**

2. In this time, have harbour porpoise collided with your gear or nets?
   **YES** **NO**

If **YES**, how frequently?

_____
_____
_____
_____

If **YES**, what type of gear or net was used?

_____
_____
_____

If **YES**, how much damage did your gear sustain?

_____
_____
_____
_____

If **YES**, what was the condition of the animal? **DEAD** **ALIVE**

If **ALIVE**, were you able to release the animal? **YES** **NO**

3. Can you recall where the incident(s) occurred and what time of year it was?

_____
_____
_____
_____
_____
_____
_____
_____
_____

4. Are there any regions of BC that you consider to be worse for harbour porpoise/gear interactions?

_____
_____
_____
_____
_____
_____
_____

5. Are there any types of gear, which you consider to have more frequent harbour porpoise interactions?

_____
_____
_____
_____

6. How many years have you fished?

_____

7. What gear type(s) have you used?

_____
_____

8. Did you fish the 2001 season?

_____

9. What region(s) do you usually fish in?

_____
_____
_____
_____

10. Have other dolphins or porpoises collided with your fishing gear? **YES** **NO**
    If **YES**, what species?

_____
_____
_____
_____

11. Are there any other details you think are important to this project?

_____
_____
_____
_____
_____

## Appendix 5

Table 12. Marine Mammal Interactions with Gill and Seine Net Fisheries By Salmon Statistical Licensing Area

| | Statistical Area | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **11** | **12** | **13** | **14** | **17** | **18** | **21** | **23** | **25** | **121** |
| Dall's Porpoise | - | - | - | - | - | - | - | - | - | 1 |
| Harbour Porpoise | - | 1 | - | - | - | - | 1 | - | - | - |
| Unknown species - porpoise | - | - | - | - | - | - | 1 | - | 1 | - |
| Pacific white-sided dolphin | - | 1 | - | - | - | - | - | - | - | - |
| Gray whale | 1 | - | - | - | - | - | - | - | - | - |
| Killer whale | - | 2 | - | - | - | - | - | - | - | - |
| **Total cetaceans** | **1** | **4** | **0** | **0** | **0** | **0** | **2** | **0** | **1** | **1** |
| | | | | | | | | | | |
| Harbour Seal | - | - | - | - | 1 | - | - | - | - | - |
| Unknown species - seal | - | - | 1 | 3 | - | - | - | 2 | 1 | - |
| California Sea Lion | - | - | - | - | - | - | 1 | - | - | - |
| Steller Sea Lion | - | - | - | - | - | - | - | - | - | - |
| Unknown species - sea lion | 2 | - | - | 10 | - | 1 | 24 | - | 2 | - |
| **Total pinnipeds** | **2** | **0** | **1** | **13** | **1** | **1** | **25** | **2** | **3** | **0** |
| | | | | | | | | | | |
| Sea Otter | 1 | - | - | - | - | - | 1 | - | 1 | - |
| **Total Mustelids** | **1** | **0** | **0** | **0** | **0** | **0** | **1** | **0** | **1** | **0** |
| | | | | | | | | | | |
| **Total Marine Mammals** | **4** | **4** | **1** | **13** | **1** | **1** | **28** | **2** | **5** | **1** |
| **Percent** | **6.67** | **6.67** | **1.67** | **21.67** | **1.67** | **1.67** | **46.67** | **3.33** | **8.33** | **1.67** |

## Appendix 6

Table 13. Chi-squared test for reported regional experience by statistical area.

| Statistical Area | Observed (Reported) | Expected | o-e | (o-e)^2 | (o-e)^2/e | X^2 |
|---|---|---|---|---|---|---|
| A | 49.00 | 70.50 | -21.50 | 462.25 | 6.56 | 150.44 |
| B | 48.00 | 70.50 | -22.50 | 506.25 | 7.18 | |
| C | 144.00 | 70.50 | 73.50 | 5402.25 | 76.63 | |
| D | 102.00 | 70.50 | 31.50 | 992.25 | 14.07 | |
| E | 101.00 | 70.50 | 30.50 | 930.25 | 13.20 | |
| F | 51.00 | 70.50 | -19.50 | 380.25 | 5.39 | |
| G | 36.00 | 70.50 | -34.50 | 1190.25 | 16.88 | |
| H | 43.00 | 70.50 | -27.50 | 756.25 | 10.73 | |
| Total | 574 | 564 | | | **150.64** | |

Eight salmon statistical areas are presented in Table 13 for the reported experience by area; this yields seven degrees of freedom for the Chi-Squared Test. The critical chi value at a probability value of 0.05 is 14.07 (Mahajan 1989). Therefore, the null hypothesis of no difference existing in fishers experience by statistical area must be rejected with a calculated chi-squared value of 150. 44 (Table 13).

For 7 degrees of freedom, the critical chi value is 14.07 at p=0.05 (Mahajan 1989), therefore a null hypothesis of equal experience per statistical area is rejected.

Table 14. Seine Net Statistical Areas

| Statistical Area | Observed (Reported) | Expected | o-e | (o-e)^2 | (o-e)^2/e | X^2 |
|---|---|---|---|---|---|---|
| A | 49.00 | 48.50 | 0.50 | 0.25 | 0.01 | 0.01 |
| B | 48.00 | 48.50 | -0.50 | 0.25 | 0.01 | |

For 1 degree of freedom, the critical chi value is 3.84 at p=0.05 (Mahajan 1989), therefore a null hypothesis of equal experience per seine statistical area is accepted.

Table 15. Gill Net Statistical Areas

| Statistical Area | Observed (Reported) | Expected | o-e | (o-e)^2 | (o-e)^2/e | X^2 |
|---|---|---|---|---|---|---|
| C | 144.00 | 115.67 | 28.33 | 802.78 | 6.94 | 10.41 |
| D | 102.00 | 115.67 | -13.67 | 186.78 | 1.61 | |
| E | 101.00 | 115.67 | -14.67 | 215.11 | 1.86 | |

For 2 degrees of freedom, the critical chi value is 5.99 at p=0.05 (Mahajan 1989), therefore a null hypothesis of equal experience per gill net statistical area is rejected.

Table 16. Troll Statistical Areas

| Statistical Area | Observed (Reported) | Expected | o-e | (o-e)^2 | (o-e)^2/e | X^2 |
|---|---|---|---|---|---|---|
| F | 51.00 | 43.33 | 7.67 | 58.78 | 1.36 | 2.60 |
| G | 36.00 | 43.33 | -7.33 | 53.78 | 1.24 | |
| H | 43.00 | 43.33 | -0.33 | 0.11 | 0.00 | |

For 2 degrees of freedom, the critical chi value is 5.99 at p=0.05 (Mahajan 1989), therefore a null hypothesis of equal experience per troll statistical area is accepted.

Table 17. Seine Net and Troll Statistical Areas

| Statistical Area | Observed (Reported) | Expected | o-e | (o-e)^2 | (o-e)^2/e | X^2 |
|---|---|---|---|---|---|---|
| A | 49.00 | 45.40 | 3.60 | 12.96 | 0.29 | 3.20 |
| B | 48.00 | 45.40 | 2.60 | 6.76 | 0.15 | |
| F | 51.00 | 45.40 | 5.60 | 31.36 | 0.69 | |
| G | 36.00 | 45.40 | -9.40 | 88.36 | 1.95 | |
| H | 43.00 | 45.40 | -2.40 | 5.76 | 0.13 | |

For 4 degrees of freedom, the critical chi value is 9.49 at p=0.05 (Mahajan 1989), therefore a null hypothesis of equal experience among areas is accepted.