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### A PRELIMINARY EVALUATION OF INCIDENTAL MORTALITY OF SMALL CETACEANS IN COASTAL FISHERIES IN BRITISH COLUMBIA, CANADA

Incidental catches in net fisheries are thought to pose a threat to small cetacean populations in many localities around the world (Perrin *et al.* 1994). Frequently, dolphins and porpoises are removed from populations for which there

are scant data to estimate the potential influence of such removals on population viability. On the west coast of Canada, commercial fisheries take small cetaceans incidentally in inshore fisheries; little data exist on abundance, productivity, or range of these species. These catches could be having significant impacts on these populations, especially if the populations are small, discrete, or exist in restricted habitats.

Based on all reports to date, three cetacean species seem to be regularly involved in inshore fishery interactions in British Columbia (B.C.): harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), and Pacific white-sided dolphin (*Lagenorhynchus obliquidens*). Cowan (1988) noted that harbor porpoise populations in B.C. may be decreasing because of mortality in gillnet fisheries. Jefferson (1990) remarked on the lack of information regarding potential threats in Canadian waters to Dall's porpoises. Stacey and Baird (1991) noted that further study on the levels of incidental mortality of Pacific white-sided dolphins in B.C. waters was warranted.

There are three methods of studying incidental mortality in fisheries: (1) questioning fishermen, (2) having dedicated observers on fishing vessels, and (3) examining stranded animals. In B.C., observers are not required in domestic fisheries, and little work had been undertaken on strandings prior to 1987. Since 1987, however, a cetacean stranding program has been in place in the province, resulting in some records of incidentally caught cetaceans. The few published records of incidental mortality were a result of examination of stranded animals or were reports by Fishery Officers or the fishermen themselves (e.g., Baird *et al.* 1988, 1991; Stacey *et al.* 1989; Langelier *et al.* 1990; Baird and Guenther 1995; Guenther *et al.* 1995). The one exception was the records of cetacean entanglements and mortality made by onboard observers in an experimental fishery for flying squid (*Ommastrephes bartrami*) in offshore B.C. and adjacent international waters (Jamieson and Heritage 1987, 1988; Baird and Stacey 1991, 1993; Stacey and Baird 1991). In the present study we have attempted to gather preliminary information on incidental mortality of small cetaceans in B.C. through a single question included in a questionnaire on gray whale (*Eschrichtius robustus*) interactions with commercial fisheries (Baird *et al.*, in press).

In November 1989 a questionnaire was sent to all holders of commercial fishing licenses in British Columbia with a postage-paid, preaddressed return envelope. A total of 5,375 questionnaires were sent (although in that year there were 8,160 licenses issued; some individuals hold more than one license as their vessels fish more than one gear type—Department of Fisheries and Oceans, License Unit statistics). License holders were requested to return the questionnaire, regardless of whether they had any incidental catches to report. An incident was defined as a cetacean coming into physical contact with any fishing gear. The survey requested an accounting of all incidents throughout the respondent's fishing career. Further questions asked for the number of years (seasons) fished and the type of fishing gear used. Any returns that failed to supply information on the number of years (seasons) fished or did not specify gear type were excluded from analysis. For each reported incident the animal's sta-

Table 1. Number of questionnaire responses and number and type of reported incidents involving small cetaceans.<sup>a</sup>

Gear type	Total number of responses	Number of certain mortalities	Number of certain injuries	Number of others released alive	Number where fate not specified	Total number of incidents
Seine	86	6	0	21	10.5	37.5
Gillnet	460	91.2	11	72	67.7	241.9
Troll	520	20.8	4	18	26.8	69.6
Trawl	40	0	0	0	1	1
Total	1,106 <sup>b</sup>	118	15	111	106	350

<sup>a</sup> The numbers listed for incident types are not always whole numbers because some incidents were reported without distinguishing between gear types and were thus divided among them.

<sup>b</sup> This differs from the total number of questionnaires analyzed (865) because some respondents hold more than one license. Excluded are gear types where there are no incidents reported and responses lacking the number of years fished or containing incomplete responses regarding gear types.

tus was classified as: (1) dead; (2) swam away, apparently uninjured or status unknown; (3) swam away injured; (4) status not specified.

A total of 990 (18.4%) questionnaires was returned; 865 were used for analysis. The response rate was similar across the four gear types involved in one or more cetacean incidents. The incidents involving small cetaceans reported to have occurred during the fishing careers of 169 different respondents totalled 350. The number of questionnaire responses and details of reported incidents are displayed by gear type in Table 1. The fate of animals was noted for 244 incidents; of these, 118 (48%) were known to have resulted in mortality.

All reported mortality resulted from collisions with salmon (*Oncorhynchus* spp.) fishing gear (gillnet, troll, and seine). Small cetaceans are also known to be killed in trawl gear (Baird *et al.* 1991), but such reports were not received in this study. Entanglements in gillnets have long been known to cause small cetacean mortality (*e.g.*, Scheffer and Slipp 1948). In the B.C. salmon gillnet fishery, nets are suspended from the surface, apparently allowing some caught animals to breathe, or be noticed by the fishermen and released alive. However, some injured animals likely die later. Some animals seemingly uninjured may also die subsequently from capture-related stress or internal injuries.

Reports of mortality resulting from animals striking troll lines were unexpected. It is probable that animals killed in this manner are either Dall's porpoises or Pacific white-sided dolphins, because harbor porpoises generally avoid vessels and almost never bow ride (Leatherwood *et al.* 1988). Respondents reported severe injuries in some cases where animals struck lines. Several respondents mentioned troll lines becoming tangled around an animal.

Estimates of annual mortality and mortality rate per incident could be extrapolated from the results reported here, but this would result in rather meaningless figures, due in part to the bias inherent in questionnaire data. The purpose here is to report in a more general way on some characteristics of incidental catch of small cetaceans in coastal British Columbia, namely gear types involved and incident outcomes, and to suggest that further research in this area is necessary. Steps should be taken to: (1) accurately estimate mortality levels; (2) determine the species composition and geographic distribution of the incidental mortality; and (3) estimate population sizes, ranges, and life history parameters for each species involved. While we recognize the inherent limitations in questionnaire surveys (*e.g.*, Lien *et al.* 1994), the results of our exercise indicate that to properly manage stocks of small cetaceans in the province, information on incidental catch should be taken into account.

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LIPOFUSCIN GRANULAR CELLS IN REGRESSING *CORPORA*  
*LUTEA* AND *CORPORA ALBICANTIA* OF OVARIES  
FROM WILD HAWAIIAN MONK SEALS  
(*MONACHUS SCHAUINSLANDI*)

Reproductive patterns in Hawaiian monk seals (*Monachus schauinslandi*) do not have some of the common elements that exist in most phocids, such as gregarious behavior and the formation of rookeries (Kenyon and Rice 1959), highly synchronized pupping and mating (Atkinson and Gilmartin 1992), and monoestrous reproductive cycles (Pietraszek and Atkinson 1994, Iwasa and Atkinson 1996). In studying reproductive anatomy and physiology, we discovered lipofuscin granular cells (LGC) in regressing *corpora lutea* (CL) and *corpora albicantia* (CA) of ovaries from wild Hawaiian monk seals (Iwasa and Atkinson 1996). Lipofuscin granular cells appeared between collagenous tissues soon after the start of luteal regression. The cells were large, rounded, and brownish, containing many granules and fat vacuoles. Once predominant in mature CL, luteal cells almost disappeared, and LGC eventually occupied whole regressing CL along with collagenous fibrin (Fig. 1). Because LGC in ovaries have not been reported in other phocids, this report attempts a further understanding of this phenomenon. The purpose of the present study was to examine the cellular origin of the LGC found by Iwasa and Atkinson (1996). Three possibilities were examined: (1) the LGC were macrophages, (2) the LGC were luteinized cells of *theca* or *granulosa* origin, and (3) the pigment was the same