Assessment of seasonal abundance of the spotted seal (*Phoca largha*) from incidental takes in fishing nets along the Notsuke Peninsula, Hokkaido

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The spotted seal (*Phoca largha*) is widely distributed along the coast of Hokkaido, the northern-most island of Japan. Breeding season concentrations in coastal areas of the Sea of Okhotsk approach 10,000 individuals (Mizuno et al. 2002). Based on an interview survey, location of haul-out sites, and analyses of incidental takes in fishing nets, damage control kills and strandings, Mizuno et al. (2001) described general features of the seasonal distribution of seals in this region. Because these results were based on limited data and potentially biased methods, however, they should be re-examined using alternative approaches. In the current study, I assess the relationship between local seal abundance and incidental take in fishing nets, and consider its effects on estimates of seasonal and regional distribution and abundance of spotted seals in Hokkaido.

Material and methods

This study was conducted along the Notsuke Peninsula, where spotted seals haul-out in all seasons except when pack ice is present (Aoki 1996). Seasonal changes in the observed number of seals hauled-out on the coast (Aoki 1996) were used as an index of abundance for comparison with the frequency of incidental takes based on reports from fishermen's cooperatives for trap net fisheries.

Along the Notsuke peninsula, trap net fishing methods differ for different target species, and net size, placement, and the number of fishermen per net vary by season. Because the seasonal salmon fishery is large and draws many fishermen to the region, I assumed that leaders of these operations would have access to information about spotted seal takes for this and other fisheries. To

assess the frequency of incidental seal takes in fishing nets, I distributed questionnaires to the each leader of the 31 fishermen's cooperatives operating in the region in 1997. Questionnaires contained the following questions:

- (1) Have you ever seen spotted seals?
- (2) Have you ever observed or heard of seals taking fish from your trap nets?
- (3) In which season did you capture seals in your trap nets?

I assumed that mis-identification of Kuril seals (*Phoca vitulina stejnegeri*) as spotted seals would be negligible along the Notsuke Peninsula, because Kuril seal haul-out sites on Hokkaido are limited to other areas of the Pacific coast (Wada et al. 1986; Kuril Seal Research Group 1999). I counted the number of fisheries' cooperatives that captured seals in each month and used it as the index of the incidental take.

For estimates of seasonal abundance at haul-out sites, I relied on data from Aoki (1996; p. 98, Figure). I chose values reported for the middle of each month as abundance indices, except for March and April, when pack ice deterred seals from hauling out (Aoki 1996).

Results and discussion

Seventeen of 31 (55%) questionnaires were completed and returned. Sixteen cooperatives (94%) reported seal observations, and all 17 cooperatives reported that seals ate fish from their nets. Fourteen cooperatives (82%) reported incidental seal takes in the nets. Seasonal changes in the number of cooperatives that reported incidental seal takes were significantly correlated with the number of seals observed by Aoki (1996) ($R = 0.90$, $P < 0.0001$) (Fig. 1).

Fig. 1. Questionnaire responses from the trap net fisheries about incidental spotted seal harvests and number of haul-out seals (Aoki 1996) in Notsuke Peninsula, Hokkaido, by month. Arrows show the type of fishery during the period: A-saffron cod (*Eleginus gracilis*); B-saffron cod and surf smelt (*Hypomesus pretiosus japonicus*); C-pink salmon (*Oncorhynchus gorbusha*); D-chum salmon (*Oncorhynchus keta*).

This result suggests that the incidental take in fishing nets is a useful index of local seal abundance. Index precision would likely be improved by comparisons of the number of seals taken incidentally per fishing net to numbers observed in the same period at local haul-out sites. Improved data on seal mortality due to incidental takes in fishing nets are needed for better management of the spotted seal population of Hokkaido. In a population of seals from the Peter the Great Bay, Russia, reports of incidental takes by the trap net fishery alerted researchers to an unsustainable level of harvest (Trukhin and Mizuno 2002).

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