Cruise Report of the Flying Squid Survey by the *Kaiun maru* in July/September, 1991

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ABSTRACT

Fishing experiments using commercial surface driftnets and subsurface driftnets (2m subsidence) were conducted on the squid driftnet fishing grounds in the North Pacific Ocean. Research involved 13 driftnet operations and oceanographic observations at 42°09' to 44°35'N and 178°47' to 177°54'W from August 3 to 24, 1991. In each driftnet operation, a total of 400 tans, 200 tans of commercial surface net (115mm mesh) and 200 tans of subsurface driftnet (115mm mesh) were used simultaneously. In the driftnet fishing, the nets were set before sunset and hauled after sunrise. The numbers of individuals entangled including those that were observed to drop out in the 2,502 effective tans of the surface driftnet was a total of 9,169, of which there were 6,949 flying squid, 746 albacore, and 949 Pacific pomfret. Marine mammals and seabirds captured included 1 northern fur seal (dead), 1 northern right whale dolphin (dead), 1 Pacific white-sided dolphin (dead), 11 laysan albatross (8 dead and 3 alive), 1 black-footed albatross (alive), and 149 shearwaters (133 dead and 16 alive). The numbers of individuals entangled including those observed to be lost in 2,565 effective tans of subsurface driftnet was a total of 6,184: 4,787 flying squid, 684 albacore and 424 Pacific pomfret. Marine mammals and seabirds entangled were only 1 northern right whale dolphin (dead), and 3 shearwaters (dead). Although the reduction in catch of seabirds effected by the subsurface net was recognized, we reached no conclusion for marine mammals, because of the few entanglements. CPUE (in number) of flying squid by the subsurface net was about 67% of that by the commercial surface net. Entanglement of salmonids was not observed. The surface water temperatures at the stations ranged from 13.2°C to 18.6°C, and high CPUE of flying squid was observed around 15°C. The mantle length of flying squid caught ranged from 22cm to 53cm. The mode of mantle length was observed around 42cm. The mantle length compositions of flying squid were similar for each type of net.
1. Introduction

It has been pointed out from former surveys that use of the subsurface net is promising in reducing the incidental catch of small cetaceans and seabirds (Hembree and Harwood, 1987; Hayase et al., 1990; Yatsu et al. 1990). However, surveys using the subsurface net during June to August which is the main fishing season of the squid driftnet fishery were few, and points which should improve the design of the subsurface net were omitted. Therefore, comparative experiments using surface and subsurface driftnets of about 400 tans each were conducted by six commercial squid driftnet fishing vessels during June to August, 1991 (Hayase and Yatsu, 1991), with scientific observers on board from Japan, the United States and Canada. Further, the National Research Institute of Far Seas Fisheries using the Kaiun maru conducted comparative fishing experiments using a newly designed subsurface driftnet and the commercial surface driftnet on the squid driftnet fishing grounds (Hayase et al., 1991). We report here an outline of the cruise of the Kaiun maru. In this cruise, Mr. Edward Hinkey from Canada was on board and engaged in observations of fishing, biological sampling, and sighting surveys on marine mammals and seabirds.

2. Methods of Research

1) Research vessel

Kaiun maru (Aomori Prefectural Fisheries Experimental Station) 299 GT 45m total length.

2) Researchers

Kichiei Kaga (Resources Division, Fisheries Agency of Japan)
Edward Hinkey (Canada)

3) Period

Departed from Hakodate: July 26
Fishing survey and oceanographic observations: August 3 to 24
Returned to Hakodate: September 4
All times noted are local time.

4) Area

North Pacific Ocean (42°09' to 44°35N, 178°47'E to 177°54'W)
(Fig. 1)

5) Research conducted

(1) Oceanographic observations

Observations using CTD were made of water temperature and salinity from the surface to depths of 300m at each survey station.
(2) **Driftnet research**

The number of research stations was 13 (Fig. 1). The nets totalled 400 tans, the surface commercial net (115mm mesh) of 200 tans, and the subsurface net (115mm mesh, 2m subsidence) of 200 tans. The nets were set before sunset, and hauling began 2 hours before sunrise. The soaking time for the fishing gear was about 11 to 12 hours. Construction of the subsurface and surface nets was almost the same except that the subsurface net was suspended about 2m below the surface of the sea, and for floating power, used two kinds of floats (Fig. 2). Namely, (1) 50 floats per tan were used for the upper rope and 6 floats for the middle rope (this is referred to hereafter as an ordinary subsurface net), and (2) rope (trade mark - One Line Rope) for the upper and middle which itself possessed floating power, and was used in a driftnet which had 10 floats for the upper rope (hereafter referred to as float-saved type subsurface net). The number of hanging ropes was set at 5 per tan based on experience (hanging ropes entangled frequently with the floats and so on) during the cruise of the Shoyo maru in 1990 (Yatsu et al. 1991). In order to avoid transformation of net meshes and to increase acoustic reflective strength, six floats per tan were attached at the middle rope. The purpose of the float-saved type subsurface driftnet was to help avoid entanglement with the hanging rope and to increase reflective acoustic strength by the "One Line Rope". One net section consisted of 100 tans of either surface or subsurface net. However, the subsurface net was composed of 60 tans of the regular subsurface net and 40 tans of the float-saved type subsurface net. The surface nets and subsurface net sections were set alternately.

Catch was recorded as that decked on the vessel and that caught by the nets, and observed to drop from the nets. Marine mammals were recorded as to live or dead condition.

(3) **Biological Sampling**

Part of the catch of squids obtained at each station and dead individual marine mammals were brought back as frozen samples to the National Research Institute of Far Seas Fisheries. We also brought back samples of dead seabirds to the Faculty of Fisheries, Hokkaido University. Some squids and fishes were provided as frozen samples to Canada. No tagged animals were caught.

(4) **Measurements of squid and fish**

Mantle length was recorded of 100 randomly selected flying squid for each type of net (surface, ordinary subsurface, and float-saved type subsurface). A maximum of thirty randomly selected fish by species were measured for body length. We observed and recorded small cetaceans by length and by sex and took photographs. We observed and recorded northern fur seal by length, sex, colour of whiskers, noted existence of tags, and took photographs.
3. **Results and considerations**

1) **Oceanographic observations**

   The surface water temperature at each station ranged from 13.2°C (St. 10) to 18.6°C (St. 7).

2) **Catch**

   Table 1 shows the total catch in numbers by type of net and by species and the numbers observed to drop-out. The number of marine mammals and seabirds caught by the surface nets, dead or alive, was 1 northern fur seal (dead), 1 northern right whale dolphin (dead), 1 Pacific white-sided dolphin (dead), 11 laysan albatross (8 dead, and 3 alive), 1 black-footed albatross (alive), and 149 shearwaters (133 dead, and 16 alive). Those caught by the subsurface nets were only 1 northern right whale dolphin (dead) and 3 shearwaters (dead). The most dominant species caught in numbers and number of drop-outs was flying squid. Table 2 shows CPUE and drop-out rate by type of net and, by species. The drop-out rate of flying squid was low, but that of blue shark and Pacific pomfret was generally high. Causes of drop-out were divided into intentional shaking off, the direction of entanglement, and natural drop-out. Since the mesh selectivity of the driftnet is prescribed by the body shape of species, size and behaviour against a net, etc., it is necessary to search for primary factors of different mesh selectivities and drop-out rates by various species.

3) **Distribution of flying squid and salmonids**

   Although flying squid were caught from all operations, there was no incidental catch of salmonids. The relationship between surface water temperature and CPUE of flying squid (combined for surface net and subsurface net) is shown in Fig. 3. Relatively high CPUE values of flying squid were obtained around 15°C.

4. **Comparative experiment of surface net and subsurface net**

   Because CPUE values for flying squid were not greatly different between the two type of subsurface net, we combined the subsurface data for comparison with the surface net data. The CPUE values for flying squid caught by the subsurface nets combined for all operations were about 67% of CPUE values for the surface nets, and CPUE values for flying squid caught by the surface net were higher in most of the operations (Fig. 4). The CPUE of Pacific pomfret caught by the subsurface nets was 37% of CPUE by the surface nets. For many other species, CPUE by the surface net was higher than by the subsurface nets (Table 2). One northern right whale dolphin was entangled in the subsurface net. There was no entanglement of northern fur seal. It is known that small cetaceans generally entangle in the upper part of the driftnet (LaGrange 1990; Inoue and Watabe 1990; Jones et al. 1987; Natale and Notarbartolo-di-Sciara 1990). But, no conclusion could be reached on any reducing effect of incidental take for small cetaceans because of the few
number of entanglements in the present survey. The incidental catch of seabirds by the subsurface nets was very low. This result was the same as experimental results using subsurface nets conducted in the past (Hayase 1990; Yatsu et al. 1990). Fifty percent of seabirds entangled in salmon gillnets have been observed to be at depths of 50cm and shallower (Akamatsu and Hatakeyama, 1991). From these facts, it is considered that the subsurface net is effective in reducing the incidental take of seabirds. It is necessary to pursue further the possibility of incidental catch reduction for those animals by subsurface nets and the mechanism of reduction.

For the ordinary subsurface net, entanglements of several floats on the upper rope with the hanging ropes were observed at 2 or 3 locations out of 160 tans of each operation. This entanglement was not observed in the float-saved type subsurface nets, and the initial research purpose was accomplished.

5. Length composition of flying squid

The mantle length compositions of flying squid (combined for all research stations) are shown in Fig. 5 by type of net. Mantle length ranged from 22cm to 53cm, with a mode around 42cm, and was similar for each type of net.

References, Tables 1 and 2 and Figs. 1 to 5 are in English in the Japanese document.