PRELIMINARY STUDY ON CHANGE IN SHAPE OF DRIFTING NETS EXPERIMENTALLY PLACED IN THE SEA

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ABSTRACT

Research activities to understand the impact of lost drifting nets on marine organisms were initiated in 1988, and an experiment to clarify how the lost nets change their shape at sea was conducted as the first stage of the activities.

Five driftnet sets (40 tans each) were placed in the water in the area around lat. 38°N, long. 158°E, and their shapes were observed from 5 to 25 May. After this, the net sets were allowed to drift, and about 3 months later (in early September) were again observed and subsequently retrieved.

The observations were visual, and recordings were made using a camera-equipped balloon and a video camera from a research vessel.

Three days after setting, one of the nets began twisting into a mass near each end of the net. As time passed, the mass grew larger: the ends of the net approached each other and the net folded in half. Each mass continued to grow, and several small masses also were formed in portions of the long, overlapped net. Twenty days after setting, the net had become one large mass.

All nets observed became masses in the same way, although the speed of formation varied. In September, when the research vessel visited these nets again, each was found floating in a mass.

INTRODUCTION

It has been noted that fishing nets, especially gillnet fragments (hereafter referred to as drifting nets), drift in the sea out of man's control and continue catching marine organisms such as fish while drifting. However, there has been only fragmentary information concerning movements of drifting nets and the actual damage done to marine organisms. Therefore,

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In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

since 1988 we have been conducting research on the movement and changes in shape of drifting nets as well as their impact on marine organisms. This paper examines the changes in the shape of drifting nets in the course of time. Gillnets are thought to be the most effective means of catching fish, as they are set in the sea in a straight line. Once freed from man's control, gillnets are believed to change shape as time passes, with their fishing efficiency gradually declining. We conducted a survey on changes in the shape of drifting nets over time in order to establish a basis for research on related changes in fishing efficiency.

METHODS OF SURVEY

The research was conducted in the North Pacific Ocean on the salmon driftnet fishing ground at lat. 35°-45°N, long. 150°E-180°. The first survey was conducted from 1 to 30 May 1988, and the second from 17 August to 30 September. Five nets were used for the experiments, and each consisted of 40 tans of nylon monofilament gillnet with a mesh size of 115 mm.

An Argos buoy and a "self-call" buoy were attached to the net, one at each end. The location of each net was recorded an average of six times a day using information from the Argos buoy.

On the first cruise, experimental drifting nets were observed by sighting from on board the vessel and photographing from above with a remote control camera attached to a balloon. On the second cruise, experimental drifting nets were located using information from the buoy. They were retrieved after visual confirmation as well as confirmation through a remote control television attached to a balloon.

RESULTS

The six experimental nets, stretched tight, were set in the area lat. 39°20'-38°43'N, long. 154°33'-155°44'E from 1406 on 6 May to 1710 on 7 May. The experimental nets were observed a total of only 16 times, since they moved in two different directions after setting, with two drifting northeast and the other three southeast. Three nets were observed four times and two were observed twice before being retrieved (Table 1).

Except for net No. 1, each experimental net showed generally the same pattern of changing although they differed in pace. First, each end of the net twisted and formed a small mass (Fig. 1A). Second, each net folded in half and its two ends approached each other. The two ends formed a mass, twisting with each other, and the rest of the net stretched long, overlapping more and more (Fig. 1B and C). Third, as time passed, the stretched part wound around the mass. After reaching the third stage, the stretched part of the net formed a mass slowly, becoming entangled and disentangled. Observed 15 and 18 days after release, it was 50 to 60 m long compared with its original length of 2 km, indicating that it did not need many days to become a complete mass. When the five experimental nets were all collected after drifting for a long time, each net had formed a complete mass (Fig. 1D).

Table 1.--Trajectory and width (← →) change of six floating nets in 1988.

Net No.	Date	Width (m)	Latitude N	Longitude E
1	25 May	2,000	40°04′	153°06′
	15 Sept.	5	40°20′	161°08′
2	7 May	2,000	39°19′	154°50′
	10 May	1,250	39°10′	155°12′
	12 May	120	39°19′	155°25′
	18 May	250	38°12′	159°04′
	23 May	60	38°31′	158°15′
	3 Sept.	5	33°56′	169°15′
3	7 May	2,000	39°05′	155°28′
	11 May	160	38°14′	156°52′
	19 May	130	37°18′	160°14′
	28 Aug.	5	40°51′	171°28′
4	7 May	2,000	38°42′	155°19′
	12 May	310	38°14′	154°55′
	18 May	120	37°29′	158°49′
	31 Aug.	5	35°34′	179°46′
5	7 May	2,000	38°48′	154°04′
	13 May	800	39°25′	153°58′
	16 May	500	39°23′	153°56′
	21 May	250	40°06′	153°45′
	25 May	50	40°12′	153°05′
	11 Sept.	5	39°57′	158°10′
6	6 May	2,000	39°06′	154°33′
	8 May	1,150	39°20′	154°28′
	10 May	1,080	39°34′	153°23′
	16 May	600	39°19′	158°07′
	22 May	180	39°32′	153°19′

Note: Measurement of width (← →) refers to Figure 1.

As for the time required to reach each stage, the five nets (excluding net No. 1) remaining in this experiment can be divided into two groups (Fig. 2): One group needed 4 to 5 days after release to reach the third stage; the other needed 14 to 16 days to reach the third stage.

The approach of both ends of a drifting net is the basic process of changing the shape. The structure and arrangement of nets and accompanying buoys also seem to affect the changes. In this experiment, buoys were

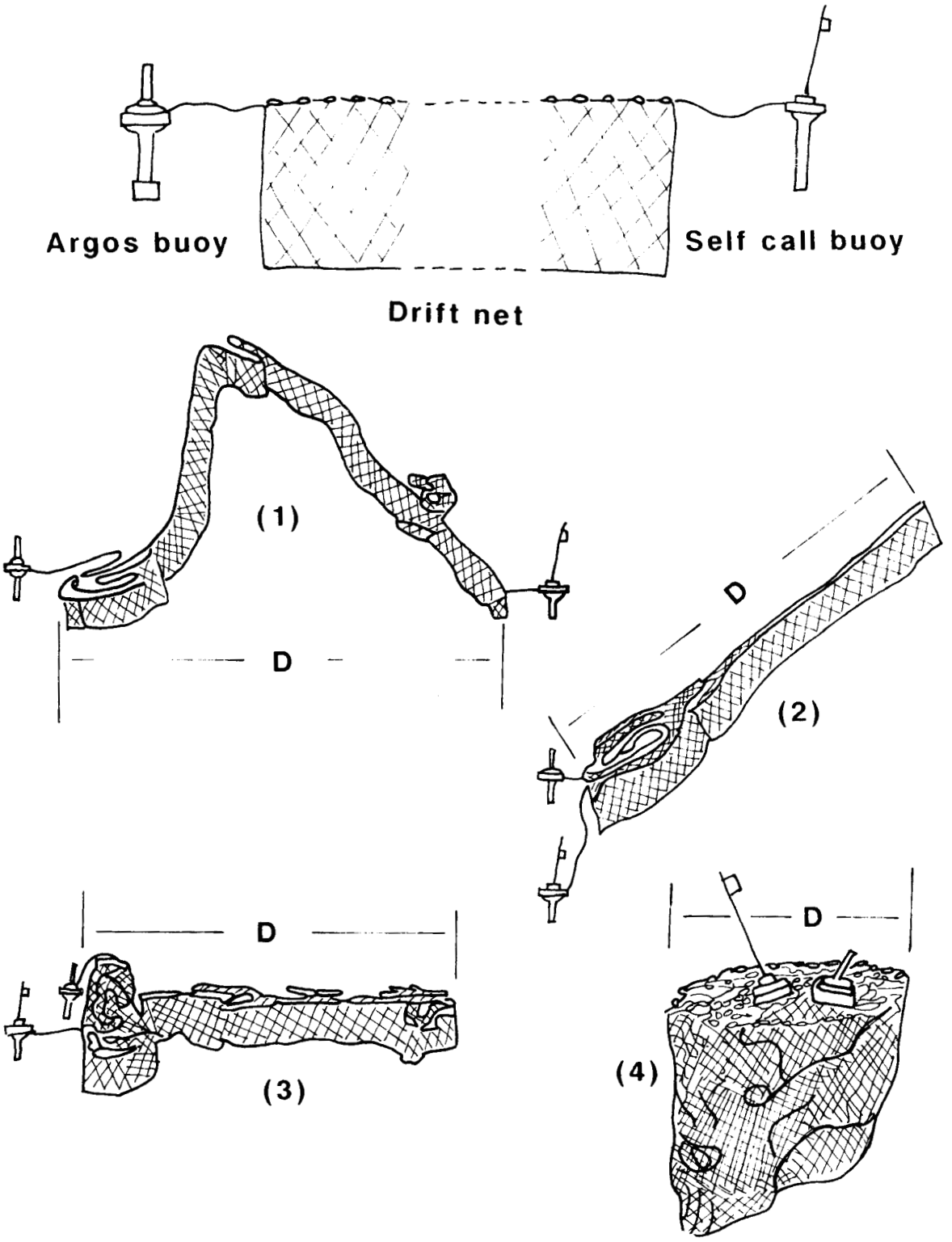

Figure 1.--Schematic diagram showing formation of a mass of floating net after setting ((← →) denotes width of floating net).

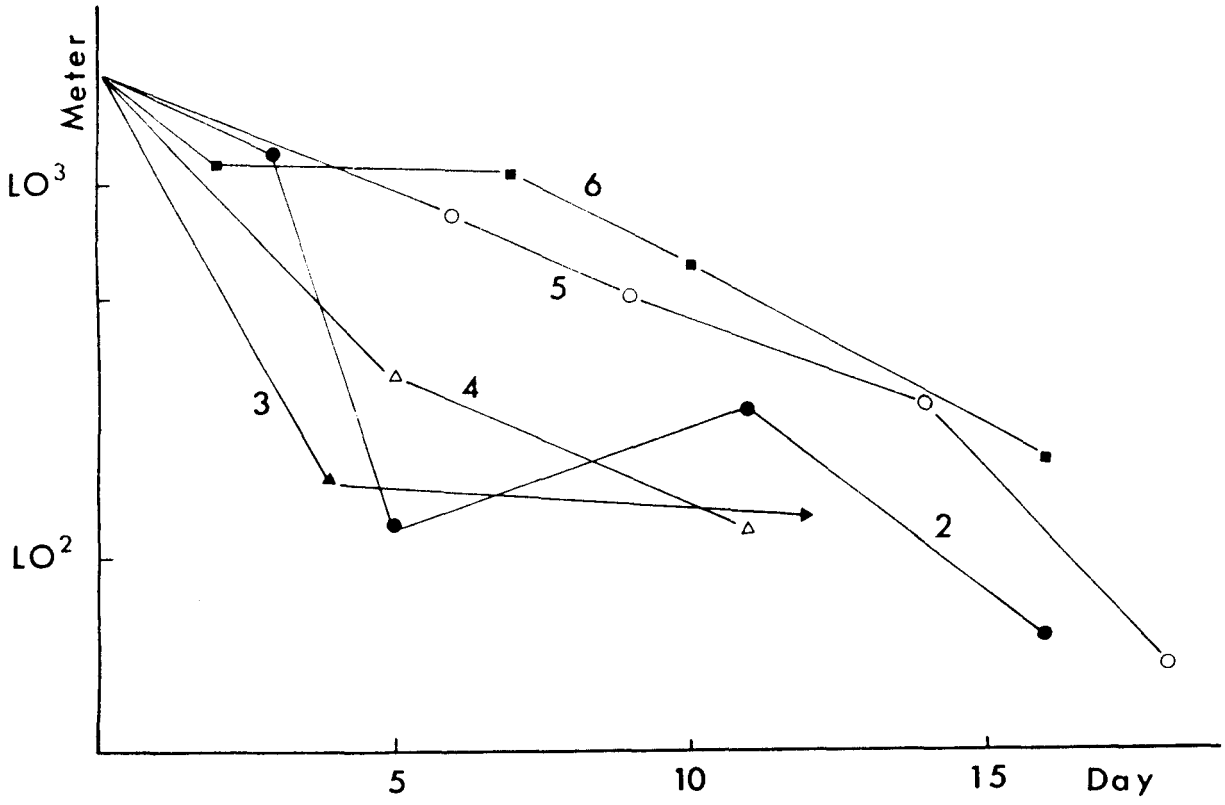

Figure 2.--Relationship between floating period and longest width of net.

attached at both ends of a net. It may be assumed that the difference in resistance between the buoys and the net helped the two ends approach each other. The Argos buoy is a cylinder 160 mm in diameter and 790 mm in height, with a float 440 mm in diameter and 200 mm in height. It is quite small compared to the size of the net. Eight days into the experiment, the Argos buoy temporarily attached to No. 4 net dropped off, and one end of the net was subject to the same resistance as the net alone. However, both ends of the No. 4 net approached each other in the same way as the other nets.

As both ends behaved in a manner similar to other nets with buoys attached on both ends, it is suggested that there would be no changes in the basic configuration even though the presence of buoys may affect the speed of shape change. We plan to conduct further experiments to study effects of different conditions on net shape changes.