

SYNTHETIC MATERIALS FOUND IN THE STOMACHS OF LONGNOSE
LANCETFISH COLLECTED FROM SURUGA BAY, CENTRAL JAPAN

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ABSTRACT

Stomach contents of a total of 372 longnose lancetfish, *Alepisaurus ferox* Lowe, 296 stranded on the beach of Miho Key in Suruga Bay between 1964 and 1983 and 76 fished by gillnets in waters near the key between 1969 and 1975, were examined. In addition to food organisms, many synthetic items such as pieces of polyethylene and vinyl were found in the stomachs. This paper examines the presence of these synthetic materials in the stomachs of longnose lancetfish. Major results of this study were as follows:

- Synthetic materials found in the stomachs were mostly soft polyethylene and vinyl pieces of various sizes and colors. Intact plastic soft drink bottles were also found.
- The feeding ratio of synthetic materials in the stomach of lancetfish was 62.2% for stranded specimens and 63.2% for gillnet specimens.
- Average number of pieces of synthetic materials in the stomach was 3.1 for stranded specimens and 2.2 for gillnet specimens.
- The feeding ratio and number of synthetic pieces in the stomachs of longnose lancetfish have increased sharply during the past several years, suggesting that there have been increases in the amounts of synthetic materials in Suruga Bay and neighboring waters. There are concerns that the neglected synthetic materials may impact large marine organisms adversely.

INTRODUCTION

Longnose lancetfish, *Alepisaurus ferox* Lowe (Alepisauridae), is widely distributed in the Pacific, Atlantic, and Indian Oceans. It has a large mouth, large eyes, and very sharp bladelike teeth. Its body tissue is soft and watery. It is well known as voracious fish (Fig. 1).

In Suruga Bay and Sagami Bay, located at the center of Honshu in Japan, longnose lancetfish are often stranded alive on the shore by waves. Strandings are especially frequent between December and May on the shores of Kambara, Numazu, Miho, and Ohsesaki, which are located at the inmost part of Suruga Bay (Kubota and Uyeno 1970).

Since 1964, the author has been collecting lancetfish caught with gillnets and boat seines and those stranded on the shore of Miho Key to study their morphology and food habits (Fig. 2; Kubota and Uyeno 1970, 1978; Kubota 1971, 1973, 1977; Kubota and Mori 1975; Okutani and Kubota 1976).

The stomachs of the fish examined contained many pieces of synthetic materials such as polyethylene and vinyl in addition to ordinary food items (e.g., fishes, cephalopods, shrimps, salps, *Pyrosoma*).

It was pointed out that synthetic materials found in the stomachs of lancetfish are from pollution of the ocean and that they served as an index for effects on large nekton such as fish (Kubota 1977). No previous study has examined the effects of synthetic materials on marine nekton.

The objectives of this study were to determine the amounts of synthetic material ingested by longnose lancetfish and to determine how it had changed with the time.

MATERIALS AND METHODS

In this study, 372 fish were examined. Of these, 296 were found stranded on the shore of Miho Key and the remaining 76 were caught in gillnets in the area near Miho Key between December and May. The lengths of the fish range from 50 to 125 cm. Immediately after collection, measurements of meristic characters were made in the laboratory. Food items found in stomachs were removed for identification. The amount and size of nonfood items were also recorded. Nonfood items included leaves, pieces of wood, straw, fragments of orange, fragments of vegetable, rubber, vinyl pieces, polyethylene pieces, and intact plastic soft drink bottles.

RESULTS

Synthetic materials eaten by lancetfish were mostly soft polyethylene and vinyl pieces. Both size and color of these items varied (Fig. 3). Besides these materials, intact plastic soft drink bottles (38 mm in diameter and 74 mm in height) were found in the stomachs of 11 lancetfish stranded on the shore between 1971 and 1973. Of these, four lancetfish had two bottles each in their stomachs in addition to food items.

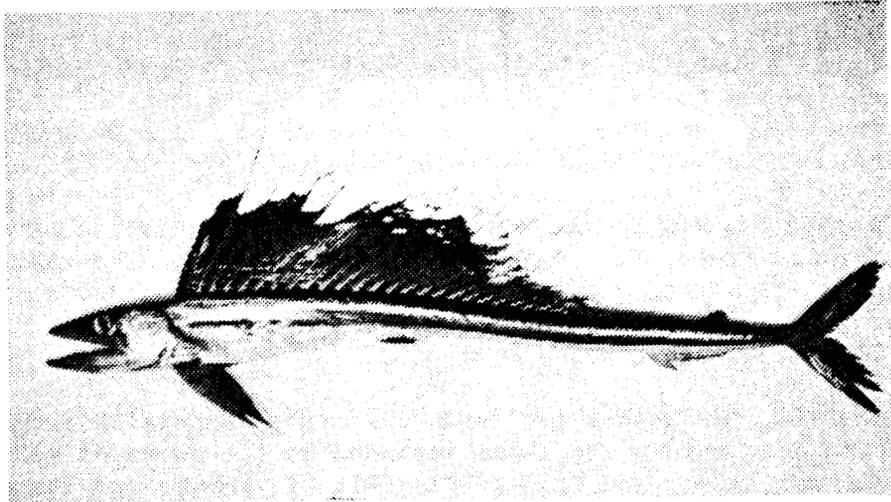


Figure 1.--A longnose lancetfish collected from Suruga Bay. Date collected: 27 April 1967, body length: 887 mm. Scale in figure indicates 300 mm.

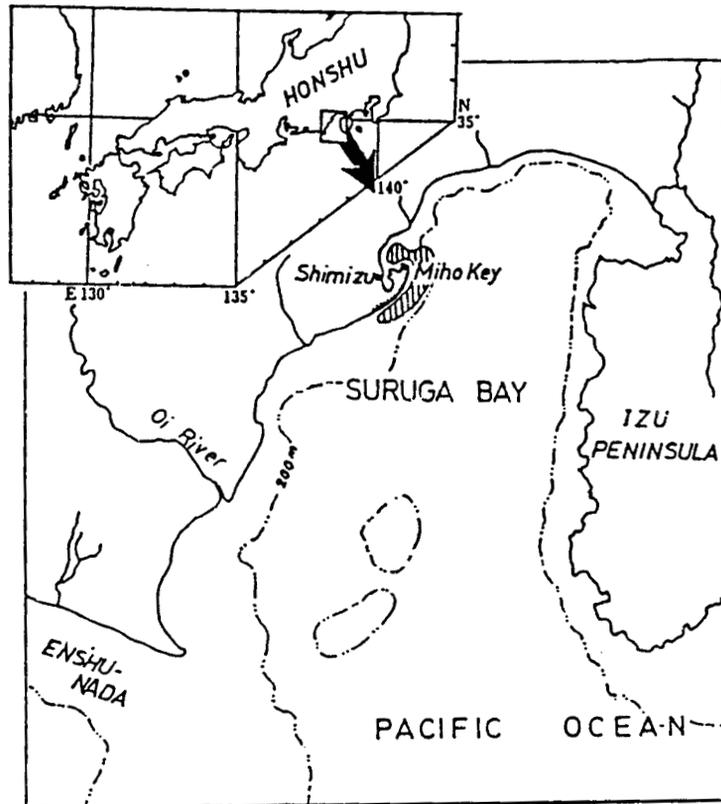


Figure 2.--Suruga Bay, central Japan. The shaded portion of Miho Key is the beach where longnose lancetfish have been stranded and the shaded area off Miho Key indicates a gillnet fishing ground.

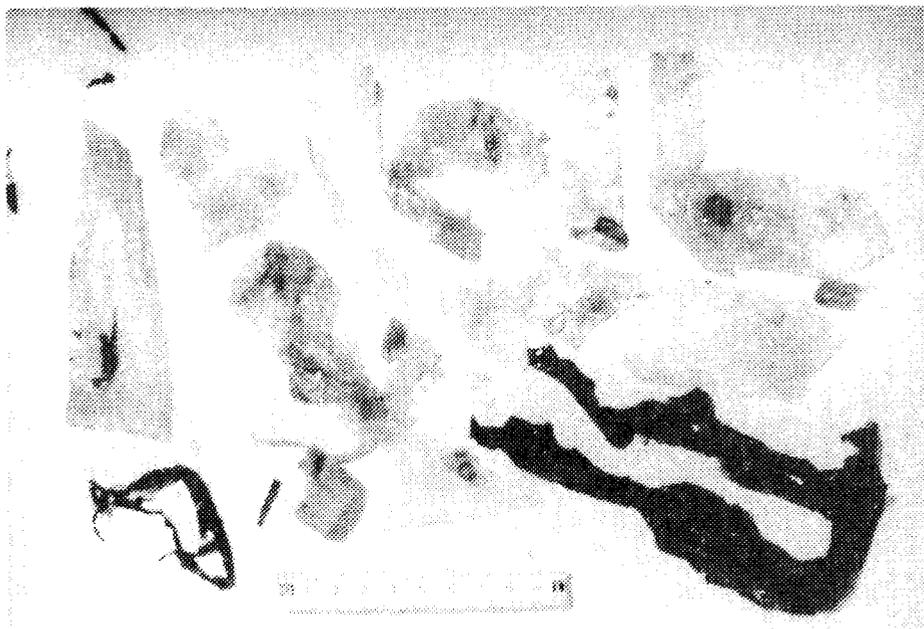


Figure 3.--Synthetic materials from stomachs of longnose lancetfish stranded on the beach of Miho Key. Date collected: May 1971. Scale in figure indicates 100 mm.

The feeding ratio of synthetic materials to food was examined for each year. The feeding ratio for 184 of the 296 specimens that were stranded on the shore was 62.2%, whereas the feeding ratio for 48 specimens among 76 caught with gillnets was 63.2%. The average amount of synthetic material per specimen for each year was also studied. The average amount of synthetic materials per specimen was 3.1 pieces for specimens stranded on the shore and 2.2 pieces for those caught in gillnets.

The results from stranded specimens cover a long time period. Therefore, the study period was divided into two parts, 1964-75 and 1978-83. The feeding ratio of synthetic materials in stomachs of lancetfish was 58.0% in the period 1964-75, and it increased to 72.0% in 1978-83. The average amount of synthetic material per specimen increased from 2.2 pieces in 1964-75 to 4.5 pieces (more than double) in 1978-83 (Tables 1 and 2).

For the samples that had synthetic materials in their stomachs, the frequency of the amount of synthetic materials was studied to see how many pieces were eaten per specimen.

Of those fish on the shore, 112 specimens did not have synthetic materials in their stomachs at all. Thirty-six samples had one piece. Of 184 fish, 135 (73.4%) ate 1 to 6 pieces of synthetic material. One lancetfish ate 17 pieces.

Table 1.--Number of synthetic pieces found in the stomachs of longnose lancetfish stranded on the beach of Miho Key.

Year	Number of lancetfish	Number of lancetfish with pieces of synthetic materials	Total number of pieces of synthetic materials	Average number of pieces of synthetic materials
1964	2	1	5	2.5
1965	2	1	7	3.5
1966	2	1	15	7.5
1967	9	2	10	1.1
1968	19	12	33	1.7
1969	19	11	29	1.5
1970	18	9	38	2.1
1971	56	30	99	1.8
1972	21	15	70	3.3
1973	24	17	72	3.0
1974	2	1	3	1.5
1975	2	1	1	0.5
1976	--	--	--	--
1977	--	--	--	--
1978	57	39	281	4.9
1979	37	24	145	3.9
1980	16	12	76	4.8
1981	--	--	--	--
1982	--	--	--	--
1983	10	8	38	3.8
Total	296	184	922	

For the fish caught with gillnets, 28 did not have any synthetic material pieces and 12 fish ate only 1 piece. One specimen had 15 pieces in its stomach. All the others contained 10 or fewer pieces (Tables 3 and 4).

These results show that synthetic material in the stomachs of longnose lancetfish is increasing. This is from the increase in synthetic materials being discarded by people into rivers and the ocean.

DISCUSSION

The longnose lancetfish is a voracious feeder. It has nonselective food habits and will catch anything in the ocean it can swallow. In most cases, the stomach contents can be identified to the species level. The feeding habits of lancetfish are the same in other areas (Haedrich 1964; Haedrich and Nielsen 1966; Fourmanoir 1969; Rancurel 1970; Fujita and Hattori 1976). Therefore, it is possible to identify the organisms in the

Table 2.--Number of synthetic pieces found in the stomachs of longnose lancetfish caught by gillnet.

Year	Number of lancetfish	Number of lancetfish with pieces of synthetic materials	Total number of pieces of synthetic materials	Average number of pieces of synthetic materials
1969	1	1	1	1.0
1970	14	6	12	0.9
1971	33	23	74	2.2
1972	21	12	63	3.0
1973	5	4	10	2.0
1974	1	1	3	3.0
1975	1	1	5	5.0
Total	76	48	168	

Table 3.--Number and frequency of synthetic pieces found in each stomach of longnose lancetfish stranded on the beach of Miho Key.

Number of pieces of synthetic materials found in each stomach	Number of lancetfish
0	112
1	36
2	29
3	25
4	16
5	16
6	13
7	6
8	9
9	6
10	5
11	4
12	4
13	3
14	4
15	3
16	4
17	1

Table 4.--Number and frequency of synthetic pieces found in each stomach of longnose lancetfish caught by gillnet.

Number of pieces of synthetic materials found in each stomach	Number of lancetfish
0	28
1	12
2	9
3	8
4	7
5	4
6	3
7	2
8	0
9	1
10	1
15	1

habitat where lancetfish live using stomach analysis. The distribution of nonfood items such as synthetic materials can also be determined.

Results showing that polyethylene and vinyl pieces found in the stomachs of lancetfish have increased over time imply that fairly large quantities of synthetic materials are present in the waters near Miho Key. In the last few years, the author has observed water surfaces of the area from the innermost part to the central part of Suruga Bay from on board a research vessel, and has seen large floating vinyl pieces. These items were not seen at all in the sea 8 years ago. This study documents the notion that quantities of discarded synthetic materials have increased in recent years. Synthetic materials mass-produced to meet the consumer demands will continue to contaminate the seas around Japan because they are discarded from houses and factories as waste and enter the sea through rivers.

Because of their feeding habits, lancetfish can serve as a biological monitor of synthetic pollution in the ocean.

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