

15. *Some Observations on the Unusual Behaviour of Fishes prior to an Earthquake.**

By Yasuo SUYEHIRO,

Imperial Fisheries Experimental Station.

(Read Dec. 20, 1933.—Received Dec. 20, 1933.)

As we are so often visited by terrible earthquakes, the unusual phenomena of the natural world accompanying them have long been observed by many scientists as well as laymen. Accordingly, papers dealing with the abnormal behaviour of fishes prior to an earthquake are exceedingly numerous all of which have been systematically embodied in the report of Mr. K. Musya.¹⁾ Prof. T. Terada²⁾ has recently made a statistical investigation of the effects of the Idu earthquakes on the horse-mackerel and bluefin tuna fisheries, Prof. S. Hatai³⁾ has studied biologically the responses of the catfish to earthquakes. All these studies equally prove the existence of a mysterious and instinctive reaction of the fish to earthquakes.

The present writer who has studied the ecology of fish and especially the feeding habits of the various fishes, chanced lately upon the following interesting facts which probably have some connection with the great earthquake of Sanriku, on March 3rd, 1933.

1) **The fact that sardines which were caught the evening previous to the earthquake, gorged mainly on bottom-adherent diatoms.**

By courtesy of Mr. S. Yamoto, the present writer was able to obtain adult sardines, *Sardina melanosticta*, which were caught by a purse seine from the adjacent waters of Misaki, Kanagawa Prefecture, on the evening previous to the day on which the Sanriku earthquake occurred.

*) Communicated by M. Ishimoto.

1) K. MUSYA, 「地震と魚の異常生態」 *Disin*, 4 (1932).

2) T. TERADA, "Earthquakes and fisheries," *Proc. Imp. Acad.*, 8, (1932), 83-86.

3) S. HATAI, "The responses of the catfish, *Parasilurus asotus*, to earthquakes," *Pro. Imp. Acad.*, 8, (1932), 8.

He cut open the sardines, as usual, to examine the digestive tracts and their contents when he observed that their stomachs were in every case swelled by their contents to an abnormal degree, as is shown in Figure 1. Impelled by his extreme interest, the writer analysed quantitatively and qualitatively the stomach contents. The results of the analysis are as is shown in the column I of the following table, the amount of food 4.9 gm in average weight, consisted mainly of bottom-adherent diatoms,^{4, 5)} such as the species of *Synedra* and *Fragilaria*. However, according to late Prof. K. Kisinouye,⁶⁾ a sardine of ca. 15 cm in length obtains usually, at least in this season, as food 1 gm of the plankton in the upper layer of the sea without any special selection of species. It is also worthy of notice that these fishes were in fact caught in the upper layer of the sea by a purse seine. Therefore, such a mode of feeding by the sardine may be regarded as quite extraordinary.

Table I.

	I (Before earthquake)	II (After earthquake)
Fish	<i>Sardina melanostica</i>	do.
Number of fish	10	do.
Date	March 2nd, 1933	March 6th, 1933
Fishing ground	Adjacent waters to Misaki	do.
Fishing implement	Purse seine	do.
Ave. weight of fish	52 gm	45 gm
Ave. length of fish	14.9 cm	14.6 cm
Ave. weight of stomach content	4.9 gm	0.8 gm
Dominant species of food	<i>Synedra fulgens</i> , <i>Rhizosolenia setigera</i> , <i>Fragilaria sp.</i>	Copepoda, <i>Coscinodiscus radiatus</i> , <i>Cos. excentricus</i> , <i>Thalassiothrix sp.</i>

In order to study the fact more clearly, the present writer collected ten more sardines, in the same locality as that above-mentioned, on the evening of March 6th, viz. three days after the great earthquake. In the analysis of the latter, however, the stomach contents had all returned

4) F. CASTRACANE, "The voyage of H. M. S. Challenger," *Botany*, 2, (1886) 21.

5) F. OLTMANN, "Morphologie und Biologie der Algen," 1 (1904), 99-100.

6) K. KISINOUE, "Notes on the natural history of the sardine (*Clupea melanosticta* SCHLEGEL)," *Jour. Jap. Imp. Fish. Bur.*, 14, (1907), 3.

already to the normal condition, as is shown in the column II of Table I.

These results will at least convince us of the possibility that the bottomadherent diatoms may, prior to the earthquake, have appeared in a large quantity in the upper layer of the adjacent sea of Misaki. A similar phenomenon has been reported by Mr. K. Tago⁷⁾ on the occasion of the Kwanto earthquake. Hence, it may be assumed that there had occurred a certain change at the bottom of the sea before the earthquake was felt by us personally.

2) The fact that *Nemichthys avocetta* and other deep sea fishes were caught.

At 7 a.m. on March 3rd, 1933, viz. some hours after the earthquake, Mr. J. Murase caught alive the rare deep sea fish, *Nemichthys avocetta*, on the coast of Odawara, Kanagawa Prefecture. The sample was the adult fish 78.8 cm in length and 7.5 gm in weight. This species is, as is shown in Figure 2 an eel-like fish with an elongated body, and usually lives on the deep-sea bottom at a depth of more than 300 fathoms.^{8), 9)} Therefore, if we suppose that the fish swam to the beach from such a depth, we cannot help coming to the conclusion that the fish had left its haunts previous to the earthquake.

Then, what circumstance compelled the fish to escape from its haunts? We can with great probability reckon that there would occur so unsuitable a change on the sea bottom that the fish was driven to leave the locality. It is also of interest that some other deep-sea fishes were caught there on the same day and afterwards.

We have now discovered two cases of the unusual behaviour of fishes which may be connected to some extent with the Sanriku earthquake. Being of interest, both cases equally gives us a hint that there most probably occur a certain change at the bottom of the adjacent sea of Misaki, prior to the great earthquake of Sanriku.

The present paper is, however, merely to report the results of a brief investigation of the unusual behaviour of fishes which may have

7) K. TAGO, "The influence of earthquake on fisheries", *Jour Geogr.*, 36, 23-28, (in Japanese).

8) D. S. JORDAN and B. W. EVERMANN, "Fishes of North and Middle America", 1 (1896), 369.

9) G. B. GOOD and T. H. BEAN, "Oceanic Ichthyology", (1895), 151-153.

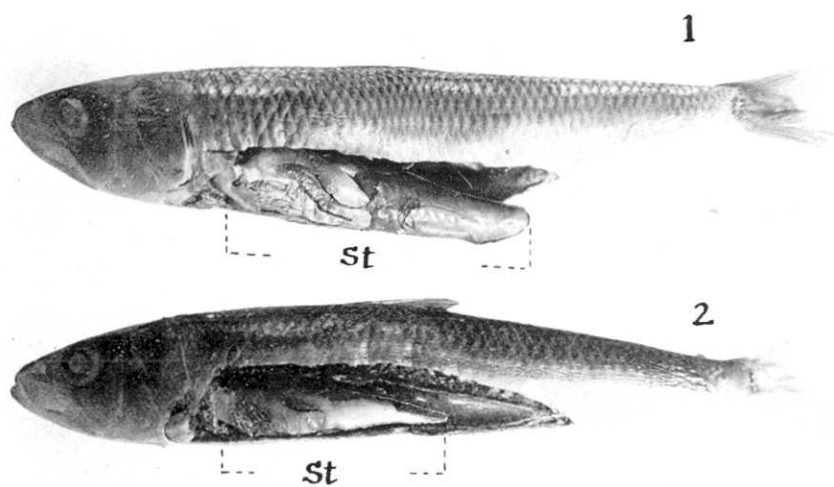
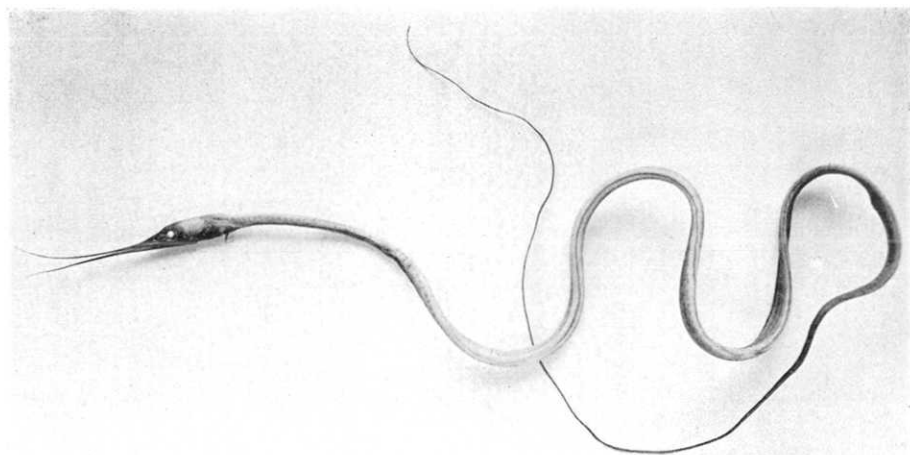


Fig. 1. 1. Sardine caught before the earthquake.
2. Sardine caught after the earthquake. **St.** Stomach.



(Mr. T. Kitamura, Photo.)

Fig. 2. *Nemichthys avocetta*.

(震研彙報別冊、第一號、圖版、末廣)

had some connection with the earthquake, and to attract the attention of futur investigators.

In leaving off writing the writer wishes to express his indebtedness to Prof. J. Hara, Prof. S. Tanaka, Prof. J. Obata, Dr. T. Tsuboi, Mr. S. Hosino, Mr. H. Aikawa and Mr. S. Usioku for their kind directions and useful informations.

15. 地震前に見らるゝ魚類の異常生態に就ての二三の観察

農林省水産試験場 末 廣 恭 雄

筆者は彼の三陸大地震發生の當時、地震の前夕及び3日後、三崎近海の表層で、真鯛、*Sardina melanosticta*、の成魚を採集した。胃内容物を査定した所前者は表 I に示したる如く専ら多量の底着性硅藻類を、後者は表 II に示したる如く適量の浮游生物を攝取して居るのを發見した。然るに岸上先生の報告にも明かである如く、真鯛は常時、少くも此季節では、浮游生物を適量攝取するのが普通である。してみると前者の場合、即ち地震發生に先立つて、海の表層に多量の底着性硅藻類が出現して居たと考へなくてはならぬ。

又、地震發生後數時間を経て小田原海岸で、常時 300 尋以上の深海底に棲息すると云はるゝ珍魚 *Nemichthys avocetta* が生きながらに採集された。若し此魚が斯る深海より岸邊まで泳ぎ來つたものとすれば、時間の關係上、魚は地震前既に其棲息地を後にして居なくてはならぬ。

では何が故地震に先立つて底着性硅藻類が海の表層に出現したか、何が故深海魚が其棲息地を捨てゝ移動したか。筆者は上記の事實を以て、地震が人體に感ずる以前、既に海底に或變化が起つたのではなからうかと推察する。
