

## Recent Increase in the Occurrence of the Deal-Fish in Adjacent Waters to Japan

BY

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### Abstract

A marked increase was observed in recent years, *i. e.*, since about 1954, for the occurrence of the deal-fish, *Trachipterus ishikawai* JORDAN & SNYDER, from the Japanese waters as compared with that during the early half of the present century. Taking as valid the view that the deal-fish may be an inhabitant of the Central Water mass in the western North Pacific, it was considered that the increase in occurrence of this mesopelagic species would suggest a recent flourishing of inflow of that water mass into the surrounding seas of Japan. The occurrence or yield pattern in several mesopelagic fishes other than the deal-fish was also shown to be in favour of this supposition. Lastly, it was suggested that the presumed fluctuation in strength of the Central Water mass might in some way or other be associated with the recent climatic change that occurred on a world-wide or, at least, semispheric scale.

THE deal-fish, *Trachipterus ishikawai* JORDAN & SNYDER (Trachipteridae; Allotriognathi), is a mid-water pelagic fish distributed in the surrounding seas of Japan. It has been regarded as one of the rarest species. Since it was first described by JORDAN & SNYDER (1901), its occurrence was reported from not more than eleven localities in Japanese waters throughout the following 50 years (Fig. 1).

Since about 1954, however, the occurrence of the deal-fish has been recorded with increasing frequency, and since 1958 in particular, the number of reported specimens has greatly augmented—According to MATSUBARA (1955) and Dr. AKIRA OCHIAI of the Department of Fisheries, Kyoto University, Maizuru (personal communication dated March 21, 1960), a specimen was caught at Maizuru, Kyoto Prefecture, on March 10, 1954. MOFI (1956 and personal communication dated March 27, 1960) reported two specimens being collected respectively at Kasumi, Hyogo Prefecture, on May 30, 1955, and at Hamada, Shimane Prefecture (date unknown). KURODA (1957) recorded a specimen about two meters long taken off Numazu, Shizuoka Prefecture, on August 7, 1956, and cited a message from Dr. TOKIHARU ABE of the Tokai Regional Fisheries Research Laboratory, Tokyo, mentioning that the latter had another specimen of about the same size, the sampling date and locality of which, however, was not specified, deposited in a refrigerated state in a cold-storage chamber. The data of the occurrence records of the deal-fish since 1958, so far as

known to me, are included in Table 1.

Table 1. Deal-fish catches in adjacent waters to Japan, 1958-1961.

Date	Locality	Body length m	Sources	Remark
Dec. 28, 1958	Anamizu-machi, Ishikawa Pref.	—	HONDA (1960)	
Feb. 3, 1959	Off Fukuura, Ishikawa Pref.	1.5	"	
Feb. 5, 1959	Nonoe, Suzu-shi, Ishikawa Pref.	—	"	
Feb. 6, 1959	Off the mouth of Iigawa River, Suzu-shi, Ishikawa Pref.	1.7	"	
Feb. 2, 1960	Near Tobishima Isl., Yamagata Pref.	1.5	NISHIMURA (1960a)	
Feb. 18, 1960	Aoyama, Niigata-shi, Niigata Pref.	1.8	"	
Early Jan., 1961	Off the mouth of Bosogawa River, Fukudamachi, Shizuoka Pref.	1.7	The Hokuriku-Chunichi Shimbun (dated Jan. 10, 1961)	Identified by the photograph
Jan. 30, 1961	Nô-machi, Niigata Pref.	1.58	NISHIMURA & MIZUSAWA (in press)	
Feb. 21, 1961	Kajiyashiki, Itoigawashi, Niigata Pref.	1.77	"	
Mar. 11, 1961	Teradomari-machi, Niigata Pref.	1.65	"	
Mar. 11, 1961	Kasumi, Hyogo Pref.	1.57	Y. OGAWA (personal comm. dated June 29, 1961)	
Mar. 18, 1961	Matsugasaki, Sado Isl., Niigata Pref.	1.51	NISHIMURA & MIZUSAWA (in press)	
Mar. 18, 1961	20 miles NNE off Hajikizaki, Sado Isl., Niigata Pref. (Two specimens)	—, —	Hokkaido Fish. Exper. Stat. (1961)	
March, 1961	Tsuiyama, Hyogo Pref.	—	Y. OGAWA ( <i>ibid.</i> )	
Apr. 14, 1961	Ogi, Uchiura-machi, Ishikawa Pref.	1.52	The Hokkoku Shimbun (dated Apr. 17, 1961)	
Apr. 30, 1961	Off Urahama, Maki-machi, Niigata Pref.	1.45	NISHIMURA & MIZUSAWA (in press)	
April, 1961	Chiba Pref.	—	NHK Broadcast	
May 23, 1961	Off Kominato, Sakata-shi, Yamagata Pref.	1.5	NISHIMURA & MIZUSAWA (in press)	
Late May, 1961	Yotsuyahama, Ôgata-machi, Niigata Pref.	1.2	"	
June 5, 1961	Iwaya, Awajishima Isl., Hyogo Pref.	0.70	R. OKUNO (personal comm. dated June 24, 1961)	
June 24, 1961	Komagabayashi, Kobe-shi, Hyogo Pref.	0.87	"	
Jul. 11, 1961	Kada-machi, Wakayama-shi, Wakayama Pref.	0.90	C. ARAGA (personal comm. to R. OKUNO)	

In addition, according to Mr. SHUMPEI KOJIMA of the Shimane Prefectural Fisheries Experimental Station, Hamada (personal communication dated March 1, 1960), nearly ten specimens of the deal-fish were brought to him for identification from localities near Hamada during the period from 1948 to 1960, and

further Dr. A. OCHIAI informed me (personal communication dated March 21, 1960) that he had a chance to observe a specimen caught off either Akita Prefecture or Aomori Prefecture towards the end of the preceding year (1959).

Excepting the two specimens, *i. e.*, the one deposited by Dr. T. ABE and the other examined by Dr. A. OCHIAI, all the catch records of this taeniosome fish during the period from about 1950 through 1961 are put on the map (Fig. 2).

Comparing with Figure 1, it is evident that the incidence of occurrence of the deal-fish has markedly increased in recent years, which is distinct in particular for the Japan Sea, and that the northern limit of occurrence in this marginal sea has greatly been shifted to a higher latitude. Although the increase

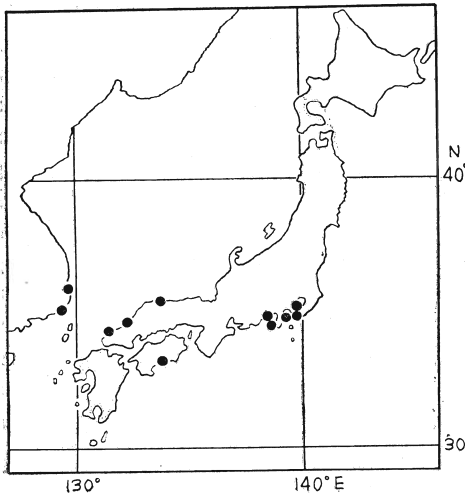


Fig. 1. Locations of the occurrence of the deal-fish in adjacent waters to Japan during the period from about 1900 to about 1950.

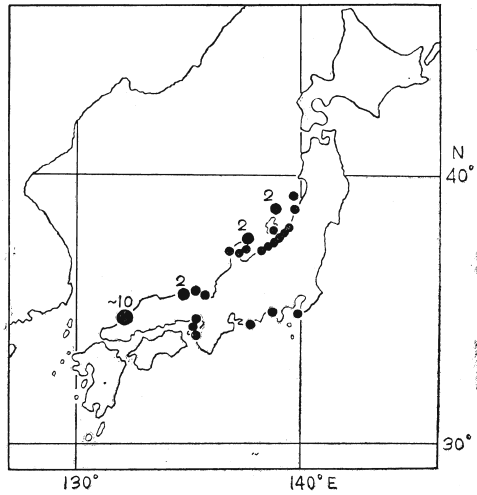


Fig. 2. Locations of the occurrence of the deal-fish in adjacent waters to Japan during the period from about 1950 to 1961.

in occurrence records may be attributed in part to an increased number of interested observers in recent years, it seems more likely that greater part of the increase would really be due to a strengthened migration of the fish to adjacent waters of Japan and particularly into the Japan Sea.

Elsewhere I have discussed (NISHIMURA, in press) that the oar-fish, *Regalecus russellii* (SHAW), akin to the deal-fish, would be a member of the animal community in the mesopelagic zone as defined by BRUUN (1955), or, in terminologies of physical oceanography, would inhabit the Central Water mass in the ocean. The Central Water is considered to be formed through the winter thermohaline convection in latitudes 30°N to 40°N and longitudes 150°E to 160°E, whence it gradually spreads over the entire western North Pacific basin (SVERDRUP *et al.* 1942), and, according to MIYAZAKI & ABE (1960), part of it penetrates into the Japan Sea. By the way, it has long been stated that the distribution of the oar-fish in the depths of the sea is the same as that of the deal-fish (GÜNTHER 1887). The similarity in their time and space distribution of occurrence is quite remarkable (GOODE & BEAN 1895). This seems also to hold true for *Regalecus russellii* and *Trachipterus ishikawai* in Japanese waters (NISHIMURA 1960b). It is therefore reasonably inferred that the deal-fish

would likewise be an inhabitant of the mesopelagic zone where the Central Water mass is prevailing. General resemblance in morphology as well as taxonomic affinity between the two species render further supports to this view. Taking the aforementioned presumption as valid, it is hypothesized that the recent increase in occurrence, and therefore in magnitude of the migrating population to Japanese waters as suggested above, of the deal-fish would indicate a possible flourishing of inflow of the Central Water mass into the surrounding seas of Japan, and particularly into the Japan Sea, in recent years. It should be here remarked that the specimens hitherto caught in Japanese waters are all of considerable body size (see Table 1), not a single individual of larvae or early-stage young definitely identified with this species having been recorded\*. This would suggest the spawning area of this taeniosome fish being situated some distance far off the Japanese main islands (possibly in an oceanic region), and the produced population being transported gradually year after year over the distance by the Central Water mass which spreads from its formation area to the entire western North Pacific southward of the Subarctic convergence. The fact that part of this water mass flows into the East China Sea bathing the marginal areas of its continental shelf, and furthermore penetrates through the Korean Straits into the Japan Sea as the subsurface warm current was already pointed out by FUKASE (1961) and MIYAZAKI & ABE (1960). Owing to this subsurface current, the fish would be able ultimately to reach the west coasts of Kyushu as well as the Japan Sea coasts of Honshu. It is as yet undetermined, however, whether the increased appearance of the deal-fish was caused simply by an increase in transport of the Central Water mass, or by a raised survival rate during the early stages of ontogenesis attained under the ameliorated condition, or by both.

The supposition that there may have taken place a reinforcement in the strength of the Central Water mass is also borne out by another observation. The deep-sea smelt, *Glossanodon semifasciatus* (KISHINOUE), likewise considered as a member of the mesopelagic community, is said, according to MATSUBARA (1955) and TOMIYAMA & ABE (1958), to be distributed in the seas south of Toyama Bay on the Japan Sea side and south of Sagami Bay on the Pacific

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\* There are, however, some reports which mention occurrence of the eggs or larvae presumably pertaining to the family Trachipteridae or the suborder Trachipterina in adjacent waters to Japan. Thus, HATTORI *et al.* (1957) obtained a single larva of the Trachipterina at a location about 90 miles south of Shionomisaki Promontory in a survey made in May 1955. In the same survey, the authors caught by surface towing a considerable number of an unidentified yet notable pelagic egg. This egg (Type A without oil-globule by the authors' tentative nomination), 2.10-2.75 mm in diameter, lacking in oil-globule and faintly salmon-pink in coloration, was caught by hundred, sixties and fifties at locations more than 50 miles off the Enshu-nada. It is highly probable that the egg is of the Trachipteridae (*vid.* EHRENBAUM 1905-1909; MURRAY & HJORT 1912; ORTON 1955; MITO 1961), and it is a noteworthy fact that the abundant occurrence of the egg is almost confined within the so-called "cold water area" off the Enshu-nada (HATTORI *et al.* 1957). Prior to this, SENTA (1955) reported an occurrence of a single pelagic egg from the southern East China Sea in February 1955, which he considered possibly belonging to the Trachipteridae. Also, MITO (1961) obtained some eggs which were supposed to be *Trachipterus* sp. during the season from June to January, next year, from surrounding seas of Kyushu, and succeeded in rearing them up to the prolarval stage. Quite regrettable, however, we cannot determine where the center of spawning of these taeniosome fishes is located in the western North Pacific on the basis of these scanty data.

side; but, since the early 1950's its yield on the Japan Sea side has been remarkably increased, with a northward expansion of the distribution area (Fig. 3). It seems rather reasonable to consider that the yield of the deep-sea smelt reflects, though not precisely, its abundance in the sea and that the increase in abundance thus presumed may have been brought out, possibly in this case,

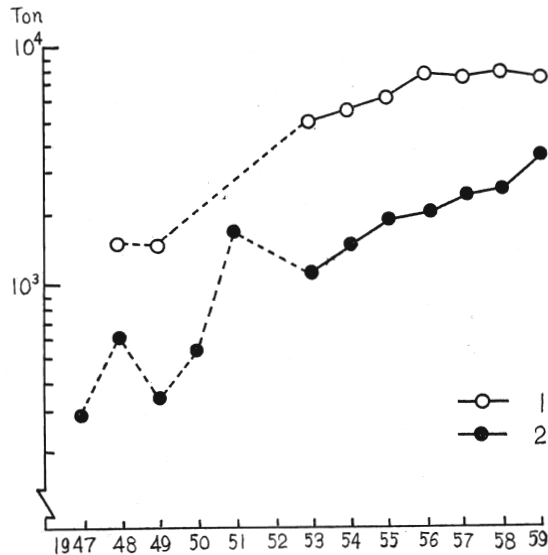


Fig. 3. Change in commercial landing of the deep-sea smelt in the southern (1) and the northern (2) region of the Japan Sea. The data prior to 1953 are somewhat incomplete.

through a raised level of survival in early life history as well as an expansion of the spawning area. This is inferred from the results of egg and larvae surveys in the field and may be understood as the consequences of the supposed reinforcement in inflow of the Central Water mass in the Japan Sea. The yield of the same species in the northeastern region of Honshu, *i. e.*, north of Ibaragi Prefecture, also shows a considerable increase in recent years. Additionally, similar situations are found for the louvar, *Luvarus imperialis* RAFINESQUE, and the centrophid fish, *Mupus japonicus* (DÖDERLEIN), both of them no doubt with a mesopelagic habit. The former, a rare species, has recently been reported of its occurrence with increasing frequency from the seas adjacent to the Izu-Shichito Isls. and the Sanriku District (ANON. 1961), and the latter has shown, as TOMIYAMA & ABE (1953) states, a rapid growth in commercial catch on the Pacific side of the central Honshu in recent years. In the Japan Sea, also, there are facts that suggest the occurrence of this stromateoid fish having very recently been increased—I unexpectedly remarked that a considerable amount of young individuals of this species (ABE 1955) were caught by set nets at Sado Island in the early summer of 1961, and moreover, about mid-day on June 30, 1961, Mr. TETSUO OGATA of the Japan Sea Regional Fisheries Research Laboratory observed on board a shoal of the centrophid fish swimming around the research vessel at latitude 38°59.5'N and longitude

135° 03'E, and succeeded to catch by angling some specimens for study. The eight specimens thus obtained ranged from 240 mm to 347 mm in total length. The position lay just in the main stream of the Tsushima Current or in the polar frontal zone. It is of special interest to note that this normally mesopelagic species occurs at surface in the polar frontal zone where the Central Water mass carried by the warm current is raised to a much lesser depth and laterally mixed with the Subarctic surface water along the isopycnic surface\*.

As stated so far, there are several indications that suggest a recent growth in the strength of the Central Water mass flowing in adjacent seas of Japan. How this strengthening was brought out may doubtlessly be a complex process presenting a difficult problem to solve, and needless to say, discussing upon this point is out of the scope of the present article. There may be, however, hardly any doubts for supposing the possibility that it is in some way or other associated with the climatic changes that are remarked to have occurred on a world-wide scale, with a particular distinctness for the northern Hemisphere, during the recent several decades (AHLMANN 1949; LYSGAARD 1949; ARAKAWA 1955; VON REGEL 1957; *etc.*). In this connection, it seems especially important to refer to YAMAMOTO (1960), who asserts that, in the Far East, the climate of the recent 10 years, *i. e.*, 1948 to 1957, during which, according to the author, the so-called extraordinary climates have often occurred, is characterized with a prevailing of the zonal (*i. e.*, not monsoonal) type of general circulation pattern and moreover with a marked northwestward shift of the border between the cold continental and the warm tropical air mass, being accompanied by a general trend towards the marked subtropicalization.

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\* The phenomenon that the normally mesopelagic species is found at or near the surface in the polar frontal zone or in areas north of it is similarly revealed by *Lepidotus brama* (BONNATERRE). This fish lives at a considerable depth (300 to 600 m) off the Pacific coasts of the central Honshu, whereas it occurs near the surface in the northern North Pacific and is occasionally taken by salmon gill-nets (ABE 1952; TOMIYAMA & ABE 1958). The same may also be true for *Alepisaurus borealis* (GILL).

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*Note added in proof*—Messrs. HIROSHI FUKATAKI and MUNEO OKIYAMA, my colleagues at the Japan Sea Regional Fisheries Research Laboratory, who visited Waki, a set-net village, in Sado Island in the middle of March 1962, informed me that the local fishermen spoke of the deal-fish as not uncommon there. According to them, the fishermen attested that the winters of 1960/61 and 1961/62 were particularly distinguished by frequent occurrences of the fish; one or two individuals had been caught almost everyday during the season, occasionally several individuals having been entrapped at one time in the same net! Messrs. FUKATAKI and OKIYAMA enjoyed a good fortune of observing vivid scene of the entrapped deal-fish swimming to and fro in the net. Through the courtesy of these gentlemen, two fresh specimens were forwarded to me; they were a 1208-mm male and a 1331-mm female (size in standard length). Detailed accounts of these fine specimens will be later given elsewhere. According to the fishermen, they say, the deal-fish hitherto caught at Waki were all of the similar body size, *i. e.*, approximately 1-1.5 m long. My cordial thanks are due to Messrs. H. FUKATAKI and M. OKIYAMA for their kindness and interests exhibited in my course of study.

## 要 約

### 近年のサケガシラの捕獲状況について

西 村 三 郎

1954年ころ以降、日本近海におけるサケガシラの出現は顕著に増加したと考えるべき傾向がある。本種がリュウグウノツカイなどと同様、西部北太平洋においては中央水 (Central Water) をその生活の場としているという結論を正しいとすれば、この中層漂泳性魚 (mesopelagic fish) の出現増加は、近年、この水塊が日本列島近海へ異常な優勢さをもつて流入してきているのではないかということを暗示する。サケガシラ以外の若干の中層漂泳性魚 (たとえば、ニギス、メダイなど) の漁獲状況・分布域の近年の変化もこの推定をうらづけるものと考えられる。おわりに、このような中央水の変動は、おそらく、近年、極東地方あるいは北半球全域にひろく認められる顕著な気候変化と関連した現象と考えられることをのべた。