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Some Ecological Observations on Fishes in Sagami Bay Appearing Together With the Drifting Sea Weeds

By

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(With 2 Text-figures and 1 Plate)

It is well known that several kinds of fishes, fish eggs and invertebrates gather under or attach to the floating weeds in the sea and migrate over long distances along current streams. Systematic studies of these weeds were made by Parr (1939) on those of the north-western Atlantic and of the Sargasso Sea and by Segawa and others (1959-1960) on those of western part of Japanese waters; their investigations made it clear that these weeds belong mostly to the Sargassum group.

On various fishes that migrate with weeds there have been carried out several systematic and ecological studies by Uchida (1924-58), Nakamura (1933-37) and Uchida and Shojima (1958). However, few investigation have been made so far on the ecological relations between fishes and weeds such as frequency of appearance, age distribution or total length composition of these fishes.

The author carried out a systematic and ecological research on fishes which appeared together with the floating sargassums in the eastern part of Sagami Bay. The present report includes a part of the author's own results obtained during last four years from March 1956 to September 1959.

The hearty gratitude of the author is expressed here to Dr. T. Uchida of Hokkaido University, to Dr. I. Amemiya of the Enoshima Aquarium and to Dr. S. Mawatari of the Research Institute for Natural Resources for their invaluable suggestions, criticisms and helps in various ways.

Materials and methods: Thirty stations were established at 2 km. intervals within a triangular area of about 87 sq. km. for monthly observations on meteorological and oceanographical conditions and for regular collections of specimens. During 3 1/2 years research about a hundred days extending over all seasons were devoted to thorough collections at the 30 stations mentioned above; more than 7500 fishes were obtained from under the floating masses of weeds.

Drifting sea weed and its accompanying fishes were taken up with a 5 mm. meshes taw net. A part of the weeds and fishes were kept alive for some days in the aquarium to observe the ecological relations between them; others were all fixed and preserved for determination and measurement. Sexual difference and maturity were determined by

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Table 1. Four years' record of monthly catches of fishes indicated in minimum-maximum individual size. (mm.)

Species name	Month											
	January	February	March	April	May	June	July	August	September	October	November	December
<i>Plotosus anguillaris</i>	--	--	--	173	--	--	--	--	--	--	--	--
<i>Ablennes anastomella</i>	--	--	--	--	--	--	48-103	--	--	--	--	--
<i>Hemiramphus sajori</i>	--	--	--	--	Eggs	30-49	70	+	--	--	--	--
<i>Cypselurus heterurus</i>	--	--	--	--	--	40, 43	--	37	--	--	--	--
<i>C. opisthopterus</i>	--	--	--	--	--	--	27, 65	--	--	--	--	--
<i>Fistularia petimba</i>	--	--	--	--	--	--	146, 190	--	135	135	174	--
<i>Syngnathus schlegeli</i>	--	--	--	+	60-112	49-135	40-142	45-108	+	60-95	54-94	83, 84
<i>Syngnathoides biaculeatus</i>	--	--	--	--	--	--	--	--	--	120	--	--
<i>Hippocampus takakurai</i>	--	--	--	--	--	--	100	--	--	--	--	--
<i>H. coronatus</i>	--	--	--	--	--	18	18, 28	--	--	--	--	--
<i>Coryphaena hippurus</i>	--	--	--	--	--	--	61	70	--	--	--	--
<i>Lepidotus brama</i>	--	--	--	--	--	60	--	--	--	--	--	--
<i>Decapterus</i> sp.	--	--	13, 16	--	--	--	--	--	--	--	--	--
<i>Trachurus</i> sp.	--	--	--	--	16-56	20-47	--	--	--	35	--	--
<i>Caranx sexfasciatus</i>	--	--	--	--	--	--	--	--	39	--	--	--
<i>Seriola quinqueradiata</i>	--	--	--	--	22-88	19-85	+	31	+	+	--	--
<i>S. purpurascens</i>	--	--	--	--	--	27-31	78, 100	--	+	25-78	--	--
<i>Leiognathus rivulatus</i>	--	--	--	--	--	97	--	--	--	--	--	--
<i>Ocyerius japonicus</i>	--	--	21, 26	--	14	75-78	+	--	--	--	--	--
<i>Oplegnathus fasciatus</i>	--	--	--	--	--	15-40	14-60	12-51	28-49	40-97	--	--
<i>O. punctatus</i>	--	--	--	--	+	14-68	+	98, 120	+	--	--	--
<i>Upeneus</i> sp.	--	--	--	--	--	--	37	--	29-55	18-39	--	--
<i>Girella punctata</i>	27	--	22	--	15-38	18-30	--	--	--	54-107	--	16-22
<i>Kyphosus lembus</i>	--	--	--	--	71, 76	--	21-90	--	--	18, 40	--	--
<i>K. cinerascens</i>	--	--	--	--	69	26	+	38-83	29-103	44-115	--	--
<i>Lutjanus</i> sp.	--	--	--	--	--	25	--	--	--	24	--	--
<i>Pelates quadrilineatus</i>	--	--	--	--	--	--	--	--	78, 93	--	--	--
<i>Blennius yatabei</i>	--	--	--	--	--	--	15, 16	--	18	--	--	--
<i>Dasson trossulus</i>	--	--	--	--	--	20-33	16-35	14-35	+	19-47	29	--
<i>Chasmichthys dolichognathus</i>	--	--	--	--	--	--	--	21, 39	--	--	--	--

<i>Pomacentrus</i> sp.	--	--	--	--	--	--	17, 19	--	--	--	--	--
<i>Abudefduf vaigiensis</i>	--	--	--	--	40, 46	16-25	15-53	15-43	11-42	16-50	21	--
<i>Chaetodon collaris</i>	--	--	--	--	--	--	--	--	84, 91	--	--	--
<i>Siganus fuscescens</i>	--	--	--	--	--	--	+	21, 24	--	--	--	--
<i>Canthidermis rotundatus</i>	--	--	--	--	--	--	100	--	65-154	--	--	--
<i>Paramonacanthus oblongus</i>	--	--	--	--	--	--	21-35	13-26	19	21-32	--	--
<i>Stephanolepis cirrhifer</i>	--	--	--	--	14, 24	12-47	6-75	6-67	11-102	9-160	--	--
<i>S. japonicus</i>	--	+	--	--	--	--	29	7-31	19-43	17-32	--	--
<i>Rudarius ercodes</i>	30	--	--	--	+	14-55	6-16	6-57	8-26	15-30	10-16	--
<i>Navodon modestus</i>	--	--	--	--	22	30-52	14-90	32-39	--	--	--	--
<i>Amanes pardalis</i>	--	--	--	--	51	60, 70	55	28	60-145	--	--	--
<i>A. howensis</i>	--	--	--	--	--	--	60	--	--	--	--	--
<i>Aluterus monoceros</i>	--	--	--	--	+	--	95-121	230	+	+	--	--
<i>A. scriptus</i>	--	--	--	--	--	50, 52	162-250	120	107-165	--	--	--
<i>Ostracion tuberculatus</i>	--	--	150	--	--	--	--	--	--	--	--	--
<i>Fugu chrysoptis</i>	--	--	--	--	200	--	--	--	--	--	--	--
<i>Arothron stellatus</i>	--	--	--	--	--	--	20	--	--	--	--	--
<i>Diodon holacanthus</i>	--	--	--	--	--	--	35-40	--	35, 100	--	--	--
<i>Sebastes</i> sp.	--	--	--	15-23	--	--	--	--	--	--	--	--
<i>S. joyneri</i>	--	--	--	20-26	40, 42	--	--	--	--	--	--	--
<i>S. hubbsi</i>	--	--	--	--	--	--	--	--	--	--	17	13-22
<i>Sebasticus</i> sp.	--	--	13-18	--	22	--	--	--	--	--	--	--
<i>Scorpaenodes</i> sp.	--	--	--	--	20	--	--	--	--	--	--	--
<i>Dactyloptena gilberti</i>	--	195	--	--	--	--	--	--	--	--	--	--
<i>Pterophryne histrio</i>	--	--	--	--	11-75	44-125	64-110	16-145	+	39-110	--	--
<i>Antennarius tridens</i>	--	--	--	--	--	30, 42	10-26	--	--	--	--	--

anatomical investigations on the reproductive organs.

Various sorts of meteorological and oceanographical conditions were recorded for further interpretation of the behavior of the fishes.

Frequency of appearance

It may be possible that the common fishes appear more numerous and frequently in periodical collections than the uncommon ones. The number of collected individuals and the days of appearance were thus used for the indication of frequency.

Table 2. Four years' total of collected individuals, days of appearance, and average total length proportions of 13 dominant fishes.

Species	Total no. of indivs.	Days of appear.	Average total length prop.
<i>Stephanolepis cirrhifer</i>	3358	40	6%
<i>Rudarius ercodes</i>	1014	18	16
<i>Abudefduf vaigiensis</i>	597	30	21
<i>Syngnathus schlegelii</i>	574	39	28
<i>Oplegnathus fasciatus</i>	407	30	8
<i>Seriola quinqueradiata</i>	362	17	5
<i>Oplegnathus punctatus</i>	217	15	9
<i>Cirella punctata</i>	158	17	5
<i>Kyphosus cinerascens</i>	156	14	18
<i>Navodon modestus</i>	132	10	8
<i>Stephanolepis japonicus</i>	113	10	9
<i>Pterophryne histrio</i>	91	22	44
<i>Dasson trossulus</i>	49	18	25

As many as 7506 individuals of 56 different fishes belonging to 7 orders and 29 families were collected during the research period together with the floating sea weeds. Most of them were proved to belong to Balonida, Syngnathida, Percida, Tetradontida, Cottida and Lophiida. Table 2 indicates 13 dominant species which occurred on more than 10 days of the total 96 collections. Most (11 spp.) of them, as shown in the table, provided over 100 individuals and the sum of them reached 7228 individuals, thus occupying 96% of the total number taken. These forms, therefore, may properly be called the common fishes that follow the drifting sea weeds.

It may be noted that 4 species of these common fishes belong to one and the same family Aluteridae. *Stephanolepis cirrhifer* occurred in 40 collections with the number of specimens amounting to 3358. The other three, *Rudarius ercodes*, *Navodon modestus* and *Stephanolepis japonicus*, supplied as many as 1259 individuals in total. The sum of these members of the family Aluteridae thus came up to 4617, being 62% of the whole catch.

Different to the 13 above mentioned common fishes the total catch of the remaining 43 species occupied only 4% of all; therefore, the occurrence of these

fishes was proved to be quite incidental. In fact 14 of these species supplied only a single specimen and 9 of them only two on one or two days. Catches of *Sebastes* sp. and *Sebastiscus* sp., curious to say, amounted respectively to 43 and 28 only in a couple of days, but the fact seems only to indicate their peculiar grouping behavior in larval stage.

Age distribution

In addition to the ascertainment of sexual maturity by ordinary ways, average total length of obtained specimens was estimated and compared in percentage to the ordinary total length of typical adult specimens of each species. This total length proportion was used for the recognition of adulthood of the collected specimens. The higher proportion, exceeding 30%, corresponded well with the sexual maturity of the fishes.

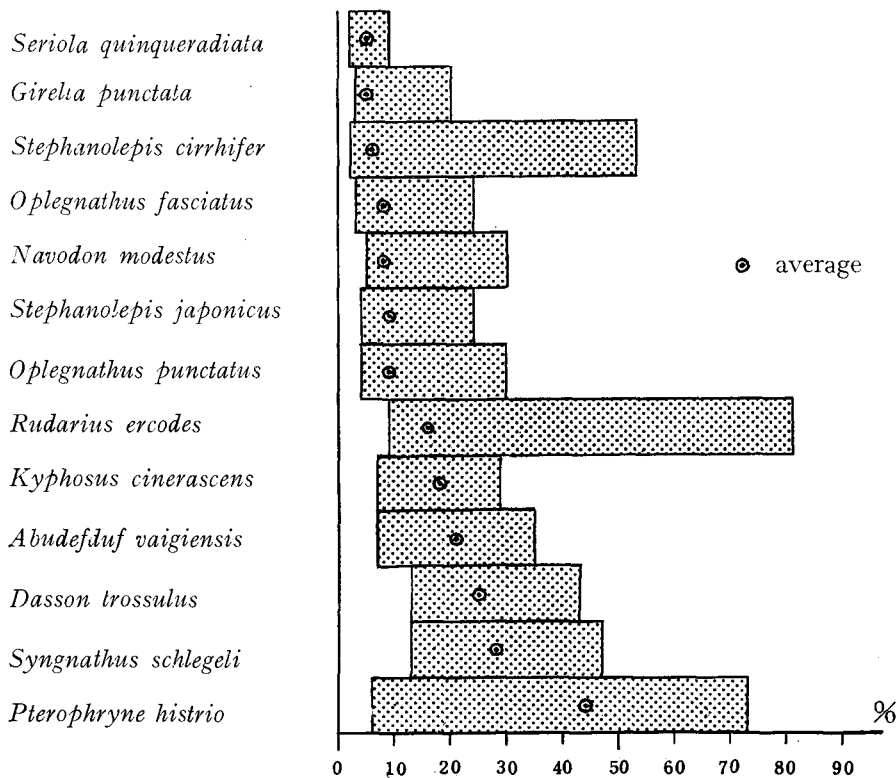


Fig. 1. Range in distribution of average total length proportions of 13 dominant fishes.

The species which showed the higher proportional total length, over 30% were as follows: *Plotosus anguillaris*, *Syngnathoides biaculeatus*, *Hippocampus takakurai*, *Leiognathus rivulatus*, *Pelates quadrilineatus*, *Chasmichthys dolichognathus*, *Chaetodon collaris*, *Ostracion tuberculatus*, *Fugu chrysops*, *Dactyloptena gilberti* and *Pterophryne histrio*. Excepting the last one, they were all incidental and furnished only one or two individuals in four years research.

Most of the specimens of the remaining 45 species were proved to be young or juvenescent. The total length proportion of 22 species fell less than 2% and that of 14 forms less than 20%. More than half of the common fishes indicated in Table 1 showed also the lowest percentage less than 2% in the proportional total length to the adult.

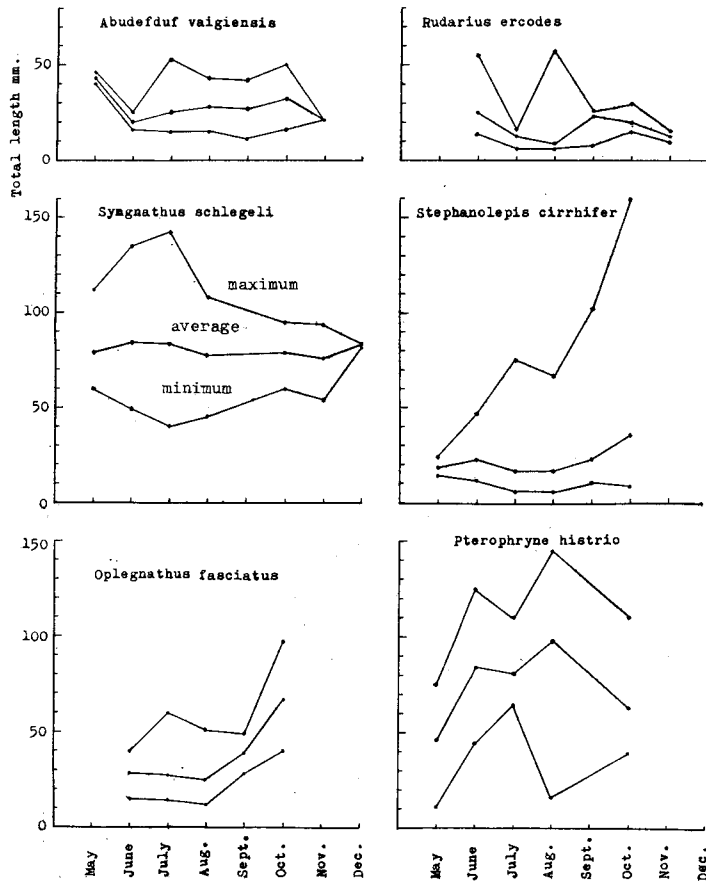


Fig. 2. Three types of monthly variation in maximum-mean-minimum total lengths of fishes.

Total length composition

The composition of members in the group of fishes may partly be explained by their size distribution. The total body length from snout to caudal fin end was therefore measured in all specimens and the results on dominant fishes were arranged by months (Fig. 1), from which the following three types may easily be distinguished (Fig. 2).

Type 1: As seen in *Syngnathus schlegeli*, *Dasson trossulus*, *Abudefduf vaigiensis*, *Stephanolepis cirrhifer*, *S. japonicus*, *Rudarius ercodes* and *Navodon modestus*, the average total length of fishes belonging to this type is almost unchanged throughout the seasons. The fact seems to indicate on the one hand that the members of groups may be frequently renewed by the continual supply of new fishes of similar size, and on the other that somewhat grown-up individuals may leave the habitat from time to time to go to the depth of the sea. The breeding season may range nearly as long as the youngs are observed under the drifting weeds.

Type 2: Total length of the fishes of this type usually increases in the latter half of their period of appearance. At least in the present research *Oplegnathus fasciatus*, *O. punctatus*, *Girella punctata*, *Kyphosus cinerascens* and *Ocyrius japonicus* were recognized to belong to this type. In the first species the average of total body length of young increased in autumn from 248–280 mm up to 385–693 mm, and that of the last form increased from 14 mm to 78 mm during 40 days in early summer. It may especially be interesting that the above mentioned growth rate of the wild *Ocyrius japonicus* is precisely in accordance with that of the individuals fed in the Enoshima Aquarium.

These facts may indicate that the components of this group are more or less constant and unchanged and that they remain feeding under the drifting sea weeds and continue to grow during their migratory life with weeds. Their breeding season may be in spring, and the grown-up youngs may leave the weeds for the depth of the sea in late autumn.

Type 3: A few fishes specially adapted to the drifting life with weed masses are placed in this type. They dwell, feed, grow and even breed among the drifting sea-weeds, and both adult and larval stages are usually seen living all together among the leaves of weeds.

Pterophryne histrio is a remarkable example observed in the present study.

Summary

1. As many as 7506 individuals of fishes were obtained while they were migrating together with drifting sea weeds.
2. About 96% of collected individuals belong to 13 common species, and 4 of them to Aluteridae. The total catch of these 4 forms reached 62% of the

entire number, while the remaining 43 species supplied only 4%.

3. Most of the fishes obtained with weeds were of small-sized juvenescent form, and the grown up adult fishes occurred only incidentally.

4. Some of the common representatives remain amongst the drifting sea weeds for a considerable length of time to grow up to some extent, but others are frequently replaced by other members of similar size.

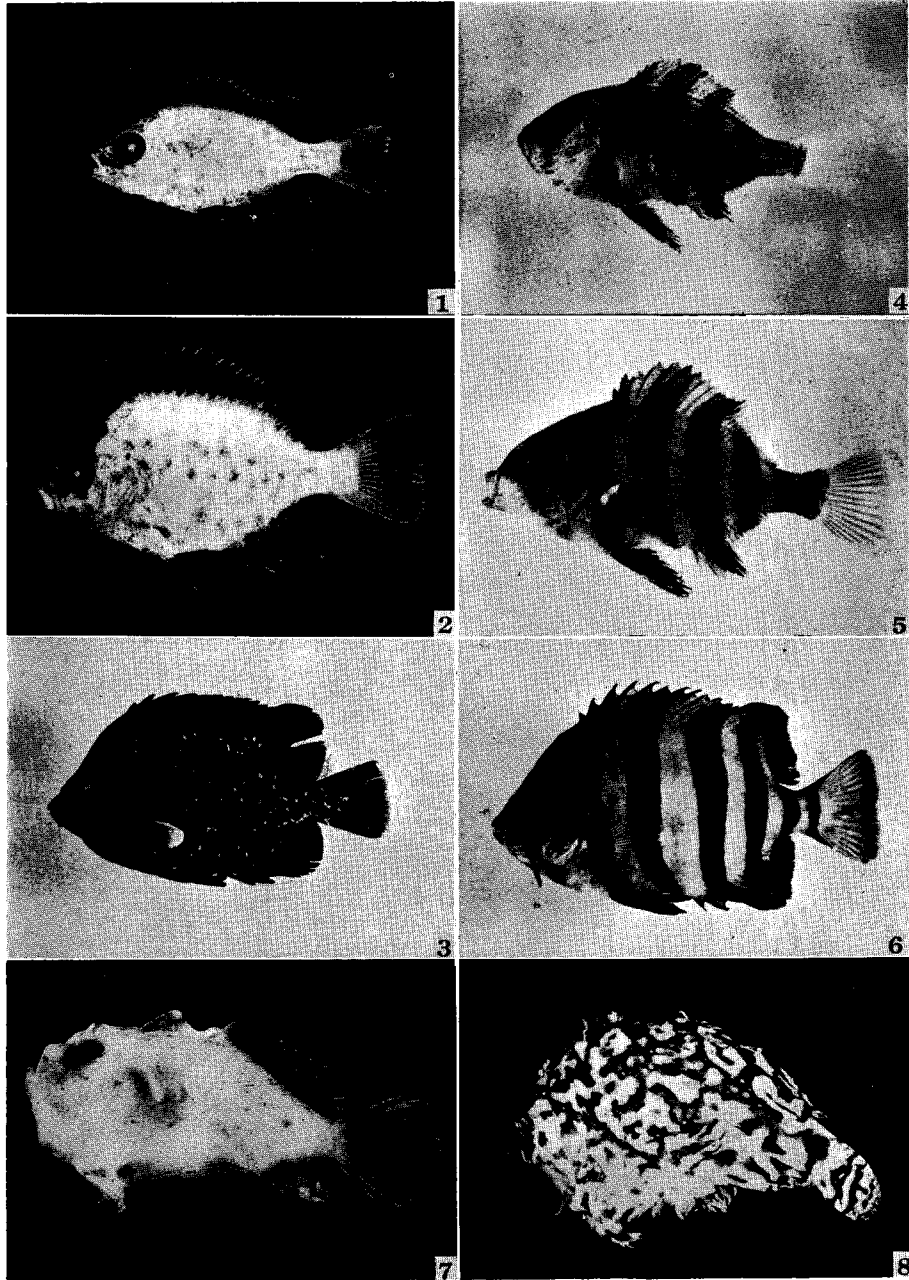
5. A few of the common fishes spend a large part of their life accompanying the drifting weeds.

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Explanation of Plate VIII

- Figs. 1-3. *Oplegnathus punctatus*.
 Fig. 1. Juvenescent stage (14 mm., 22 June 1956).
 Fig. 2. Juvenescent stage (23 mm., 22 June 1956).
 Fig. 3. Young fish (96 mm., 6 Aug. 1956).
 Figs. 4-6. *Oplegnathus fasciatus*.
 Fig. 4. Juvenescent stage (14 mm., 18 July 1956).
 Fig. 5. Juvenescent stage (24 mm., 22 June 1956).
 Fig. 6. Young fish (96 mm., 23 Oct. 1957).
 Figs. 7-8. *Pterophryne histrio*.
 Fig. 7. Juvenescent stage (13.5 mm., 19 May 1958).
 Fig. 8. Adult fish (112 mm., 19 May 1958).



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