

## Preliminary Report on the Results of Statistical and Ichthyological Investigations made at the Plymouth Laboratory.

By

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DURING my stay, from August to October, 1897, at the Laboratory of the Marine Biological Association of the United Kingdom, I was especially engaged in investigating the variability of *Pleuronectes flesus*, Linn., and *Siphonostoma typhle*, Linn. Of the results so obtained, some of more local faunistic importance are briefly reported here.

I take this opportunity of expressing my hearty thanks to the officers of the Laboratory, especially to the Director, Mr. E. J. Allen, for their help and kind interest in my researches. A paper containing a full statement of the statistical results has been prepared, and will be published shortly.

### 1. *Pleuronectes flesus*, Linn.

The flounders of Plymouth, when compared with those of the Baltic and the south-eastern parts of the North Sea, form a distinct race. The characteristics of this race are:

1. A high number of fin-rays in the dorsal and anal fin (average, dorsal 61-62, anal 43-44).

2. Almost entirely smooth squamation on the blind side. In both respects it is similar to the variety *Pleuronectes italicus*, Günther, of the Mediterranean.

The variation in the number of fin-rays has been studied in 1120 individuals, of which 602 (=53.75 per cent.) were males, and 518 (=46.25 per cent.) were females. Of the males 40 (=6.6 per cent.) had the eyes on the left side of the head, of the females only 20 (=3.8 per cent.). On drawing the curves representing the observed total lengths for each sex separately, a distinct size group, similar to

those suggested by Petersen,\* was found only for the small individuals from 7 to 14 cm. In other portions of the curve no distinct humps were observed.

The males proved more variable than the females in the number of fin-rays. Table I. gives the indices of variability (Airy's error of mean square  $\sqrt{\frac{\sum(x^2)}{n}}$ ) for each fin in both male and female.

TABLE I., showing the Indices of variability of the number of fin-rays.

	MALES.		FEMALES.	
	Index.	Number of Individuals.	Index.	Number of Individuals.
Dorsal fin *	2.4445	602	2.3118	518
Anal fin *	1.6521	602	1.5397	518
Left Pectoral fin †	0.7454	562	0.6978	498
Right Pectoral fin †	0.7152	562	0.6993	498
Left Ventral fin †	0.3318	562	0.3483	498
Right Ventral fin †	0.3147	562	0.2225	498

\* Right- and left-eyed individuals.  
 † Right-eyed individuals only.

Differences of age or sex corresponding to differences in the number of fin-rays were not distinctly shown in the dorsal, anal, and ventral fins. In both pectoral fins a slight increase of the numbers of rays seems to occur with age (*i.e.* with increase of total length).

Table II. gives the arithmetical mean values of the number of fin-rays in six size groups of both sexes. Group I. contains individuals below 10 cm. in total length; group II., from 10 to 14.9 cm., etc.; group VI., above 30 cm. (See page 174.)

The variation is normal in three cases; in three (dorsal and both ventral fins) it is skew, according to Pearson's Type IV. (*Phil. Trans. Roy. Soc.*, Vol. 186 A.); in the dorsal, however, this skewness is only slight. The correlation (according to Pearson's † formula) between the numbers of fin-rays of the dorsal and anal fin is very high,  $r=0.672$ . ‡ This is higher even than that of the pectoral fins,  $r=0.588$ . The latter I find to be less than in the symmetrical species mentioned below, in which  $r=0.700$  and  $0.720$  respectively. The correlation of the ventral fins is only  $0.2085$ .

\* Report of the Danish Biol. Station, IV., 1893, "The Biology of our Flatfishes."

† *Phil. Trans. Roy. Soc.*, Vol. 187 A, p. 265.

‡ Compare this with the corresponding values of the Acanthopterygians *Acerina cernua*, Linn.,  $r=0.238$ , and *Cottus gobio*, Linn.,  $r=0.300$ .

TABLE II., showing the size-differences in the average number of fin-rays  
(right-eyed individuals only).

SIZE.	Dorsal Fin.		Anal Fin.		Left Pectoral.		Right Pectoral		Left Ventral.		Right Ventral.		Number of Individuals.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
I.	61.52	61.95	43.80	43.75	9.96	10.05	10.44	10.75	6.00	5.75	6.00	6.05	25	20
II.	61.27	61.25	43.68	43.28	9.86	9.74	10.60	10.56	5.96	5.95	6.01	5.99	113	115
III.	61.74	61.91	43.84	43.56	10.22	10.02	10.88	10.63	5.93	5.96	5.95	5.95	148	116
IV.	61.76	62.11	43.46	44.03	10.26	10.31	10.93	10.93	5.97	5.95	5.99	5.96	170	127
V.	61.59	61.72	43.43	43.78	10.34	10.40	11.03	10.93	5.94	5.95	5.93	5.98	100	82
VI.	62.17	61.95	43.50	43.87	10.00	10.29	11.33	10.71	6.00	5.95	6.00	6.00	6	38
TOTAL (average)	61.7214		43.6098		10.1425		10.8036		5.9500		5.9745		1060	

2. *Syngnathus rostellatus*, Nilss.

The reasons for separating this common and widely-distributed species from *S. acus*, Linn., are the following:—

1. The differences between the two forms are so distinct and of such a degree that they are not likely to be due to differences of age.

A comparison between twenty-two individuals of the former species and forty-seven of the latter, gives the following ranges of variation:—

	<i>S. rostellatus</i> , Nilss.	<i>S. acus</i> .
Ann. corp. . . . .	13-15	19-20
Ann. caud. . . . .	39-41	43-46
Summa ann. . . . .	52-56	62-66
Ann. p. dors. . . . .	10-12	8-11
Rad. p. dors. . . . .	36-44	36-45
Ann. burs. gen. . . . .	20-25	25-28
Observed Total Length . . . . .	7.7-16.4 cm.	16.0-44.8 cm.

2. The individual variation in the number of body rings in the *Syngnathidae* (corresponding to the individual variation of abdominal vertebrae in other fishes) is a very low one. (*Siphonostoma typhle*, Linn. *Syngnathus pelagicus*.)

3. The fully-developed young in the brood-pouches of the males of both forms differ by the same number of rings as the adult, as well as differing in their total lengths. (They are about 1.5 cm. and 2.5 cm. respectively.)

4. Sexual maturity has been observed in individuals of *S. rostellatus*, Nilss., above 11 cm. long, in *S. acus* not below 30 cm.

5. Cross-breeding between the two forms seems unlikely, in consequence of the difference of the sizes of the eggs and brood-pouches in the two cases.

At Plymouth I obtained *S. rostellatus*, Nilss., from Cawsand Bay and from the Yealm River; *S. acus* from the same places and from the Hamoaze. I also possess specimens of *S. rostellatus*, Nilss., from the western Baltic, the North Sea, and the Mediterranean. Through the kindness of Mr. E. W. L. Holt I was also able to compare some specimens from the River Humber.