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Food, Feeding and Growth of Juvenile Flatfish

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Introduction

This paper is trying to give some preliminary figures on food-ration, increase of weight and conversion of food of plaice (Pleuronectes platessa) flounder (Platichthys flesus) and turbot (Psetta maxima) in the first summer of their life.

Juvenile plaice were caught by a shrimptrawl in the creek "Sand-loch" of the Northfrisian shallow off Büsum between June 1 - 14, 1965. Trawling-time was 50 - 60 minutes at a depth of 1,5 - 3.0 m. The surface-temperature was 16 - 17° C. 29 samples were chosen for my investigations. During the time of observation the population was very stationary with little or no exchange with plaice of other areas.

The creeks and shallows of the German Bight offer good living-conditions to flatfish in the first year of life because of the high water-temperatures and the abundance of food.

24 samples of flounder were taken by push netting outside Kiel Fjord. The mesh-size of the net was 6 mm, catching time was about 10 minutes, depth 0,2 - 1,5 m and temperatures 18 to 20° C. All fishes caught were investigated.

A very good material of turbot were kindly provided by Mr. O. Bagge, Charlottenlund. The fishes were caught in July and August 1959 to 1963 by a push-net along the coast of Bornholm. Catching time was 2 to 10 minutes, depth of water 0,2 to 1,5 m. Samples caught at various days were anranged in a daily cycle. Samples taken at the same time at different days were joint into one sample. This has been done assuming that feeding periods-like other biological events - are steady and characteristic for these species. Possible differences in feeding-time from day to day and from fishing ground to fishing ground had to be left un-considered.

All samples were immediately preserved in 4 % Formaldehyd. The juveniles were measured to full mm, adhering water was removed by blotting paper, then the fish were weighed, putting all specimen of the same mm-group together on the scale. So the mean fresh weight was determined for each mm interval. After that the stomachs were cut out, the content of which was weighed again by putting the food eaten by fishes of the same length together on the scale. The food animals were sorted into higher systematical groups and counted.

Food of Juvenile Plaice.

Investigations by RAUSCHENPLATT (1901), FRANZ (1910), EHRENBAUM (in LÜBBERT 1925), BREGNBALLE (1961), ARNDT and NEHLS (1964) and MACER (1967) show, that young plaice feed on a mixture of annelids (polychaetes, oligochaetes), crustacea (harpacticids, amphipods, isopods, cumacea) and molluscs (bivalves) during the first year of life.

The main food animals of juvenile plaice (22 - 36 mm long) from creek "Sandloch" are given in table 1.

Bivalves: Siphons of Macoma and Mya were found on an average of 6.4 specimen per stomach (28.4 % of the total number of food animals). This kind of food is eaten to a large extend during late morning and late evening hours. Intake and digestion takes a short time only. After one hour up to 80 % of the siphons have passed the stomach.

Polychaetes: The main genus the fishes were grazing on was Polydora. Mostly young specimen or fractions of bigger animals were found. The mean number found in one stomach was 7.3 (29.5 % of the total); with this Polydora outnumbers the siphons of the two bivalves mentioned above. The highest number of specimen found in one stomach was 52 (June 1, 1965, 14 hr. 26 mm). Polychaetes are eaten mainly during late morning hours and in the afternoon. Feeding goes fon for about 2 hours, the digestion takes a relatively short time. One hour after the last intake of polychaetes only 10 % of this food can still be found in the stomach.

The species Magelona papillicornis was eaten too by many juvenile plaice but the number eaten by one fish was small.

Nematods of the family Enoplidae is also a considerably important food-component. 1.8 specimen per stomach were found on the average. The number of nematods eaten increased from afternoon to midnight.

Crustacea: This group built one of the main food components of the fishes. 6.8 specimen (30.5 %) were found on average in one stomach. But because of their low individual weight (table 1) the nutritive value of the crustacean is low and of subordinate importance. Copepods are eaten mainly when there seems to be a shortage in bivalves and polychaetes. One fifth of all copepods were represented by Pseudocalanus elongatus, further Ectinosoma spec. and Microsetella spec. were found.

Pseudocuma longicornis (Cumacea) was eaten during early afternoon and at night in small numbers (0.4 specimen per stomach on average). Ostracods were rare in the stomachs, if any were eaten, they were found in the evening samples. Sometimes 3 specimen per stomach were counted. Crangon crangon also was rarely eaten by the young plaice. Only once several specimen were found in some stomachs, although there were always many small shrimps of the first bottom stage in the gear. Thoracic appendages of balanids built an extremely rare food factor.

The Food of Juvenile Flounders

Crustacea (Copepods, mysids, amphipods) and oligochaetes are mentioned by RAUSCHENPLATT (1901), LADIGES (1935), HASS (1939), BREGNBALLE (1961), ARNDT and NEHLS (1964) to be the main food animals of young flounders, while molluscs and polychaetes are of less importance.

The main food animals of juvenile flounders of 20 - 60 mm caught in the outer part of the Kiel Fjord from July 3 - 6, 1965 are listed in table 2. Night catches were less rich than day catches, thus statements on the fluctuation in food-intake over a 24-hours period may be wrong. Main food animals were polychaetes besides

oligochaetes and copepods.

Polychaetes. Nereis diversicolor was one important food factor in the diet of the flounder 0.9 specimen (3.2 % of the total number of food animals) per stomach were found on average. Usually pieces 1 cm long of the polychaetes are bitten off by the fish. Polychaetes ranged to more than 50 % in weight of the stomach content. Nereis was eaten to some extent in the morning but the bunch of it was found in the afternoon and still during early night hours. The digestion of Nereis takes only a short time.

Oligochaetes: Paranais litoralis was found with an abundance of 7.4 specimen per stomach on average (33.2 % of the total). The frequency distribution over a day-length period indicated that the fish fed on these animals three times a day.

Paranais was eaten always after the polychaetes and was digested more slowly than polychaetes.

Crustacea: The average of crustacea found per stomach was 31.7 specimen (63.1 %), this outnumbers all other food animals. Crustacea (Microsetella and Harpacticus) were eaten all the day long. A maximum appeared during midnight hours. Ostracods, amphipods (Gammarus locusta, G. sarsii, Corophium volutator), isopods (Jaera albifrons) and decapods (Crangon crangon)

Nematods were rare in the stomachs. Not more than 18 specimen were found in total. Siphons were not important at all to this population of young flounders.

The Food of Juvenile Turbot

According to EHRENBAUM (1936) fish is not yet the main diet in young turbots. HAGMEIER and KÜHNE (1950) describe ostracods and mysids and occasionally fish to be food animals of the turbot.

My own investigations are based on turbots 19 to 70 mm long, which were caught off Bornholm at August 17, and 18, 1959, at August 20 th and 22nd 1960 and at August 14th, 1963 during day hours.

The samples showed, that during its first year the turbots were living on crustacean and fish food (table 3). That together with the fact, that annelids and moluscs are lacking in the diet of the

turbots indicates striking differences to the feeding habits of plaice and flounder.

Crustacea: In all three years a high amount of amphipods was found in the stomachs, particularly Gammarus zaddachi and G. locusta were eaten. The average content of amphipods per stomach was 3.7 specimen or 64.6 % of the tatal food animals. Corophium volutator was rare in the material investigated, so were mysids (Neomysis vulgaris), the latter of which run to 0.6 specimen per stomach on average. Isopods as Idotea viridis and Eurydice pulchra were preferred to a somewhat higher extend in 1959.

Fish: This kind of food amounted only to 3.4 % in number per stomach. But its volume was high. Two species were eaten: Ammodytes lancea (30 - 36 mm in length), and to a lesser extent Pomatochistus (Gobius) minutus. It was always head of the prey fish which had entered the stomach first. Digestion of the prey proceeds from head to tail, often two third of a captures fish is still hanging out of the mouth of the predator while the other part is already under digestion. As soon as the prey is swallowed totally it is turned in the stomch, in a way that finally the head is near to the oesophagus again. It seemed that the turbots after being caught by the net never vomited their prey even when part of it was still hanging out of the mouth.

Feeding periodicities

FRANZ (1910), HERTLING (1929), JONES (1952), SHELBOURNE (1953), HEMPEL (1956 and 1964), BREGNBALLE (1961), KRUUK (1963), ARNDT and NEHLS (1964) and DE GROOT (1964) agree in finding that the number of animals eaten varies over a 24 hours period. They show that most of the fishes they investigated were empty of food early in the morning, food-intake starts at dawn and stops after sunset. The extent up to which the stomach was filled, was described by the percentage of food weight to total body weight.

In young plaice feeding activity stated some hours after sunrise (table 1, Fig. 1). 47.7 % of all stomachs were empty at sunrise, one hour later it was even 78.9 %, two hours later it was still 73.7 %. Not earlier than 7 a.m. the stomachs got filled ant at 8 a.m. all fish had started feeding. Fillihg and clearing of

the stomachs took place in clear-cut intervals. The fourth period of intense feeding coincided with the beginning of the swimmung activity of the young plaice at night. Food left the stomach very quickly. After the stomach's contents had gone down to a certain level intake of food started again. This showed that feeding activity takes place within several phases (fig. 1). One maximum can be observed at 10 a.m., then polychaets and few siphons of molluscs were eaten. Around noon the stomachs' contents mainly consisted of small siphons, the fish started eating polychaetes again at about 1 p.m. At about 2 p.m., they again were feeding almost entirely on polychaetes. The peak at 5 p.m. contains a few siphons and the highest amount of polychaetes found over a day's period. The late maximum at 10 p.m. is based on siphons mainly. There was no indication that some plaice had specialized on siphons. All investigated specimen contained the same mixture of food animals, with nematods being the only exceptions. Some plaice had eaten a lot of nematods others- of the same sample - only a few. Nematods were eaten - with the exception of the 10 p.m. feeding period - always between two main feeding periods.

While in most plaice stomachs were empty during the early morning hours, there was no such distinctive minimum in the flounder (table 2, Fig. 2). The smallest percentage of filled stomachs was observed before sunrise and at 2 p.m. (47.1 % and 34.9 % of all fishes). Filling and clearing of the stomachs took place without marked intervals. The main food component of the flounder was a mixture of polychaetes and oligochaetes. A maximum filling at 8 a.m. was caused by feeding on many polychaetes and few oligochaetes. Maxima observed at 5 to 7 p.m. and at 9 to 10 p.m. were built by an even mixture of polychaetes and oligochaetes. No flounder was found specialised to certain food.

In contrast to plaice, flounders with empty stomachs were often found during day-time. From 3 a.m. to 5 p.m. - with one exception at 8 a.m. - at least some specimen with empty stomachs always were found. The most active feeding period was from 5 p.m. to 9 p.m. Samples made from 9 p.m. to 3 a.m. included only few fishes.

Nothing can be said how feeding activity went on during this part of the day. The turbots I got showed such a heterogenity with regard to their stomach's content that no analyses of their feeding activities can be made.

Growth Rates

For determination of growth of juvenile plaice I used seven samples from the creek "Sandloch". One smaple consists of several catches made during the same day. The growth rate can be determined from the shifting of the mean length values (table 4, fig. 3). I calculated the mean growth rate in two different ways. On one hand by determining the increase in length from one catching day to the next and on the other hand by determining the increase in length from the day when the first sample was taken, that is June 1, 1965, to the day when aech of the following sample were taken. The second way of course shows the smallest variance in growth rate, its accuracy however depends highly on the reliability of the estimate of initial length distribution and average length in the population (June 1, 1965).

The average growth rate within the whole period of investigation was determined to 0.62 mm per day. Taking this figure for a back calculation of mean length from June 8 and 9 back to june 1 (8 days = 4.96 mm) one arrives at 28.4 mm for June 1, the value actually measured was 28.3 mm. The small difference makes it likely that sampling was unbiassed. The steep rise however, of the growth curve at June 1 may be caused by an unproportionately high number of plaice that measured about 25 mm in length. An increase in variance of the lengths distribution was correlated with an increase of age. While the lengths of the plaice caught during early June varied within a limit of 21 mm, variation range increased to 29 mm one week later and to 48 mm in August.

Daily Increase in Weight

To determine how the food is used by the young fishes it is important to know how much is eaten by a fish daily and how much body length and weight increase. In young plaice from the shallows of the south eastern North Sea the daily growth rate was 0.62 mm; in young flounders from Kiel Fjord it was 0.5 mm (APSTEIN, 1905); in young turbots it was determined to 0.47 mm according to length measurements given by JOHANNSEN (1915) and

KÄNDLER (1944). Increase in weigth was determined as mean difference in weight of fishes grouped in 2 mm length intervals. The daily food consumption was determined according to the maximum stomach content found in the "best" specimen of each of the different length groups investigated. Even the selection of the best specimen gives sometimes not a very reliable estimate of of maximum feeding capacity, because of the few specimen of the smallest length groups.

In case of the plaice a potential time of feeding activity of 16 hours per day (light period) can be assumed. The clear intervals in feeding activity of this fish during a 24 hours' period seem to indicate that the stomach of each specimen gets filled to its maximum four times a day. The total intake, resulting from a maximum filling four times a day, was assumed to be the daily need of food for the plaice. Turbot might fill its stomach twice a day. It takes 3.2 days for the young plaice to grow 2 mm in length, 4.0 days for the young flounder and 2.8 days for the young turbot. These data were multiplied by the amount of food eaten, which was estimated by taking the maximum filling of the stomachs into account. That rough calculation gives the amount of food required for fishes of the different length-groups to grow 2 mm in length. Increase in weight was estimated from the observed increase in length (table 5 - 7). Conversion factors for the three different species of flatfishes amounted to 3 to 9, the average being 5. They coincide with data found in experimental investigations by other authors. With exception of data given by DAWES (1930/31)(which are very low presumably for technical reasons) all average conversion factors are ranging from 4.0 to 8.5. BÜCKMANN's (1952) investigations found conversion factors being 5.8 to 8.9 when the fishes were fed with meat of Mytilus. HATANAKA et al (1956) found food quotients of 4.6 to 6.2. BREGNBALLE (1961) showed an increase in weigth of at least 10 % of the body weight for young plaice by theoretical calculations. The conversion efficiency was 5.2 in those plaice but 4.0 in young flounders.

My results which are based on flounders, plaice and turbots living under natural conditions and living on a mixed diet are very similar to those gained in feeding experiments. Further investigations would be necessary to proof whether the increase of the conversion factor with body length is realistic.

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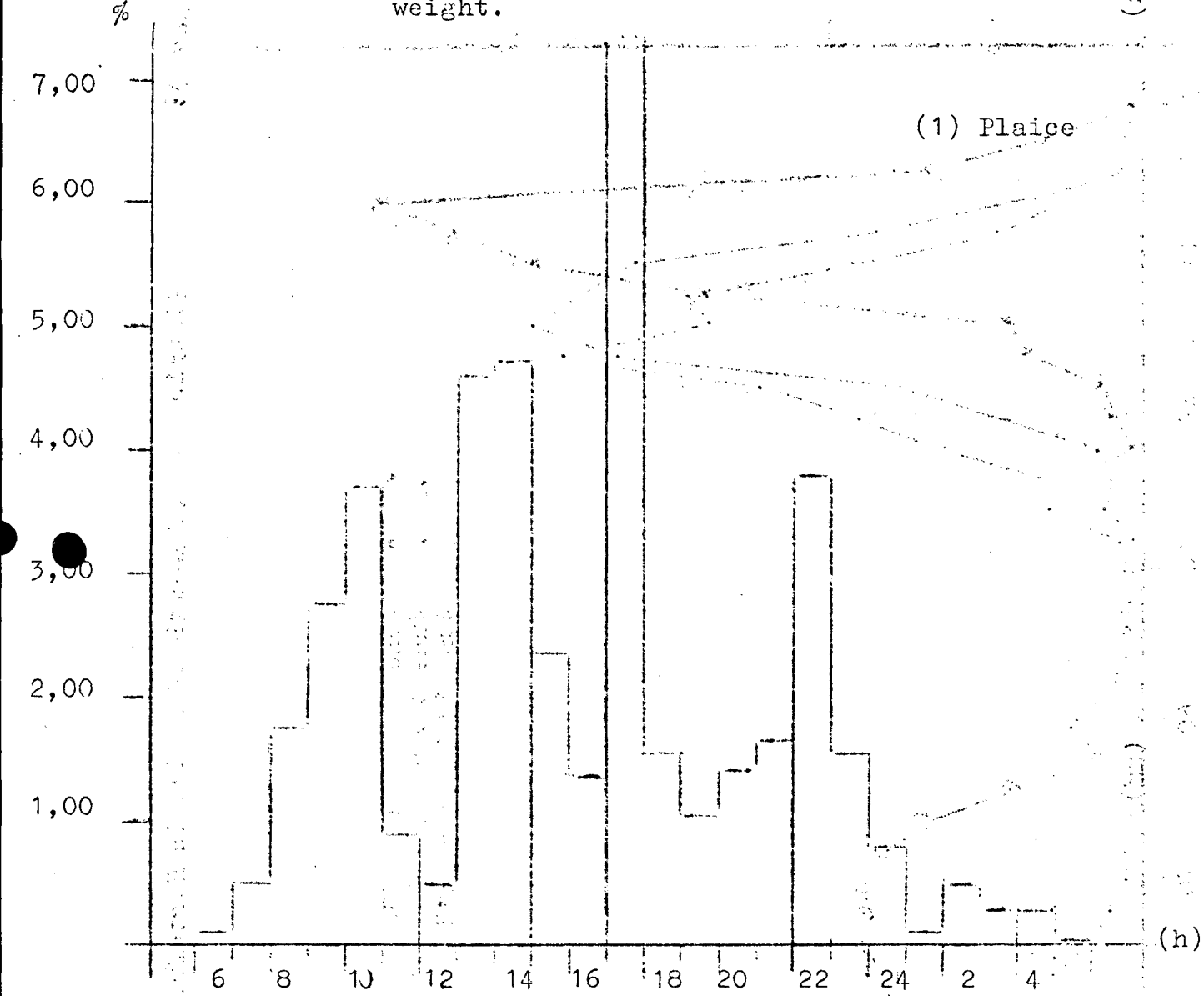
Figure 1 and 2: Weight of stomach content in % in propotion to weight.



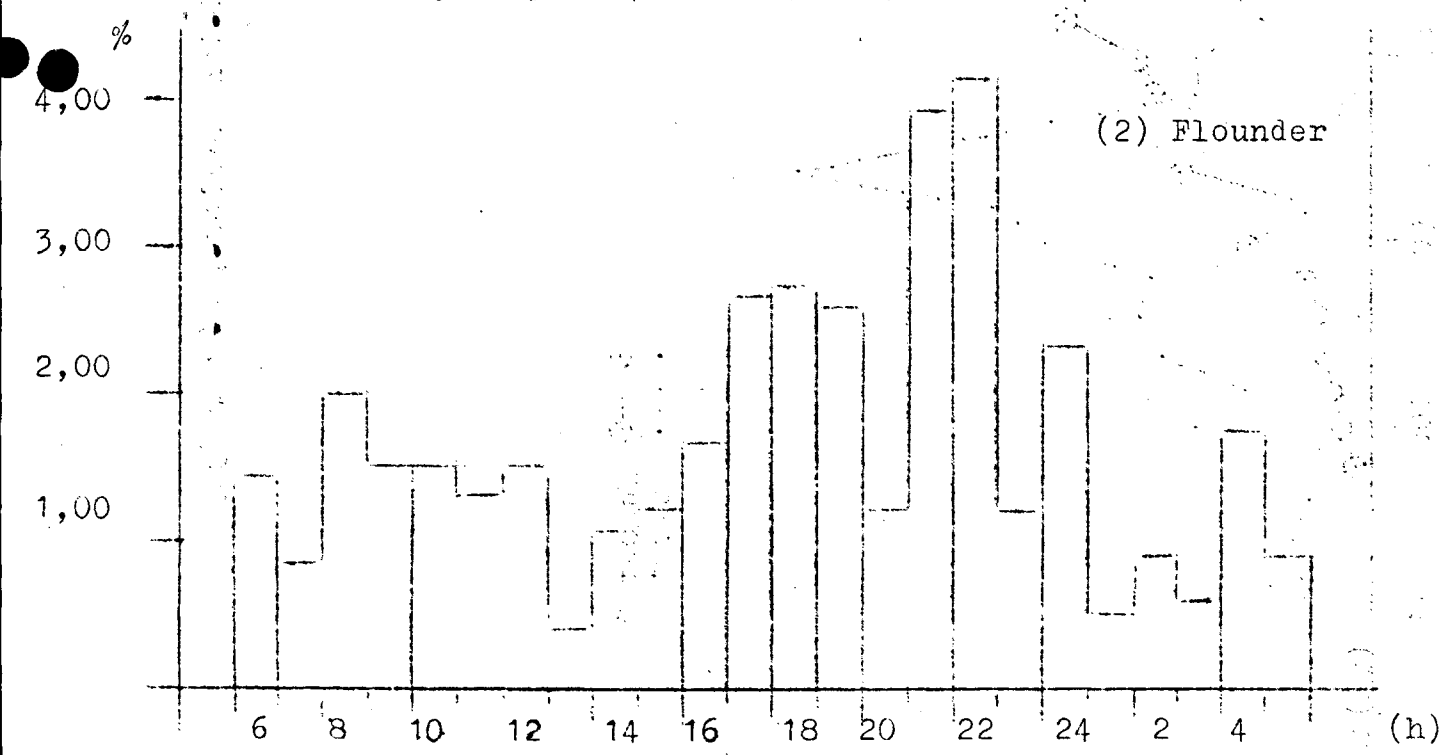


Figure 3: Distribution of Length of Plaice in Northfrisian Shallows, Summer 1965

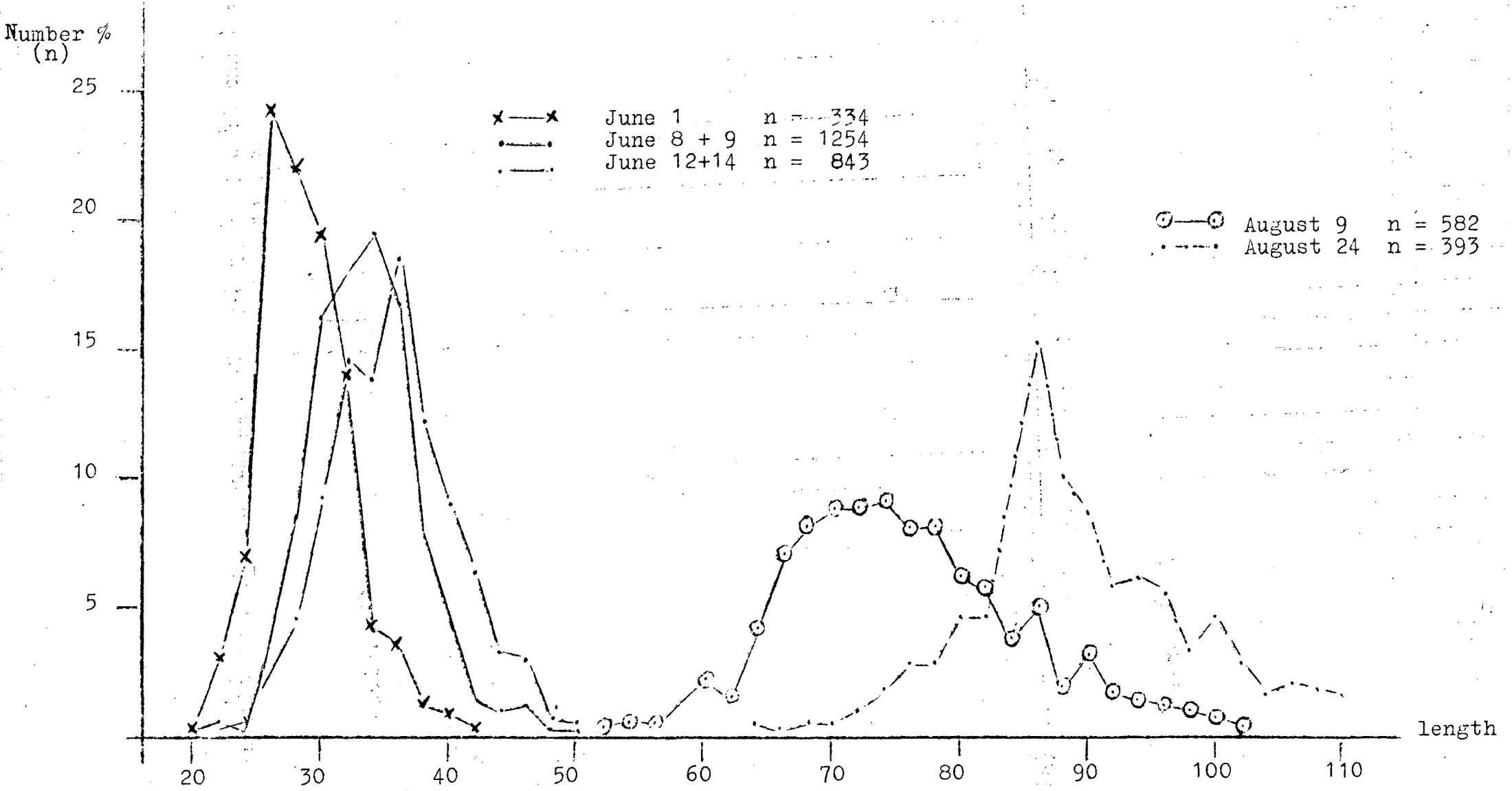


Table 1

Mean Number and Weight of Food Species of Juvenile Plaice caught in the Northfrisian Shallow ("Sandloch"), fine sands Sunrise = 3.51 MET; Sunset = 20.51 MET

Time (h)	Date 1965	Number of plaice, in () with empty stomachs	Mean length (mm)	Mean weight of food per plaice (mg)	Mean Number of food species per stomach: Nematoda	Mollusca (Siphons)	Polychaeta	Ostracoda	Copepoda	Cumacea
24	13.6	53 (4)	29,8	2,0	11,3	3,0	2,0	0,9	8,5	0,1
1	13.6	35 (-)	30,1	2,5	3,8	2,8	1,2	-	33,8	1,1
2	13.6	17 (-)	34,9	1,9	2,8	1,3	4,5	-	5,7	0,5
3	13,6	43 (14)	29,7	0,8	0,8	0,9	2,4	-	0,4	0,2
4	2.6	44 (21)	24,4	0,4	0,7	1,4	0,5	-	-	0,1
5	8,6	66 (52)	29,2	0,1	0,3	0,8	0,2	-	1,0	-
6	8.6	57 (42)	30,7	0,3	-	0,8	0,3	-	0,3	-
7	8.6	38 (8)	29,5	1,2	0,1	1,0	9,4	0,1	2,2	-
8	8.6	71 (-)	27,7	3,5	0,8	9,1	5,6	-	2,4	-
9	8.6	40 (-)	29,1	6,5	1,1	16,7	11,4	-	1,9	-
10	8.6	61 (-)	28,2	7,8	0,3	2,2	14,4	0,4	7,2	-
11	8.6	97 (8)	27,7	1,7	0,2	7,9	1,3	-	0,5	-
12	1.6	56 (9)	28,0	1,0	0,1	5,5	-	-	0,3	-
13	1.6	27 (-)	31,7	14,6	0,9	30,6	11,1	0,1	0,6	-
14	1.6	37 (-)	32,7	16,5	0,7	2,1	34,7	0,3	6,1	-
15	14;6	41 (-)	29,8	6,0	1,4	8,0	4,4	-	34,2	0,3
16	14.6	50 (1)	28,4	3,5	1,1	1,9	3,2	-	27,9	0,5
17	9.6	27 (-)	30,0	19,0	1,7	3,5	45,8	-	0,6	-
18	9.6	60 (-)	30,0	4,0	1,7	5,2	2,5	0,5	4,1	2,3
19	9.6	53 (-)	29,3	2,5	2,3	8,1	0,3	0,7	1,0	4,5
20	9.6	27 (2)	29,3	3,5	1,1	5,2	4,2	-	3,2	-
21	9.6	20 (-)	28,7	3,5	1,0	15,3	1,2	-	0,6	-
22	12.6	30 (1)	32,4	12,0	4,3	14,4	9,8	2,0	7,8	-
23	12.6	34 (-)	31,0	4,4	3,8	6,5	5,9	1,8	12,1	-
Total		1084 (162)								
mean length			29,3							
mean filling/hour				4,9	1,8	6,4	7,3	0,3	6,8	0,4

Table 2

Mean Number and Weight of Food Species of Juvenile ~~Plaice~~ Flounder caught in Kiel Fjord muddy fine sand. Sunrise = 4.10 MET; Sunset = 20.40 MET

Time (h)	Date 1965	Number of flounder, in () with empty stomachs	Mean length (mm)	Mean weigth of food per flounder (mg)	Mean Number of food species per stomach Nematoda	Polychaeta	Oligochaeta	Copepoda	Amphipoda
24	6.7	7 (-)	31,9	9,2	-	0,3	1,1	111,5	0,1
1	6.7	5 (-)	36,8	3,6	0,4	0,2	3,4	83,8	-
2	6.7	6 (-)	45,8	23,8	0,3	-	21,3	76,6	0,1
3	6.7	17 (8)	39,0	4,5	-	-	5,0	17,2	-
4	5.7	41 (2)	33,2	7,9	-	0,1	14,0	14,9	-
5	5.7	37 (3)	33,7	4,1	-	-	2,9	27,3	-
6	3.7	41 (7)	36,4	8,8	-	0,8	1,9	26,0	-
7	5.7	40 (10)	32,5	3,6	-	0,5	3,4	22,3	-
8	5.7	47 (-)	32,7	8,6	-	2,6	0,9	12,5	-
9	5.7	54 (6)	34,5	7,8	-	1,5	0,6	23,4	-
10	4.7	47 (14)	33,9	8,1	-	0,1	10,5	26,0	-
11	4.7	44 (1)	35,2	7,2	-	0,1	7,3	8,2	-
12	4.7	46 (2)	33,7	7,4	-	0,5	1,6	20,7	-
13	4.7	46 (11)	33,9	2,1	-	0,4	0,9	2,9	-
14	4.7	43 (15)	34,7	5,3	-	0,5	1,5	0,5	-
15	4.7	44 (7)	34,9	5,8	-	0,4	1,6	20,4	-
16	3.7	21 (2)	35,9	10,0	-	2,8	0,8	0,3	0,5
17	4.7	43 (3)	34,7	14,6	0,2	2,6	3,7	1,4	0,2
18	3.7	27 (-)	34,8	14,3	0,1	2,1	8,4	4,1	0,1
19	4.7	39 (-)	33,0	10,9	-	2,2	3,6	0,3	0,2
20	3.7	44 (-)	32,8	18,0	-	1,1	48,6	68,3	-
21	3,7	15 (-)	38,9	34,1	-	1,7	24,6	38,0	0,3
22	5.7	4 (-)	36,0	7,8	-	2,0	3,5	21,0	-
23	5.7	4 (-)	33,8	6,2	-	0,7	6,0	134,2	-
Total		762 (91)							
mean length			34,4						
mean filling/hour				9,7	-	0,9	7,4	31,7	0,1

Table 3

Mean Number and Weight of Food Species of Juvenile Turbot at Bornholm Coast, fine sands.

Time (h)	Date	Number of Turbot, in () with empty stomachs	Mean length (mm)	Mean weight of food per Turbot (mg)	Mean Number of food species per stomach: Mysidacea	Amphipoda	Isopoda	Pisces
				1960				
11.05	20.8	11 (2)	28,0	13,7	-	1,4	-	0,2
11.35	22.8	10 (1)	36,0	71,0	0,6	0,5	-	0,7
13.00	22.8	46 (3)	27,6	16,0	-	2,1	-	0,1
13.30	22.8	2 (-)	40,0	85,0	4,5	-	-	-
13.45	22.8	2 (-)	41,5	47,0	-	1,5	-	-
14.15	22.8	10 (1)	39,9	55,4	4,0	1,3	-	-
15.30	20.8	2 (-)	41,5	92,0	-	8,0	-	1,0
16.20	20.8	10 (-)	33,9	38,0	0,1	3,9	-	0,1
16.30	22.8	5 (-)	43,1	85,2	0,6	3,8	-	0,4
Total		98 (7)						
mean length			31,9					
mean filling				56,0	1,1	2,5	-	0,3
				1963				
8.35	14.8	41 (2)	28,8	62,7	-	3,7	-	-
9.30	14.8	26 (7)	30,0	10,0	0,3	1,4	-	-
10.00	14.8	7 (-)	40,4	45,0	0,4	5,0	-	-
10.20	14.8	22 (5)	30,5	20,8	-	1,2	-	0,1
11.15	14.8	37 (-)	36,1	40,2	-	6,4	-	0,1
14.00	14.8	18 (-)	38,8	57,5	-	9,4	-	0,1
15.00	14.8	14 (-)	39,4	79,1	-	12,2	1,3	0,1
16.00	14.8	21 (9)	31,9	47,3	0,2	1,1	-	0,1
17.00	14.8	9 (1)	38,4	26,3	-	3,0	-	0,1
Total		195 (24)						
mean length			33,4					

Table 3

Mean Number and Weight of Food Species of Juvenile Turbot at Bornholm Coast, fine sands.

Time (h)	Date	Number of Turbot, in () with empty stomachs	Mean length (mm)	Mean weight of food per Turbot (mg)	Mean Number of food species per stomach: Mysidacea	Amphipoda	Isopoda	Pisces
				1959				
8.45	18.8	13 (4)	26,2	13,8	-	1,7	-	-
9.30	18.8	76 (2)	34,5	30,0	-	7,2	-	-
10.00	18.8	10 (2)	34,8	11,0	0,8	0,7	-	-
10.15	18.8	19 (12)	30,3	2,1	0,2	0,2	-	-
11.00	18.8	13 (-)	29,5	31,5	0,1	11,1	0,7	0,2
11.30	18.8	17 (3)	42,5	103,0	-	0,6	0,3	0,6
13.00	17.8	19 (7)	35,4	82,3	2,2	0,6	0,1	0,2
13.00	18.8	10 (3)	35,8	36,0	0,1	2,8	-	0,3
13.30	18.8	57 (-)	32,4	41,0	-	7,4	0,3	-
13.30	17.8	12 (1)	45,0	214,0	5,2	0,6	-	1,3
14.20	17.8	20 (13)	35,7	9,0	-	2,0	0,2	-
14.50	18.8	7 (3)	40,9	35,0	1,4	0,6	-	-
16.00	18.8	10 (2)	36,1	22,0	0,1	1,9	-	0,1
17.15	18.8	11 (-)	29,1	20,0	-	4,8	8,6	-
18.15	18.8	20 (-)	38,7	80,0	0,4	14,2	0,1	0,5
Total		331 (52)						
mean length			34,5					
mean filling				48,7	,7	3,7	0,7	0,2

Table 4

Length measurements of 0.-Group Plaice in the Northfrisian Shallow (Sandloch)

Date of catch 1965	Number of Plaice (n)	Mean Length (mm)	Diff. in Days	Increase of Length (mm)	Mean Increase mm/day	Diff. in Days after June 1	Increase since June 1 (mm)	Mean Increase mm/day
June, 1	334	28,3						
			7	4,4	0,63	7	4,4	0,63
June, 8	548	32,7						
			1	0,4	0,40	8	4,8	0,60
June, 9	706	33,1						
			3	1,4	0,47	11	6,2	0,56
June, 12	564	34,5						
			2	1,2	0,60	13	7,4	0,57
June, 14	279	35,7						
			56	39,4	0,70	69	46,8	0,68
August, 9	582	75,1						
			15	13,5	0,90	84	60,3	0,72
Aug. 24	393	88,6						
					0,62			0,63

Table 5

Daily Increase of Weight and Food Quotient of Plaice in the Northfrisian Shallow, June 1965

Length mm	Weight in ( ) Number mg n	Stomach Content mg	Diff. of Weight mg	Average in Weight mg	Daily Increase of Weight mg	Mean Weight %	Foodration mg	daily %	Food Quotient FQ
22	85 (15)	5							
			33	111	10,3	9,3	34	30,6	3,3
24	118 (34)	12							
			34	135	10,6	7,8	48	35,5	4,5
26	152 (117)	12							
			29	166	9,1	5,5	66	39,7	7,2
28	181 (232)	21							
			43	202	13,4	6,6	84	41,6	6,3
30	224 (293)	21							
			54	251	16,9	6,7	86	34,3	5,1
32	278 (246)	22							
			60	308	18,7	6,1	116	37,07	6,2
34	338 (92)	36							
			83	379	25,9	6,8	168	44,3	6,4
36	421 (42)	48							
Average:						7,0		37,7	5,6

Table 6

Daily Increase of Weight and Food Quotient of Flunder in Kiel Fjord, July 1965

Length	Weight in () number		Stomach content	Difference in weight	Average in Weight	Daily mean Increase of Weight		Foodration Daily		Food Quotient
mm	mg	n	mg	mg	mg	mg	%	mg	%	FQ
24	138	(10)	9							
				49	162	12,2	7,5	48	29,6	3,9
26	187	(22)	15							
				53	213	13,2	6,2	60	28,2	4,5
28	240	(43)	15							
				60	270	15,0	5,5	64	23,7	4,3
30	300	(106)	17							
				70	332	17,5	5,3	90	27,1	5,1
32	370	(130)	28							
				57	398	14,2	3,6	102	25,6	7,2
34	427	(112)	23							
				90	477	22,5	4,6	96	20,1	4,3
36	517	(105)	25							
				104	569	26,0	4,6	126	22,1	4,8
38	621	(94)	38							
				89	665	22,2	3,3	194	29,2	8,7
40	710	(59)	59							
				132	776	33,0	4,2	230	29,6	7,0
42	842	(38)	56							
				114	898	28,5	3,2	224	24,9	7,8
44	956	(13)	56							
				122	1017	30,5	3,0	228	22,4	7,5
46	1078	(8)	58							
				200	1179	50,0	4,2	336	28,5	6,7
48	1278	(3)	110							
Average:							4,6		25,9	6,0

Table 7

Daily Increase of Weight and Food Quotient of Turbot at Bornholm Coast, August 1959-1963

Length	Weight in () Number	Stomach content	Difference in weight	Average in Weight	Daily mean Increase of Weight		Foodration Daily		Food Quotient
mm	mg	n	mg	mg	mg	mg	%	mg	%	FQ
28	256	(24)	38							
				45	278	16,1	5,8	83	29,8	5,1
30	301	(36)	45							
				95	348	33,9	9,7	96	27,6	2,8
32	396	(29)	51							
				101	446	36,0	8,1	104	23,3	2,9
34	497	(19)	53							
				86	540	30,7	5,7	147	27,2	4,8
36	583	(24)	94							
				92	626	32,8	5,2	194	31,0	5,9
38	657	(24)	100							
				152	751	54,2	7,2	210	28,0	3,9
40	827	(18)	110							
				178	916	63,5	6,9	230	25,1	3,6
42	1005	(16)	120							
				92	1051	32,8	3,1	293	27,9	8,9
44	1097	(9)	173							
				218	1206	77,8	6,4	333	27,6	4,3
46	1315	(25)	160							
				195	1412	69,6	4,9	327	23,1	4,7
48	1510	(6)	167							
				250	1635	89,2	5,4	397	24,3	4,4
50	1760	(13)	230							
				222	1871	79,2	4,2	480	25,6	6,1
52	1982	(10)	250							
				253	2108	90,3	4,3	530	25,1	5,7
54	2235	(4)	280							
				441	2455	157,5	6,4	560	22,8	3.5
56	2676	(3)	280							
Average:							5,9		26,3	4.7