



Serial No. 1335
(D.c. 10)

Document No. 40.

ANNUAL MEETING - JULY, 1964

Preliminary Research Report on the Food of Cod and Redfish Larvae
collected by R.V. DANA during NORWESTLANT Cruises II and III.

by

V. BAINBRIDGE
Oceanographic Laboratory, Edinburgh.

There is some information in the literature on the diet of the larvae of the cod, Gadus morhua L. and the redfish Sebastes marinus (L) but no strictly comparable data exists. Wiborg (1948) analysed the stomach contents of cod larvae from the coastal waters of Northern Norway, especially the Lofoten area. Young cod, from 4 to 10mm in length were feeding mainly on copepod nauplii, particularly those of Calanus, Metridia and Oithona. Other organisms present in the guts included the eggs and copepodite stages of copepods, lamellibranch larvae and Evadne. The food of Sebastes larvae within this same size range has been investigated by Bainbridge (1964) using material collected during the Continuous Plankton Recorder Survey. Individuals smaller than 10mm from the Irminger Sea area during May were found to be feeding principally on Calanus eggs, Spiratella larvae being virtually the only other organisms eaten. As Einarsson (1960) observed, there was a trend towards larger food organisms as the larvae became larger and the diet of individuals of 15mm or more in length included the calyptopis and furcilia stages of euphausiids as well as the copepodite stages of Calanus.

The diet of the early larvae of the two species show the most interesting differences, some of which are no doubt related to the different planktonic environments in which the larvae occur. Further studies of the food and feeding habits of the larvae are obviously required and this paper presents a progress report of work on material collected during the Continuous Plankton Recorder and NORWESTLANT Surveys of 1963.

Redfish larvae taken by the Continuous Plankton Recorder.

Sebastes larvae were comparatively scarce in the Irminger Sea during 1963 (Henderson, ICMF Serial No. 1337, Doc. No. 42) and it was possible to dissect out and examine the gut contents of only a few larvae from this region during the period of the NORWESTLANT Surveys. Results confirm those obtained from previous years in that Calanus eggs, followed by Spiratella larvae, were virtually the only food organisms of specimens less than 10mm in length in this area.

By pooling data obtained from 1958 to 1963 in the sub-areas B6, B7 and C7 shown in Figure 1 (see also Glover and Robinson, ICMF Serial No. 1338, Doc. No. 43, Figure 1b), it has been possible to demonstrate that there are marked diurnal fluctuations in the numbers of Calanus eggs per gut and that the intensity of feeding is also related to the numbers of Stage VI Calanus present (Figures 2 and 3).

In July 1963 exceptionally high numbers of young Sebastes were found east of Newfoundland between 48° and 52°N and unlike the oceanic stocks, these were larvae with sub-caudal melanophores (Henderson, ICMF Serial No. 1337, Doc. No. 42). About 30 of these larvae varying from 9 to 11mm in length have been dissected and Calanus eggs were also found to figure prominently in the diet.

Cod and Redfish larvae taken during the NORWESTLANT Survey.

Mr J. Møller Jensen has kindly allowed me to examine the cod and redfish larvae from the samples collected with stramin nets during the NORWESTLANT cruises of DANA, and Dr A. Kotthaus has recently sent me the redfish larvae collected from ANTON DORN. Together the samples give a wide coverage of Greenland-coastal waters and adjacent seas and will allow a comparison of food organisms in the stomach contents of the two species in different regions. The Hensen-net samples taken by DANA will also permit a comparison of the gut contents with the composition of the plankton. Only a few of the samples have yet been analysed, attention being directed/

directed mainly to those taken during May and early June which contain young larvae, usually less than 10mm in length.

When possible 10 larvae selected at random from each sample have been dissected and the gut contents identified and counted. These were in an excellent state of preservation and clearly showed various stages of digestion, from entire Calanus eggs to empty egg membranes and from perfect nauplii to exoskeleton 'ghosts'. Most of the nauplii and copepodites found in the guts of both species could be referred to Calanus. Stations from which the gut contents of larvae have been analysed are shown in Fig. 1, and the results are arranged in Tables I-IV according to area sampled. The guts of young Sebastes from the Irminger Sea and the open ocean to the south west were usually full and Calanus eggs were apparently eaten almost to the exclusion of other organisms (Table I). By contrast, the stomachs of redfish larvae taken close to the continental edge off Greenland usually contained little food with Calanus eggs and copepod nauplii (mainly those of Calanus) occurring with almost equal frequency (Table II). At one station however the stomachs of the larvae were again filled with Calanus eggs.

Tables III and IV give the gut contents of cod larvae taken at stations in the Davis Strait, the open coastal waters of west Greenland and in Godthaab Fiord. These larvae were feeding principally on copepod nauplii, especially those of Calanus, and, in the larger larvae (8-12mm), on early copepodite stages. Calanus eggs were rare and found only in two very small larvae from one station. Copepod nauplii, on the other hand were usually more abundant than in Sebastes larvae of the same size.

Discussion.

Plankton organisms with average dimensions of less than about 250 μ are not filtered quantitatively with a Hensen net so it is not possible to compare the relative numbers of Calanus eggs and nauplii in different localities. However, since the development of Calanus eggs from laying to hatching takes from 25 to 65 hours at temperatures between 5° and 10°C (Marshall & Orr, 1955), it seems likely that high numbers of Calanus eggs will frequently be accompanied by high numbers of early nauplii. The gut contents of the redfish larvae suggest that they feed far more successfully on Calanus eggs than on Calanus nauplii during the early weeks after extrusion. The reverse may be true for cod larvae since these usually contained more nauplii than were present in redfish larvae of the same size. There was, however, only a little overlap at the fringes of distribution of the larvae of the two species in west Greenland waters during May and June, and it is noteworthy that redfish larvae were mainly found in the area where most adult Calanus were present.

Acknowledgements.

I wish to thank Mr J. Møller Jensen for allowing me to examine the cod and redfish larvae taken during the cruises of the DANA and Dr A. Kotthaus for supplying me with the redfish larvae collected from the ALTON DOHRN. The Recorder survey was supported by H.M. Treasury and by Contract N62558-3612 between the Office of Naval Research, Department of the United States Navy, and the Scottish Marine Biological Association.

REFERENCES.

- BAINBRIDGE, V. (1964). A preliminary study of Sebastes larvae in relation to the planktonic environment of the Irminger Sea. ICNAF Environmental Symposium Contribution No. B3, 5pp.
- EINARSSON, H. (1960). The fry of Sebastes in Icelandic waters and adjacent seas. Rit. Fiskid., Vol. 2, No. 7, 67pp.
- MARSHALL, S.H. and ORR, A.P., (1955). Biology of a marine copepod. Calanus finmarchicus (Gunn.). Oliver & Boyd Ltd., Edinburgh. vii + 188pp.
- WIBORG, K.F. (1948). Investigations on cod larvae in the coastal waters of Northern Norway. Rep. Norweg. Fish. Invest., Vol. IX, No. 3. 27pp.

TABLE I. Gut contents of redfish larvae from the Irminger Sea during NORWESTLANT II. Number of organisms per larva. D = DANA and A.D. = ANTON DOHRN stations.

Station and Date	No. examined and size range	<u>Calanus</u> <u>eggs</u>	Copepod <u>nauplii</u>	Copepod <u>copepodites</u>	Other <u>organisms</u>
D.11889 (20/5)	10 (7-9mm)	4.4	1.6	-	0.1 <u>Oithona</u>
D.11893 (22/5)	10 (7-9mm)	24.8	0.3	-	1.0 <u>Spiratella</u>
D.11895 (23/5)	10 (8-10mm)	12.5	-	-	0.3 <u>Spiratella</u>
AD.546 (29/5)	10 (7-10mm)	36.3	-	-	0.1 Crustacean egg (indet.)
AD.552 (31/5)	10 (7-12mm)	18.3	-	-	-
AD.587 (3/6)	10 (9-12mm)	45.4	3.3	0.1	0.1 Calyptopis

TABLE II. Gut contents of redfish larvae from stations near the continental edge off the south-west and south-east coasts of Greenland during NORWESTLANT II and III. Number of organisms per larva. D = DANA and A.D. = ANTON DOHRN stations.

Station and Date	No. examined and size range	<u>Calanus</u> <u>eggs</u>	Copepod <u>nauplii</u>	Copepod <u>copepodites</u>	Other <u>organisms</u>
D.11907 (28/5)	10 (7-9mm)	0.8	0.7	-	-
D.11910 (30/5)	10 (7-9mm)	31.8	0.7	-	0.2 <u>Spiratella</u>
D.11914 (1/6)	10 (8-9mm)	0.8	0.4	-	0.1 Crustacean egg (indet.)
D.11919 (2/6)	3 (8-9mm)	0.7	0.7	-	-
D.11928 (3/6)	5 (7-8mm)	4.6	1.4	-	-
D.11947 (11/6)	7 (7-10mm)	1.3	1.3	-	0.1 <u>Spiratella</u>
D.11970 (1/7)	10 (10-12mm)	-	2.3	0.3	-
AD.563 (2/6)	7 (6-9mm)	0.6	3.1	0.1	0.3 Crustacean egg (indet.)

TABLE III/

TABLE III. Gut contents of cod larvae from DANA stations off east coast of Greenland and Davis Strait during NORWESTLANT II and III. Number of organisms per larva.

<u>Station and Date</u>	<u>No. examined and size range</u>	<u>Calanus eggs</u>	<u>Copepod nauplii</u>	<u>Copepod copepodites</u>	<u>Other organisms</u>
D.11929 (4/6)	5 (6-7mm)	-	2.6	-	-
D.11931 (4/6)	2 (5-6mm)	-	1.0	-	-
D.11945 (11/6)	5 (6-7mm)	-	2.0	0.2	-
D.11947 (11/6)	2 (5-8mm)	-	2.5	-	-
D.11953 (13/6)	2 (5-6mm)	1.0	1.0	-	-
D.12013 (10/7)	5 (6-9mm)	-	0.8	-	-
D.12017 (10/7)	5 (8-12mm)	-	1.2	5.2	-
D.12018 (11/7)	5 (8-11mm)	-	5.2	0.4	-
D.12029 (12/7)	4 (9-10mm)	-	0.7	5.5	-

TABLE IV. Gut contents of cod larvae from DANA stations in Godthaab Fiord during NORWESTLANT II. Number of organisms per larva.

<u>Station and Date</u>	<u>No. examined and size range</u>	<u>Calanus eggs</u>	<u>Copepod nauplii</u>	<u>Copepod copepodites</u>	<u>Other organisms</u>
D.11960 (20/6)	3 (6-8mm)	-	2.7	-	-
D.11962 (21/6)	5 (6-8mm)	-	2.6	-	-

LEGENDS FOR FIGURES. /

LEGENDS FOR FIGURES.

- FIGURE 1. The distribution of samples used for the analysis of the food of cod and redfish larvae. Sub-areas B6, B7 and C7 of the Recorder Survey are shown by the dashed lines. Closed circles indicate DANA stations and open circles ANTON DOHRM stations listed in Tables I and II. The hatched area encloses all the DANA stations listed in Table III.
- FIGURE 2. Histograms showing the frequency of occurrence of Sebastes larvae in relation to the number of Calanus eggs per gut. The data have been arranged in four groups according to the time of sampling so as to illustrate diurnal variations in feeding activity. All undamaged larvae on alternate Recorder samples taken during the month of May from 1958 to 1963 have been included.
- FIGURE 3. Histograms showing the frequency of occurrence of Sebastes larvae in relation to the number of Calanus eggs per gut. The data are grouped according to the numbers of adult Calanus in the same Recorder samples as the larvae. All undamaged larvae on alternate Recorder samples during the month of May from 1958 to 1963 have been included.

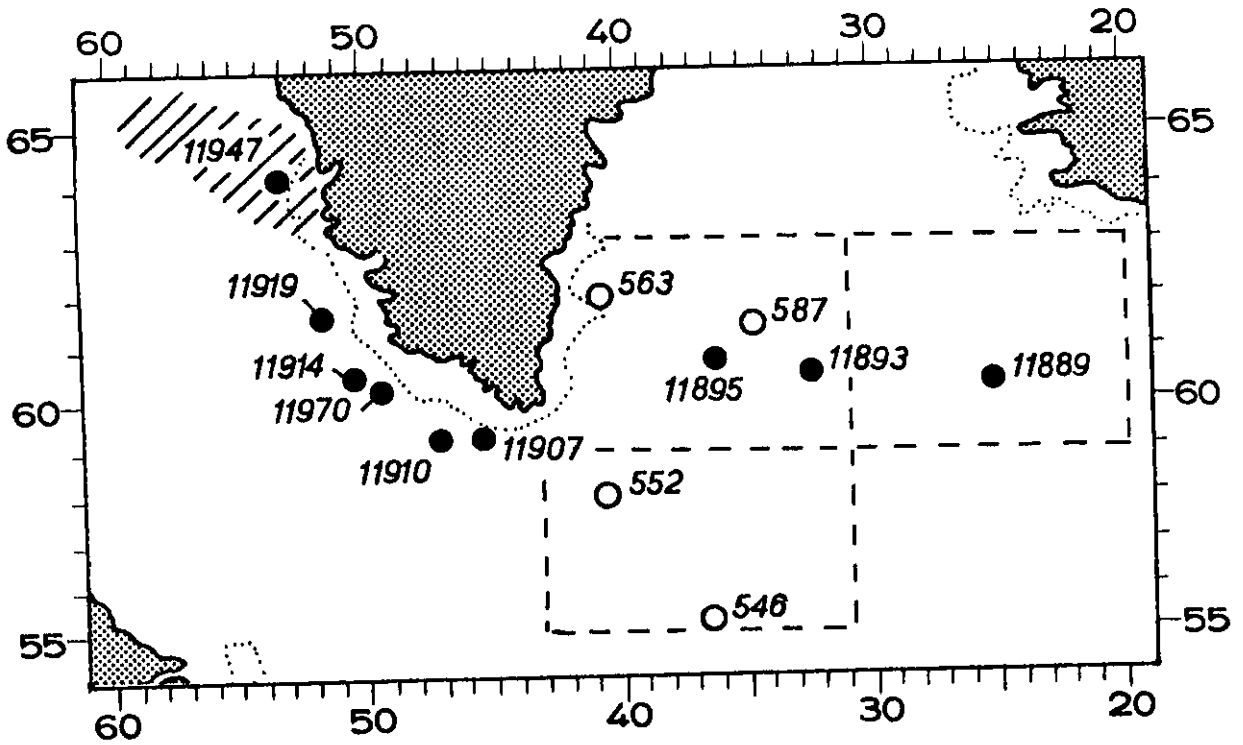


Figure 1

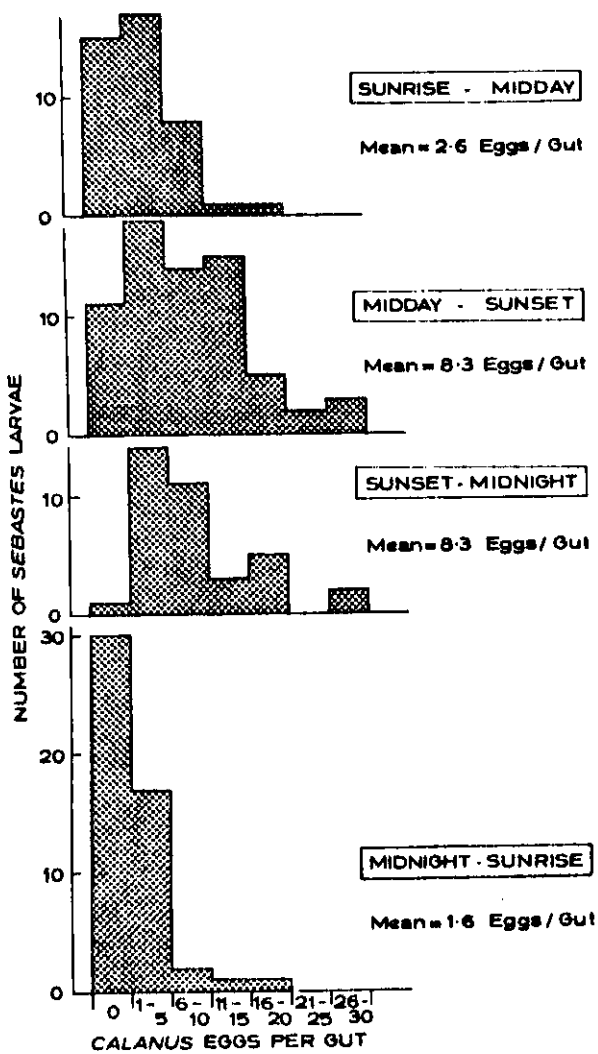


Figure 2

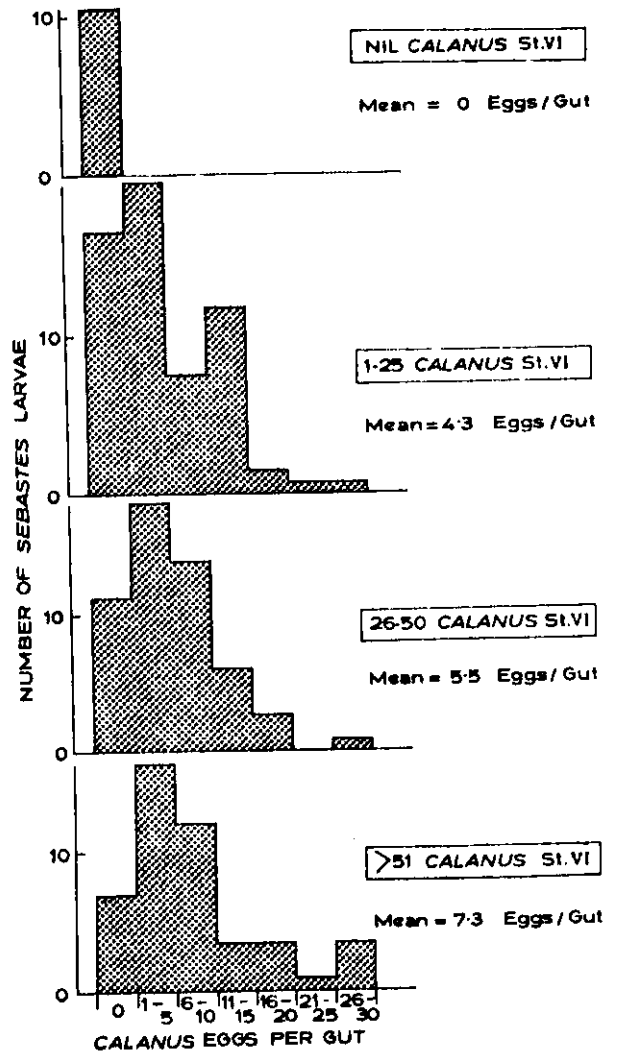


Figure 3