

NOTES ON THE DISTRIBUTION AND ECOLOGY OF *MYXINE GLUTINOSA* L.

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The hagfish (*Myxine glutinosa* L.) is very common on muddy bottoms along the west coast of Norway, and has for at least 80 years been a favourite subject for anatomical and histological research. Its life history is not, however, correspondingly well known, and although it may live for a long time (several months) in aquaria, it does not breed there. The embryology is practically unknown.

In recent years Foss (1962) has made important contributions to the knowledge of the ecology of the species by discovering its burrows (in Ulvikpollen in Hardanger, West Norway) and by tagging experiments.

The present notes are concerned with the distribution and ecology of the species, based on observations made by the author during 11 years of field work in the Bergen area and the Hardanger Fjord, and also on an analysis of the available literature.

The hagfish has figured in Norwegian scientific literature since the time of LINNÉ, and several authors have taken part in the discussion of its relation to the major systematical groups. (For instance GUNNERUS 1763, and KALM 1753). KRØYER (1852–53) stated that the species is found all along the Norwegian coast, and NILSSON (1855) mentioned its abundance on some parts of the Scandinavian coasts. COLLETT (1875) said that it is found in all suitable localities along the Norwegian west coast, and NANSEN (1886 and 1888) mentioned that several hundred specimens could be collected at Alverstrømmen (north of Bergen) (cf. BRINKMANN 1961), and that it is “more common than any other fish” in the fjords around Bergen.

Contribution given in honour of Gunnar Rollesen at his 70th birthday.

According to GRIEG (1914 p. 52), it is found down to a depth of 500 metres around Bergen, is abundant in the Hardangerfjord, and "occurs quite commonly up to about a depth of 10 metres in the innermost part of Jondalsbugten on muddy bottoms". TAMBS-LYCHE (1954) found that the species occurred almost everywhere in Sjørfjorden and Osterfjorden in North Hordaland, on muddy bottoms up to a depth of about 100 metres.

Throughout its area of distribution, the hagfish is a characteristic animal on the muddy bottoms which cover most of the fjord deeps.

As mentioned above, GRIEG (1914) found that the hagfish occurred down to 500 metres around Bergen. In later years, however, it has repeatedly been caught, sometimes in large numbers, at a depth of 690 metres in Korsfjorden near the Biological Station Espegrend; and LYNNGES (1930) mentions catches taken at a depth of 1100 metres in the Sognefjord. At one station (ZF 176) in the Hardangerfjord (Samlafjord near Ålvik), 473 specimens were caught in baited eel-traps at a depth of 864 metres. The greatest depth mentioned by BIGELOW and SCHROEDER (1948) is 524 fathoms (985 metres). One may therefore conclude that there is, at present, no real indication of the maximum depth at which it may be found.

It is also of greater interest to find the upper limit of its occurrence.

As mentioned above, GRIEG (1914) found the species "quite commonly" at a depth of 10 metres in Jondalsbukten in Hardanger. In July 1959, the present author thoroughly investigated the locality but was unable to find the species between 8 and 24 metres, from which depth the bottom of the bay descends steeply. In any case the bottom of the bay is not suitable for the hagfish as the mud is mixed with coarse sand and gravel. It is therefore probable that GRIEG's statement is erroneous, or perhaps more likely, the figure 10 may be a misprint for 100 metres. The species, in any case, does not occur at the depth stated.

All available information shows, however, that *M. glutinosa* ascends to lesser depths as one passes from the open coast towards the inner fjords. In the relatively open waters of the outer areas, for instance, near the Biological Station Espegrend, it has so far not been caught above 95 to 102 metres (near Ospøya in Raunefjorden), although several attempts have been made to find it in shallower localities where it might be studied. Near Herdla (the site of the Biological Station before 1940), it was known to occur regularly in Ypsøy sound, where the depth varies between 30 and 70 metres (Herdla collecting station No. 12). It is probable that the species was caught at the greater of these depths rather than at the lower. Ypsøy sound is near the "bottom" of the Herdla fjord, and forms a small, rather closed basin with sills at both ends. There is a considerable amount

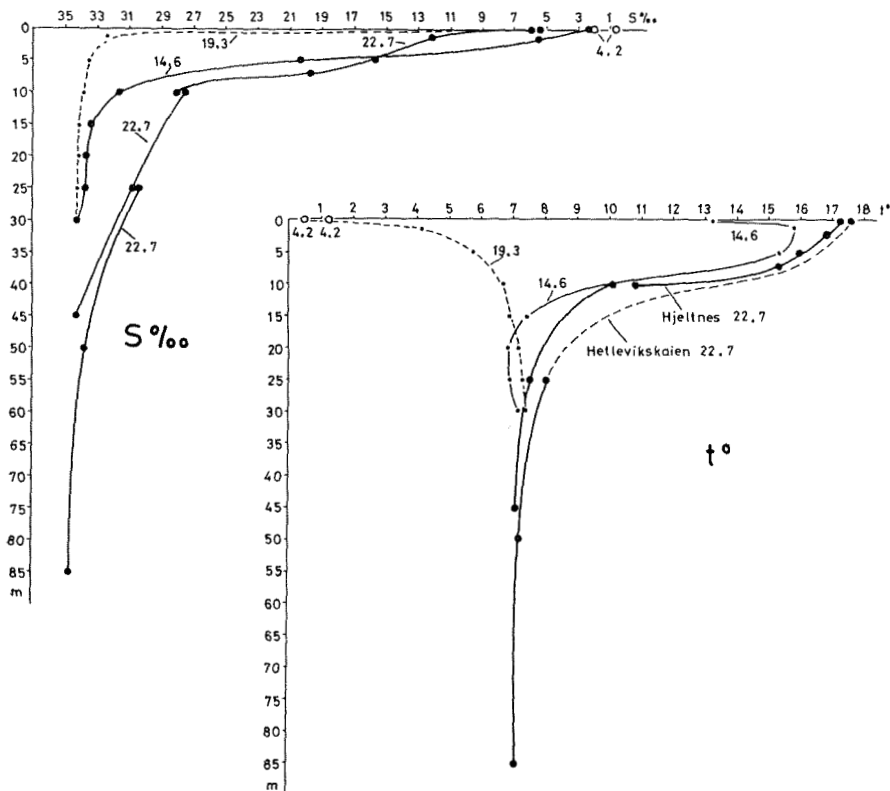


Fig. 1. Hydrographic observations in Ulvikpollen, Hardanger 1959 (July) and 1960 (winter and June). Open rings: winter observations. Filled dots: summer observations. Observations on 22 July were made at three different localities; in the bay proper (bottom at about 15 metres), at the opening of the bay (bottom at about 50 metres), and near Hetlevikskaien (bottom about 90 metres).

of fresh water run off from the nearby Rosselandspollen and from lakes on Holsenøy.

In Ulvikpollen, in the innermost part of the Hardangerfjord, *M. glutinosa* has been caught regularly between 24 and 48 metres in relatively large numbers during the Hardanger fjord investigations (see also Foss 1962). Trials at depths of 9 to 10 metres were always negative.

The available information on the hydrography of Ulvikpollen has been plotted in Fig. 1. It shows that there are large annual variations in temperature and salinity in the layers above 30 metres, but from that depth to the bottom, the temperature and salinity conditions are remarkably constant throughout the year. This figure should be compared with a corresponding one from a locality very similar to the one at Raunefjorden by BURDON-JONES and TAMBS-LYCHE (1960 p. 19). It shows that

a corresponding stability throughout the year in the outer fjord districts, is found only at a depth of 90 to 100 metres, the minimum depth where *M. glutinosa* occurs in that area.

It may be that a high and constant salinity (32 to 35‰), and also a constant and not particularly high temperature (<about 8°C) are the limiting factors for the distribution of the species. But the physical features of the bottom are evidently also of importance.

Observations of the minimum depth of the species' occurrence in other parts of its area of distribution correspond well with what is known from the Bergen coast.

KRØYER (1852-53) mentions 12 to 20 fathoms as the common depth at which it is found in the Kattegat, and says that it has been found repeatedly at 7 to 8 fathoms. However, PETERSEN and LEVINSEN (1900) found it only in trawlings between 300 and 40 fathoms, the only exception being a single specimen caught north of Læsø at a depth of 20 fathoms. KRØYER received his information from fishermen, and their depth figures may not have been so accurate as PETERSEN and LEVINSEN's records.

BRATTSTRÖM (1948) found one specimen near Kullen at the northern entrance to Øresund, at a depth of 20-23 metres (length 380 mm.)

LYNGNES (1930) found the species up to 20 fathoms on the Møre coast, and COLLETT (1875) also mentions 20 fathoms as the minimum depth, while in 1905 he said that it "may be found in shallow bays of only 20 metres depth".

LILLJEBORG (1891) mentions 15 fathoms as the upper limit on the Swedish west coast, and RETZIUS (in SMITT 1875) gives 16 to 17 fathoms as the minimum depth in Gullmarfjorden. GUSTAFSON (1934) mentions 30 metres as the upper limit in the same fjord.

The North Atlantic distribution of *M. glutinosa* extends from Murmansk to Gibraltar. It has been found a short distance east of the Straits of Gibraltar, but does not occur elsewhere in the Mediterranean. It has been found in the Sound (see above), but not in the Baltic. Possibly the salinity is too low. It seems to be more common in the northern part of the area of distribution than in the southern. It has been recorded near the east coast of Iceland at a depth of 940 metres by KONSTANTINOV and SCHEGOLEV (1958). IVERSEN (1936) found two specimens at East Greenland (63°40'N 39°6'W). FABRICIUS (1780), KRØYER (1852-53) and JENSEN (1926) record it in West Greenland waters. The species is also distributed from the Gulf of St. Lawrence (VLADYKOV 1951) to Delaware Bay and Cape Fear in North Carolina.

BIGELOW and SCHROEDER (1948) compared North American specimens with Norwegian ones, but did not find sufficient difference to consider them as separate, either at the species or subspecies level. They

therefore considered *Myxine limosa* GIRARD 1859, described from North America, as a synonym for *M. glutinosa*.

There is, however, one difficulty not mentioned by BIGELOW and SCHROEDER. The largest European hagfish recorded were 470 mm (COLLETT 1875) (from Øksfjord in Finnmarken) and 455 mm long (NILSSON 1955) (from West Norway). The present author, in the course of his stay at Espegrend, measured a total of 1682 specimens from the vicinity of Bergen and the Hardanger fjord, and found the largest animal to be 382 mm long. The average length in most catches was not above 260 to 280 mm. However, a maximum size of 790 mm has been reported from U.S.A., and CONEL (1917) mentions a series with an average length of 620 mm.

The size of the animals caught depends to some degree upon the size of the gear used to catch them. At Espegrend, common eel-traps were mostly, but not exclusively used. It may be that some other gear might have caught individuals larger than 382 mm. There is no indication as to the gear used by CONEL, but it seems very unlikely that this should be the reason for the great difference in size recorded. It seems therefore worthwhile to make a closer investigation as to the size-distribution of the species on both sides of the Atlantic. If a difference in the maximum size, such as the one mentioned above, is confirmed, that would indicate that at least different subspecies occur in the eastern and western Atlantic.

SUMMARY

The distribution and ecology of the hagfish, *Myxine glutinosa*, in the Bergen area is discussed, especially its depth occurrence. The ascent of the species to lesser depths in the inner fjords is seen in relation to the stability of the water masses. The total distribution of the species is reviewed, and it is suggested that a pronounced difference in size of the animals on both sides of the Atlantic may, if confirmed, indicate that there are different subspecies.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the co-operation of his friends on the staff of the Biological Station Espegrend, in the tiring and not always pleasant work on hagfish.

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Received 28 June 1969

Printed 10 November 1969