Dana, vol. 4, pp. 41-48, 1985

Greenland eels, *Anguilla rostrata* LeSueur

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Abstract

The paper deals with a material of 23 eels from Færingehavn, Greenland. All specimens refer to *Anguilla rostrata* LeSueur. Their habitat is the northernmost so far known for the species.

Ovarial development of the 21 females range from immaturity up to GSI = 5.9. Otoliths are not well suited for age determinations. Scale zones are easily read. A 'growth relation' for the females (total length versus number of scale zones) closely resembles a corresponding relation for eels from Bermuda.

A possible route of larval drift from the breeding area via the Irminger system to Greenland is suggested.

Contents

Preface

Eels are rare in Greenland. In 1972, however, eels were caught in numbers in a small lake near Færingehavn. From this locality 23 eels caught during 1973, 1974 and 1975 were obtained for the present study.

The author wishes to express his gratitude to Mr Bjarne Pedersen, who caught the eels, and to supervisor T. Bojsen, Færingehavn, who kindly arranged for shipment of the eels and for local photos. Thanks are also due to technician Erik Hansen, Fiskeribiologisk Laboratorium, Nuuk (Godthåb), for advice and information.

General distribution of *Anguilla rostrata*

Elvers are recorded to ascend the Atlantic coastal area of North America from the Virgin Islands in the South (Boëtius 1980) to Quebec in the north (Vladykov 1966). A typical 'target area' of ascent (as known for *A. anguilla* in Europe) has not been indicated for American elvers.

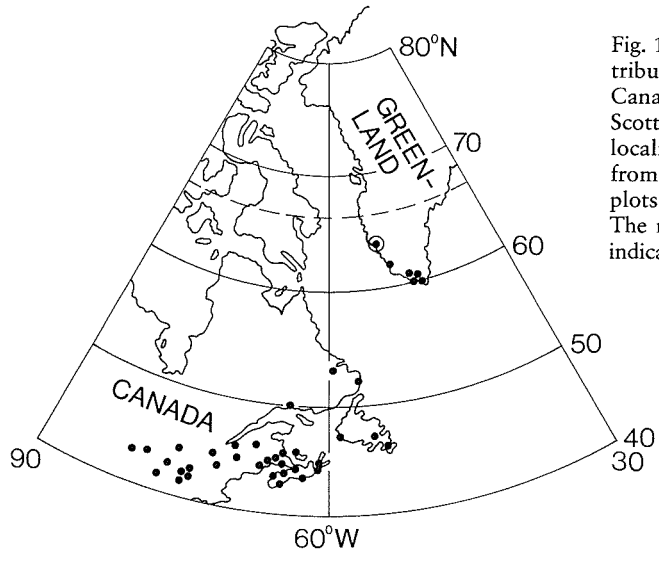

Fig. 1. Map showing the northern distribution of *Anguilla rostrata*. The Canadian records are re-drawn from Scott & Crossman, 1973. A single locality in the Quebec area is added from Vladykov, 1966. The Greenland plots refer to preserved specimens. The northernmost dot is circled and indicates the Færingehavn material.

Adult (yellow) eels: Southernmost documented finds are from Shark River, Trinidad (Vladykov 1964, and Boëtius 1980). The northern distribution is shown in Fig. 1. The Canadian records are re-drawn from Scott & Crossman (1973). The records are distributed evenly over the Atlantic drainage basin. The northernmost continental limit is Hamilton Inlet, the mouth of which is situated about 54°20′N. Vladykov (1955) does not give a northern continental limit in his text, but from his map (on back cover) eels seem to be present up to about 58°N. Eales (1968) repeats this information in his map. The discrepancy is most likely due to the circumstance that Scott & Crossman restrict their records to museum specimens and references from literature.

Records from Greenland up to 1972

Based on correspondence and on material present in the Zoological Museum, Copenhagen, Jensen (1937) arrives at the conclusion that the Greenland eel, 'Nimeriak', must be very rare.

Jensen's museum material comprises six specimens only. They were caught in the period 1841-1920 at four localities in southwest Greenland. From the northernmost locality (Tinninertok, 62°18′N) 3 eels (about 11 cm long) were taken. The remaining 3 eels (from 3 localities) were 59-66 cm long. Two of them had 'silver' appearance, one was yellow. The Jensen eels were all *A. rostrata*.

From the period 1920-72 the author is aware of two records only. The preserved specimens are both yellow eels:

1946, August. Itivdliaitsiak, Nanortalik (Greenland Fisheries Investigations)
1965, August. Ilua, Tunngdliarfik. 60°58′N, 45°45′W.
(Zoological Museum, Copenhagen).

Thus up to 1972 documented records exist from 5 localities in SW Greenland (note that the 1946-eel from Nanortalik is from a locality already represented in Jensen's material). They are plotted in the map Fig. 1.

The recent eel catches at Færingehavn were given a short note in the Greenland newsletter 'Sermitsiak'. Commenting on this note J. Motzfeldt (*ibid.* 1975.08.29) relates that eels have occurred regularly for several years a little north of K'agssimiut in the district of Julianehåb. Eels (some of them more than 50 cm long) have been caught by nets at places where arctic char were caught.

The Færingehavn material

Habitat

The 23 specimens were all captured in 1973-75 (July-September) by fyke net in a small shallow lake near the bottom of the fiord Kangerdluarssoruseq, south of Færingehavn. The position of the lake is 63°42′48″N, 51°20′18″W which is about 150 km's north of the so far documented northernmost occurrence of the species.

In the photo Fig. 2 the camera faces the bottom of the fiord. The lake is seen in the centre of the picture vertically above the island. A rivulet connects the lake and the fiord. The surface temperature of the lake was 10.3°C at 11 a.m., September 13th, 1973.

Fig. 2. The bottom of the fiord Kangerdluarssoruseq south of Færingehavn. The small lake seen vertically above the island is the northernmost habitat of *Anguilla rostrata* so far known. Photo August 13, 1976.

Taxonomy

The material was shipped frozen to the laboratory in Charlottenlund. The data for individual eels are given in Table 1.

The eels were X-rayed and counted for total numbers of vertebrae. One of the eels had an incomplete tail tip. Thus for N = 22 the following result was achieved: Mean ± 2 × SE (range): 106.96 ± 0.62 (104-110). This vertebra number is typical of *Anguilla rostrata* LeSueur.

The ano-dorsal distance is the distance between verticals through the anus and the origin of the dorsal fin as a percentage of the total length. This measure is considered a distinguishing character between the two Atlantic *Anguilla*-species. It is generally independent of body size (Ege 1939). In the present material (N = 23) we get: Mean ± 2 × SE (range): 8.34 ± 0.45 (6.4-11.0). Also this value is typical of *A. rostrata*.

Table 1. *Anguilla rostrata* from Færingehavn, Greenland. Nos 1-9: 1973, nos 10-18: 1974, nos 19-23: 1975

Eel no.	Total no. of vertebrae	Total length, cm	Body weight, g	Ano-dorsal distance[1]	Eye 'area',[2] mm²	Max. no. of scale zones	Sex	Max. width of gonads, mm	Weight of gonads, g	GSI[1]
1	107	52.5	201	9.0	48.3	4	f	14	11.9	5.9
2	104	47.7	117	8.8	34.8	3	–	5	<0.5	<0.5
3	108	46.7	135	7.5	33.6	3	–	5.5	<0.5	<0.5
4	106	45.9	132	9.2	20.3	3	–	9	1.2	0.9
5	104	36.9	71	7.9	24.4	2	–	5	<0.5	<0.5
6	110	40.4	93	8.9	35.8	3	m	1.5	~0.1	~0.1
7	108	46.2	131	6.5	33.9	4	f	7	1.9	1.5
8	108	48.9	185	7.8	29.8	4	–	14	5.8	3.2
9	107	66.7	521	8.6	53.2	5	–	9	3.6	0.7
10	106	37.5	70	6.4	21.2	2	–	7	<0.5	<0.5
11	109	40.2	98	11.0	23.5	4	–	8	<0.5	<0.5
12	107	41.3	99	6.8	22.4	5	–	5	<0.5	<0.5
13	109	40.8	84	7.8	22.6	3	–	7	<0.5	<0.5
14	106	43.9	118	7.3	27.0	5	–	10	0.8	0.7
15	106	46.5	126	9.0	21.6	4	–	10	1.0	0.8
16	107	50.8	194	7.7	35.4	5	–	20	4.4	2.2
17	107	48.0	206	8.8	45.9	5	–	20	8.5	4.1
18	106	54.2	194	9.0	37.6	6	–	17	4.8	2.5
19	106	44.2	112	7.7	12.5	5	–	7	<0.5	<0.5
20[3]		45.5	132	9.2	33.6	5	–	8	0.9	0.7
21	107	45.0	115	8.9	36.6	5	–	9	0.9	0.8
22	107	34.5	72	8.1	29.6	4	m	1.5	~0.1	~0.1
23	108	35.7	59	9.0	15.9	3	f	9	<0.5	<0.5

1. The terms ano-dorsal distance and GSI are explained in the text.
2. Horizontal × vertical diameter (mm). 3. Tail tip incomplete.

Coloration

A distinction between 'yellow' and 'silver' stages was not possible. All eels had dark (olive, greyish) dorsal sides and more or less canary ventral sides often with a narrow median whitish stripe.

Sex and gonads

21 eels were female. The two male eels had typical Syrski organs.

In Table 1 the maturity is indicated by GSI (= gonado-somatic index = weight of gonads as a percentage of total body weight).

9 out of 21 females proved 'immature' (GSI-values below 0.5). In the remaining 12 eels GSIs ranged from 0.7 to 5.9. Wenner & Musick (1974) give a mean GSI of 4.81 of female eels migrating from Chesapeake Bay, Boëtius *et al.* (1962) give the range of GSIs of four catadromous Canadian eels as 4.5-6.8. On this background eels nos 1 and 17 (GSIs 5.9 and 4.1) in the present Greenland material are considered 'catadromous' or 'silver' although their coloration does not differ essentially from the other eels in the material.

Otoliths and scales

The otoliths were prepared by the method described by S.W. Smith, 1968. Otoliths of eels nos 13, 19 and 22 had an almost amorphous appearance. The remaining 20 showed a pattern similar to that presented in Fig. 3 where eels nos 8 and 17 have been chosen as representative of the material.

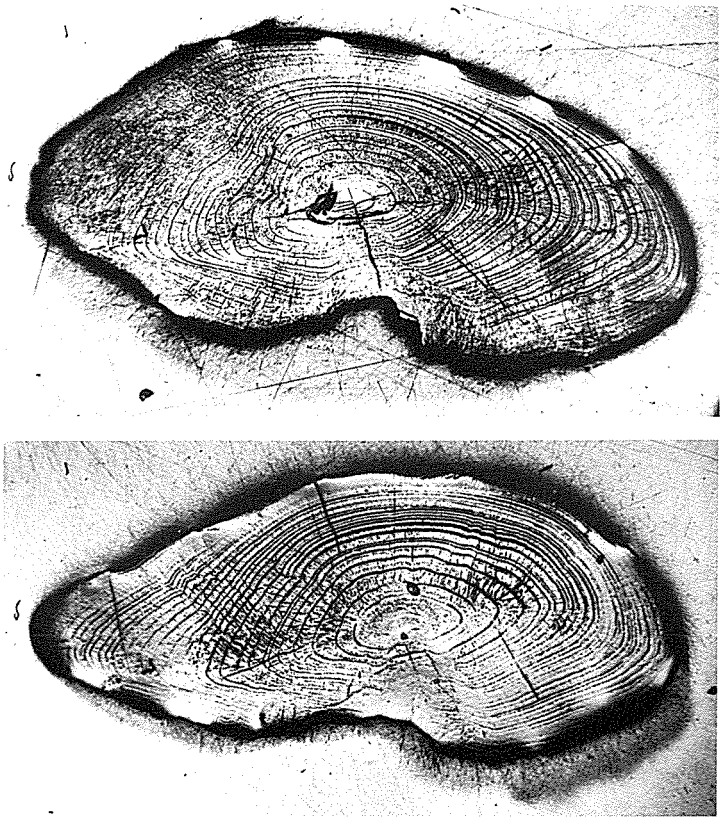

Fig. 3. Otolith photos of two female eels.
Top: *no. 8.* 48.9 cm, GSI = 3.2, 4 scale zones.
Bottom: *no. 17.* 48.0 cm, GSI = 4,1, 5 scale zones.

Concentric rings are sharply indicated and 'paired rings' are present in all 20 otoliths. In none of them, however, do the rings join in zones which could possibly be interpreted as annual zones. Thus the author refrains from making any use of the Greenland otoliths for age determination.

For scale reading were chosen 20 dorso-laterally situated scales from the region above the anus. Individual maximum numbers of scale zones are given in Table 1.

Scale zones are considered annual zones but do not necessarily indicate the true age. Additional information is needed about the year in which the first scale appear (the so called 'scale age').

The scale age of the Greenland eels is not known. The 3 specimens (about 11 cm long) from Tinninertok (Jensen 1937) were re-examined by the author. They had no scales.

In Table 2 the number of scale zones is presented versus total lengths. The data in the left-hand part of the table give a growth relation to 'post scale age' for female Greenland eels. The right part of the table gives corresponding data for 75 *Anguilla rostrata* from Bermuda. They had a scale age of about one year (Boëtius & Boëtius 1967).

It is a remarkable fact that the growth rates of these two eel populations seem to be almost equal.

Table 2. Number of scale zones versus total lengths in 21 female Greenland eels and 75 female eels from Bermuda (Boëtius & Boëtius 1967).

Number of scale zones	Greenland		Bermuda	
	N	Total length, cm mean ± 2 SE	N	Total length, cm mean ± 2 SE
1	–	–	11	22.1 ± 2.1
2	2	37.2	29	34.6 ± 2.9
3	5	43.4 ± 4.5	17	43.1 ± 2.0
4	5	46.9 ± 4.0	13	47.3 ± 1.9
5	8	48.2 ± 5.7	5	51.3 ± 4.0
6	1	54.2	–	–

Food

Remnants of food were expected to be poor as the eels had been staying in the fyke net for up to a week before tending.

The stomachs of all 23 eels were empty. From the intestines, however, food elements were identified in five specimens. In both male eels (nos 6 and 22) numbers of water fleas (*Cladocera*) were present (about 300 in no. 22). The intestine of eel no. 5 contained 2 larval midges (*Chironomidae*); eels nos 7 and 18 had a few caddisworm cases (*Trichoptera*) in their gut. In eel no. 18 also a number of *Cladocera* was present.

How do American eels arrive in Southwest Greenland?

Jensen (1937) is of the opinion that eels have reached Greenland by swimming actively from their northernmost American continental habitats. To the present author it seems unlikely that even small yellow eels (11 cm long) are capable of crossing the southward Labrador Current and the northward West Greenland Current as well.

Jensen's principal argument for excluding a suggested larval drift of *Anguilla rostrata* from the breeding area to Greenland was the acceptance of a pure stock of *A. anguilla* in Iceland. Boëtius (1980), however, has shown that about 2 per cent of the Islandic stock is made up by eels which are likely to belong to *A. rostrata*.

A possible route for *A. rostrata*-larvae to reach Greenland from the Sargasso area is proposed in Fig. 4. The map shows the distribution of the two Atlantic *Anguilla* species. The breeding area and migration pattern of the *A. anguilla*-larvae are mainly based upon Schmidt's data. The information about *A. rostrata* is based on Schmidt 1925, Vladykov 1964, and Kleckner & McCleave 1982. The area of overlap is estimated from Schmidt's primary data.

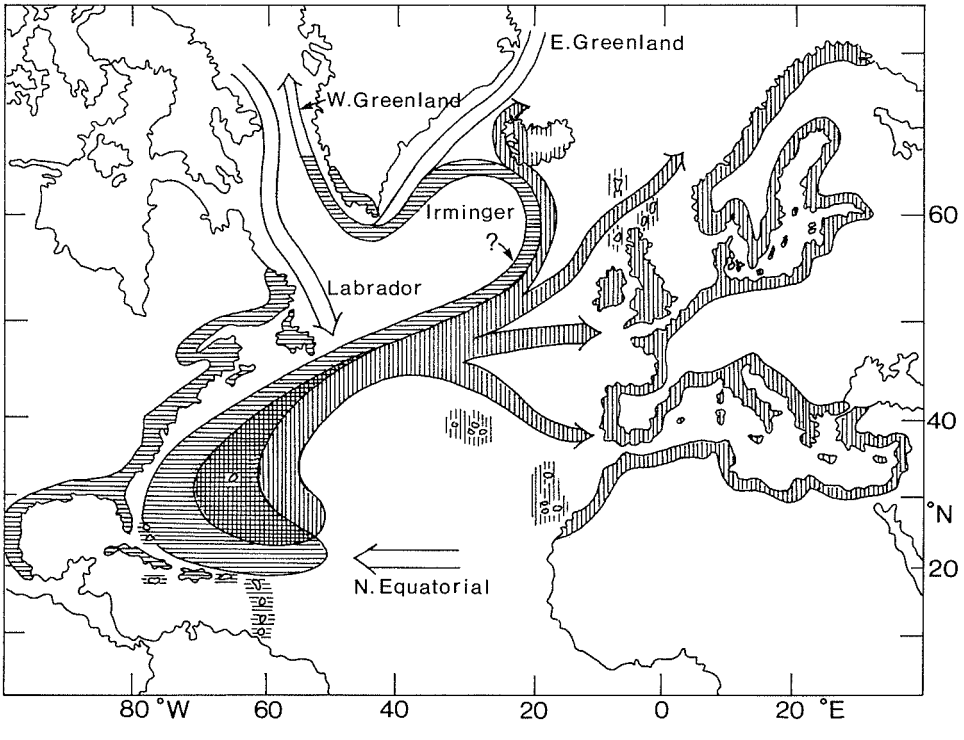

Fig. 4. In this map the Irminger current system is proposed as a hypothetical route of *Anguilla rostrata* larvae drifting from the breeding area to Greenland. Horizontal hatching: *A. rostrata*. Vertical hatching: *A. anguilla*.

Larvae of both species are taken up by the Gulf Stream system. Of special interest for the Greenland problem is the fact that the northward Irminger Current is split into two divisions: 1) and eastern branch which bends north of Iceland supplying this region with 98 per cent of *A. anguilla* and 2) a western branch joining the West Greenland current. This western branch has a potential ability of supplying Greenland with a (no doubt very modest) number of *A. rostrata*-larvae.

The suggestions about the immigration route of the Greenland eels put forward here are purely theoretical. In fact no *Anguilla*-larva was ever caught north of 62°45'N. Also it should be noted that only an insignificant fraction of the larvae in the comprehensive Danish material caught east of 40°W was determined to species by myomere counts.

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