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REVISION OF THE ARCTIC COD GENUS, *ARCTOGADUS* (PISCES, GADIDAE)

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WITH 7 FIGURES AND 6 TABLES IN THE TEXT,
AND 1 PLATE

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Abstract

An attempt is made to clarify the status of the four species referred to the genus *Arctogadus* DRJAGIN, 1932. Observations were obtained or examination made on the following material: *A. glacialis* (PETERS, 1874) (46 specimens), *A. borisovi* DRJAGIN, 1932 (17 specimens), *A. pearyi* (NICHOLS and MAXWELL, 1933) (2 specimens), and *Phocaegadus megalops* JENSEN, 1948 (37 specimens). It is shown that *A. pearyi* and *P. megalops* are junior synonyms of *A. borisovi* and *A. glacialis* respectively. —*A. glacialis* is found pelagically in the western Polar basin north of the polar circle. *A. borisovi* is most often caught close to the bottom and occurs in the high-arctic regions of Greenland, Canada, and Asia, with the exception of two specimens taken off South West Greenland.

INTRODUCTION

The purpose of this paper is to clarify the status of the four species referred to the genus *Arctogadus*. When trying to identify two specimens collected off South West Greenland (see p. 24) the result differed greatly, being either *A. borisovi*, *glacialis*, *megalops*, or *pearyi*, depending on the literature used. Consequently, as much information on this genus as possible was procured from different museums.

Material or information on material (a total of 105 specimens) was obtained from the following institutions:

Arctic Biological Institution, Quebec	– ABS
American Museum of Natural History, New York	– AMNH
Greenland Fisheries Investigation, Charlottenlund	– GFI
Museum of Comparative Zoology, Cambridge, Mass.	– MCZ
National Museum of Canada, Ottawa	– NMC
Tromsø Museum, Norway	– TM
University of British Columbia, Vancouver	– UBC
University of California, Los Angeles	– UCL
University of Ottawa	– UO
United States National Museum, Washington	– USNM
Zoological Institute, Leningrad	– ZIL
Zoological Museum, Copenhagen	– CpZM
Zoological Museum, East Berlin	– ZMB

The material is generally in an exceptionally bad condition. This is mainly caused by some of the collecting methods; e.g., by using explosives, and by opening up the stomachs of predators (seals etc.). Dried specimens washed ashore and specimens frozen into the ice have also been found in the material. Thus in some cases, the morphometric characters are very uncertain. However, the South West Greenland specimens are an exception; they were caught in a trawl and are in excellent condition.

All measurements taken by the present authors are made in accordance with HUBBS and LAGLER (1958). The morphometric characters are given in percentages of the standard length. When a character forms less than 10% the uncertainty factor has been put to 0.1, between 10% and 50% to 0,5, and over 50% to 1. Figures in parenthesis give the average value of the character in question.

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ARCTOGADUS DRJAGIN, 1932

Phocaegadus JENSEN, 1948.

The most characteristic features of the genus *Arctogadus* are palatine teeth usually present (see p. 9) and scales cylindrical and imbricated, by which it is distinguished from the closely related genus *Boreogadus* GÜNTHER, 1862. From another related genus *Eleginus* FISHER, 1813 it differs i.a. in having imbricated scales, a protruding lower jaw, and parapophyses with non-swollen tips. All genera belong to the type of Gadidae provided with three dorsal and two anal fins. A detailed description of *Arctogadus* is given by SVETOVIDOV (1948 pp. 214–215).

As a result of the present examinations an addition can be made to the generic diagnosis. The length of the ventral fins shows sexual-dimorphism, being longest in the male. Both DRJAGIN (1932) and SVETOVIDOV (1948) characterize the length of the barbel as "not shorter than the pupil of the eye". However, the examination of the extensive *A. glacialis* material now available shows that the barbel of *glacialis* is rudimentary or absent.

Four species have been described:

Gadus glacialis PETERS, 1874. Holotype in the Zoological Museum, East Berlin. (Type examined).

Arctogadus borisovi DRJAGIN, 1932. (Type species). Holotype in the Zoological Institute, Leningrad. (Radiograph of type examined).

Boreogadus pearyi NICHOLS and MAXWELL, 1933. Holotype in the American Museum of Natural History, New York. (Type not seen).

Phocaegadus megalops JENSEN, 1948. Holotype in the Zoological Museum, Copenhagen. (Type examined).

None of the meristic characters in the four columns of table 1 differ much, but among the morphometric ones those of *A. borisovi*

disagree in several cases from the other three. However, this is apparently caused by the differences in standard length (502 mm *vs* 130–213 mm). When a smaller *borisovi* specimen (table 5 column 4) is used for comparison only a few disagreements remain.

In the following discussion the material of each of the four nominal species will be treated separately, even though we recognize but two.

Key to the species of *Arctogadus*:

1. "Barbel" rudimentary or absent. "Number of gill rakers" 27(30)34. "Fleshy interorbital width" 4.4(5.6)6.8% and "Horizontal diameter of orbit" 8.0(9.0)11.0% of the standard length ... ***A. glacialis*** (PETERS, 1874) = (***Phocaegadus megalops*** JENSEN, 1948).
2. "Barbel" well-developed. "Number of gill rakers" 31(33)35. "Fleshy interorbital width" 5.1(6.1)7.0% and "Horizontal diameter of orbit" 6.2(7.1)8.5% of the standard length ... ***A. borisovi*** DRJAGIN, 1932 = (***Boreogadus pearyi*** NICHOLS and MAXWELL, 1933).

The only unambiguous key-character is the presence or absence of a barbel. The other three characters used in the key overlap, but regarding the "Number of gill rakers" the average value for *A. glacialis*, of which 50 specimens have been examined, is smaller than the minimum value for *A. borisovi* (18 specimens examined). For the "Fleshy interorbital width" it is found that the average width in *A. glacialis* (61 specimens examined) is less than in *A. borisovi* (12 specimens examined). Finally, considering the "Horizontal diameter of orbit", the average value found for *A. borisovi* (7 specimens examined) in smaller than the minimum value for the *A. glacialis* material (64 specimens examined).

In previous keys to the genus *Arctogadus* the lengths of the paired fins have been used in separating the species (SVETOVIDOV 1948). This character has been omitted here as it can be shown (figs. 2 and 4) that the length of the ventral fins depends on the sex, and is longest in the male. Furthermore, the length of the pectoral fins cannot be used; these form 17.0(19.0)22.5% of the standard length in *A. borisovi* (15 specimens examined) and 14.0(19.5)21.5% in *A. glacialis* (51 specimens examined). Also the "Number of pyloric coeca" is an unsuitable key character because of a very large variation, a fact which is clearly demonstrated by the *Phocaegadus megalops* material which has 25–42 coeca (13 specimens examined).

Biology

The main difference between *glacialis* and *borisovi*, the absence or presence of a barbel, suggests that the former occurs pelagically and the latter benthically. (More thorough information is given in connection with each particular species).

Table 1. *Comparison between the holotypes of the species belonging to the genus Arctogadus:*

	glacialis[1])	*borisovi*[2])	*pearyi*[2])	*megalops*[1])
Sex	♀	–	–	♀
Standard length	130	502	213	204
D_1 fins	12	13	12	11
D_2 fins	18	18	20	15
D_3 fins	22	22	22	20
A_1 fins	20	21	23	18
A_2 fins	21	20	22	21
P fins	21	19	19	19
V fins	6	6	6	6
Gill rakers	30	–	approx. 34	28
Branchiostegal rays	7	7	7	7
Pyloric coeca	–	–	–	29
Vertebrae	61	57	–	58
Lateral line scales	140–150	–	approx. 155	approx. 140
Morphometric characters in % of std. 1.				
Head	26.0	28.5	29.5	30.0
Snout	8.5	10.5	8.9	8.6
Postorbital	11.0	12.5	–	12.5
Diameter of eye	8.5	5.9	8.9	8.8
Fleshy interorbital width	5.4	6.6	6.6	4.8
Upper jaw	11.0	–	–	12.0
Lower jaw	15.0	16.5	–	16.0
Preanal	52	55	53	50
Predorsal	31.5	38.0	32.0	35.5
Preventral	28.5	24.0	–	25.5
Base of D_1	11.0	10.0	–	10.5
„ „ D_2	17.5	18.0	–	17.0
„ „ D_3	16.5	14.0	–	15.5
„ „ A_1	18.5	18.5	–	17.0
„ „ A_2	17.5	14.5	–	15.5
Ventral length	17.5	15.5	25.5	18.5
Pectoral „	–	–	22.5	20.0
Barbel „	0	4.2	4.6	0

[1]) reexamined. [2]) not seen by the authors.

Distribution

Figs. 3 and 5 show the distribution of the genus. Apart from the two specimens from South West Greenland all individuals were found north of the Polar circle. One would have expected *Arctogadus* to have a circumpolar distribution, and consequently, also occur off Spitsbergen and Franz Josef Land. But this does not seem to be the case. Through

correspondance with P. HOGNESTAD, Tromsø, it appears that *Arctogadus* has never been caught off Spitsbergen, while *Boreogadus saida* is taken rather often.

ARCTOGADUS GLACIALIS (PETERS, 1874)

(Fig. 1 and plate I fig. B)

Gadus glacialis PETERS, 1874.
Phocaegadus megalops JENSEN, 1948.

Material examined:

1 specimen, std. l. 130 mm. Die zweite deutsche Nordpolarfahrt, Sabine Ø. (74°30′ N, 19° W). ZMB. (Holotype).
1 specimen, std. l. 115 mm. Danmark Exped., St. 12 (77°55′ N, 14°35′ W), 8–8. 1906. CpZM. (Cat. No. 608).
2 specimens, std. l. 245–250 mm. Danmark Exped., Stormbugt (77° N, 19° W), 31–5. 1908. CpZM. (Cat. Nos. 604–5).
1 specimen, cranium. Danmark Exped., Stormbugt (77° N, 19° W), July 1908. CpZM. (Cat. No. P 371663).
1 specimen, cranium. Arctic Archipelago, Ibbet Bay, westside of Melville Isl., NWT, Canada, June 1915. NMC. (Cat. No. 58–76-S).
1 specimen, std. l. 176 mm. Port Epworth, Coronation Gulf, McKenzie District, NWT, Canada, 15-5. 1916. NMC. (Cat. No. 58–87).
1 specimen, std. l. 109 mm. Godthaab Exped. 1928, St. 73 (74°52,5′ N, 62°12′ W), sigsbeetrawl, 30-7. 1928. CpZM. (Cat. No. P 37626).
12 specimens, std. l. 127–242 mm. Godthaab Exped. 1928, St. 81 (75°35′ N, 65°41′ W), ottertrawl, 1-8. 1928. CpZM. (Cat. Nos. P 37631 (holotype), P 37632–3, P 37635–41, P 371585–6).
3 specimens, std. l. 104–144mm. Godthaab Exped. 1928, St. 90 (77°17′ N, 69°59′ W), ottertrawl, 5–8. 1928. CpZM. (Cat. Nos. P 37678–80).
1 specimen, std. l. 132 mm. Treårsexpeditionen til Chr. d. X's Land. 1932, Duséns Fjord (73°15′ N, 24° W), 11-8. 1932. CpZM. (Cat. No. P 37693).
6 specimens, std. l. 103–148 mm. Treårsexpeditionen til Chr. d. X's Land. 1932, Kejser Franz Josephs Fjord, East Greenland, sigsbeetrawl, 13-8. 1932. CpZM. (Cat. Nos. P 37694–9).
2 specimens, std. l. 121–170 mm. Treårsexpeditionen til Chr. d. X's Land. 1932, St. 99, inside of the western entrance to Antarctic Sund, sigsbeetrawl, 14-8. 1932. CpZM. (Cat. Nos. P 37700–1).
2 specimens, std. l. 65–77 mm. Treårsexpeditionen til Chr. d. X's Land. 1932, St. 130, between Maria Ø and Ella Ø, sigsbeetrawl, 25-8. 1932. CpZM. (Cat. Nos. P 37704–5).
1 specimen, std. l. 70 mm. Danish Pearyland Exped., Jørgen Brønlund Fjord, North Greenland, 31-7. 1947. CpZM. (Cat. No. P 371632).
1 specimen, std. l. 80 mm. Danish Pearyland Exped., Jørgen Brønlund Fjord, North Greenland, 14-8. 1947. CpZM. (Cat. No. P 371633).
4 specimens, (dried). Danish Pearyland. Exped., Jørgen Brønlund Fjord, North Greenland, July 1949. CpZM. (Cat. Nos. P 371635–8).
1 specimen, cranium. Mould Bay, Prince Patrick Isl., Franklin District, NWT, Canada, summer 1952. NMC. (Cat. No. 59–13-S).
1 specimen, 210 mm. Hole in Fog Bay, Ellef Ringnes Isl., Franklin District, NWT, Canada, 4-7. 1954. NMC. (Cat. No. 60–444-F).

2 specimens, std. 1. 265–325 mm. Hole in Fog Bay. NWT, Canada, 24-7. 1954. UO. (Cat. Nos. 3433 R–3434 R).
3 specimens, 46–72 mm. Hole in Fog Bay, Ellef Ringnes Isl., Franklin District, NWT, Canada, 5–8. 1954. NMC. (Cat. Nos. 60–444-B).
4 specimens, std. 1. 148–238 mm. Floating ice STATION CHARLIE (76°51'N, 171°01'W), 11–12. 1959. MCZ. (Cat. No. 40709).
30 specimens, std. 1. 122–238 mm. Floating ice STATION CHARLIE (77°12'N, 168°12'W), 21-12. 1959. MCZ. (Cat. No. 40709).
1 specimen, std. 1. 78 mm. Eureka Sound, NWT, Canada, 8-5. 1961. NMC. (Cat. No. 62–320). (Specimen found in medusa).
1 specimen, std. 1. 275 mm. Byam Martin Channel, east of Melville Isl., NWT, Canada, 15-7. 1962. NMC. (Cat. No. 64–41).

In 1874 PETERS described a new arctic cod, *Gadus glacialis*. It was caught near Sabine Ø, off the coast of East Greenland during the second German North Polar Expedition in 1869–70.

JENSEN (1948) described a new genus and species, *Phocaegadus megalops*. However, both ANDRIASHEV (1954) and WALTERS (1955) showed that *P. megalops* and *A. glacialis* are identical. We are of the same opinion, so consequently, *P. megalops* will be included in the *A. glacialis* material but in such a way that information on material of the former can be separated from that of the latter. Table 3 gives the variation of some of the meristic and morphometric characters of the *P. megalops* material not discussed by JENSEN (1948).

Below are listed the different genera and species to which the species *glacialis* PETERS, 1874 has been referred:

Gadus glacialis (PETERS 1874)
Gadus saida (JOHANSEN 1912)
Arctogadus glacialis (DRJAGIN 1932)
Phocaegadus megalops (JENSEN 1948)
Boreogadus saida (JENSEN 1948)
Arctogadus pearyi (SVETOVIDOV 1948)

See further comments on the above papers on p. 27.

Table 3 shows the results of the measurements from the material in the Zoological Museum, Copenhagen. It includes the material treated by JENSEN (1948) and a few specimens collected by PALLE JOHNSEN in north-east Greenland in 1949. Table 2 gives the results of the measurements of the rest of the material, i.e. *A. glacialis* exclusive of *P. megalops*. PETERS (1874) gave the total length to 120 mm, but a reexamination of the holotype of *P. glacialis* revealed that the standard length is 130 mm.

WALTERS (1961) mentioned that 35 specimens of *A. glacialis* were taken from two positions during the drift of "Station Charlie" (table 2 columns 2–4). Our examination of the 35 individuals showed that 30

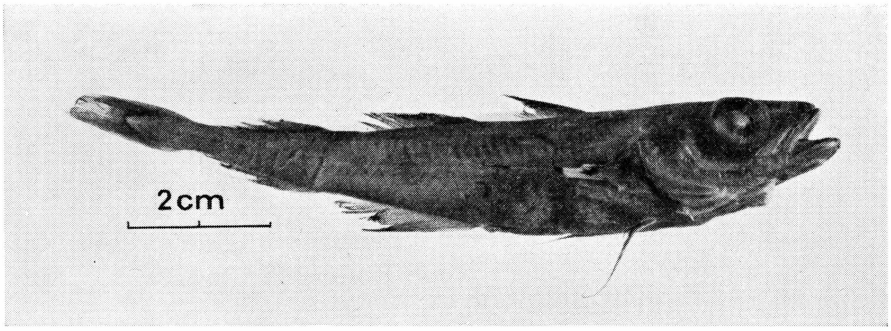

Fig. 1. Holotype of *A. glacialis* (PETERS, 1874). Std. 1. 130 mm.

were definitely *A. glacialis* and one specimen belonged to *A. borisovi* (table 5 column 6). The remaining four individuals all lack the teeth on the palatines, one of the most important generic characters of *Arctogadus*. However, as shown in table 2 columns 3 and 4 all the meristic

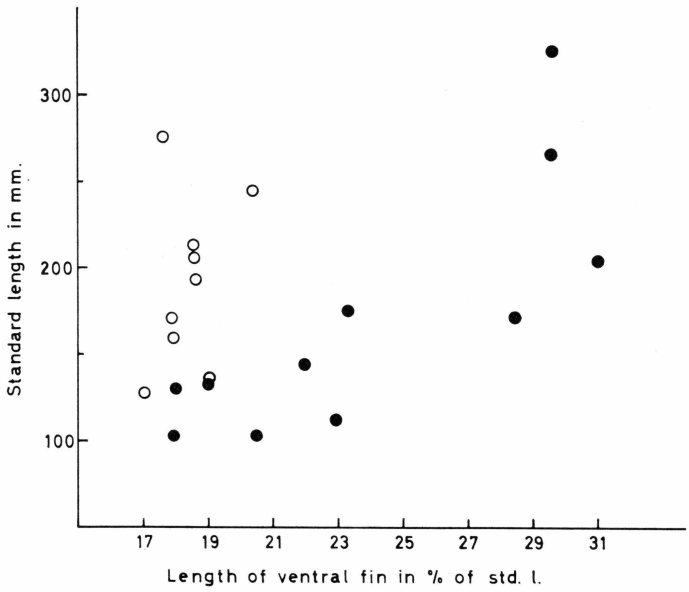

Fig. 2. Sexual dimorphism of the ventral fin length of *A. glacialis*. ○ (♀); ● (♂).

and morphometric characters agree with those of *A. glacialis*. Furthermore, all four have imbricated scales, another character which separates *Arctogadus* and *Boreogadus*. Among the rest of the "Station Charlie" material some few specimens only have teeth on one of the palatine bones and other specimens have but few teeth on each palatine bone.

Table 2. *Arctogadus glacialis*

	Holotype ZMB	"Station Charlie" MCZ 40 709			NMC 60–444–B 3 specimens	NMC 60–444–F	NMC 64–41	NMC 58–87	NMC 62–320	UO 3433 R 3434 R 2 specimens
		76°51′ N 171°01′ W 4 specimens	77°12′ N 168°12′ W + palatine teeth 26 specimens	77°12′ N 168°12′ W ÷ palatine teeth 4 specimens						
Meristic characters										
Standard length	130	148–238	122–238	129–204	46–72	210	275	176	78	265–325
D_1	12	11–13	11-12(16)[10	12–13	12	13	12	12	–	12
D_2	18	17–19	17–20 [10	20	17–20	19	17	17	–	19
D_3	22	23–24	20–24 [10	20–24	20–22	21	22	22	–	20–22
A_1	20	20–23	18–23 [10	21–24	20–21 [2	21	20	18	–	21–22
A_2	21	21–24	20–24 [10	21–23	19–21	21	20	22	–	21–22
P	21	20–21	19–20 [10	19–21	18–20	20	20	21	20	19
V	6	6	6 [10	6	6	6	6	6	6	6
Gill rakers on ant.arch.	30	30–33	27–34 [10	27–33	28–29	30	29	33	29	32
Branchiostegal rays	7	7	7 [6	7	7	7	7	7	–	7
Vertebrae (÷ urostyle)	61	58–60	–	56–58	–	–	–	–	–	–
Scales in lat. line	140–150	–	–	–	–	–	–	–	–	–
Sex	♂	–	–	–	–	♀	♀	♀	–	2 ♂
Morphometric characters in % of std. length										
Head	26.0	28.5–31.0	26.5–31.5[10	29.0–30.0	25.0–26.5	29.0	26.5	29.0	29.0	28.5
Snout	8.5	8.9–10.5	9.0–11.0[10	9.0–9.7	7.7–8.5	9.1	9.1	8.6	9.0	8.7–9.2
Postorbital	11.0	11.5–12.0	10.0–12.0[10	11.0–12.0	8.5–10.0	11.0	10.5	11.0	10.5	11.0–12.0
Horizontal diam. of orbit	8.5	8.3–9.3	8.0–10.0[26	8.2–9.1	8.4–8.7	8.8	8.6	8.1	9.3	8.1–8.5
Fleshy interorbital width	5.4	5.5–6.3	4.4–6.8 [26	5.3–6.4	5.0–6.0	5.7	4.9	5.6	5.8	5.3–6.1
Upper jaw	11.0	11.0–13.5	11.5–14.0[10	12.0–12.5	9.8–11.0	12.5	12.0	12.0	11.5	13.0
Lower jaw	15.0	15.5–17.0	15.0–17.0[10	16.0–16.5	13.5–14.5	15.0	14.5	15.5	15.5	16.0–16.5
Preanal	52	49.5–57	45.0–52 [10	47.0–54	43.0–46.0	52	52	53	52	53–56
Predorsal	31.5	35.0–39.5	34.5–39.0[10	34.0–37.5	32.0–33.5	33.0	34.5	34.0	34.5	34.5
Preventral	28.5	25.5–27.0	23.0–29.0[10	25.5–27.0	23.0–23.5	28.5	23.0	27.0	26.5	31.5
Base of D_1	11.0	10.0–13.5	8.9–12.5[10	8.5–11.0	7.5–9.0	11.5	11.0	11.5	–	9.9–11.5
„ „ D_2	17.5	14.5–18.5	15.5–19.0[10	15.5–20.0	11.0–13.5[2	16.5	18.5	16.5	–	18.5–19.0
„ „ D_3	16.5	15.5–16.5	14.0–18.0[10	14.5–15.0	14.0–18.0	16.5	16.0	17.0	–	13.5–15.5
„ „ A_1	18.5	18.0–20.0	17.0–20.5[10	16.0–21.0	17.5–20.0	19.5	16.5	18.0	–	19.0–19.5
„ „ A_2	17.5	14.5–16.5	14.5–17.5[10	14.0–16.0	16.0–19.0	16.0	16.0	16.0	–	14.5–16.0
Ventral fin length ♂	18.0	–	–	–	–	–	–	–	–	29.5
Ventral fin length ♀	–	–	–	–	–	18.5	17.5	–	–	–
Pectoral fin length	–	–	19.0–23.0[26	–	15.0 [1	22.0	21.0	17.0	14.0	20.5–22.0

Table 3. *Phocaegadus megalops.*

	Holotype P 37631	604 605 2 specimens	P 37626	P 37632–633; 635–637; 639–641 P 371586 9 specimens	P 37693	P 37694–698 5 specimens	P 37700	P 37704	P 37678–680 3 specimens	P 371633
Meristic characters										
Standard length	204	245–250	109	127–242 [9	132	103–148 [2	121	77	104–144 [3	80
D_1	11	11	11	10–13 [8	11	11–12 [4	13	12	10–11 [3	–
D_2	15	16–17	18	15–18 [8	19	18–19 [4	16	18	16–20 [3	–
D_3	20	21	22	20–22 [8	21	21–22 [4	22	22	20–21 [3	–
A_1	18	18–19	20	18–21 [8	21	19–20 [4	20	18	18–21 [3	–
A_2	21	20–21	21	20–23 [8	20	19–21 [4	23	21	21 [3	–
P	19	20 [1	–	19 [4	–	–	–	–	–	–
V	6	6 [1	–	6 [3	–	–	–	–	–	–
Gill rakers on ant.arch	28	29–30	29	27–29 [7	32	29–33 [5	29	33	30–32 [3	–
Vertebrae (÷ urostyle)	58	–	59	57–59 [5	60	60–61 [4		–	59–60 [3	–
Scales in lat. line	140	–	–	–	–	–	–	–	–	–
Pyloric coeca	29	40 [1	36	33–34 [3	44	32–42 [4	–	–	36–49 [3	–
Sex	♀	♂ + ♀	♂	♂ 2 + ♀ 6	♂	2 ♂ + 2 ♀	♂	–	2 ♀ + 1 ♂	–
Morphometric characters in % of std.length										
Head	30.0	badly	29.5	27.0–31.5 [9	27.5	27.5–28.0 [2	28.0	27.5	27.0–29.5 [3	26.0
Snout	8.6	damaged	8.4	8.0–9.0 [9	8.3	7.9–8.4 [2	7.0	8.1	8.1–8.7 [3	8.1
Postorbital	12.5		11.5	10.0–12.5 [9	10.5	9.7–10.0 [2	10.5	10.5	9.8–11.5 [3	10.5
Horizontal diam. of orbit	8.8		10.0	8.2–10.0 [9	9.2	9.5–9.6 [2	9.4	8.0	9.0–11.0 [3	8.5
Fleshy interorbital width	5.1		5.4	5.1–6.5 [7	4.9	5.3–5.5 [2	5.6	–	4.5–5.4 [3	5.1
Upper jaw	12.0		13.5	11.5–13.0 [9	12.0	11.5 [2	12.5	11.0	11.5 [3	10.5
Lower jaw	16.0		16.5	15.0–16.5 [9	15.5	15.5–16.0 [2	16.0	15.0	15.5–16.0 [3	14.0
Preanal	50		52	47.0–56 [9	49.0	48.0–48.5 [2	52	48.0	49.5–52 [3	47.0
Predorsal	35.0		34.0	33.0–35.5 [9	33.5	33.0–33.5 [2	34.0	33.0	33.0–35.0 [3	36.0
Preventral	25.5		29.0	25.0–29.0 [9	24.0	24.0–26.5 [2	30.0	26.0	25.0–27.0 [3	26.0
Base of D_1	10.5		9.7	8.3–12.5 [9	10.5	11.0–11.5 [2	11.0	11.5	9.7–11.5 [3	–
„ „ D_2	17.0		17.0	16.0–19.0 [9	18.0	16.5–17.5 [2	15.5	15.5	17.5 [3	–
„ „ D_3	15.5		17.0	14.5–18.5 [9	16.0	16.0–17.0 [2	15.0	17.5	15.0–17.0 [3	–
„ „ A_1	17.0		18.0	18.0–20.5 [9	19.5	18.5–19.5 [2	16.5	19.0	19.0–20.0 [3	–
„ „ A_2	15.5		17.0	14.5–16.5 [9	15.5	14.5–17.5 [2	14.5	16.0	15.5–16.5 [3	–
Ventral fin length ♂	–		23.0	23.5–31.0 [2	19.0	20.5 [1	28.5	–	22.0 [1	–
Ventral fin length ♀	18.5		–	17.0–20.5 [6	–	–	–	–	18.0–19.0 [2	–
Pectoral fin length	–		18.0	18.0–20.5 [6	20.0	19.0 [1	20.5	–	17.0–19.0 [3	14.0

Table 4. *Total variation of Phocaegadus megalops and Arctogadus glacialis.*

	Phocaegadus megalops	*Arctogadus glacialis*	*Phocaegadus megalops + Arctogadus glacialis*
Meristic characters			
Standard length	77–250 [26	46–325 [44	46–325 [70
D_1	10(11.5)13 [22	11(11.5)13(16) [27	10(11.5)13(16) [49
D_2	15(17.5)20 [22	17(18.5)20 [26	15(18.0)20 [48
D_3	20(21.0)22 [22	20(22.0)24 [27	20(21.5)24 [49
A_1 fin rays	18(19.5)21 [22	18(21.0)24 [26	18(20.0)24 [48
A_2	19(21.5)23 [22	19(21.5)24 [27	19(21.5)24 [49
P	19(19.0)20 [6	18(20.0)21 [28	18(20.0)21 [34
V	6(6.0)6 [4	6(6.0)6 [28	6(6.0)6 [32
Gill rakers on ant. arch.	28(30.0)33 [22	27(30.0)34 [28	27(30.0)34 [50
Branchiostegal rays	–	7(7.0)7 [20	7(7.0)7 [20
Vertebrae (÷ urostyle)	59(59.0)60 [15	56(59.0)61 [7	56(59.0)61 [22
Scales in lat. line	–	140–150 [1	140–150 [1
Pyloric coeca	29(37.5)49 [13	–	29(37.5)49 [13
Morphometric characters in % of std. length			
Head	26.0(28.5)31.5 [20	25.0(28.5)31.5 [28	25.0(28.5)31.5 [48
Snout	7.0(8.4)9.0 [20	7.7(9.3)11.0 [28	7.0(8.9)11.0 [48
Postorbital	9.7(11.0)12.5 [20	8.5(11.0)12.0 [28	8.5(11.0)12.5 [48
Horizontal diam. of orbit	8.0(9.3)11.0 [20	8.0(8.8)10.0 [44	8.0(9.0)11.0 [64
Fleshy interorbital width	4.5(5.4)6.5 [17	4.4(5.7)6.8 [44	4.4(5.6)6.8 [61
Upper jaw	10.5(12.0)13.5 [20	9.8(12.0)14.0 [28	9.8(12.0)14.0 [48
Lower jaw	14.0(16.0)16.5 [20	13.5(15.5)17.0 [28	14.0(15.5)17.0 [48
Preanal	47.0(50.0)56 [20	43.0(49.5)56 [28	43.0(49.5)56 [48
Predorsal	32.0(34.0)35.5 [20	31.5(35.0)39.5 [28	31.5(34.5)39.5 [48
Preventral	24.0(26.5)30.0 [20	23.0(26.5)31.5 [28	23.0(26.5)31.5 [48
Base of D_1	8.3(10.5)12.5 [19	7.5(10.5)13.5 [27	7.5(10.5)13.5 [46
„ „ D_2	15.5(17.0)19.0 [19	11.0(17.0)20.0 [26	11.0(17.0)20.0 [45
„ „ D_3	14.5(16.0)18.5 [19	14.0(16.0)18.0 [27	14.0(16.0)18.0 [46
„ „ A_1	16.5(19.0)20.5 [19	16.0(18.5)21.0 [27	16.0(18.5)21.0 [46
„ „ A_2	14.5(15.5)17.5 [19	14.5(16.0)19.0 [27	14.5(16.0)19.0 [46
Ventral fin length ♂	19.0(23.0)31.0 [7	18.0(27.5)29.5 [3	18.0(24.5)31.0 [10
Ventral fin length ♀	17.0(18.5)20.5 [9	17.5(18.0)18.5 [2	17.0(18.5)20.5 [11
Pectoral fin length	14.0(19.0)21.5 [18	15.0(20.5)23.0 [33	14.0(19.5)21.5 [51

This means that it is possible to find all transitions between fully toothed palatines and edentate palatines.—One of the specimens from "Station Charlie" had 16 rays in the anterior dorsal fin while the rest of the material had 10–13 rays.

Table 4 shows the minimum, mean, and maximum values of the meristic and morphometric characters of *Phocaegadus megalops*, *Arctogadus glacialis* (s. str.), and of *A. glacialis* (s. lat.). The information given in tables 2 and 3 shows that *P. megalops* definitely is a synonym of *A. glacialis*.

The most important specific characters of *A. glacialis* are mentioned in the key (p. 5).

Fig. 2. shows that the length of the ventral fins depends on the sex, being longest in the male. (JOHANSEN (1912 p. 666) was aware of this sexual dimorphism). In addition fig. 2 indicates that the longer the specimens the more pronounced are the differences in the ventral fin length, suggesting that the growth of this fin is allometric. No other characters show a significant allometric growth except for the relative length of the pectoral fins which may increase with the growth.

Biology

Not many observations have been made on the biology of *A. glacialis*. Except for one specimen caught near a river mouth, all the material reported upon in this paper was taken in salt water, in contrast to *A. borisovi* which often is caught in brackish water. In agreement with the lack of a barbel, *A. glacialis* occurred pelagically in all cases possible to check. These observations were mainly made from floating ice stations (ANDRIASHEV (1957) and WALTERS (1961)). WALTERS mentions that on one day about 1000 specimens of *A. glacialis* were found in the "Hydro-hole" and in the "Shot-hole". The position of the "Station Charlie" was 77°11′ N 167°43′ E and the depth was 540 m.—According to JOHANSEN (1912) specimens of the present species were found around seal-holes on the ice, apparently brought up by seals, as some of the specimens had marks of teeth of *Phoca foetida*.

WALTERS (1961) found that no females caught from "Station Charlie" had ripe ovaries and no specimens were observed in the same area in the preceding summer. Therefore, he presumed that *A. glacialis* undertakes a midwinter feeding migration (all stomachs examined were full of small crustaceans) across the shallow waters of the Chukchi Rise (north west of Point Barrow, Alaska).

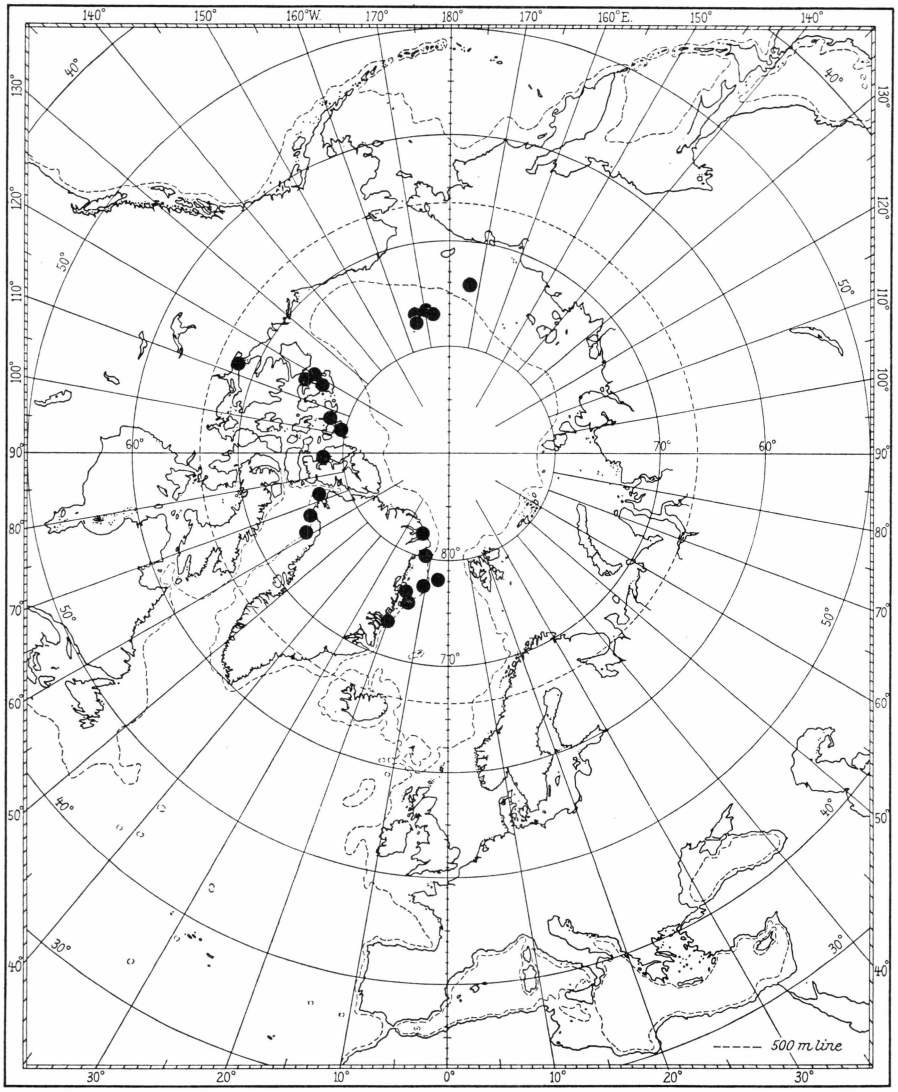

Fig. 3. Distribution of *A. glacialis*.

Distribution

The geographical distribution of *A. glacialis* is limited to the western part of the North Polar basin (fig. 3).

ARCTOGADUS BORISOVI DRJAGIN, 1932 (s. lat.)

Boreogadus pearyi NICHOLS and MAXWELL, 1933.

The treatment of *A. borisovi* (s. lat.) will be divided into three parts: 1. *A. borisovi* (s. str.). 2. *A. pearyi*. 3. The two specimens from South West Greenland.

Biology

A. borisovi (s. str.) is known to occur both in salt water and in fresh water at river mouths. According to ANDRIASHEV (1954) it lives near the coasts in salt water, and "goes for short visits into estuaries". The presence of one specimen of *A. borisovi* in the collections obtained by seismic blasts from a floating ice station (WALTERS 1961), indicates that this species might also occur pelagically. The depth at the station was 540 metres, but the efficient fishing depth apparently much less. MCALLISTER sent information on three specimens (table 6 columns 1–3) caught in Cambridge Bay, Victoria Island, N.W.T., Canada in 1961, but because of a very brief survey no ecological data were collected. However, in 1964 J. G. HUNTER returned to this locality and has most kindly sent the following information: *A. borisovi* was readily taken by handline, longline, and gill net. It was most often found at depths between 17 and 40 metres, not actually on, but closely associated with the bottom. The bottom temperatures varied between ÷ 0.18° and 1.38° C. with corresponding salinities of 28.87 ‰ and 29.23 ‰. The echo-sounder traces showed small, dense schools close to the bottom. RASS (1948) assumes that spawing most probably takes place in the summer in the warm, coastal waters. ANDRIASHEV (1954) mentions that fry with a length of 26–41 mm were caught on October 1st during bottom trawling in the East Siberian Sea. Remnants of Amphipoda were found in stomachs of young specimens from Tiksi Bay. POPOV (1933 p. 160) published a drawing of a juvenile specimen.

Nothing is known of the biology of *A. pearyi* except that the type-material was taken in arctic waters (Northern Greenland).

The two specimens from South West Greenland form an exception as the temperature of the water masses in which they were caught was approx. 3.4° C. Also many of the common faunal-elements from this locality must be characterized as boreal (see HORSTED (in HORSTED and SMIDT 1956) and further comments on p. 26).

The presence of a barbel fits well with the little that is known of the biology of *A. borisovi* (s. str.) and of the two South West Greenland specimens, as, with one exception, all individuals known have been found close to the bottom or in river mouths.

Distribution

See fig. 5.—This species may also occur off Boothia. According to Ross (1835 pp. 1–1i), "Specimens of *Gadus callarias* were caught along the shores of the inlet to the west of the peninsula of Boothia". Judging from information given by Ross, especially concerning the fin ray formulae and the presence of a well developed barbel (forming about 4 %

Table 5.
A. borisovi (s. lat.).

	A. borisovi (s. str.)							*A. pearyi*		*A. borisovi* (s. str.) + *A. pearyi*	SW.Greenland specimens	
	Holotype ZIL	Type mat. 6 specimens ZIL	No. 26490 ZIL	P 371601 CpZM	NMC 58–87 NMC ♀	40709 MCZ ♀	Inst. Fish. UBC ♂	Holotype 9699 AMNH	20450 AMNH	[4]) 22 specimens	P 371611 CpZM ♂	P 371612 CpZM ♀
Meristic characters												
Standard length	502	408–502	167	152	197	148	306	213	188	148–502	285	360
D_1	13	11–12	12	12	12	13	10	12	13	10(12)13 [9	13	13
D_2	18	16–20	19	18	16	16	18	20	20	16(18)20 [9	17	20
D_3	22	19–21	23	21	21	21	23	22	20	19(21)23 [9	22	23
A_1	21	19–21	20	21	20	22	24	23	21	19(21)24 [9	21	21
A_2	20	20–21	21	22	20	20	23	22	19	19(21)23 [9	22	22
P	19	16–21	21	20	20	21	19	19	18	16(19)21 [9	21	20
V	6	6	6	6	6	6	6	6	6	6	6	6
Gill rakers on ant. arch.	–	32–34	33	31	34	31	32	ca. 34	34	31(33)34 [12	32	35
Branchiostegal rays	7	7	7	7	7	7	7	7	6	6(7) [9	7	8
Pyloric coeca	–	–	–	34	–	–	–	–	–	–	32	40
Vertebrae[1]	57	–	–	59	58	–	–	–	–	–	60	61
Scales in lat. line	–	ca. 150[2]	ca. 150	–	–	–	162	ca. 155	–	–	ca. 140	140–150
Morphometric characters in % of std. length												
Head	28.5	26.0–28.5	27.5	28.5	29.0	28.5	29.0	29.5	31.5	26.0(28.5)31.5 [12	27.0	26.0
Snout	10.5	8.9–10.5	8.4	8.9	9.1	8.1	–	8.9	9.6	8.1(9.2)11.0 [11	8.3	8.9
Postorbital	12.5	11.5–12.5	12.0	12.0	12.0	11.0	–	–	–	11.0(12.0)12.5 [9	12.5	11.0
Horizontal diam. of orbit	–	–	8.0	7.5	7.6	8.5	–	–	–	6.2(7.3)8.5 [7	6.7	6.5
Diameter of eye	5.9	5.2–5.9	–	–	–	–	8.2	8.9	9.3	–	–	–
Fleshy interorbital width	6.6	5.5–6.6	5.9	6.3	5.7	5.7	5.9	6.6	6.7	5.1(6.1)7.0 [12	6.7	5.6
Bony interorbital width	–	–	–	4.6	4.2	4.7	–	4.3	4.6	3.9(4.4)4.7 [14	5.1	4.3
Upper jaw	–	–	11.5	12.0	13.0	12.0	–	–	–	11.5(12.0)13.0 [4	13.0	11.0
Lower jaw	16.5	14.5–16.5	15.0	15.5	16.0	15.5	–	–	–	14.5(15.5)16.5 [6	15.0	15.0
Preanal	55	51–56	47.5	50	51	48.5	52	53	54	47.5(52)56 [12	55	56
Predorsal	38.0	35.5–38.0	32.5	32.5	34.5	33.5	–	32.0	37.0	32.0(35.0)38.0 [11	32.5	33.0
Preventral	24.0	24.0–26.5	26.5	27.5	27.5	26.5	–	–	–	24.0(26.0)27.5 [9	26.5	26.5
Base of D_1	10.0	9.9–11.0	13.0	12.0	10.5	12.0	–	–	–	9.9(11.0)13.0 [9	12.5	11.5
„ „ D_2	18.0	16.5–20.5	19.0	18.0	16.5	15.5	–	–	–	15.5(17.5)20.5 [9	17.5	19.5
„ „ D_3	14.0	14.0–15.5	18.5	17.5	17.5	15.5	–	–	–	14.0(16.0)18.5 [9	16.0	14.5
„ „ A_1	18.5	16.0–19.5	18.5	18.0	19.0	20.0	–	–	–	16.0(18.5)20.0 [9	17.5	19.5
„ „ A_2	14.5	13.5–16.0	18.0	18.0	16.0	15.0	–	–	–	13.5(15.5)18.0 [9	16.5	14.0
Ventral fin length	15.5	–	20.0	19.0	17.5	17.0	27.0	25.5	27.5	♀16.0(17.0)17.5 [6 ♂19.5(22.0)27.0 [6	20.5	15.0
Pectoral fin length	–	–	18.0	20.0	19.0	19.0	–	22.5	22.5	17.0(19.0)22.5 [15	20.0	18.5
Barbel length	4.2	2.5–4.2[3]	4.4	3.7	2.5	3.6	2.2	4.6	3.1	2.2(3.6)4.9 [11	3.9	0

[1]) When counting the vertebrae the urostyle was excluded. [2]) Only one specimen (No. 23922). [3]) Only two specimens, viz. the longest (std. l. 502 mm with a barbel 21 mm long) and the shortest (std. l. 408 mm with a barbel 10 mm long). [4]) The 22 specimens include columns 2–8 of table 5 and colums 1–9 of table 6. The numbers in parenthesis ( ) indicate the average value of the character in question. The numbers in bracket [indicate number of specimens examined.

of the standard length), these specimens most probably belong to *Arctogadus*. Owing to the long barbel they may furthermore, be referred to *A. borisovi*.

1. *Arctogadus borisovi* Drjagin, 1932 (s. str.)

Material examined:

1 paratype, std. l. 457 mm. Near mouth of Kolyma river, 1928. ZIL. (Cat. No. 23922).

1 specimen, std. l. 152 mm. Russian Polar Exped, 1903. Svetovidov det. CpZM. (Cat. No. P 371601).

1 specimen, std. l. 167 mm. Laptev Sea near mouth of Yana river, 1912. ZIL. (Cat. No. 26490).

1 specimen, std. l. 197 mm. Port Epworth, Coronation Gulf, NWT, Canada, 1916. NMC. (Cat. No. 58–87).

1 specimen, std. l. 148 mm. Floating ice Station Charlie (77°12′ N, 168°12′ W), 1959. MCZ. (Cat. No. 40709).

A radiograph of the holotype of *A. borisovi*, std. l. 502 mm.

Besides the above specimens measurements were sent us concerning the following individuals hitherto not published upon:

6 specimens, std. l. 204 mm (Tiksi Bay, Lena river mouth), 149, 154, 158, and 160 mm (74° N, 128°20′ E), and 151 mm (near Kolyma river mouth). ZIL (Measured by A. P. Andriashev).

1 specimen, std. l. 306 mm. 78°47′ N, 103°32′ W, 1960. Inst. of Fisheries, UBC (Measured by D. E. McAllister).

3 specimens, std. l. 259–379 mm. Cambridge Bay, Victoria Isl., NWT, Canada, 1961. NMC. (Cat. Nos. NMC 64–329 and NMC 64–18). (Measured by D. E. McAllister).

Table 5 column 2 also includes the characters of the holotype. The reason why some of the meristic characters in column 1 do not agree with those of column 2 might be that the reexamination of the holotype was based on a radiograph, a method which often gives more correct information of the number of fin rays. Column 2 derives from Drjagin (1932), although with a minor modification, (he expressed some characters in percentage of the length of the head and others in percentage of the total length). In the present paper all Drjagin's percentages are converted to percentage of the standard length, thereby facilitating comparisons.

The specimens from columns 7, 8, and 9 have not been examined by us, but countings and measurements were sent by McAllister (column 7) and Rosen (columns 8 and 9).

The characters of the paratype (No. 23922) generally fit well with the variation of the type-material shown in column 2. One of the few disagreements was found in the "Diameter of the eye", which Drjagin gave as 5.2–5.9 % of the standard length while we found the "Horizontal

diameter of the orbit" to be 6.3%. This indicates that DRJAGIN did not measure the "orbit" (see below).

In table 5 the characters of the specimens examined are shown in separate columns, making it possible to compare the characters of the particular individuals. There are separate lines for "horizontal diameter of orbit" and "diameter of eye" as in some cases the method used when

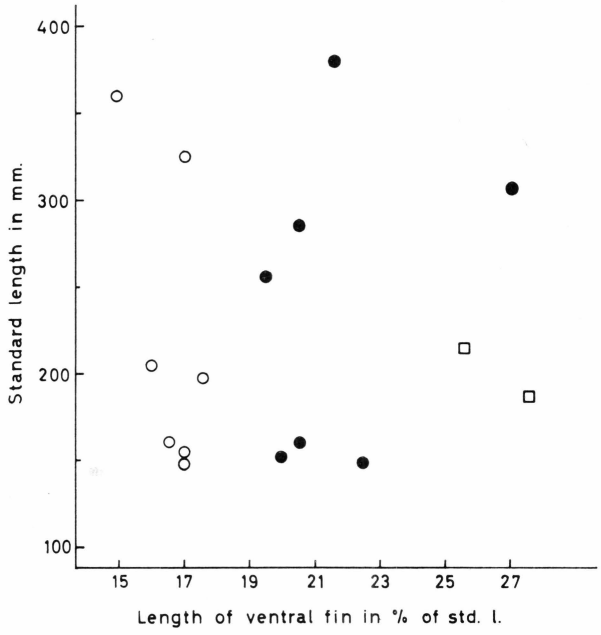

Fig. 4. Sexual dimorphism of the ventral fin length of *A. borisovi* (s. lat.). ○ (♀); ● (♂); □ (*A. pearyi*), not determined to sex.

measuring the diameter was not specified. The importance of indicating whether either the fleshy or the bony interorbital width was measured is clearly demonstrated by column 4, which shows the different results obtained by using these two ways of measuring.

The number of specimens of *A. borisovi* examined (15) is too small to show anything definite about possible allometric growth. However, when considering the characters of *A. borisovi* (s. lat.) an indication of allometric growth is found in "Horizontal diameter of orbit" and in "Preanal length".

From fig. 4 it is evident that the "Length of the ventral fins" shows sexual dimorphism, varying in the females (7 specimens) from 15.0–17.5% of the standard length, and in the males (7 specimens) from 19.5–27.0%. The material used in fig. 4 comprises all the specimens from tables 5 and 6 identified to sex. In addition, the type-material of

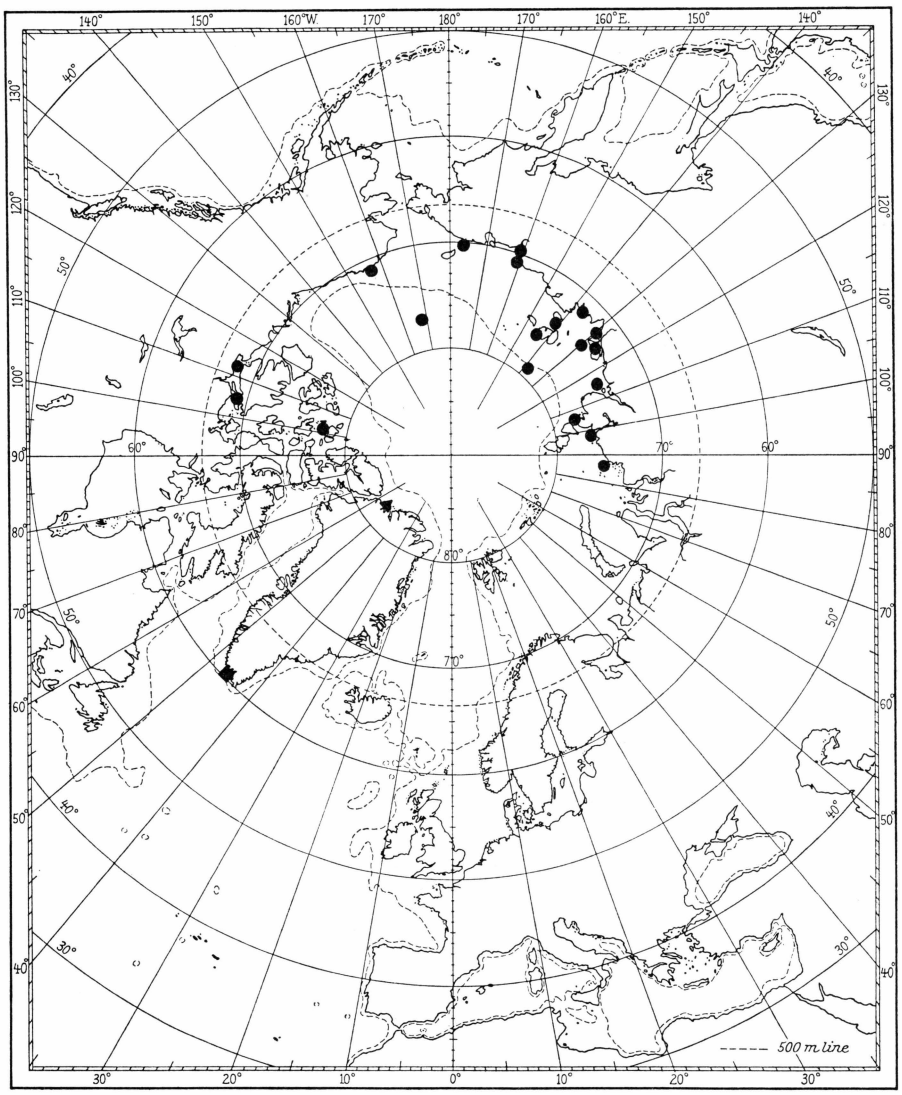

Fig. 5. Distribution of *A. borisovi* (s. str.) (●); *A. pearyi* (▲); South West Greenland specimens (■).

A. pearyi has also been included, indicating that the two specimens are most probably males.

Since only few specimens have been available for examination, and most of these have been in a rather bad condition, no thorough description of the species will be given. Descriptions are found in Drjagin (1932), Popov (1933), Svetovidov (1948), and Andriashev (1954).

According to Svetovidov (1948) this species is so common that there is even the possibility of a future industry based on this species together

with *Boreogadus saida*. Despite its commonness, we have been unable to find a description of *A. borisovi* in which it is possible to see the characters of single individuals or the variation in standard length and the number of specimens examined. For instance SVETOVIDOV (1948) did not clearly state the size of his material or the length of his specimens, but judging from the meristic characters he apparently examined specimens in addition to DRJAGIN's material from 1932.

Affinities

See the notes under the treatment of *A. pearyi* (p. 22).

Distribution

From Cape Sterlegov (Kara Sea) eastwards to arctic Canada (fig. 5).

Table 6. *Characters of specimens of A. borisovi (s. str.) not seen by the present authors* (cf. p. 17):

(The meristic characters are given in percentages of the standard length).

	NMC 64-329	NMC 64-18	NMC 64-18	Zool. Inst. Leningrad					
Sex	♂	♀	♂	♀	♀	♂	♀	♂	♂
Standard length	259	324	379	204	160	158	154	149	151
Total number of gill rakers	34	34	34	–	–	–	–	–	–
Horizontal diameter of orbit	6.6	7.1	6.2	–	–	–	–	–	–
Fleshy interorbital	7.0	6.7	5.1	–	–	–	–	–	–
Bony interorbital	4.2	4.6	3.9	4.4	4.6	4.6	4.4	4.5	4.1
Pectoral length	18.5	21.0	18.5	17.5	17.0	18.0	17.5	17.0	18.5
Ventral length	19.5	17.0	21.5	16.0	16.5	20.5	17.0	22.5	20.0
Barbel length	4.3	4.9	0.7[1])	–	–	–	–	–	–

[1]) Barbel broken.

2. *Arctogadus pearyi* (NICHOLS and MAXWELL, 1933).

The only specimens referred to *A. pearyi* are those mentioned by NICHOLS and MAXWELL (1933) and by WALTERS (1953 and 1955), a total of seven more or less well-preserved individuals. (SVETOVIDOV (1948) considers *pearyi* and *glacialis* identical, but uses the name *pearyi* even though it is 60 years younger than the name *glacialis*. Furthermore, *glacialis* has been in use in the entire period).

Material:

3 "types". Lincoln Hav, North Greenland, 1–9. 1905. AMNH. (Cat. Nos. 9699, 20450, and 12131).

1 skeleton from off Borden Isl., North-West Territories. USNM. (Cat. No. 27379).

*1 skull from the west side of Melville Isl., North-West Territories, June 1915. NMC. (Cat. No. 58–76-S).

*2 specimens from Port Epworth, Coronation Gulf, North-West Territories, 15-5. 1916. NMC. (Cat. Nos. 58–87).

The three specimens marked with an asterisk were examined by us and information on two specimens (Cat. Nos. 9699 and 20450 from AMNH) and on the skeleton (USNM Cat. No. 27379) was sent by DONN E. ROSEN and ROBERT H. GIBB, Jr. respectively.

Remarks

This species was originally referred to the genus *Boreogadus*. Apparently NICHOLS and MAXWELL did not recognize the genus *Arctogadus*, as from their description it appears that they were aware of the presence of teeth on the palatines and also that they had seen DRJAGIN's description of *Arctogadus* from 1932. SCHULTZ and WELANDER (1935) correctly placed *Boreogadus pearyi* in the genus *Arctogadus* because of the dentigerous palatines.

There is some confusion as to the number of specimens of *A. pearyi* actually known. NICHOLS and MAXWELL (1933) mention two specimens, but only the characters of the larger (AMNH No. 9699) were given. WALTERS (1955 p. 303) refers to "three types" all of which are said to be in the collections of AMNH. However, only the two mentioned by NICHOLS and MAXWELL are found here as the third specimen (AMNH No. 12131, caught together with the two other specimens) had disappeared. Various ichthyologists have divergent opinions as to the identity of this third specimen; ROSEN (*in lit.*) regards it as belonging to *Eleginus navaga* PALLAS, 1811. (As the identity of this third specimen appears to be uncertain, and as the specimen furthermore is lost, it will not be taken into consideration in the following). The smaller of the two specimens mentioned by NICHOLS and MAXWELL was not even assigned a museum number, but was placed in the same jar as the holotype under the name of the holotype. Later it was recatalogued as AMNH No. 20450. Table 5 columns 8 and 9 shows without doubt that the two specimens belong to the same species.

Unfortunately, we have not been able to examine the *A. pearyi* type-material. The meristic and morphometric characters in table 5 are based upon information sent us by DONN E. ROSEN. The condition of the two specimens is very bad. They are i.a. so greatly curled that radiographs could not give sufficient information. Furthermore, the specimens are so fragile that it was too risky to pack and mail them. ROSEN observed that the standard length of the holotype is 213 mm and not 225 mm as stated by NICHOLS and MAXWELL. The latter length was obtained by measuring to the end of the scale extension on the caudal fin.

Besides the two or three specimens in AMNH, WALTERS (1953 and 1955) mentions some additional specimens belonging to *A. pearyi* (see p. 20). By courtesy of D. E. MCALLISTER we have been allowed to borrow all the *Arctogadus* material from the National Museum of Canada, including the three specimens mentioned in the list of material.

One of the two specimens (table 5 column 5) from Coronation Gulf (std. l. 197 mm, ♀) is a typical *borisovi*, with a well-developed barbel and a large number of gill rakers. The other specimen (std. l. 176 mm, ♀) is more difficult to identify as it combines characters of both *borisovi* and *glacialis*. However, the lack of a barbel and the relatively large eye both speak in favour of *A. glacialis* (table 2 column 8). The third specimen examined by us only consists of the head and gill region. This is impossible to identify with any degree of certainty as none of the anterior gill arches has all the rakers intact, and there is no trace of a barbel. Absence of the latter might be due to the skeletal-like condition. Only the toothed palatines certify that the specimen belongs to the genus *Arctogadus*.

Finally, the skeleton (USNM Cat. No. 27379) is in a very bad condition. According to R. H. GIBBS, JR. (*in lit.*) it is incomplete and twisted, without traces of a barbel. The standard length was estimated to be 250–300 mm. A note was attached the skeleton stating the number of gill rakers to be 28, but a recount was impossible. The teeth on the palatines show that it belongs to *Arctogadus*, but all the specific characters were so badly preserved that a species determination would be open to doubt. If the number of gill rakers is correct the skeleton most probably belongs to *A. glacialis*.

WALTERS (1953 and 1955) writes that *A. pearyi* is probably also found in Fury and Hecla Strait, North-West Territories. He finds that the fin ray count of the *Boreogadus saida* material from the "Fifth Thule Expedition" (PFAFF 1937) indicates the presence of specimens of *Arctogadus* sp. However, an examination of the said material (which is kept in the Zoological Museum, Copenhagen) shows that representatives of this genus are not present, as none of the specimens have teeth on the palatines or have imbricated scales.

The conclusion must be that all the *A. pearyi* material (except AMNH Cat. Nos. 9699 and 20450) belongs either to *A. borisovi*, *A. glacialis* or to *Arctogadus* sp. *indet.*

Affinities

a) One of the characters in which *A. pearyi* appears to differ from *A. borisovi* (s. str.) is in the "Interorbital width" (see table 5 and WALTERS (1955 table 15)). However, DRJAGIN (1932) did not state how he

measured the interorbital width, but judging from measurements made by us on a specimen of the type-material of *A. borisovi*, it seems probable that he measured the "Fleshy interorbital width". NICHOLS and MAXWELL (1933) found the "Interorbital width" of the holotype to form 6.6% of the standard length, while WALTERS (1965) found it to be 4.3%. From correspondance with DONN E. ROSEN it has appeared that the "Fleshy interorbital width" of the type-material of *A. pearyi* forms 6.6–6.7% of the standard length, while the "Bony interorbital width" only forms 4.3–4.6%. This information fully explains the difference between the original description and WALTERS' statement and also explains the difference between *pearyi* and *borisovi* (s. str.) regarding the "Interorbital width".

In some previous works (e.g. SVETOVIDOV 1948) the length of the paired fins was used when separating *pearyi* and *borisovi*, a character which is inclined to be doubtful as the tips of these fins often are broken. However, it is now shown (see table 6) that in *A. borisovi* the length of the ventral fins depends on the sex, being longest in the male. The sex of the type-material of *A. pearyi* is not determined, but the length of the ventral fins, forming 25.5 and 27.5% of the standard length, indicates that both specimens are males. The length of the ventral fins of some males of *A. borisovi* varies from 19.5 to 27.0% of the standard length (fig. 4). Consequently, the length of the ventrals is of no use as a key character.—Concerning the pectoral fin-length there is disagreement; this forms 22.5% of the standard length in *A. pearyi*, but only 17.0–21.0% in *A. borisovi*. However, as only the pectoral fins of very few specimens have been measured not too much attention should be paid to this minor difference. No sexual dimorphism was shown in the length of the pectoral fins.

Finally, the "Diameter of the eye" has been used as a specific character when separating *A. pearyi* and *borisovi*, but it is always rather difficult to compare measurements taken by different authors and especially in this case, as the "Diameter of the eye" can be measured in various ways (eyeball or orbit). In *A. pearyi* the diameter forms 8.9–9.3% of the standard length and in *A. borisovi* 5.2–8.5%. In DRJAGIN's type-material (6 specimens) the "Eye-diameter" forms 5.2–5.9% of the standard length. Measurements made by the present authors on one of DRJAGIN's specimens indicate that he actually measured the eye-ball, meaning that the lower end of the variation in *A. borisovi* (s. str.) can be eliminated (see p. 17). Allometric growth is not definately shown for this character, but the great variation can be explained by the above.

In table 15 WALTERS (1955 p. 303) characterizes the barbel of *A. pearyi* as "obsolete or exceeds pupil". The term "obsolete" refers to one specimen only (WALTERS *in lit.*), viz. to the specimen labelled

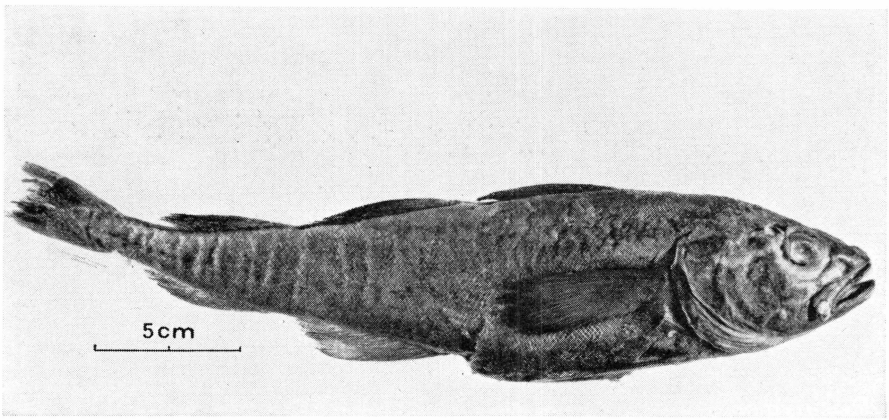

Fig. 6. *A. borisovi* from S–W Greenland. Std. 1. 285 mm. P 371611.

AMNH 12131 (see above). If this specimen belongs to *Eleginus navaga* the conclusion must be that all material of *A. pearyi* is provided with a well-developed barbel, like *A. borisovi* (s. str.).

b) A comparison between *A. pearyi* and *glacialis* (including *Phocaegadus megalops*) shows all the differences mentioned in the key (see p. 5), the "Interorbital width", the "Horizontal diameter of the eye", the "Number of gill rakers", and the "Presence or absence of a barbel". Yet, BERG (1933) and SVETOVIDOV (1948) regard *A. pearyi* and *glacialis* as synonyms, but on the other hand they only knew of one *glacialis*-specimen, the holotype.

c) The third possibility, to maintain *A. pearyi* as a separate species, must, on the basis of arguments on the previous pages, be out of the question. However, until a comparison between NICHOLS and MAXWELL's type-material and that of *A. borisovi* has been made nothing definite can be stated.

Distribution

Only known from the type-locality in Lincoln Hav, North Greenland (fig. 5).

3. *South West Greenland specimens.*

Material (2 specimens):

1 specimen, std. 1. 285 mm (♂). Niaqornaq Kangerdluarssuk (61°02′ N, 46°08′ W) near Narssaq, depth 405 m, shrimptrawl, bottom temp. 3.35° C, 20–2. 1954. CpZM. (Cat. No. P 371611).

1 specimen, std. 1. 360 mm (♀). Same locality, depth 410 m, clay and ooze, shrimptrawl, bottom temp. approx. 3.4° C, Nov. 1954–April 1955. CpZM. (Cat. No. P 371612).

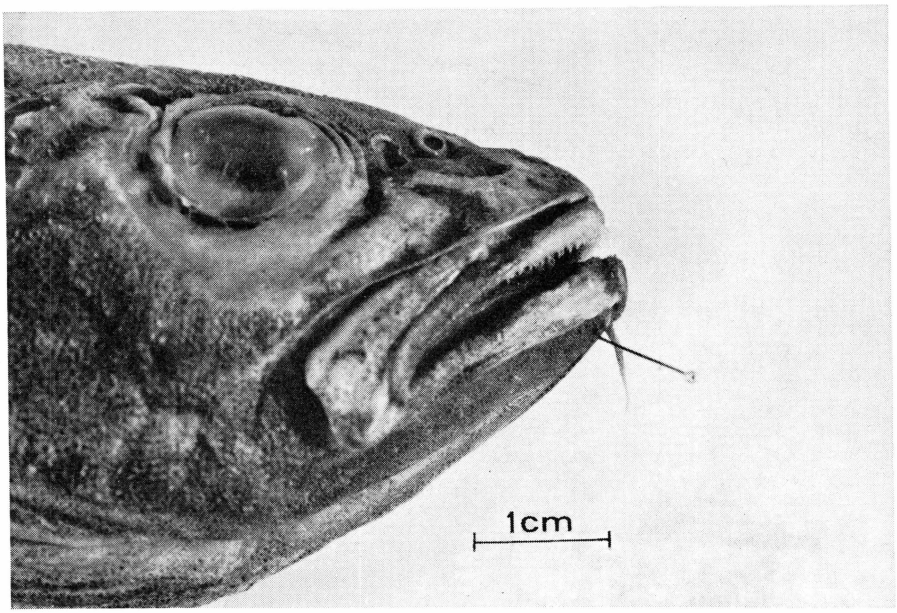

Fig. 7. *A. borisovi.* Head of the specimen from fig. 6 with the barbel raised.

Both specimens were produced by "Grønlands Fiskeriundersøgelser", Charlottenlund, and later transferred to the Zoological Museum, Copenhagen.

Table 5 columns 11 and 12 show the characters of the two specimens in question. They only differ from each other in two characters. "Length of ventral fin" and "Length of barbel". The former is caused by the different sex of the two specimens, but it is more difficult to find an explanation for the latter disagreement. As there is no trace of a barbel having been lost by accident, the specimen might thus be considered an abberation concerning the barbel-character. However, except for the absence of the barbel it is a typical *A. borisovi*-specimen, (cf. "Gill rakers", "Bony orbit", and "Interorbital width"). A comparison of the present two specimens with column 10 (table 5) shows that in all cases the characters of the South West Greenland specimens fall within the variation of those of *A. borisovi* (s. str.) and *pearyi.*

The cycloid, imbricated scales are of almost the same size as those found in *A. glacialis* and in the other *A. borisovi* specimens with 140–150 scales in the lateral line.

Biology

Temperature conditions in the locality where the present two specimens were caught are rather curious (see Horsted p. 68 (in Horsted

and SMIDT 1956)). Between the surface and a depth of approx. 300 m the water masses are influenced by yearly fluctuations. However, below about 300 m depth the temperatures are almost constant throughout the year. HORSTED explains that these conditions are due to an inflow of the Irminger Current, a branch of the Gulf Stream.

A bottom temperature of approx. 3.4° C is exceptionally high for *A. borisovi*, as other localities from which this species is known have usually shown temperatures below zero. It would therefore seem more likely that the two specimens were caught pelagically, between the surface and 300 m depth. However, the chances of catching fish while hauling the gear up or setting it are very small, especially as the otterboards of the shrimptrawl close almost completely over the opening during ascent.

Among other fishes caught at this locality are *Molva byrkelange* (WALBAUM, 1788) and *Glyptocephalus cynoglossus* (LINNÉ, 1758), both species with a boreal distribution.

The locality is shown on fig. 5.

RÉSUMÉ OF OPINIONS

1. JOHANSEN (1912) listed four specimens of *A. glacialis* as *Boreogadus saida.*
2. DRJAGIN (1932) described *A. borisovi* n. gen. et sp. and referred *Gadus glacialis* to the genus *Arctogadus.*
3. JENSEN (1948) described *Phocaegadus megalops.* He did not recognize *Arctogadus glacialis*, but arranged *Gadus glacialis* in the list of synonyms of *Boreogadus saida* without further comments.
4. SVETOVIDOV (1948) considered *Arctogadus* as consisting of two species, *borisovi* and *pearyi*, and used the length of the paired fins and the eye-diameter as key-characters. Strangely enough, he considers *glacialis* a synonym of *pearyi* despite the fact that *glacialis* was described 60 years prior to *pearyi.*
5. BERG (1949) recognized two species, *glacialis* and *borisovi*, and considered *pearyi* a synonym of *glacialis.*
6. ANDRIASHEV (1954 and 1957) recognized three species, differing between *borisovi* and *pearyi* owing to the eye-diameter and considered the absence of a barbel as typical for *glacialis.*
7. WALTERS (1955) treated the three *Arctogadus* species separately, but indicated that they might prove to belong to a single species, which according to the rule of priority should have the name *A. glacialis.*
8. NIELSEN and JENSEN in the present paper consider the genus *Arctogadus* to contain two species, *A. glacialis* (including *Phocaegadus megalops*) and *A. borisovi* (including *A. pearyi*).

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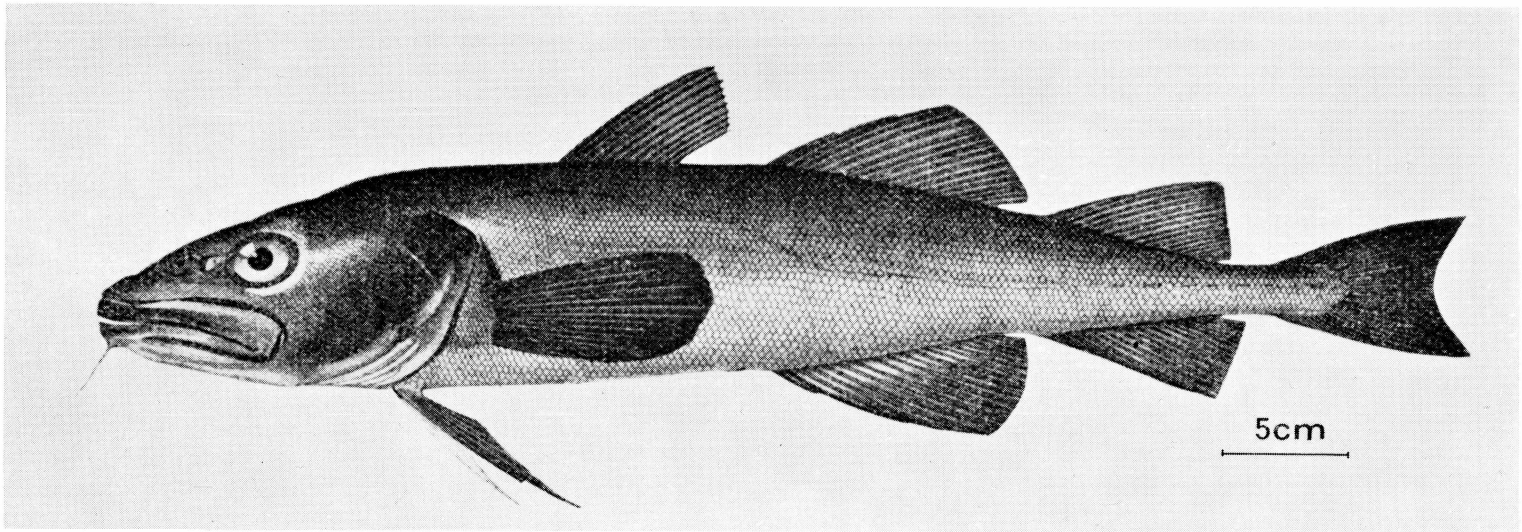

Fig. A. Holotype of *Arctogadus borisovi* Drjagin, 1932. Std. 1. 502 mm. (From Drjagin (1932)).

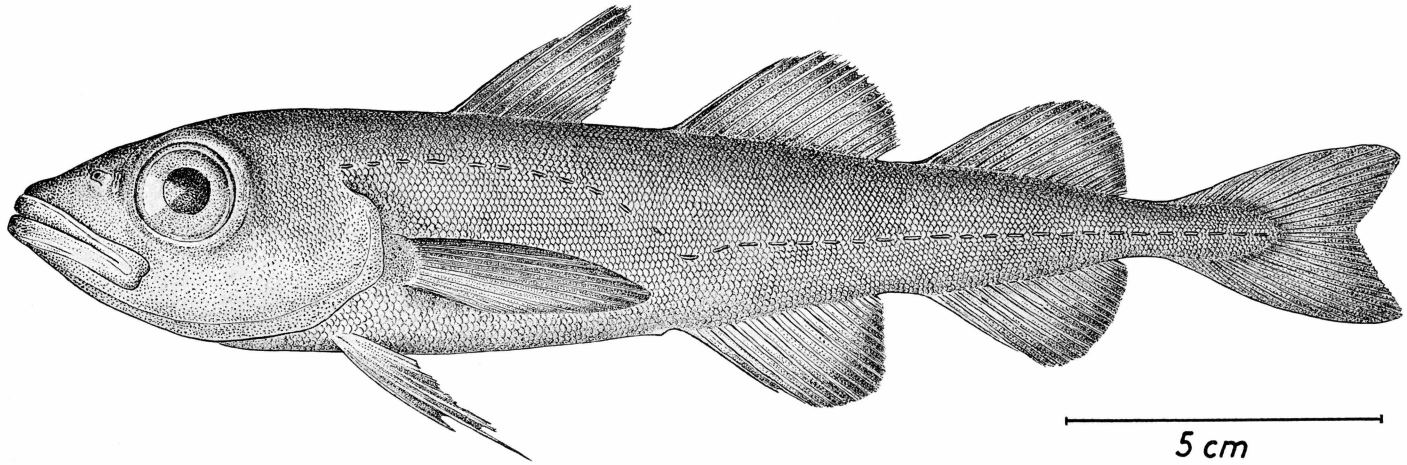

Fig. B. Holotype of *Phocaegadus megalops* Jensen, 1948. Std. 1. 204 mm. (From Jensen (1948)).