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Aspects of the life history of the Atlantic poacher, *Leptagonus decagonus*, in Svalbard waters

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Abstract: The aim of the study is to describe aspects of the life history of the Atlantic poacher (*Leptagonus decagonus*) obtained during early October 2010 and late September 2011 from the Hinlopen Strait, located between Nordaustlandet and the Spitsbergen Archipelago. Length was measured for 142 individuals, and 82 out of these were weighed, sexed and the age in years determined. The sex distribution in the population was 45% females and 55% males. Gut content examination revealed the domination of the mesopelagic and hyper-benthic calanoid *Bradyidius similis* that was recorded in 87% of the stomachs analysed. Overall there was a significant difference in size (length and weight) between the sexes, and a difference in length and weight at age between the sexes. There was no difference in age distribution between the sexes, but there was a larger age range within the male population than in the female population. The sexual dimorphism in size is likely linked to different reproductive strategies. This study represents the first data on the life history of the Atlantic poacher in Svalbard waters.

Key words: Arctic, Agonidae, Atlantic poacher, size and age distribution, length-weight relationship, diet.

Introduction

The Atlantic poacher *Leptagonus decagonus* (Bloch *et* Schneider, 1801), family Agonidae, is commonly encountered in Arctic waters (Ponomarenko 1995; Mecklenburg *et al.* 2011; Wienerroither *et al.* 2011). It has a circumpolar distribution, occurring both in the North Pacific and Arctic Ocean (Mecklenburg *et al.* 2011), from northern Nova Scotia and Grand Bank to Newfoundland and the Greenland waters, in the western parts of the North Atlantic (Fahay 2007).

The Atlantic poacher is usually found at depths from 100 to 350 m (Andriyashev 1954; Dolgov 1994), but has been found in deeper waters in Svalbard, Iceland

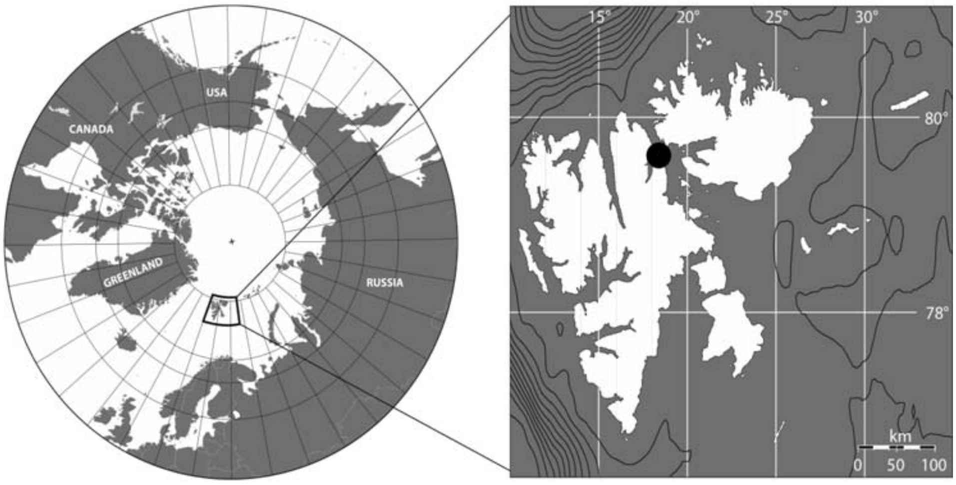

Fig. 1. The study area: Hinlopen Strait (Svalbard).

and west Greenland, at 1475 m, 600 m and 930 m, respectively (Pethon 2005). The Atlantic poacher is frequently encountered in soft bottom habitats with an admixture of stones (Andriyashev 1954). The diet of the Atlantic poacher has not been studied in detail yet but previous studies have shown that it mainly feeds on pelagic crustaceans, bottom dwelling amphipods and Polychaeta (Andriyashev 1954). The spawning season is dependent on the geographic location and varies from May to July (Andriyashev 1954; Dolgov 1994; Pethon 2005).

The Atlantic poacher tolerates wide range of temperatures (+4.4 to -1.7°C), and has shown an affinity towards high salinity waters (Andriyashev 1954; Byrkjedal and Høines 2007). But despite its wide temperature tolerance, its general distribution appears to be linked with temperatures ranging between 0.2 and 3.5°C (Dolgov 1994; Byrkjedal and Høines 2007). Hence the distribution of the Atlantic poacher in the south-western Barents Sea is mainly north of the Polar Front (Fossheim and Nilssen 2002; Byrkjedal and Høines 2007). In the south-western Barents Sea the Atlantic poacher is a commonly recorded species (Ponomarenko 1995; Byrkjedal and Høines 2007). During the 2000 summer survey of the Institute of Marine Research it occurred at 40.1% of all stations sampled (Byrkjedal and Høines 2007). This common occurrence of the species suggests that the Atlantic poacher is an important part of the Arctic system. It is therefore necessary to obtain information on the life history and ecology of the Atlantic poacher in order to understand its role in the system.

Material and methods

Samples were obtained in the Hinlopen Strait on 3 October 2010 at 7938.86433 N, 1855.02782 E, and 20 September 2011 at 7937.90082 N, 1856.23096 E. They were sampled from the R/V *Helmer Hanssen* using a Camplen 1800 shrimp trawl (mesh size 10 mm) towed at ~3 knots for ~15 minutes at 157–323 m depth.

Measurements. — Caudal length measurement (CL, cm) was obtained from 142 specimens. 82 specimens were dissected: 40 specimens from 2010 and 42 specimens from 2011. The dissection of the fish took place on board R/V *Helmer Hanssen* right after the fish was sampled. Gutted weight (GW, 0.1 g) was measured after all internal organs were removed and sex was determined from the gonads. The age (years) was determined for 82 specimens by surface reading of otoliths in water under a LEICA MZG stereo-microscope. The interpretation of the annuli followed the "Manual on generalised age determination procedures for groundfish" (Committee of Age Reading Experts 2006). Thus, the core of the otolith was assumed to represent the first year of growth, and the outer-most part at the rim was assumed to be from the current year (calculated from January 1st to date of catch) and therefore not counted. The stomachs from the fish were put in 70% alcohol, and 30 stomachs were analysed in the lab at the University Centre in Svalbard. The prey items were taxonomically identified to the order level with the exception of *Bradyidius similis*, *Calanus* spp. and Ostracoda (class). The importance of each prey category is expressed as FOC (frequency of occurrence).

Data treatment. — Statistical analysis and figures were made in R (2.15.2 GUI 1.53 Leopard build 64-bit (6335)). The significance level of the statistical analyses was set to $p = 0.05$. No statistical difference was found between the samples from 2010 and 2011 and all data were therefore pooled for subsequent analysis. Length, weight and age between the sexes were tested by two-sample t-test.

To investigate the relationship between CL and GW a log linear regression model was used.

$$\log(GW) = \log(a) + b*\log(b)$$

where a is the intercept, b is the slope of the line.

Results

Diet. — The mesopelagic calanoid copepod *Bradyidius similis* (G.O. Sars, 1902) was the dominating prey category found in the stomachs of the Atlantic poacher (Fig. 2). *B. similis* was found in 87% of the 30 stomachs that were examined. When *B. similis* was not present, the gut content consisted of a mixture of other small crustaceans. *B. similis* was rarely recorded in the stomachs of other demersal fish species examined during the two cruises.

Sex, size and age distribution between the sexes. — The sexes were evenly distributed within the sample: 37 females and 45 males. Females were significantly longer (two-sample t-test: $p < 0.001$) and heavier (two-sample t-test: $p = 0.001$) than

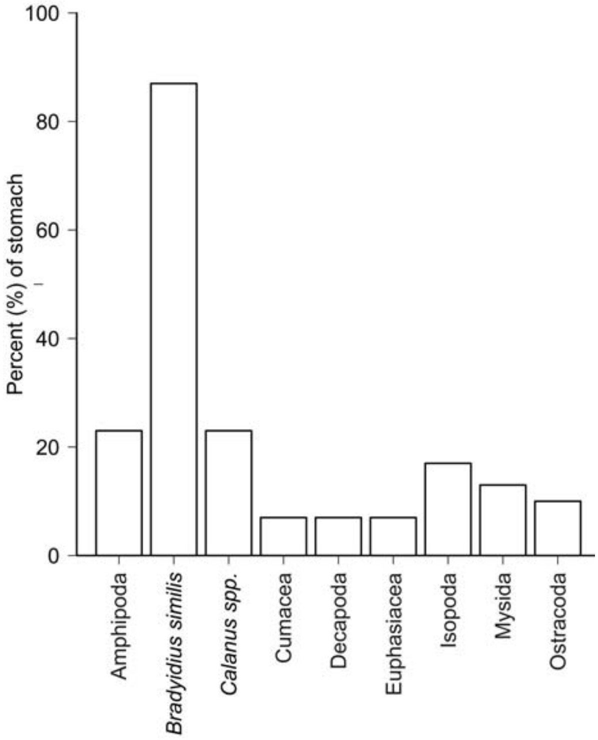

Fig. 2. Stomach content of 30 specimens of Atlantic poacher studied.

males. Females had a mean CL of 13.58 cm (range: 10.20–17.20 cm), and males had a mean CL of 12.22 cm (range: 8.10–15.2 cm) (Fig. 3a). Furthermore, females had a mean GW of 8.75 g (range: 4.0–20.35 g), while males had a mean GW of 6.34 g (range: 2.32–13.35 g) (Fig. 3b). There was no significant difference in age distribution between the sexes (two-sample t-test: $p = 0.28$). Mean age for females was 3.94 years (range: 2–7 years, NA = 1), and males had a mean age of 4.42 years (range: 1–14 years) (Fig. 3c, NA = 0).

Body condition (length-weight relationship). — The log linear regression analysis reveals that there is no statistically significant difference in the intercept or slope between females and males, thus there is no significant difference in condition between the sexes (Table 1, Fig. 4). The Atlantic poacher has a weak negative allometric growth ($b < 3$), *i.e.* the length increases relatively more than the weight as the fish gets larger. The R^2 value ($R^2 = 0.83$) shows that there is a linear relationship between CL and GW, and that the model fits well the data.

Size at age. — The data suggest that there was a difference in size at age. The females appear to be longer (Fig. 5a) and heavier (Fig. 5b) than the males at the same age; this was however not tested because the sample size was too small. The sexual dimorphism seen in size at age is likely to be linked to reproduction.

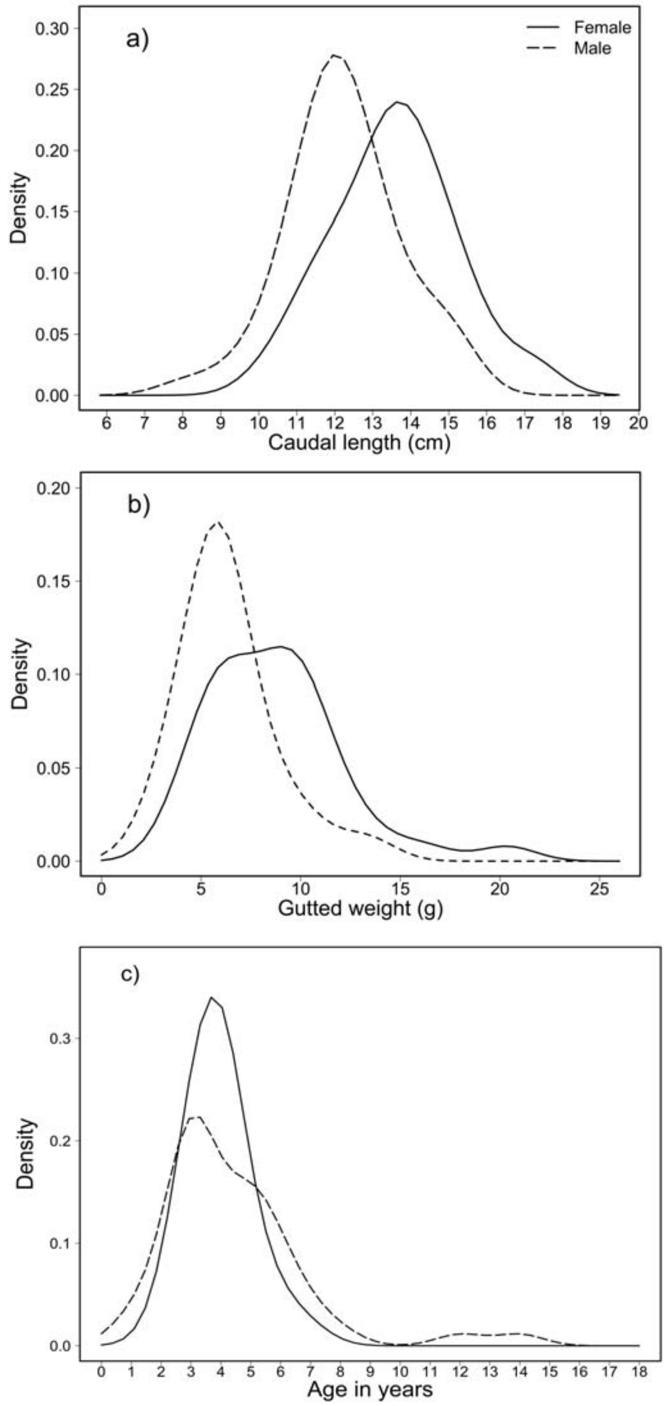

Fig. 3. Length (**a**), gutted weight (**b**) and age (**c**) distribution in 82 individuals of *Leptagonus decagonus* measured (37 females, 45 males).

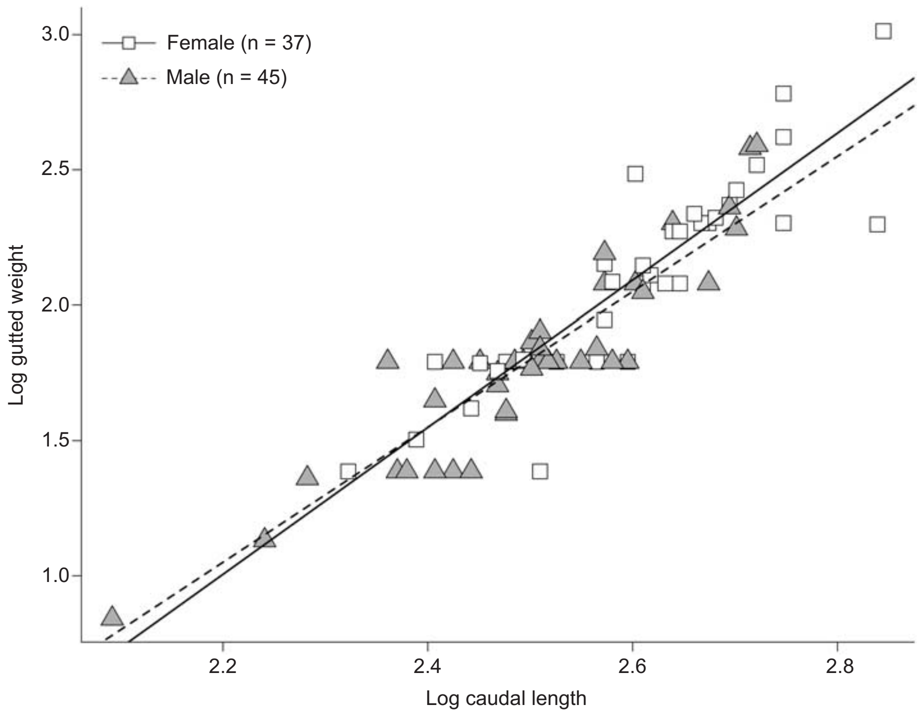

Fig. 4. Length/weight relationship in *Leptagonus decagonus* population studied (82 specimens).

Table 1

Output from the log-linear regression of the length-weight relationship between the sexes of the Atlantic poacher with weight as the dependent variable. Two outliers were removed from the female population and one from the male population. ANCOVA was used to test if there was any significant difference in the b values between the sexes.

Parameter	Female	Male
n	35	44
a (intercept)	-4.97	-4.45
b (slope)	2.72	2,50
t-test a		
t-test b	183.2	
Multiple R^2	76	
P	<0.001	
ANCOVA: p	0.417	

Discussion

A copepod, *Bradyidius similis*, dominated the diet of the Atlantic poacher, suggesting that it is a specific feeder. Previous studies have also found the diet of the Atlantic poacher to be dominated by pelagic copepods (Andriyashev 1954;

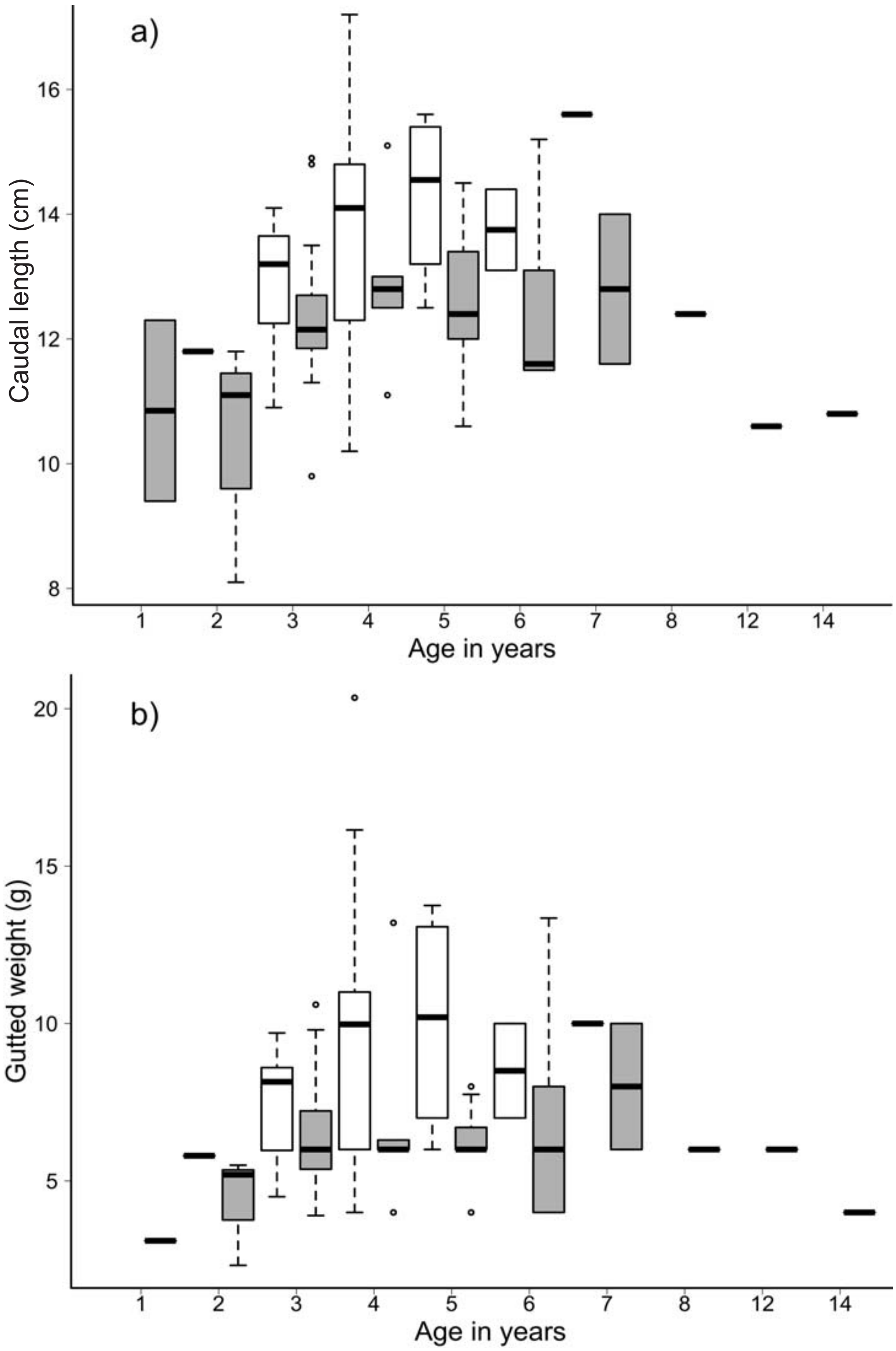

Fig. 5. Length (**a**) and weight (**b**) at age between the two sexes of *Leptagonus decagonus* (82 specimens: 37 females and 45 males).

Kallgren *et al*. 2014). However these studies found a greater diversity in the diet, with bottom dwelling amphipods, polychaetes, and shrimps to be important elements in the diet, and Dolgov (1994) found amphipods to be the most important prey group. The results from these previous studies may reflect that there are differences in the diet between different locations. The diet may also vary between seasons. Our specimens were collected at the same time of the year.

The females were longer, and heavier than the males; this indicates that the Atlantic poacher is sexually dimorphic in size. Glubokov and Orlov (2008) also found the females of two other Agonidae species to be longer and heavier than the males. Other characters such as the pelvic fins have been found to be different between the sexes of the Atlantic poacher (Kanayama 1990). This has also been found in other Agonidae species (Smith and Gillispie 1988), indicating a sexual dimorphism in morphology within this family. The longer pelvic fins of adult males probably have a signal function related to reproduction (Smith and Gillispie 1988). Also our results suggest that there is a difference in length and weight at the same age. The sexual dimorphism in size is likely linked to reproduction, females may need a larger size and body mass than males to tolerate energy allocation from growth to egg production, which is very energy demanding.

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References

ANDRIYASHEV A.P. 1954. Fishes of the Northern Seas of the U.S.S.R. *Zoological Institute of the U.S.S.R Academy of Sciences* 53: 459–462 (in Russian).

BYRKJEDAL I. and Høines Å. 2007. Distribution of demersal fish in the southwestern Barents Sea. *Polar Research* 26: 135–151.

COMMITTEE OF AGE READING EXPERTS – C.A.R.E. 2006. *Pacific Coast Groundfish Ageing Technicians. Manual on Generalized age Determination Procedures of Groundfish*. Pacific States Marine Fisheries Commission, Seattle, Washington: 1–52.

DOLGOV A.V. 1994. Some aspects of biology of non-target fish species in the Barents Sea. *International Council for the Exploration of the Sea* 1994/O: 12.

FAHAY M.P. 2007. *Early stages of fishes in the Western North Atlantic Ocean: Davis Strait, Southern Greenland and Flemish Cap to Cape Hatteras (Volume 2)*. Northwest Atlantic Fisheries Organization, Dartmouth, Nova Scotia: 982 pp.

FOSSHEIM M. and NILSSEN E. M. 2002. Identification of fish communities in the Barents Sea. Is there a faunal discontinuity across the Polar Front? *International Council for the Exploration of the Sea* CM L: 17.

KALLGREN E., PEDERSEN T. and NILSSEN E.M. 2014. Food resource partitioning between three sympatric fish species in Porsangerfjord, Norway. *Polar Biology*: 1–7.

GLUBOKOV A.I. and ORLOV A.M. 2008. Data on distribution and biology of poachers agonidae from the northwestern part of the Bering Sea. *Journal of Ichthyology* 48: 426–442.

KANAYAMA T. 1990. Taxonomy and phylogeny of the family Agonidae (Pisces: Scorpaeniformes). *Memoirs of the Faculty of Fisheries Hokkaido University* 38: 1–199.

MECKLENBURG C.W., MØLLER P.R. and STEINKE D. 2011. Biodiversity of arctic marine fishes: taxonomy and zoogeography. *Marine Biodiversity* 41: 109–140.

PETHON P. 1998. *Aschehougs Store Fiskebok*. H. Aschehoug & Co, Oslo: 344 pp.

PONOMARENKO V.P. 1995 On the frequency of occurrence and fecundity of some species of the families Agonidae, Cottuncuidae, Cottidae, Lumpenidae, Cyclopteridae, and Zoarcidae in the Barents Sea. *Journal of Ichthyology* 35: 245–247.

SMITH R.L. and GILLISPIE J.G. 1988. Notes on the biology of Bering Poacher, *Ocella dodecahedron* (Tilesius), and the Sturgeon Poacher, *Agonus acipenserinus* Tilesius in the Southeast Bering Sea. *Copeia* 2: 454–460.

WIENERROITHER R., JOHANNESEN E., DOLGOV A., BYRKJEDAL I., BJELLAND O, DREVETNYAK K., ERIKSEN KB., HØINES Å., LANGHELLE G., LANGØY H., PROKHOROVA T., PROZORKEVICH D. and WENNECK T. 2011. *Atlas of the Barents Sea Fishes*. Institute of Marine Research/Polar research Institute of Marine Fisheries and Oceanography, Joint Report Series 1-2011, Bergen: 274 pp.

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