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## SHORT NOTE

## *Lycodes adolfi* Nielsen and Fosså, 1993 (Teleostei: Zoarcidae) found in the Arctic Ocean

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**Abstract** Adolf's eelpout, *Lycodes adolfi*, was found at five bottom trawl stations in 2007–2009, on the slope towards the Sofia Deep north of Spitsbergen, at depths of 970–1,220 m and water temperatures below 0°C. Previously, the species has been known from cold and deep waters south of 74°N to both sides of Greenland and in the Norwegian Sea. The present material represents the first records from the Arctic Ocean and may indicate a wider arctic distribution of this species.

**Keywords** Eelpouts · Zoarcidae · *Lycodes adolfi* · Arctic Ocean · Svalbard · Distribution

### Introduction

Adolf's eelpout, *Lycodes adolfi* Nielsen and Fosså 1993, has so far been known from the waters between 68° and 74°N on the east and west side of Greenland including waters south of Iceland (Jørgensen et al. 2005; Jónsson and Pálsson 2006) and recently also recorded in the south-eastern and eastern part of the Norwegian Sea (Byrkjedal et al. 2009). The species is found in deep water, mostly below 800–900 m and in temperatures below 0°C (Nielsen and Fosså 1993; Møller and Jørgensen 2000; Byrkjedal et al. 2009).

Due to a more northerly retreat of the polar ice in later years, fisheries research has been carried out at higher

latitudes than previously. Bottom trawling at the slopes north of Svalbard has revealed the existence of this little studied species in the Arctic Ocean. We report these records and discuss the distribution of this eelpout in these northern waters.

### Materials and methods

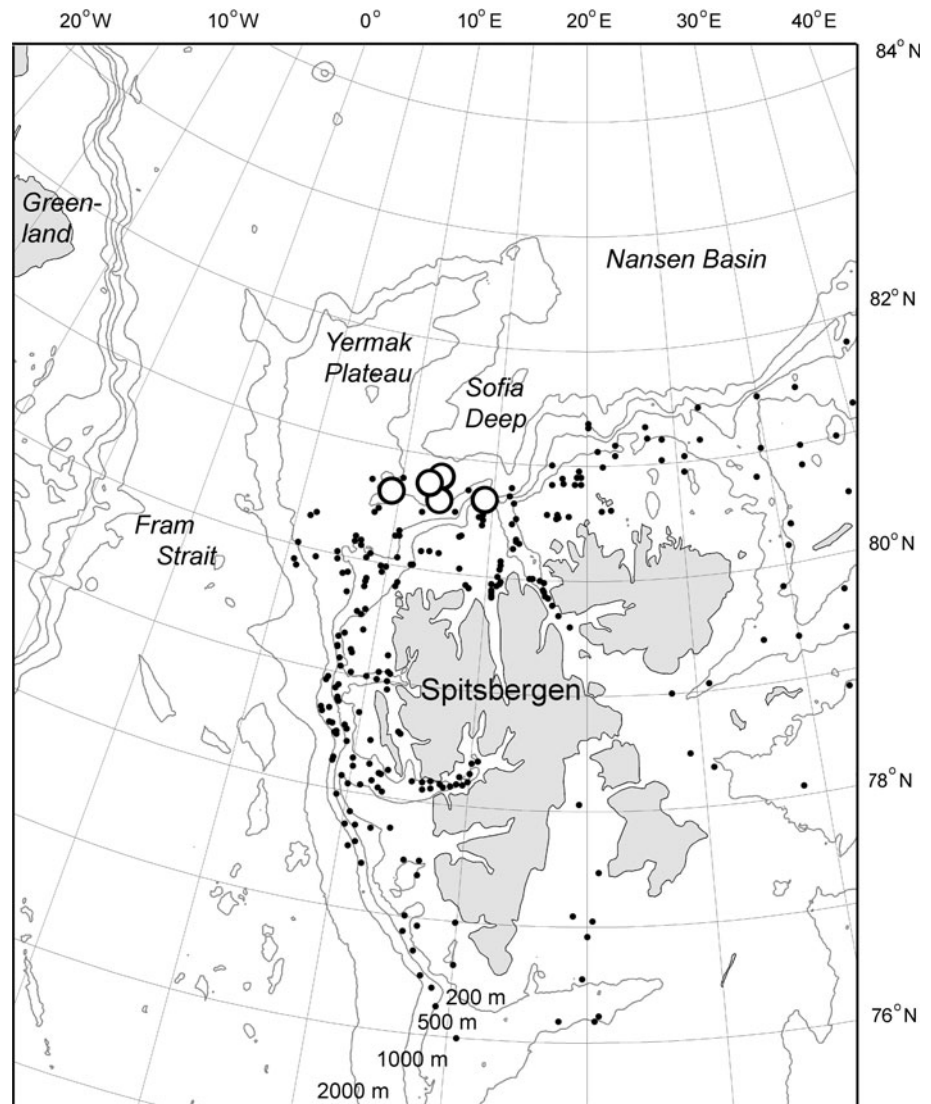
The cruises were conducted with the research vessels *Jan Mayen* in the periods 10–25 September 2007 and 2009, and 9 September–3 October 2008, comprising 250 valid bottom trawl hauls (Fig. 1). Of these, five stations were at depths of more than 800 m in 2007 and 2008, and four stations in 2009. A Campelen 1800 shrimp trawl with 40 m sweeps and a cod-end equipped with a 22 mm mesh size inner lining was used. The trawl carried a rockhopper ground gear (Engås and Godø 1989) and strapping was used to stabilize the opening of the trawl. Vaco trawl doors were employed (6 m<sup>2</sup>, 1,500 kg), and the trawl was equipped with Scanmar sensors that measured the distance between the doors, the trawl's vertical opening and contact with the bottom. The standard trawling time was 30 min at 3 knots. Temperature c. 10 m above the bottom was obtained from CTD measurements at 30 oceanographic stations in 2007, 48 in 2008 and 54 in 2009, scattered over the area fished. Temperatures from the CTD stations closest to the trawl stations and at similar bottom depth were used in the analysis.

The fresh material was frozen onboard. Thirty-three of the specimens were brought to Bergen Museum as permanent vouchers (ZMUB catalogue numbers 19632, 19771, 19839, 19841, 19909). When brought to the museum, smaller specimens (<ca 10 cm long) were preserved in 70% ethanol, while larger individuals were fixed in 4% formalin and then transferred to ethanol. Seven specimens were

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**Fig. 1** Circles indicating the five localities at which *L. adolfi* has been caught at the edge of the Arctic Ocean. Bottom trawl stations north of 76°N operated by the Ecosystem Surveys of the Institute of Marine Research, Bergen, in 2007, 2008 and 2009 are marked by dots



included in the reference collection of the Institute of Marine Research (HIFIRE catalogue numbers F5856, F5860). Species identification followed the criteria given by Nielsen and Fosså (1993), Byrkjedal et al. (2009): pre-anal length less than 45% of  $S_L$ , single lateral line, depth at anus less than 10% of  $S_L$ , pectoral fins with 17–18 rays and almost reaching anus, squamation restricted to hind part of the body, opercular tip pointed, less than 25 scale rows between dorsal and anal fins and no striped patterns. (Two specimens had 19 pectoral fin rays on one side and 18 on the other and one had 19 rays on both sides.)

## Results

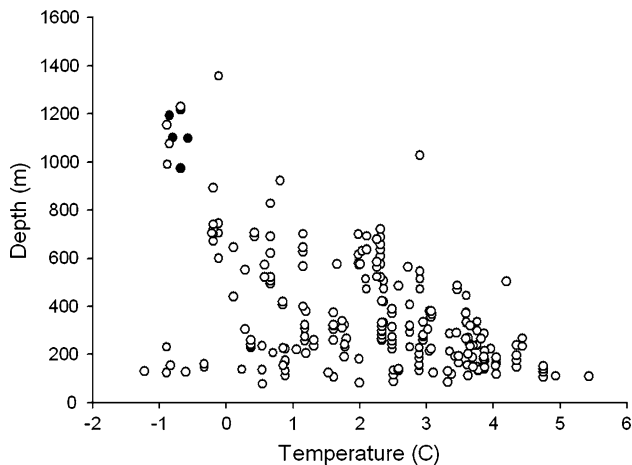
Altogether 44 individuals were caught at five trawl stations, all of which were on the slope on the eastern side of the Yermak Plateau, towards the Sofia Deep (Fig. 1). In 2007, 7 individuals were caught 14 September at 80°36'N–9°55'E

(gear depth 1,110–1,053 m, temperature  $-0.8^\circ\text{C}$ ) and 22 individuals 15 September at 80°39'N–12°26'E (gear depth 1,221–1,185 m, temperature  $-0.9^\circ\text{C}$ ). In 2008, 6 individuals were caught 12 September at 80°31'N–14°28'E (gear depth 973–970 m, temperature  $-0.7^\circ\text{C}$ ) and 4 individuals 13 September at 80°40'N–12°33'E (gear depth 1,220–1,200 m, temperature  $-0.7^\circ\text{C}$ ). The 5 individuals in 2009 were caught 17 September at 80°38'N–12°33'E (gear depth 1,068 m, temperature  $-0.6^\circ\text{C}$ ). None were caught at stations shallower than 970 m even in subzero temperatures (Fig. 2).

Standard lengths of individuals ( $n = 38$ ) in the present material ranged from 61.5 to 219.5 mm and averaged 127.7 mm ( $\pm 45.36$  SD,  $n = 38$ ).

## Discussion

The present records of *L. adolfi* in these waters at subzero temperatures and great depths confirm that this is a species



**Fig. 2** Occurrence of *L. adolfi* (black dots) in relation to depth and bottom temperature. Trawl stations with no catches of *L. adolfi* indicated with open circles

adapted to arctic conditions, and greatly extend the known distribution of this species, previously known only south of 74°N on both sides of Greenland and in the Norwegian Sea. The fact that it occurs east of the Yermak Plateau makes it probable that the distribution extends eastwards along the slope of the Nansen Basin, and judged from the temperature and depth conditions in the Arctic Ocean a wider distribution in this ocean might be expected. More data are, however, needed for this to be confirmed.

Apparently, low water temperatures are not sufficient for this species to occur. Depth below the photic zone seems also to be required. The species was lacking in trawl hauls shallower than 970 m, and it has not been reported from Russian fisheries cruises undertaken at less depth around Spitsbergen (Shevelev 2004), nor from waters north of the Polar Front in the well-studied and much shallower Barents Sea (Dolgov 2004, 2006; Byrkjedal and Høines 2007; Karamushko 2008). The characteristic appearance of this eelpout makes it unlikely to have been overlooked in the well-fished areas referred to above.

The numbers in the present catches indicate that it can be a relatively common species, a conclusion also reached by Jørgensen et al. (2005) for the Baffin Bay and by Møller et al. (2010) for Greenland. The largest specimens corresponded in

size to those found to be sexually mature in Greenland waters (Nielsen and Fosså 1993).

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