

Nomads of northern coasts: distribution of *Aporrhais pespelicani* (Gastropoda: Stromboidea) in the Barents Sea

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ABSTRACT. Gastropod *Aporrhais pespelicani* was recently recorded for the first time in several localities along the Murman Coast (SW Barents Sea). In all areas, only single specimens were collected with the exception of Kislaya Inlet where the dense population was found. We repeated field study in the Kislaya Inlet decade later after the first findings of the species. No living specimens were found at the place of the previous habitat of the population of *Aporrhais pespelicani*, however, two adult snails were collected in a remoted locality from the same waterbody. We hypothesize that distribution of *Aporrhais pespelicani* in the its northern edge of range fit to “core-satellite” metapopulation model, where Murman local populations representing “satellites” of the Norwegian “core”. There is no evident proof on the relation of recent records of *Aporrhais pespelicani* with range extension due to the climate change, as it was suggested before.

Странники северных берегов: распространение *Aporrhais pespelicani* (Gastropoda: Stromboidea) в Баренцевом море

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РЕЗЮМЕ. Брюхоногий моллюск *Aporrhais pespelicani* в сравнительно недавнее время был впервые обнаружен в нескольких местах у Мурманского берега (юго-западная часть Баренцева моря). Во всех местах находок были обнаружены только единичные экземпляры, за исключением губы Кислая, где было найдено плотное поселение этого вида. Мы повторили полевые исследования в губе Кислая спустя десятилетие после первого обнаружения там этих моллюсков. Ни одного живого экземпляра *Aporrhais pespelicani* не было обнаружено на месте их предшествующего поселения, однако два живых моллюска было поймано в другом местообитании в той же губе. Мы предполагаем, что распространение

Aporrhais pespelicani в Баренцевом море соответствует на его северном краю ареала гипотезе основных и сателлитных популяций, где мурманские локальные популяции являются сателлитными и пополняются за счёт основной норвежской. Нет чётких подтверждений того, что недавние находки *Aporrhais pespelicani* связаны с изменениями климата, как это предполагалось ранее.

Introduction

The gastropod mollusk *Aporrhais pespelicani* (Linnaeus, 1758) (“Pelican’s foot”) is distributed along the European coast of the eastern Atlantic. More recently, new data has been published on the findings of these molluscs, significantly expanding our knowledge about the species range. Firstly, *A. pespelicani* was found in the northwestern part of the Black Sea, a relatively well-studied water area in which this species was not previously observed [Snigirov *et al.*, 2013]. Secondly, mollusks were recorded off the Kola Peninsula (Barents Sea) in several places: in the Ura Inlet (Kislaya Bay and Nasha Bay) and the Dalne-Zelenetskaya Bay [Kantor *et al.*, 2008; Nekhaev, 2014] (Fig. 1). In all cases in the Barents Sea, except for the Kislaya Bay, only single individuals of *A. pespelicani* were found. In the Kislaya Bay, a population of the species with

a high density was localized in area of several ten of meters long and no mollusks were found in other parts of the bay. It should be noted here that the pelican's foot was known from the West Finmark, SW Barents Sea before 2000-x [Sars, 1878, Høisæter, 2009]. Recent records expand the known range of the species by about 400 km to the east (Fig. 1).

According to the authors of one of the studies, the finding of the population of *A. pespellicani* in the Barents Sea is undoubtedly associated with the expansion of its range due to climate change [Kantor *et al.*, 2008].

Our study aims to estimate the current population state of *Apporrhais pespellicani* in the Kislaya Inlet.

Materials and Methods

Study area

Kislaya Inlet is a secondary bay of the Ura Inlet located near the mouth of the Motovskiy Bay (Murmansk Coast, SW Barents Sea) (Fig 1). The inlet has a maximal length *ca.* 3.2 km and width *ca.* 1 km, its total area is about 1.1 km², maximal depth is 36 m. Kislaya Inlet is connected with Ura Inlet only by a very shallow and narrow strait (*ca.* 40–50 m width). In 1965 due to the building of Kislaya Guba Tidal Power Station in the strait, the water exchange between Kislaya Inlet and Ura Inlet became artificially regulated; it entails changing of environmental conditions in the Inlet, e.g. significant desalination of the water and decreasing of tide level [Semenov, 1988]. The most dramatic environmental effects were observed two times: in 1965-1968 and in 1981-1982, in both cases, the inflow of marine water in the Kislaya Inlet was significantly limited [Semenov, 1988, 1997]. Currently the community is at least partially recovered, and abundance of some invertebrates is similar to that of neighboring parts of the Ura Inlet [Semenov, 1997; Sennikov *et al.*, 2018].

Sampling site and field studies

The fieldwork was carried out in November 2018. During the present study we repeated the sampling in the place when the population of *A. pespellicani* was first found ("Station 1") at 69°22.09'N, 33°03.87'E – 69°21.855'N, 33°03.48'E (coordinates reported by Kantor *et al.* [2008] are incorrect and referred to a place outside from Kislaya Inlet in the mouth of Motovskiy Bay with depth about 150-200 m). The sampling site representing a shallow-water place with a sandy bottom and smooth slope (Fig. 2A). Area about several hundred of meters long in the depth range 5-15 m was studied by two SCUBA divers simultane-

ously. All shells of *Apporrhais pespellicani* and their fragments were collected from the bottom manually and then studied in the laboratory. For revealing of possible burrowed snails ten samples with bottom sediments were collected and then manually sorted in the laboratory.

Apart of the place of the first record, one more site in the Kislaya Inlet (69°22.50'N, 33°04.59' – 69°22.38'N, 33°04.715' – "Station 2") and single locality in the Ura Inlet outside the Kislaya Inlet (69°22.67'N, 33°04.613'E – 69°22.747'N, 33°04.688'E – "Station 3") were investigated by the same methods (Fig. 1).

Results

At the Station 1 living specimens of *Apporrhais pespellicani* were not found during the present studies. Only several empty shells and shell fragments were observed by divers (Fig. 2 B-C) and found in seven of ten samples. Two living specimens and a single empty shell were found in the same sample at Station 2 where the snails were not previously recorded. No living snails nor empty shells were found at station 3.

Discussion

Population density of *Apporrhais pespellicani* in the Kislaya Inlet was not estimated during the previous study [Kantor *et al.*, 2008]. The total number of the collected specimens was estimated as "several hundred" and snails were very easy to collect manually (S.M. Rusayev, unpublished observation). Hence, our results demonstrate extinction or at least severe decreasing of large relatively dense population of pelican's foot in the Kislaya Inlet.

Several conceptual metapopulation models were suggested to explain the distribution of invertebrates [Grimm *et al.*, 2003; Harrison, 1991]. The "core-satellite" model best fits our current evidence of pelican's foot known distribution in the northern part of its range, including the Barents Sea. The model implies presence of single large area where the species is constantly distributed ("a core populations") and numerous relatively small temporary patches of occurrence ("satellite populations") which are initially formed by migrants from the core population. The live cycle of satellite population can usually include stages of rapid population growth and subsequent decreasing or full local extinction [Schoener, Spiller, 1987].

Such pattern is demonstrated by population of *Apporrhais pespellicani* in the Kislaya Inlet. Several other confirmed records of pelican's foot along the Kola Peninsula are based on few specimens which probably can indicate presence of one or more satellite populations at the Murmansk Coast. Absence

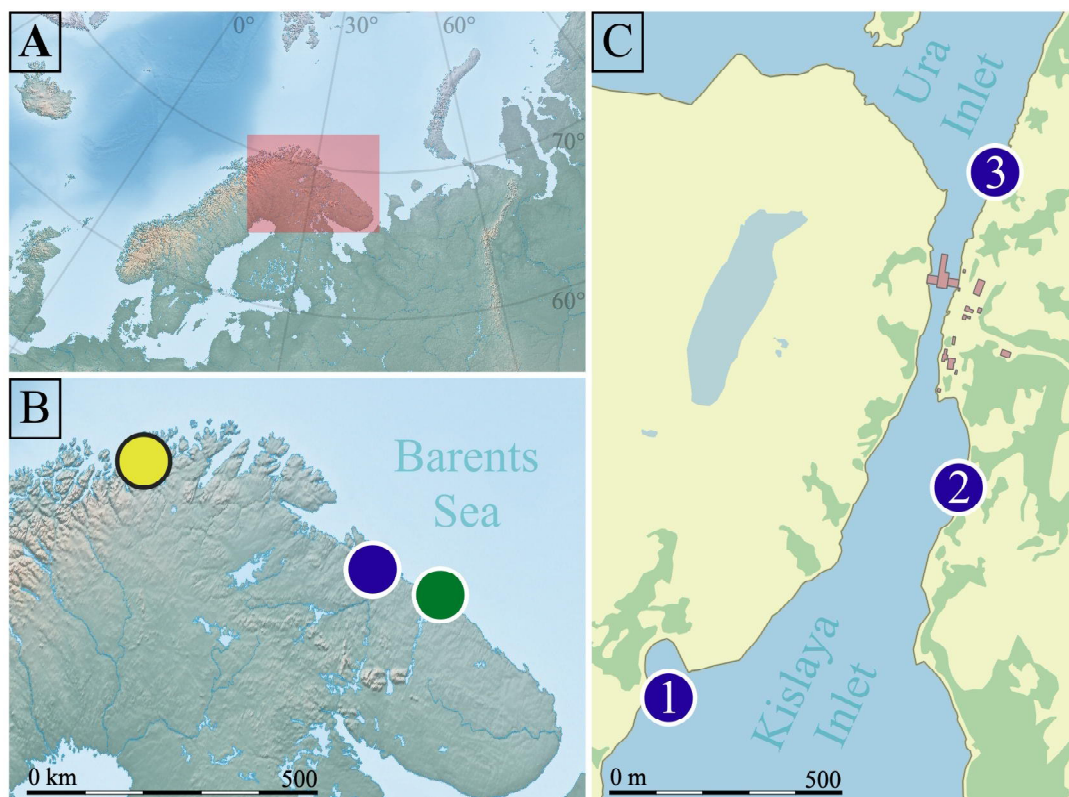


FIG. 1. Map of studied region. **A** – general position of the region; **B** – published records of *Aporrhais pespelicani* in the Barents Sea: Øxfjord (yellow circle), Ura Inlet (blue circle) and Dalne-Zelenetskaya Bay (green circle); **C** – position of sampling sites in the Kislaya and Ura inlets, station number indicated within the blue circles.

РИС. 1. Карта исследованного района. **A** – общее положение региона; **B** – опубликованные находки *Aporrhais pespelicani* в Баренцевом море: Оксфьорд (жёлтый круг), губа Ура (синий круг) и Дальне-Зеленетская губа (зелёный круг); **C** – расположение исследованных локаций в губах Кислая и Ура, номера станции указаны внутри кругов.

of living juvenile specimens of *Aporrhais pespelicani* and their shells in the Barents Sea do not allow us to conclude that there are long-lived self-reproduced populations.

Changes of environmental conditions such as increasing of temperature can be drivers for appearing or extinction of local populations. However, this effect is usually difficult to establish, since it is influenced by a complex of both abiotic and biotic factors [Benincà *et al.*, 2015; Collins, Glenn, 1991; Schoener, Spiller, 1987]. This is the case for the Kislaya Inlet where the ecosystem was recently renewed after isolation of the water body by Tidal Power Station.

It is also difficult to estimate the time of appearance of the first population of *Aporrhais pespelicani* at the Murman Coast. We suggest that the categorical statement about the association of the findings of the species with the range extension [Kantor *et al.*, 2008] needs reliable proof. Despite the fact that the species is easy to identify due to its shell morphology, the previous findings, if any, were likely

to remain unpublished since only several papers with lists of molluscan species collected during the hydrobiological studies were issued prior to 2000s [Nekhaev, 2016]. Analyses of all recent molluscan findings along the Murman Coast demonstrated that the ratio of new records of boreal versus Arctic species is similar to that of known fauna. However, only the findings of the boreal species are published as separate notes. This creates a bias that prevents one from assessing the real impact of climate and other changes on the fauna of the region [Parmesan, Yohe, 2003; Thomas, 2010; Nekhaev, 2016].

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FIG. 2. Habitat of *Aporrhais pespelicani* in the Kislaya Inlet (station 1). **A.** General view (frame side = 1 m). **B, C.** Shells of *Aporrhais pespelicani* on the bottom.

РИС. 2. Местообитание *Aporrhais pespelicani* в губе Кислая (станция 1). **A.** Общий вид (сторона рамки = 1 м). **B, C.** Раковины *Aporrhais pespelicani* на дне.

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