# **Abundance distribution patterns of intertidal bivalves *Macoma balthica* and *Cerastoderma edule* at the Murman coast tidal flats (the Barents Sea).**

Sophia Nazarova1,2,\*, Evgeny Genelt-Yanovsky1, Ksenia Shunkina3

1 – Department of Ichthyology and Hydrobiology, St Petersburg State University, 16 Line, 29, Vasilevsky Island, St Petersburg, 199178, Russia

2 – Department of Zoology, Russian State Pedagogical University, Moyka emb., 48, St-Petersburg, 191186, Russia

3 – Laboratory of Evolutionary Morphology, Zoological Institute RAS, Universitetskaya emb., 1, St-Petersburg, 199034, Russia

\* Corresponding author: Sophia Nazarova, e-mail: [sophia.nazarova@gmail.com](mailto:sophia.nazarova@gmail.com)

*Density distribution of the common infaunal bivalves,* Macoma balthica *and* Ceastoderma edule*, was studied along the Murman Coast of the Barents Sea during 2002–2010. In both species, abundance was generally higher in West Murman in contrast to East Murman. Highest density of* Macoma balthica *reaching 1535 ind. m-2 was observed in the Kola Bay.* Cerastoderma edule *was less abundant; its density rarely exceeded 10 ind. m-2 in all but one site, where 282 ind. m-2 was registered. Reconstruction of abundance distribution across species geographic ranges revealed that both range shapes does not match “abundant-centre” pattern, having features of ramped north in* Macoma balthica *and ramped south in* Cerastoderma edule*.*

Keywords: *Cerastoderma edule*;cockle; *Macoma balthica*, Barents Sea, spatial distribution, abundance, latitudinal variation

# INTRODUCTION

Patterns of species' abundance at the biogeographic extremes, may provide insights into such essential issues in ecology as identification of borders between adjacent biogeographic regions and causes of species range limits. Large-scale distribution of species abundance is also a key element of applied sciences such as planning of protected areas and designation of species into regional Red Lists. A widespread paradigm, known as «abundant-centre hypothesis» (ACH) is widely used to test whether the highest species abundance belongs to the range centre and declines towards range edges (Sagarin et al., 2006). Intertidal fauna is an ideal test system for studying latitudinal gradients. In Western Europe, many intertidal and high subtidal marine invertebrates have extended ranges with distinct north (or northeastern) and south (or southwestern) limits characterized by diametrically opposed combination of environmental conditions. Recent studies on wide-spread marine coastal invertebrates have shown that abundance centre pattern does not apply to most species equally, and even closely related species could show different spatial patterns (Sagarin, Gaines, 2002; Rivadeneira et al., 2010).

Empirical approaches to quantify abundance in different parts of the range vary widely. One of the main challenges for examining the abundant centre pattern is a logistical difficulty of sampling throughout the whole species range. Particulary, it could be a problem to get adequate samples from the range edge, where local populations are not stable in time and can spontaneously become extinct and later reoccupy suitable habitats (Sagarin, Gaines, 2002; Sexton et al., 2009).

Species ranges are not stable in time, often shifting, expanding and contracting (Gaston, 2003). Fluctuations of environmental variables, such as climate oscillations, may alter population fitness at the distribution limits and range shifts can lag behind environmental changes (Pfenninger et al., 2007; Svenning et al., 2008). Marginal populations exhibit greater temporal variability in abundance being near the species’ limit of environmental tolerance, especially in extreme years (Gaston, 2009). Since temporal variation can introduce errors in estimation of spatial abundance distribution, it is highly important to apply monitoring data series to improve the understanding of differences in abundance between central and edge populations (Holt, Keitt, 2000; Johnstone, Chapin, 2003). The spatial distribution and patchy structure of population density are also likely to determine range limits. Edge populations usually considered to be smaller and more spatially fragmented than populations in the centre of the range (Brown et al., 1995). They may exhibit reductions in diversity and in number of immigrants due to spatial arrangement only, thus resulting in an isolation-by-distance effect (Sexton et al., 2009).

Here, we present the results of the study of abundance distribution of *Macoma balthica* and *Cerastoderma edule,* two key bivalve species at the tidal flats of the Barents Sea*. Macoma balthica* is currently regarded as a complex of Pacific *Macoma balthica balthica* and Atlantic *Macoma balthica rubra* subspecies (Nikula et al., 2007). In Europe this complex spreads from Bay of Biscay up north to the western Kara sea (figure 1 A). Pure *M. balthica balhica* northern distribution limit belongs to the Varanger Peninsula, while populations in the White and Barents seas are proved to form a broad «hybrid swarm» - their genetic composition is intermediate between Atlantic and Pacific forms (Strelkov et al., 2007). *Cerastoderma edule* range is shaped into at least two genetically different groups of populations along the North Atlantic coast, but separation between these groups does not have a subspecies level (Krakau et al., 2012). Earlier we suggested that low density of individuals is typical for *C.edule* in the Barents Sea, a North-Eastern distribution limit for the species (Genelt-Yanovskiy et al., 2010)(figure 1 A). We put together our data and published records of mean bivalve density across numerous locations in Europe to study latitudinal and longitudinal clines in geographical abundance distributions.