Enlargement and reductions on habitat of sub-tropical and boreal intertidal species of gastropods along Atlantic coast of Iberian Peninsula in a global warming scenario

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INTRODUCCIÓN

In the current global warming scenario several studies found similar range shifts of intertidal organisms. These range expansions or contractions of boreal and sub-tropical intertidal gastropods were firstly recorded by Fischer-Piette in the 1940s and 1950s along the north coast of the Iberian Peninsula. The Atlantic coast of the Iberian Peninsula due to its particular oceanographic conditions is the north and south range boundary of many intertidal sub-tropical and boreal species, respectively. These boundaries are constantly changing to fit with the shifting climatic conditions. In this study we explored changes on the distribution range of boreal and sub-tropical species of intertidal gastropods. They play a key role in shaping the structure of rocky intertidal assemblages and thus, changes in their diversity or abundance can have dramatic effects in rocky shore assemblages. Our results showed a significant range expansion of sub-tropical species (i.e. *Siphonaria pectinata*, *Phorcus sauciatus* and *Stramonita haemostoma*) while boreal species showed a range contraction (e.g. *Littorina saxatilis* and *Nucella lapillus*) and in some cases their presence was limited to some environments which seem to serve as refuge (e.g. *Littorina littorea*). Future research will explore the role of biotic and abiotic factors in these range shifts, ecological consequences in the rocky shore assemblages and changes in intra-specific diversity of boreal and sub-tropical gastropod species related to range shifts.

Global warming

Greenhouse gas concentrations have increased global average temperatures by ~0.2°C per decade over the past 30 years.

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This added energy is absorbed by the world's oceans

↓

Sea surface temperature (SST) warming is far from being uniform.

Global warming

North East Atlantic region is particularly susceptible to climate warming.

↓

Increases of up to 1°C have been recorded in this area (Hawkins et al. 2003).

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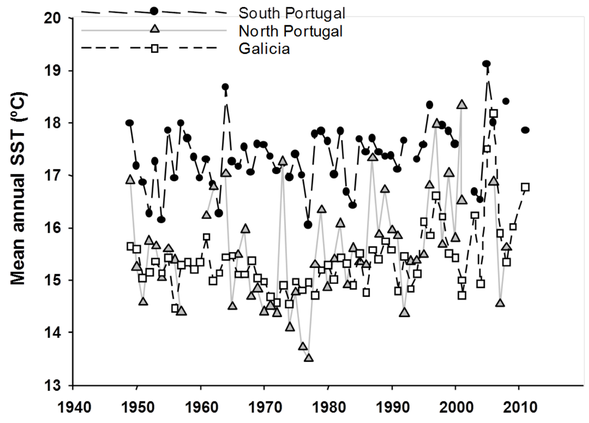
BIOLOGICAL CONSEQUENCES
Maybe Y (X) N ( )

What is happening in Iberian Peninsula?



Sampling

Target species:

Sub-tropical species:

- *Phorcus sauciatus*
- *Stramonita haemastoma*
- *Siphonaria pectinata*

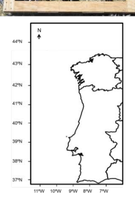
Cold-water species:

- *Nucella lapillus*
- *Littorina littorea*
- *Littorina saxatillis*

Sampling

- 20 quadrats for each species.

- 141 sampling sites separated at least 2 km.



Why these species?

- Relative big size
- High abundances
- Easy to identify in the field

Historic view

Distribution ranges were compared with historical data collected by:

Hidalgo (1917); Nobre (1940); Fischer Piette (1955; 1956; 1958; 1960; 1963); Troncoso (1990); Boaventura et al. (2002); Rubal et al. (2011; 2014)

Iberian Peninsula:

- Temperature gradient from North to South.
- Southern limit of many cold-water species and northern limit of sub-tropical species.
- Lack of quantitative historical data.

Cold-water species:

- ***N. lapillus* and *L. saxatillis*.**
- **Reduction on their abundance.**

Sub-tropical species:

Phorcus sauciatus:

Common in Macaronesian

Not inside Mediterranean

Cantabrian Coasts

Phorcus sauciatus

Range extension southwards (166 Km)

Phorcus sauciatus

Fischer-Piette and Kisch (1957)

Current study (2014)

Stramonita haemostoma

Increased their distribution range on the last decades.

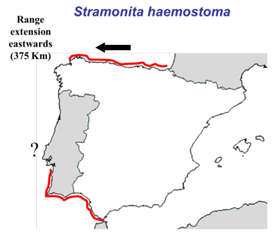
First record in Galician waters after 1940 = (Souto et al. 2008)

Stramonita haemostoma

Hidalgo (1917); Nobre (1940)

Stramonita haemostoma

Range extension eastwards (375 Km)



Current study (2014)

Siphonaria pectinata:

- Abundant at the Mediterranean Sea (Hidalgo 1914).
- Northern limit at Buarcos (Nobre 1940).

Siphonaria pectinata

Well established populations 400 Km northern than at 1940

Siphonaria pectinata

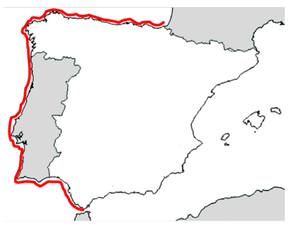
Range extension northwards (400 Km)

Siphonaria pectinata

Hidalgo (1917); Nobre (1940)

Current study (2014)

Littorina saxatillis



Hidalgo (1917), Nobre (1940)

Littorina saxatillis

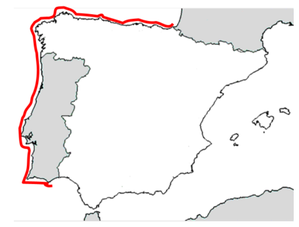
Range contraction northwards (295 Km)

Current study (2014)

Littorina littorea:

- Very common on rock surface (Hidalgo 1914; Nobre 1940).
- Lack of *L. littorea* on exposed shores.
- Restricted to few shelter sites.

Littorina littorea



Hidalgo (1917), Nobre (1940)

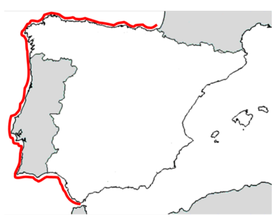
Littorina littorea

Range contraction restricted to sheltered shores

Current study (2014)

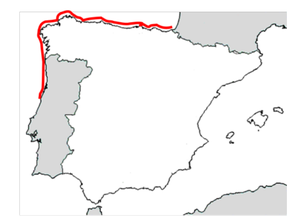
Nucella lapillus

Nucella lapillus



Range contraction northwards (328 Km)

Nucella lapillus



Hidalgo (1917), Nobre (1940)

Current study (2014)

CONCLUSIONES

1. **Sub-tropical species are increasing their distribution range.**
2. **Cold-water species are contracting their distribution range.**
3. ***Littorina littorea* has almost disappeared from intertidal exposed areas, actually this species is restricted to sheltered shores**

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