ABSTRACT

Numerous analyses of both observed and projected environmental changes in the Antarctic Environment have revealed that a large part of the Southern Ocean is or will be affected by at least one climate change stressor. The current phenomenon of environmental stress causes southern shifts of the major frontal zones', existing habitats and is likely to modify planktonic and pelagic communities' structure. The geographical range of the keystone Antarctic species - *Euphausia superba* - is moving southwards to remain in favorable thermal conditions, therefore squeezing their distribution range closer to the Antarctic continent. At the same time, new habitats will open for flexible organisms that are capable of adaptation like *Salpa thompsoni*.

Salpa thompsoni (Tunicata; Thaliacea) is a planktonic tunicate with a gelatinous body structure without segmentation. This Antarctic chordate is among the most efficient pelagic repackager of small particles into larger ones, therefore it plays a crucial role in the Antarctic marine planktonic and pelagic communities. In contrast to many other Antarctic species, salps stand out because they respond positively to higher water temperatures, with significant increases in their number recorded over the past decades. It seems that the ongoing climate trends promote jelly-like taxa expanding their distribution range, affecting alternations in their population structure as well as demographic profiles. A salp dominated ecosystem would likely cause perturbation of the whole Antarctic food chain as some species will consider salps as their food source, while others will exclude this possibility, because of their low and insufficient nutritional value.

Information about the demography and structure of key Antarctic populations play a substantial role in providing geospatial knowledge of Antarctic biodiversity and allow us to track and define various abiotic and biotic processes occurring in the Southern Ocean. For a better understanding of Antarctic environment modifications, it is essential to identify distribution range and hot spots of crucial polar species as well as monitor their limitations, abilities, and project their future distribution. Molecular tools and methods enable us to define genetic diversity within and among keystone populations in their geographic range, therefore allowing their evolutionary processes to be inferred.

Therefore, for a comprehensive study of the *Salpa thompsoni* population, the presented doctoral dissertation has been divided into three major chapters with specific research questions, including:

1. Analysis of a long-term historical database collected in the Atlantic Sector of the Southern Ocean over a twenty years' time span (1975-2001) to reconstruct spatial distribution and abundance of the *S. thompsoni* population. The primary focus of the dissertation was to identify environmental requirements and limitations of *S. thompsoni* distribution as well as provide missing predictions of the Antarctic salp population dynamics in the next 50 years.
2. Investigation of *S. thompsoni* blastozooids reproduction capacity, in the eastern and western part of the Atlantic Sector of the Southern Ocean. The study goal was to examine the developmental preferences of salp embryos and explore whether adverse environmental conditions such as low temperature and chlorophyll-*a* concentration may drive its population to collapse.
3. Inferring about the contemporary population structure of *S. thompsoni* from different areas of the Southern Ocean in order to confirm previous hypotheses about population homogeneity. The aim of the study was to define the plausible genetic mechanisms underlying salp responses to specific environment conditions using molecular methods.

The presented dissertation has confirmed that significant variability in *Salpa thompsoni* abundance is strongly connected with the observed sea ice cover decrease, and the environmental modification related to the El Niño phenomenon prevailing over the previous 2- 3 years. The presented model revealed that the preferences of Antarctic salps might be obtained by a combination of deep, open, and ice-free waters with temperatures around 1-2°C, which is characteristic of the Antarctic Circumpolar Current. However, further analysis suggested that the Southern Boundary of the Antarctic Circumpolar Current is not a barrier for *S. thompsoni* occurrence, and salps may exist even in harsh conditions, further than 68°S with water temperature around 0°C, and presence of sea ice. For the first time, this study revealed that the hot spots of salp abundance were located within the shallow, cold shelf waters close to the Antarctic Peninsula, which was not considered as the favourable environment for these pelagic tunicates. The inference of future salp distribution

demonstrated that the range of *S. thompsoni* would move southwards, enlarging their habitat area by over 500 000 km^2 in the next 50 years.

Consequently, the second research topic revealed that the range of *Salpa thompsoni* distribution was broader than previously believed and actively reproducing individuals have been found between latitudes 35-62°S, within their northernmost border - in the Subtropical Convergence- as well as far beyond their southernmost limits - in shallow shelf Antarctic waters. The most numerous and various population structure has not been found in warmer water masses, but south of the 60°S, within cooler and non-productive waters, in the Antarctic zone of the Drake Passage. Actively reproducing individuals were numerously recorded regardless of the low chlorophyll-*a* concentration and lower temperature values. These findings may suggest that growth of *S. thompsoni* individuals during summer season 2010 were not inhibited by cold and low chlorophyll-*a* concentration did not limit their proper development nor drive their population to collapse.

The results of the third research topic provide novel and significant evidence to exclude the hypothesis considering *Salpa thompsoni* as a panmictic population. The visible population structure suggests that some demography processes occur in the area of the Polar Front, and some forces are supporting the higher genetic diversity. Results of this manuscript may explain the high ecological flexibility and better adaptability of Antarctic salp to changing environmental conditions. In addition, there is a slight signal that this population is currently undergoing expansion due to some environmental modifications, which also forced them towards rapid molecular responses. Phylogenetic analysis confirmed the presence of a new, distinct mitochondrial lineage in the *S. thompsoni* population and suggests that we can face the time of new species formation.

Concluding, the presented doctoral dissertation reveals previously unrecognized habitat preferences of *Salpa thompsoni* and provides a new and valuable insight into the current dynamics of this species confirming also its high adaptive potential due to its ecological and molecular plasticity.