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DISTRIBUTION OF BENTHIC DINOFLAGELLATES ON THE SWEDISH WEST COAST AND CLIMATE CHANGE RELATED GROWTH EXPERIMENTS

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PROJECT OVERVIEW

Marine benthic dinoflagellates (MBDs) occur globally and include several toxin-producing species. Their noticeable increase in terms of bloom intensity, frequency and distribution has alerted the scientific community and could be correlated with the effects of climate change. Here are presented the results from what is to our knowledge the first study of MBDs in Sweden. The project includes two main parts. Firstly, a field study conducted at three locations along the Swedish West coast, Gothenburg, Tjärnö and Kristineberg; to characterise the distribution and abundance of MBDs with the use of two different sampling methods, the macroalgae (MA) and the artificial substrate (AS). And secondly, two growth experiments with the MBDs *Prorocentrum lima* and *Coolia monotis*, which were exposed to a wide range of temperatures (5-25°C) and salinities (5-35 PSU).

CONCLUSIONS

- There are MBDs in the West coast of Sweden. *Prorocentrum lima* and *Coolia monotis* were abundant and presented an patchy distribution inside the locations sampled. Both species are considered toxic dinoflagellates, *P. lima* is a producer of Okadaic acid and analoges, while C. monotis is a producer of Cooliatoxin.
- In the MA samples *Prorocentrum compressum*, a planktonic dinoflagellate, presented higher abundances than any other planktonic species. We encourage the study of this species ecology, which it might have a benthic phase in its life cycle.

Species Identified	Highest Abundance in Macroalgae (MA)	Highest Abundance in Artificial Substrate (AS)
P. lima	1766	33
C. monotis	805	22
P. compressum	168	34

Table 1. Highest cell abundances observed for each dinoflagellate species collected with the two sampling methods used, the MA (cell gr^{-1} fresh-weight (FW) of macroalgae) and the AS (cell cm^{-2} of artificial substrate).

- *Prorocentrum lima* abundances recorded in Tjärnö were above the alarm threshold of 1000 cells g^{-1} FW of macroalgae (Roden, J. et al., 2005; CEFAS, 2012). Prorocentrum lima is a phycotoxin producer and may accumulate in marine filter feeders. In the Swedish west coast, this species is monitored as part of the phytoplankton ignoring its benthic ecology. The lack of monitoring this MBD might pose a risk to the shellfish aquaculture on the Swedish west coast.
- The AS method was not efficient for monitoring MDBs and might not be representative for moderate to low cell abundances in nature and may be affected by the specific behaviour of different MBDs.
- Temperature and salinity had an effect in the growth rate of the MBDs *P. lima* and *C. monotis*, which demonstrated their adaptability to a wide range of values from both abiotic factors. The effect of climate change in the Swedish coastline might have future ecological implications in MBDs populations, increasing the risk of possible impacts in the environment, the aquaculture industry and human health.

FIELD STUDY RESULTS

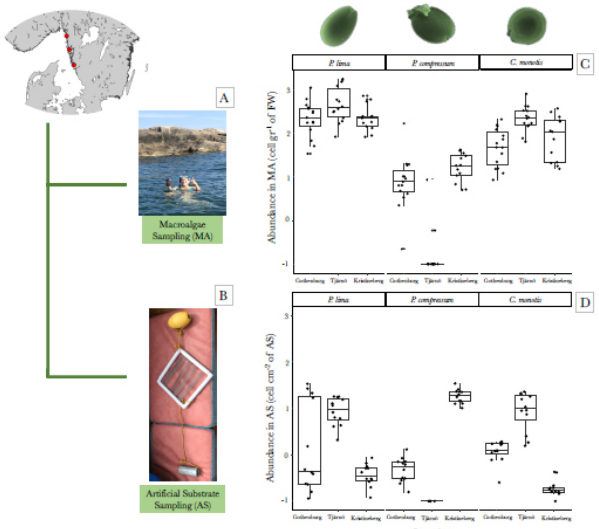

Fig 1. Three locations from the Swedish west coast were sampled using two methods, the macroalgae sampling (A) and the artificial substrate sampling (B). The species' abundance (cell gr^{-1} fresh-weight of macroalgae) per location collected with the MA sampling (C). The species' abundance (cell cm^{-2} of artificial substrate) per location collected with the AS sampling (D). In both graphs, the data was previously log-transformed and each black circle represents an individual sample (N=15 per site).

GROWTH EXPERIMENTS RESULTS

Species	Type of Experiment	Experimental conditions
Prorocentrum lima	Temperature	5 – 25 °C, 26 PSU, 16:8 L:D, 70 µmol s^{-1}
	Salinity	5 – 35 PSU, 16 °C, 16:8 L:D, 70 µmol s^{-1}
Coolia monotis	Temperature (3 strains tested)	5 – 25 °C, 30 PSU, 16:8 L:D, 70 µmol s^{-1}
	Salinity (2 strains tested)	5 – 35 PSU, 20 °C, 16:8 L:D, 70 µmol s^{-1}

Table 2. Description of the experimental conditions in the growth tests with *P. lima* and *C. monotis*.

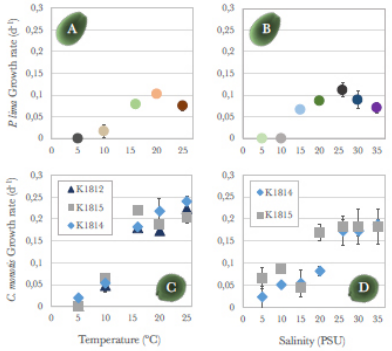

Fig 2. *P. lima* growth rates (d^{-1}) obtained in the temperature (A) and salinity experiments (B). Growth rates (d^{-1}) of three strains of *C. monotis* (K1812, K1814, K1815) in the temperature experiment (C). Growth rate of two strains of Coolia monotis (K1814, K1815) in the salinity experiment (D).

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The distribution of benthic toxin-producing dinoflagellates along the Swedish west coast and climate change related growth experiments

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Abstract

Marine benthic dinoflagellates (MBD) occur globally and include several toxin-producing species. Their noticeable increase in terms of blooms intensity, frequency and distribution has alerted the scientific community and appears to be correlated with the effects of climate change. Here we present the results from what is probably the first study of MBD in Sweden. The project includes two main parts. The first one is a field study conducted at three locations along the Swedish West coast, to characterise distribution and abundance of MBD. The second part includes growth experiments with the benthic species *Prorocentrum lima* and *Coolia monotis*, which were exposed to a wide range of temperatures and salinities. The aim of these experiments is to investigate growth characteristics in a future climate change scenario. The growth experiments were ongoing at the time of the abstract submission. Our first findings confirm the presence of MBD species, such as *P. lima* and *C. monotis*, on the Swedish West Coast, with maximum abundances of 1767 cells/g and 805 cells/g of fresh-weight of macroalgae respectively. *P. lima* is a producer of Diarrhetic Shellfish Toxins (DST) while *C. monotis* produces cooliatoxin, a neurotoxin. DST produced by *P. lima* pose a potential risk for the mussel farming industry due to Diarrhetic Shellfish Poisoning (DSP). Our study underlines the need to defined alarm-thresholds in Swedish marine waters for toxic benthic dinoflagellate species, like *P. lima,* to safety manage coast waters and seafood consumption.

Keywords:

benthic dinoflagellates, harmful algae, aquaculture, climate change

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