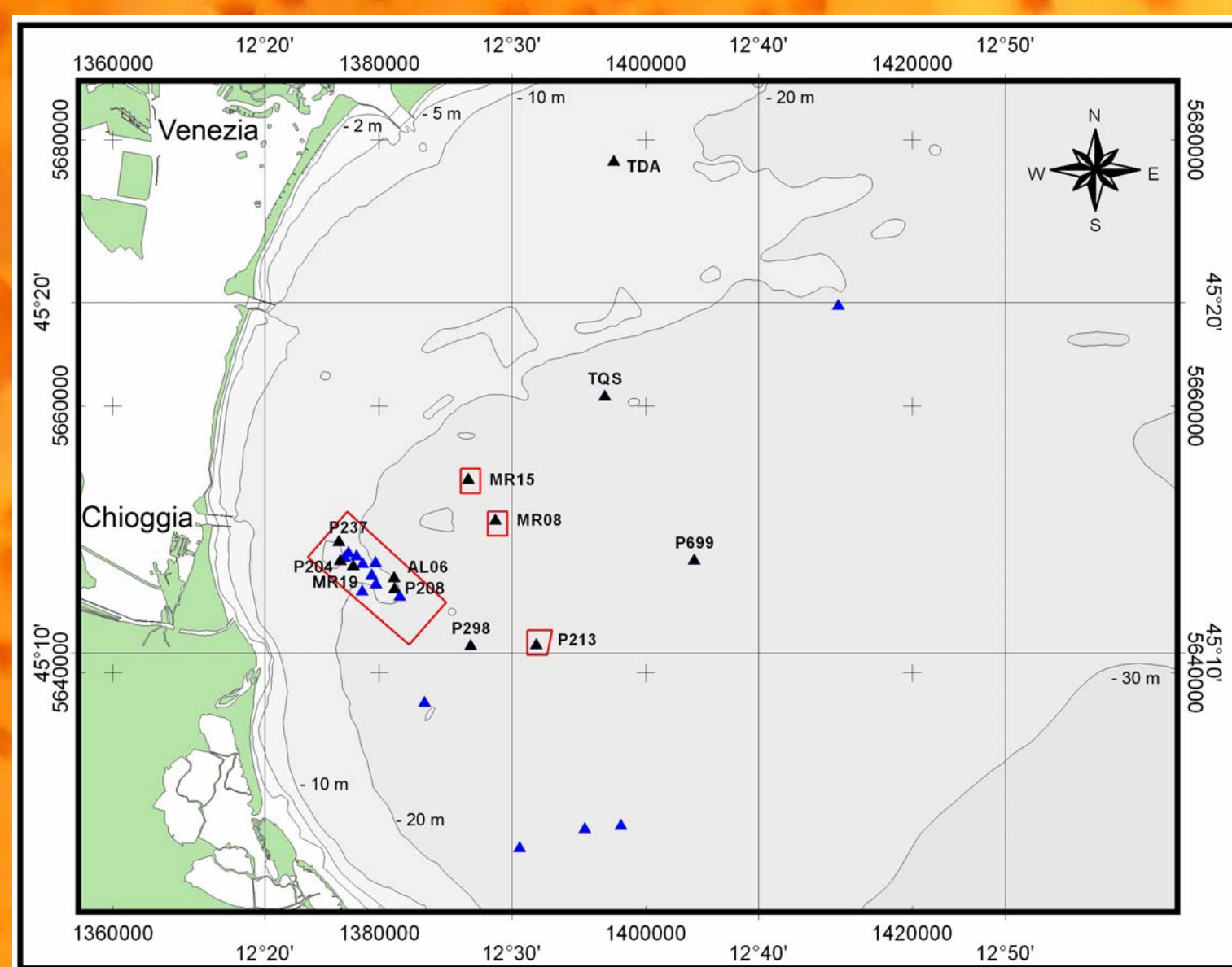


# Spatial-temporal variability of epibenthic assemblages on rocky outcrops in the northern Adriatic continental shelf

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## INTRODUCTION



Numerous coralligenous rocky outcrops occur in silty-sandy bottom of the Northern Adriatic Sea between 10 and 40 metres in depth, ranging in size from only a few to several thousands square metres, and raising between 1 and 4 metres from surrounding bottoms.

These rocky outcrops are reef buildings made predominantly by calcareous algae and they are characterized by a high biodiversity in term of epibenthic assemblages, endobionthic organisms and ichthyic fauna (Casellato and Stefanon, 2008).

Although these outcrops, locally named *tegnùe*, were discovered and documented since the 18th century (Olivi, 1792) their assemblages were analysed only in few locations until now (Gabriele et al., 1999; Soresi et al., 2004).

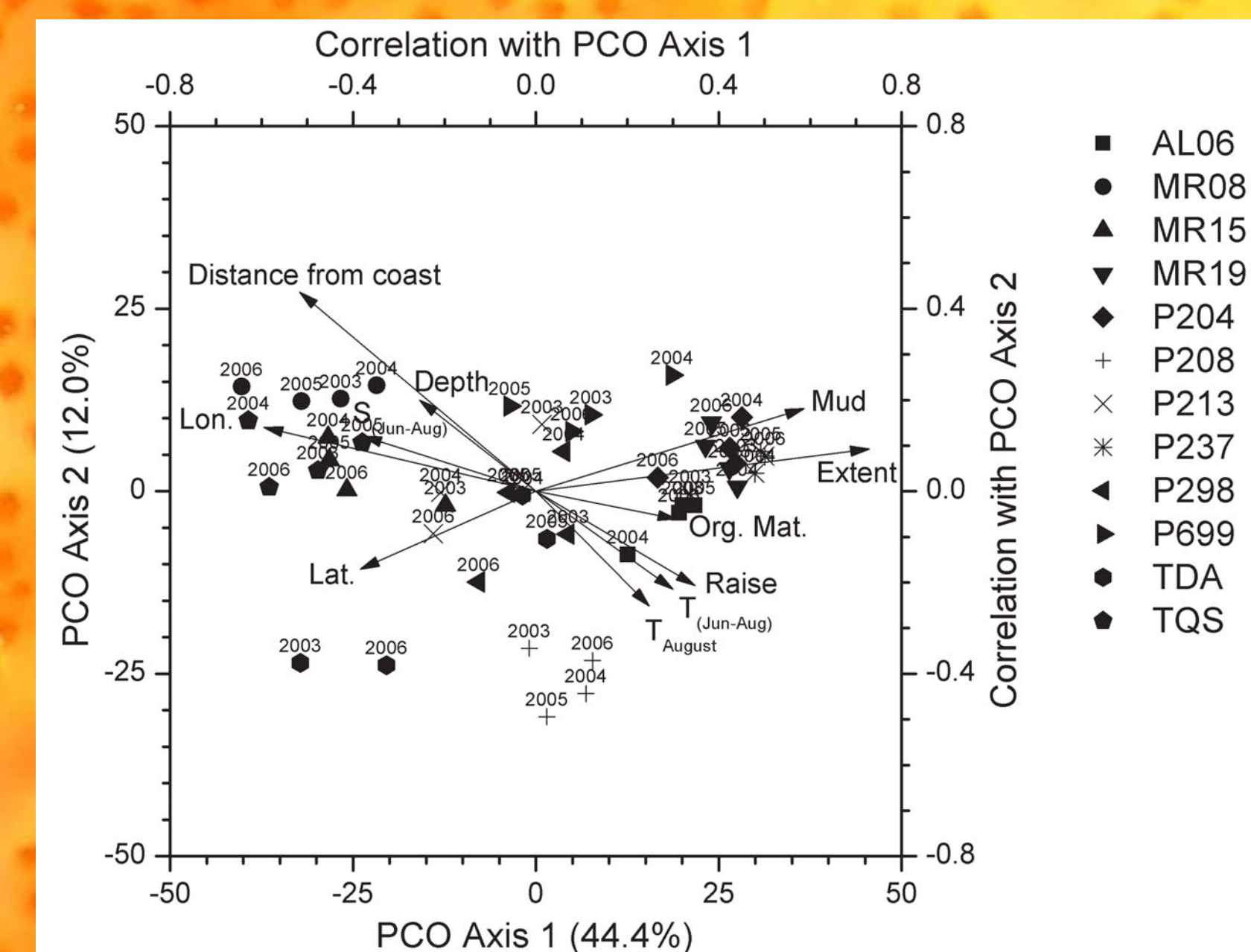
The aim of this study was to analysed regional distribution and temporal variation of the epibenthic assemblages.

## MATERIALS AND METHODS

The studied area covered approximately 500 km<sup>2</sup> of the northern Adriatic continental shelf offshore of Chioggia and Venice, between 18 and 30 m in depth and from 6 to 24 km from the coast (Lat. 45° 24' - 45° 04' N; Lon. 12° 23' - 12° 43' E). Species reference collection was carried out by means of photographs and collected specimens exploring twenty six outcrops. This collection includes some new records for the northern Adriatic Sea.

Epibenthic assemblages were annually investigated using a non-destructive photographic sampling method (Roberts et al., 1994) on twelve randomly selected outcrops. Samples were collected at each site in August from 2003 to 2006. Ten photos for each site and date were haphazardly selected to be analyzed by superimposing a grid of 100 equal sized squares; abundance of sessile organisms was quantified by visual percentage cover estimation.

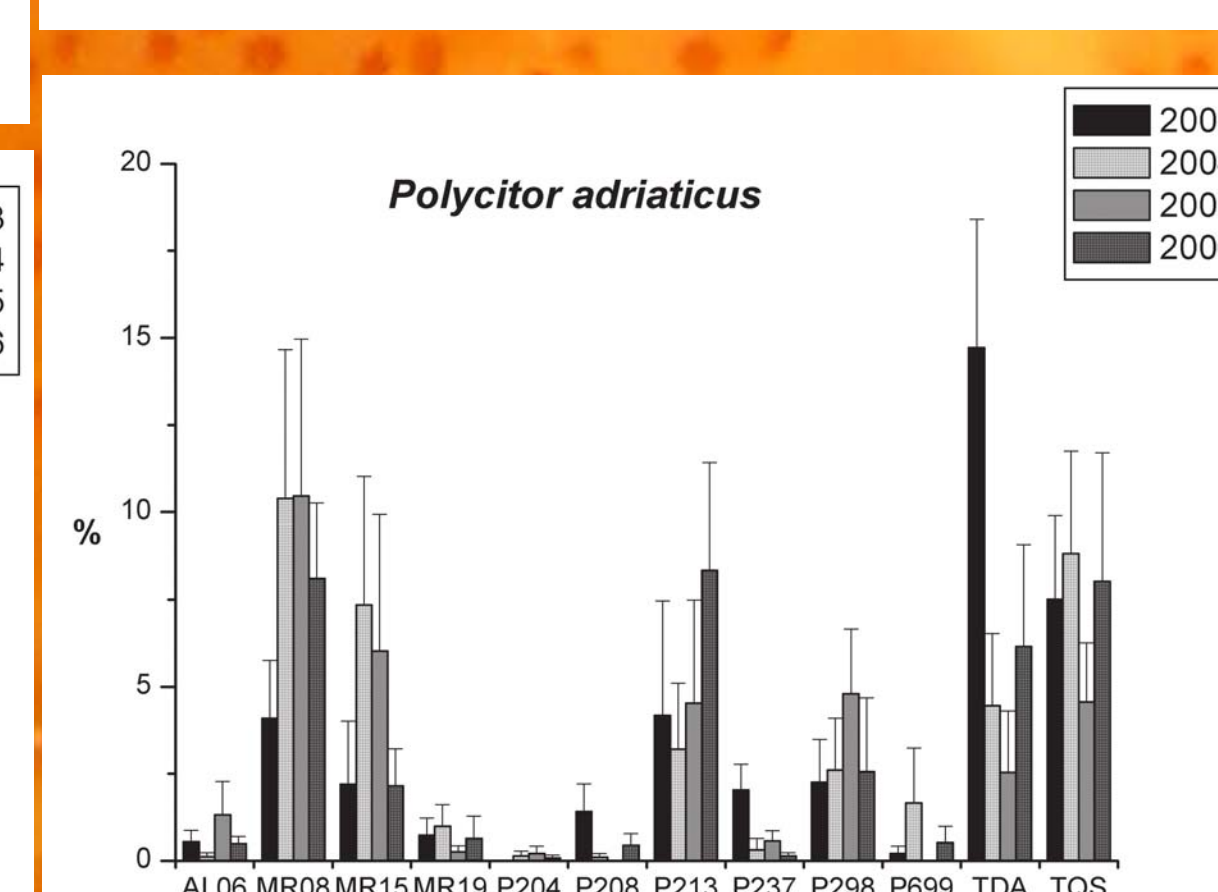
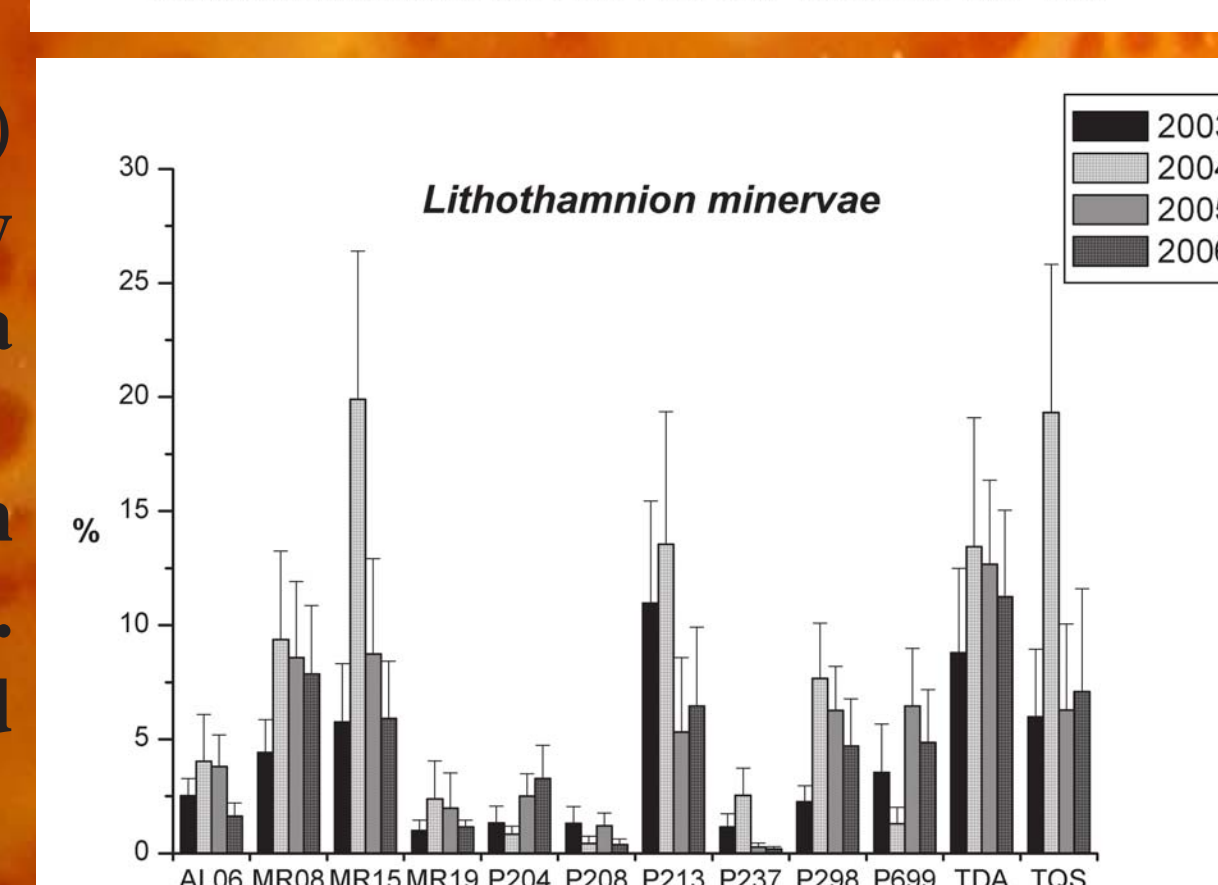
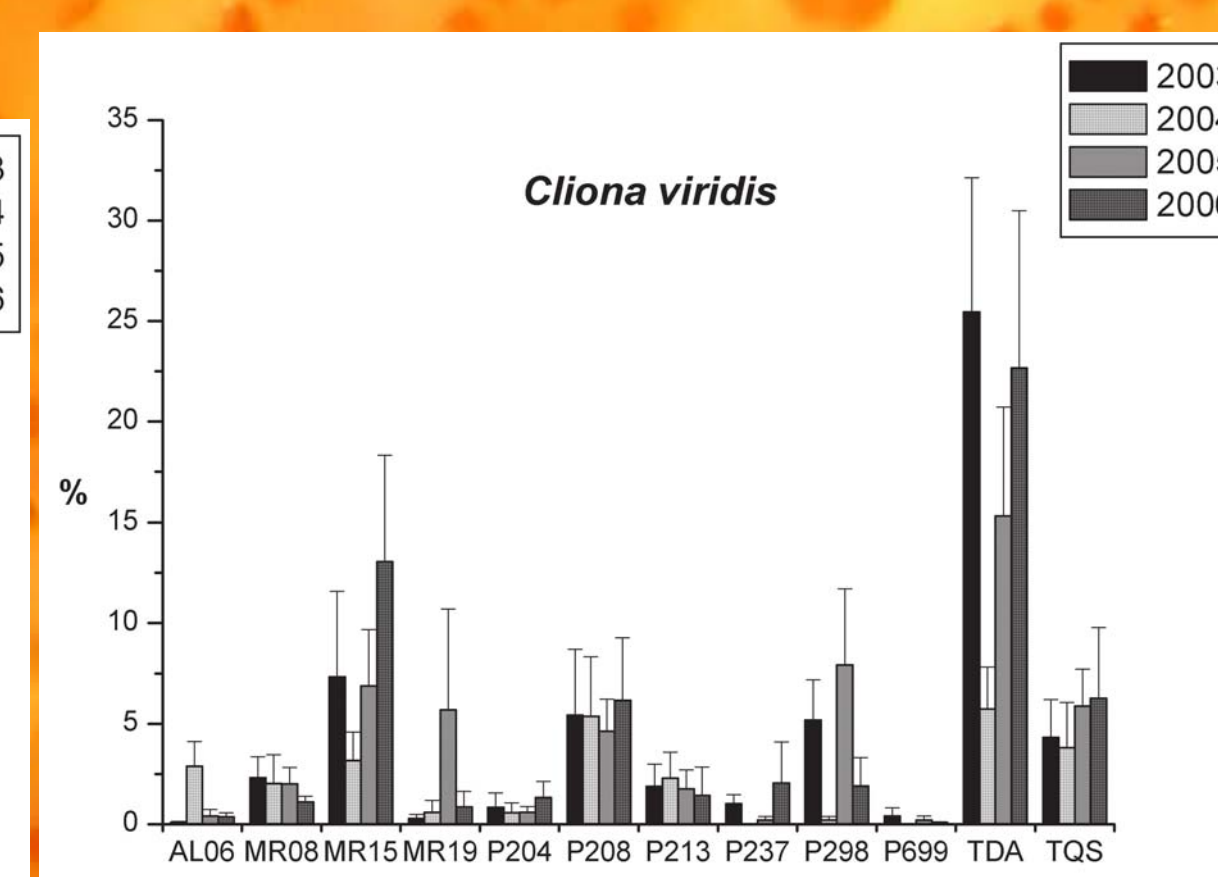
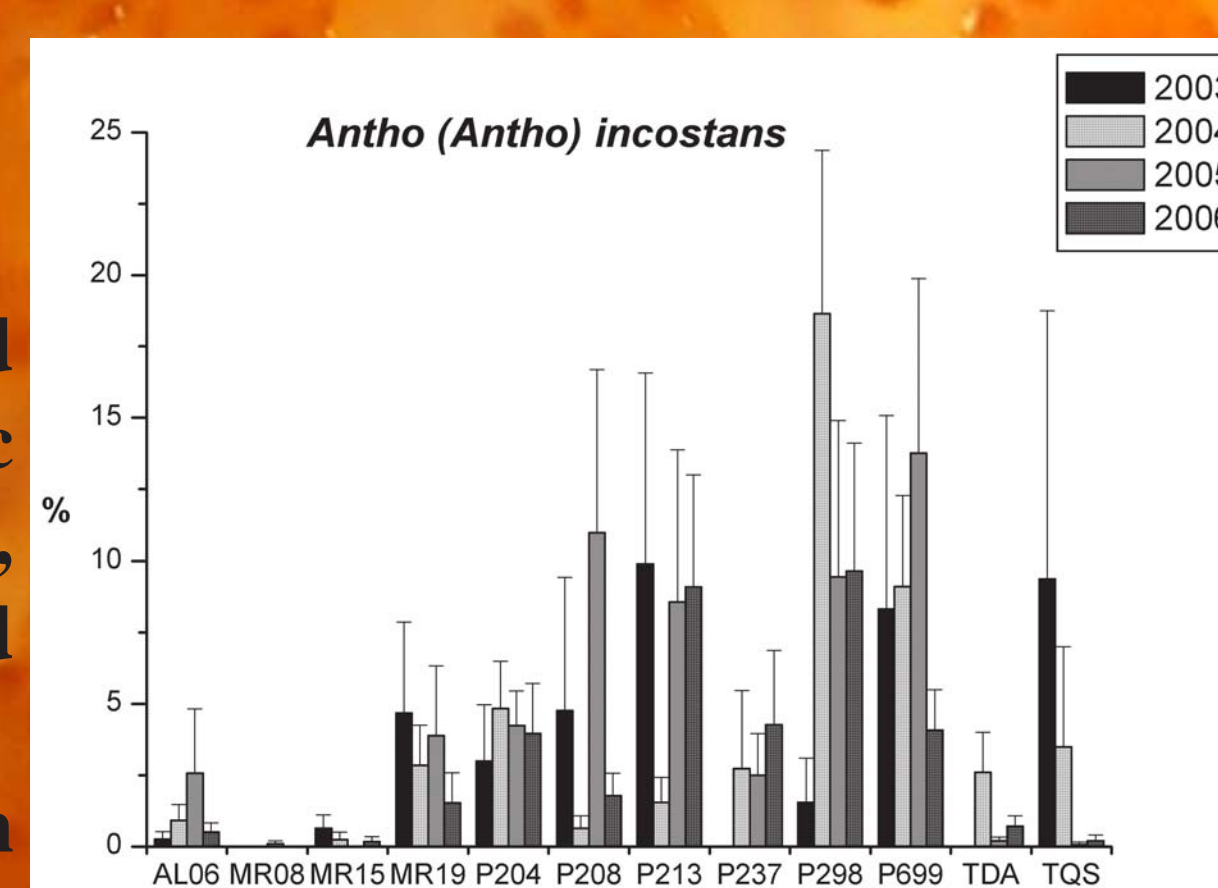
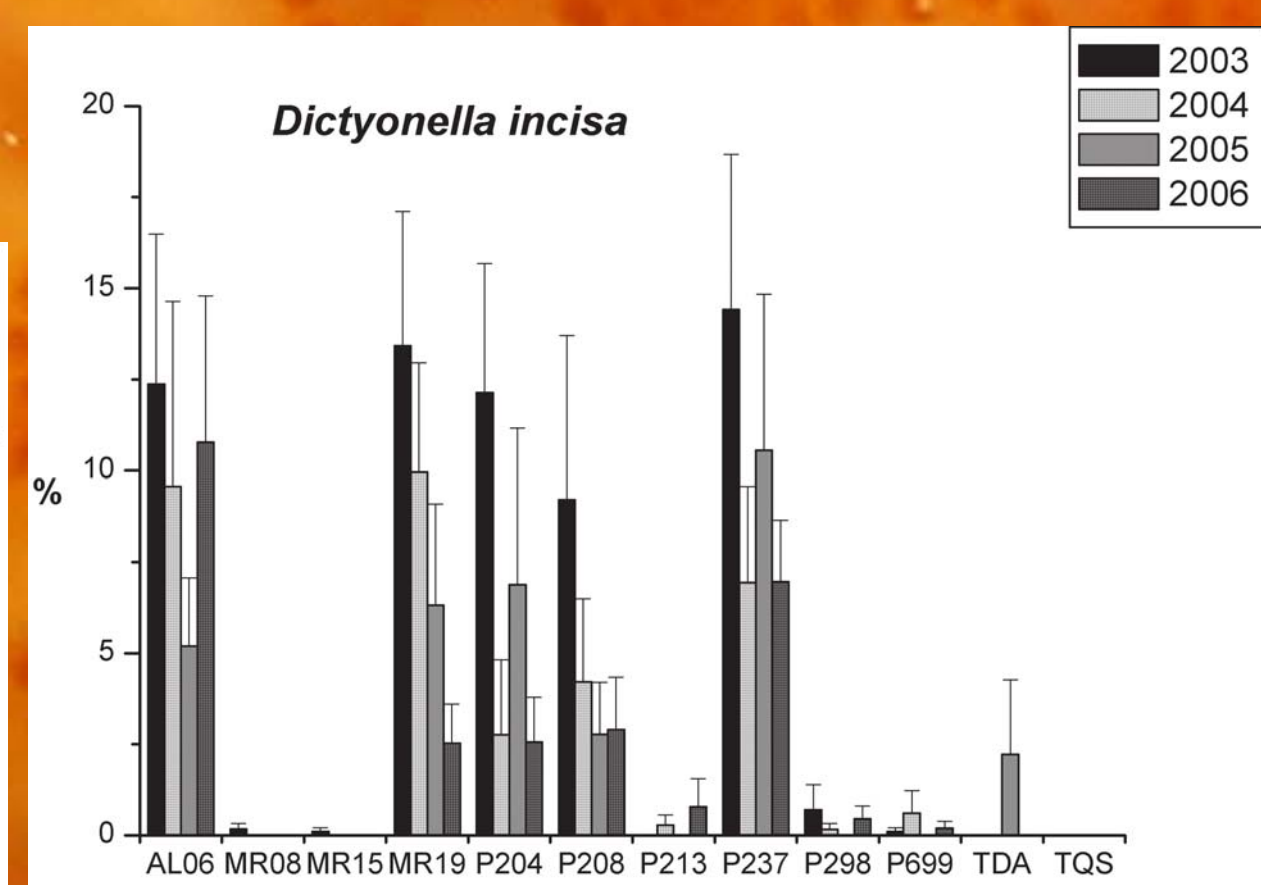
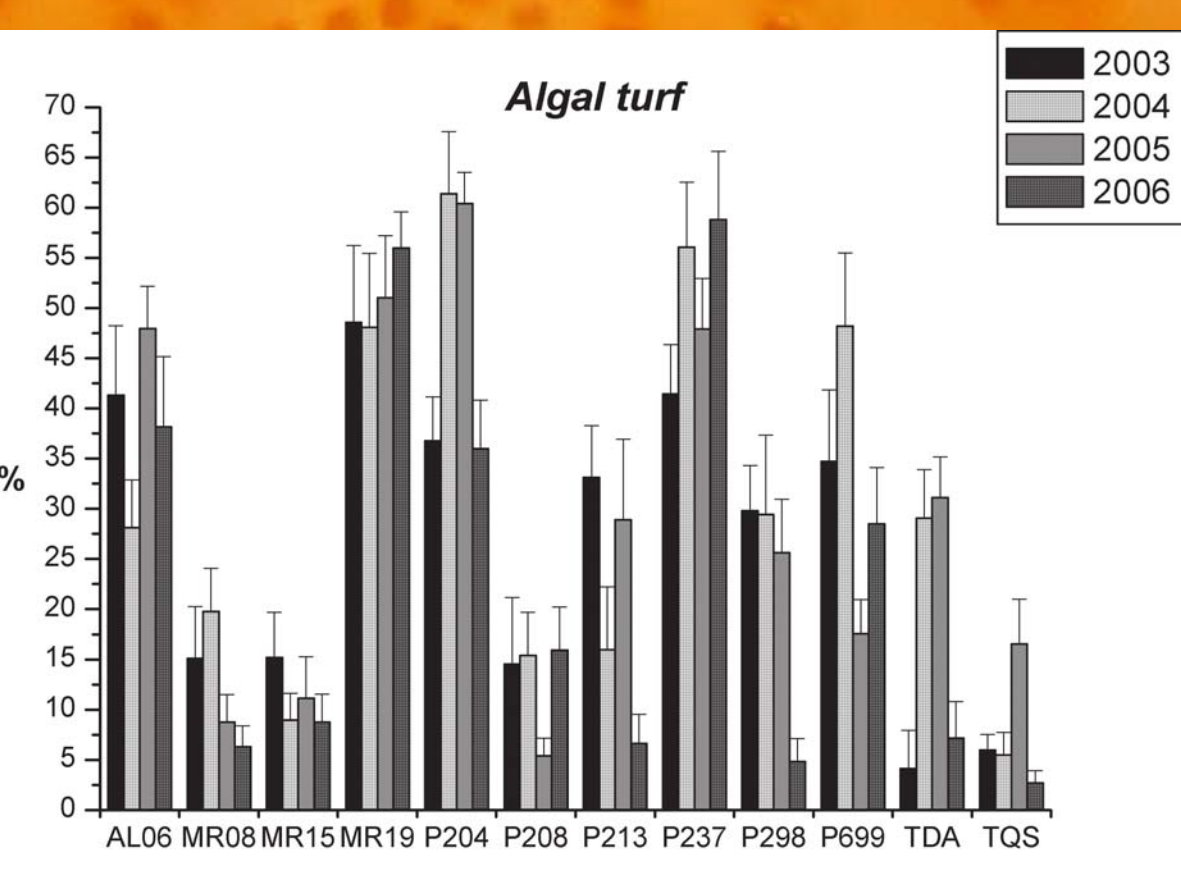
Sediment features were analysing in term of sand-silt-clay and organic content in sample collected near the outcrops; since measured hydrographical data were not available, mean daily temperature (°C) and salinity (psu) near the bottom for each sampling site and for the whole study period were obtained from the ASHELF model, based on the Princeton Ocean Model (Zavatarelli and Pinardi, 2003 and references therein), developed within the ADRICOSM project (<http://gnoo.bo.ingv.it/adricosm/>).



## RESULTS

Epibenthic assemblages showed a high variability in term of space and time as confirmed by PERMANOVA analysis that detected significant differences in the interaction Year X Site ( $p < 0.001$ ). The complex distribution pattern of the assemblages can be observed in the PCO ordination plot.

Multivariate multiple regressions indicated that the environmental variables: outcrops extent (log<sub>10</sub> transformed), distance from coast, depth, elevation, longitude, sediment mud, mean temperature in August, sediment organic matter, mean summer temperature (June-August), mean summer salinity (June-August) and latitude showed a significant relationship with patterns of similarity of the benthic assemblages.



Some ecological groups like non calcareous algae and encrusting sponge showed significant differences in the interaction Year X Site with complex site-specific temporal trends while other groups like boring sponges, calcareous algae, cnidarians, colonial ascidians and massive sponges were steady in time but differed between sites. In particular:

- Algal turf showed differences both in time and space with complex distribution patterns. The abundance increased near the coast in the wider outcrops.
- The most abundant encrusting sponges *Dictyonella incisa* and *Antho (Antho) incostans* significantly differed between sites, while the first one appeared steady in time and more abundant in shallow and wider outcrops, the second exhibited a high spatial and temporal heterogeneity increasing with depth.
- The most important boring sponge *Cliona viridis* showed a site-specific distribution and it was significantly more abundant in shallow and small outcrops as the site TDA.
- The calcareous algae *Lithothamnion minervae* appeared constant in time but differed between sites dominating the small and far locations.
- *Polycitor adriaticus* was characterized by a high spatial heterogeneity with a dominance at the little sites far from the coast.

## DISCUSSION

The present study showed that the structure of the epibenthic assemblages changed thorough years and sites even if spatial heterogeneity was higher than temporal changes, as well showed by the ordination plot. Spatial distribution of assemblages appeared strongly correlated with the morphological features and geographical location of the outcrops, while seemed less affected by the hydrological conditions that changed over time. This work represents an important contribution to knowledge of marine biodiversity, which is the base to better understand ecological processes and develop conservation projects.

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