RIUNIONE SCIENTIFICA 2021

GRUPPO DI ALGOLOGIA

Società Botanica Italiana

Tenuta in modalità mista

(in presenza e telematica)

Catania, 12 novembre

PROGRAMMA E RIASSUNTI

A cura di:

Rossella Pistocchi

Comitato scientifico:

Stefano Accoroni, Giuseppina Alongi, Simona Armeli Minicante e Anna Maria Mannino

Organizzazione della riunione (in presenza e telematica):

Giuseppina Alongi

RIUNIONE ANNUALE
CATANIA, VENERDÌ 12 NOVEMBRE 2021
PROGRAMMA

9:00 **Introduzione ai lavori – Rossella Pistocchi e Direttivo del Gruppo di Algologia**

Sessione 1 – Moderatore Laura Pezzolesi

9:15 R Relazione ad invito: Yusuke Matsuda
Molecular aspects of diatom photosynthesis based on transporters, carbonic anhydrases, and the pyrenoid.

10:00 R C. Auciello, C. Pennesi, C. Ciniglia, M. Iovinella, S. Dobretsov, M. De Stefano
First survey of epibenthic diatom communities on marine phanerogams and invertebrates from Omani coasts

10:15 R F. Cipolletta, D. Sarno, M. Montresor, O. Arace, M.G. Buonomo, R. Rossi, V. Soprano, A. Zingone
Overview of the potentially toxic microalgae in the Campania coasts

10:30 P C. Pennesi, M. Poulin, F. Hinz, T. Romagnoli, M. De Stefano, C. Totti
Revision of the genus *Mastogloia*, section Ellipticae: phylogenetic relationships and description of new taxa

10:45 R V. Malavasi, I. Černajová, L. Vančurová, P. Škaloud
A preliminary insight into the biodiversity of aero-terrestrial green algae in a Czech steppic locality: comparing different methodological approaches

11:00 ***Pausa***

Sessione 2 – Moderatore Stefano Accoroni

11:30 P F. Neri, T. Romagnoli, S. Accoroni, A. Campanelli, M. Marini, F. Grilli, C. Totti
Phytoplankton and environmental drivers at an LTER-offshore station in the northern Adriatic Sea (1988-2018)

11:45 R G. Molinari, M. Marieschi, L. Martinez Bosch, R. Bolpagni, A. Torelli
Sulfur interaction on chromium tolerance in the unicellular green alga *Scenedesmus acutus*: role of O-acetyl-Serine (Thiol) Lyase (OAS-TL)

12:00 R
M. De Stefano, C. Pennesi, C. Auciello, C. Ciniglia, M. Iovinella, J.H. Moritz, M.A. Qurban, L. Rabaoui
Biodiversity and ecological significance of diatom community on seagrasses and corals from Saudi Arabian coasts of the Arabian Gulf

12:15 R
M. Bruno, C. Gerotto
Acclimation to low sulfate availability in marine phytoplankton

12:30 P
D. Spagnuolo, V. Zammuto, M.G. Rizzo, A. Spanò, A. Di Martino, S. Guglielmino, G. Calabrese, F. Capparucci, C. Gervasi, M.S. Nicolò, A. Manghisi, C. Gugliandolo, M. Morabito, G. Genovese
Algal polysaccharides as inhibitors of biofilm formation

12:45 R
V. Natali, T. Cibic
Studio sperimentale sugli effetti della chiusura del MOSE sulla comunità microfitobentonica nella laguna di Venezia (nord Adriatico)

13:00 ***Pausa***

Sessione 3 – Moderatore Antonella Bottalico

15:00 R
S. Savio, S. Farrotti, A. Di Giulio, S. Ceschin, N.T.W. Ellwood, R. Congestri
Functionalization of the frustules of *Staurosirella pinnata* for Ni adsorption from aqueous solutions

15:15 R
M. Simonazzi, L. Pezzolesi, P. Galletti, C. Gualandi, R. Pistocchi, N. De Marco, Z. Paganelli, C. Samorì
Biosynthesis of polyhydroxybutyrate (PHB) by Cyanobacteria for bio-plastic production

15:30 P
C. Giommi, G. Sarà, A.M. Mannino
How temperature shapes algal diversity in rocky pools

15:45 R
A. Falace, G. Marletta, G. Savonitto, F. Candotto Carniel, M. Srijemsi, S. Bevilacqua, M. Tretiach, G. Alongi
Is the south-Mediterranean canopy-forming *Ericaria giacconei* (= *Cystoseira hyblaea*) a loser from ocean warming?

16:00 P
R. Trentin, E. Moschin, A. Grapputo, F. Rindi, S. Schiaparelli, I. Moro
Multi-gene phylogeny reveals a new genus and species of Hapalidiales (Rhodophyta) from Antarctica: *Thalassolithon adeliense* gen. et sp. nov.

16:15 P
A. Petrucciani, A. Norici
Luce e Silicizzazione: la luce è coinvolta nella deposizione di Si nel frustulo e nella capacità di affondamento di diatomee con diversa morfologia?

16:30 R. Ranaldi, L. Rugnini, F. Gabriele, N. Spreti, C. Casieri, L. Bruno
R **Phototrophic biofilms deteriorating stone monuments: characterization and development of innovative and sustainable control methods.**

16:45 A. Mincuzzi, A. Lisco, N. Dipierro, A. Ippolito, A. Bottalico
P **Attività antifungina di estratti da macroalghe delle coste pugliesi**

17:00 G. Furnari
P **Amenità algologiche e non solo….**

17:30 **Comunicazioni al Gruppo e saluti – Rossella Pistocchi**

RIASSUNTI

First survey of epibenthic diatom communities on marine phanerogams and invertebrates from Omani coasts

C. Auciello, C. Pennesi, C. Ciniglia, M. Iovinella, S. Dobretsov, M. De Stefano

Benthic microalgae living in shallow coastal regions give a reliable contribution to the dynamics of the aquatic ecosystems, in terms of primary production, oxygenic activity and trophic processes (Mac Intyre et al., 1996). Among benthic microalgae diatoms are reported to colonize sponges (Cerrano et al., 2004a, b), hydrozoans (Bavestrello et al., 2008), bryozoans (Wuchter et al., 2003), crustaceans (Ikeda, 1977), bivalves (Round, 1981), and vertebrates (Round, 1981), with a high degree of specificity for some hosts. The species composition of epibenthic diatom communities seem to be influenced by the nature of substrate and by their biogeographic distribution. The diatoms communities appear to be composed by a limited number of genera, that can be considered fully adapted to the epibenthic lifestyle. Moreover, ecological studies on epibenthic diatom communities based on a rigorous taxonomic approach are very rare due to the small size of such organisms. Indeed, most of the species have average size less than 20 microns with taxonomic characters not resolvable in light microscopy, so the scanning electron microscopy (SEM) results the only possible approach for a correct quantitative analysis. Our study, entirely based on scanning electron microscopy (SEM) investigation of diatom communities in undisturbed conditions gave us the first data on the hidden biodiversity of diatom assemblages associated to macrophytes and different invertebrates including sea urchins, gastropods, crustaceans and bivalves along Omani coasts in terms of functional classes and species composition. Our results demonstrated that all invertebrates and macroalgae collected along the coastal areas of Oman hosted benthic diatom communities which in both the case constituted the major element of their epibenthic microalgal flora. Significant differences in terms of cell density, specie composition and comunities structure were observed between the diatom communities of invertebrates and macroalgae which appear quite similar within sampling locations analysed. Cells densities of macrophytes diatom communities resulted more than ten times higher than those of invertebrates with mean values approximately ranging 1000-4000 cell/mm^2 in the former versus 100-400 cell/mm^2 in the latter. Noteworthy is that the specie composition of macroalgae diatom communities was characterized by the complete dominance of adnate genus Cocconeis (represented by five species). Clam and gastropod diatom communities seem to be dominated still by the adnate genera Amphora and Cocconeis with a higher contribution of the former in clam and of the latter in gastropods respectively. Corals and sea urchins seem able to actively contrast diatom settlement by means of self-excreted mucilaginous matrices that trap the individual cells. Nevertheless, some genera of motile (Mastogloia, Navicula, Diploneis Nitzschia and Pleurosigma) and erect (Achnanthes, Licmophora) diatoms manage to colonize this complex and dynamic habitat.

References

Bavestrello, G., Cerrano, C., Di Camillo, C., Puce, S., Romagnoli, T., Tazioli, S., Totti, C. (2008). The ecology of protists epibiontic on marine hydroids. *J Mar Biol Assoc Uk.* 88: 1611–1617.

Cerrano, C., Calcinai, B., Cucchiari, E., Di Camillo, C., Nigro, M., Regoli, F., Sarà, A., Schiaparelli, S., Totti, C., Bavestrello, G. (2004a). Are diatoms a food source for Antarctic sponges? *Chem Ecol*. 20: 57–64.

Cerrano, C., Calcinai, B., Cucchiari, E., Di Camillo, C., Totti, C., Bavestrello, G. (2004b). The diversity of elationships between Antarctic sponges and diatoms: the case of Mycale acerata Kirkpatrick, 1907. *Polar Biol.* 27: 231–337.

MacIntyre, H.L., Geider, R.J., Miller, D.C. (1996). Microphytobenthos: the ecological role of the secret garden of unvegetated, shallowwater marine habitats. I. Distribution, abundance and primary production. *Estuaries*. 19: 186–201.

Ikeda, A.T. (1977). A pelagic marine copepod associated with diatoms. *Bull Plankton Soc Jpn*. 24: 115–118.

Round, F.E. (1981). The Ecology of Algae. *Cambridge: Cambridge University Press*.

Wuchter, C., Marquardt, J., Krumbein, W.E. (2003). The epizoic diatom community on four bryozoan species from Helgoland (German Bight, North Sea). *Helgoland Mar Res.* 57: 13–19.

AUTHORS

Concetta Auciello (concetta.auciello@unicampania.it), Mario De Stefano, Claudia Ciniglia, Department of Environmental, Biological and Pharmaceutical Sciences and Technologies, University of Campania "L. Vanvitelli", via Vivaldi 43, 81100 Caserta, Italy

Chiara Pennesi, Stazione Zoologica Anton Dohrn, Sede Calabria, Italy

Manuela Iovinella, Department of Biology, University of York, YO105DD, York UK

Overview of the potentially toxic microalgae in the Campania coasts

F. Cipolletta, D. Sarno, M. Montresor, O. Arace, M. G. Buonomo, R. Rossi, V. Soprano, A. Zingone

Knowing the potentially toxic species that are present in a given area is a prerequisite for adequate management activities as well as for maritime spatial planning in the coastal area. Here we present the diversity of potentially toxic microalgae In the Campania coasts, investigated through a range of methods from light microscopy to molecular tools in 20 years of studies (1999-2019), along with algal toxin data from cultured strains and natural material data. A total of 57 potentially toxic species were identified: 11 species belonging to the Bacillariophyceae, 4 species belonging to the Haptophyceae, 3 species belonging to the Raphidophiceae, 2 species belonging to the Dictyochophyceae and 37 species belonging to the Dinophyceae. Among these species, toxin production was confirmed in culture material of 10 species belonging to the genera *Alexandrium*, *Azadinium*, *Ostreopsis*, *Prorocentrum*, *Protoceratium* and *Pseudo-nitzschia*. In 14 natural phytoplankton net samples, the most recurrent lipophilic toxins detected were domoic acid, okadaic acid and yessotoxin, likely produced by *Pseudo-nitzschia* spp., *Dinophysis sacculus* and *Protoceratium reticulatum*, respectively, which were identified in light microscopy in the same samples. Despite the absence of cases of impact and aquaculture closure in the Campania region, our results corroborate the importance of taxonomic studies aimed to resolve the great diversity of potentially toxic and harmful microalgae in a local-scale approach, as well as highlight the importance of toxin production assessment, particularly in view of the future expansion of aquaculture and recreational activities.

AUTORI

Francesco Cipolletta (francesco.cipolletta@szn.it), Diana Sarno, Marina Montresor, Adriana Zingone, Dipartimento di Ecologia Marina Integrata – Dipartimento delle Infrastrutture di Ricerca per le Risorse Biologiche Marine, Stazione Zoologica Anton Dohrn (SZN), Villa Comunale, 80121, Napoli.
Maria Giovanna Buonomo, Istituto Zooprofilattico del Mezzogiorno, Via Salute, 2, 80055, Portici (Napoli).
Rachele Rossi, Istituto Superiore di Sanità, Viale Regina Elena, 299, 00161, Roma.
Olga Arace, Vittorio Soprano, Istituto Zooprofilattico del Mezzogiorno, Via Salute, 2, 80055, Portici (Napoli).

Revision of the genus *Mastogloia*, section Ellipticae: phylogenetic relationships and description of new taxa

C. Pennesi, M. Poulin, F. Hinz, T. Romagnoli, M. De Stefano, C. Totti

Mastogloia Thwaites ex W. Smith is a large, mostly marine diatom genus occurring in microphytobenthic communities of temperate to tropical coastal regions (Hustedt 1933). It encompasses a high number of epilithic and epiphytic species, with some 140, 340 and 410 taxa reported by Hustedt (1933), VanLandingham (1971) and Novarino (1989), respectively. Morphologically, the genus *Mastogloia* is isopolar and is mainly characterized by a modified valvocopula which consists in a series of adjacent partecta (i.e., chambers sensu Hustedt 1933) running internally along each valve margin to form a partectal ring (Paddock & Kemp 1990, Round et al. 1990, Pennesi et al. 2011, 2012). Hustedt (1933) classified the genus *Mastogloia* into ten sections mainly based on the valve outline, type of partecta, shape of areola, form of raphe, transapical striae in 10 µm and longitudinal pattern style, while he grouped all freshwater inland species in a separate and distinct section. The section Ellipticae includes a fairly uniform group of species sharing all a distinct elliptical valve outline, even if rarely, several species can have elliptical-lanceolate valve shape or barely noticeably protracted ends or both. Externally, the valve shows two raphe branches without the terminal fissures ending on the mantle and a striation that can form a longitudinal or quincunx pattern. Internally, the partecta are not conspicuously different from one another and they can be restricted or not in their distribution along each valve margin (Hustedt 1933).
In this study, the phylogenetic relationships, based on cladistic methodologies using morphological features, among all taxa belonging to the genus *Mastogloia* section Ellipticae (i.e., 33 taxa) were investigated using the parsimony method. The character states that describe variations of central area, raphe, areola vela and partectal position have a tendency to be very homologous and useful in recovering phylogenies. The typical character states of this section, such as rounded apices, represents an ancestral homology. The phylogenetic hypothesis supports the probable monophyletic origin of the section Ellipticae (synapomorphy). We also reported the taxonomical review of the section, including the description of species new to science, such as *Mastogloia matthaei*, *M. stellae*, *M. rosalbae* and *M. aegyptiaca*.

Letteratura citata

Hustedt F (1933). Die Kieselalgen Deutschlands, Österreichsund der Schweiz unter Berücksichtigung der übrigen LänderEuropas sowie der angrenzenden Meeresgebiete. In Raben-horst L (ed) Kryptogamen Flora von Deutschland, Österreichund der Schweiz. Akademische Verlagsgesellschaft, Leipzig,Vol. 7, Part 2, pp 577–736.

Novarino, G. (1989) An update of the taxa of the genus Mastogloia, with a "resemblance list" for the more recently described ones. Diatom Research 4: 319–343.

Paddock T.B.B. & Kemp K.-D. (1990) An illustrated survey of the morphological features of the diatom genus Mastogloia. Diatom Research 5: 73–103.

Pennesi C., Poulin M., De Stefano M., Romagnoli T. & Totti C. (2011) New insights to the ultrastructure of some marine Mastogloia species section Sulcatae (Bacillariophyceae), including Mastogloia neoborneensis sp. nov. Phycologia 50: 548–562.

Pennesi C., Poulin M., De Stefano M., Romagnoli T. & Totti C. (2012) Morphological studies of some marine Mastogloia (Bacillariophyceae) belonging section Sulcatae, including the description of new species. Journal of Phycology 48: 1248–1264.

Round F.E., Crawford R.M. & Mann D.G. (1990) The diatoms. Biology and morphology of the genera. Cambridge University Press, Cambridge. 747 pp.

VanLandingham S.L. (1971) Catalogue of the fossil and recent genera and Species of diatoms and their synonyms. Part. IV Fragilaria through Naunema. Lehre, Germany. 2133–2178 pp.

AUTORI

Chiara Pennesi (chiara.pennesi@szn.it), Dipartimento di Ecologia Marina Integrata (EMI), Stazione Zoologica Anton Dohrn, Calabria Marine Centre, C. Torre Spaccata, 87071 Amendolara (Cs), Italia.
Michel Poulin (mpoulin@nature.ca), Research and Collections Division, Canadian Museum of Nature, PO Box 3443, Station D, Ottawa, ON KIP 6P4, Canada.
Friedel Hinz†, Alfred Wegener Institute for Polar and Marine Research, Am Handelshafen 12, D-27570 Bremerhaven, Germany
Tiziana Romagnoli (t.romagnoli@univpm.it), Cecilia Totti (c.totti@univpm.it), Dipartimento Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, via Brecce Bianche, 60131 Ancona, Italia.
Mario De Stefano (mario.destefano@unicampania.it), Dipartimento di Scienze e Tecnologie Ambientali Biologiche e Farmaceutiche, Università degli Studi della Campania Luigi Vanvitelli, via Vivaldi 43, 81100 Caserta, Italia

A preliminary insight into the biodiversity of aero-terrestrial green algae in a Czech steppic locality: comparing different methodological approaches

V. Malavasi, I. Černajová, L. Vančurová, P. Škaloud

The authors report the preliminary data on the terricolous and aerophyic algal diversity from a Czech steppic locality. To date, it is known that most terrestrial green microalgae belong to the Chlorophyta lineage and that the biodiversity of this taxonomic group is still poorly explored using molecular techniques (Rindi et al. 2009, Bates et al. 2013; Hodač 2016). During our investigation, soil and rock samples were collected from two long-term plots within the spatio-temporal research site during three seasons. The free-living aero-terrestrial algal community has been characterized by Sanger sequencing of the ITS2 rDNA region and DNA metabarcoding approach. Moreover, the inverted light microscope was used to conduct a morphological investigation.
In total, we retrieved 45 genera belonging to eight orders. Most of the genera belong to the class Trebouxiophyceae. These preliminary results indicate that a combination of multi-tool field-based observations with novel experimental approaches allows us to get a more detailed insight into the diversity and distribution of this community of terrestrial eukaryotic microalgae.
The purpose of this study is to contribute to the knowledge on the diversity and distribution of free-living aero-terrestrial green algae, including the lichen symbiotic partners. Moreover, we present a novel approach to detect the presence of *taxa* that cannot be grown in culture, based on single cell PCR of Percoll gradient fractioned cells.

Letteratura citata

Bates S.T., Clemente J.C., Flores G.E., Walters W.A., Parfrey L.W., Knight R., Fierer N. (2013). Global biogeography of highly diverse protistan communities in soil. The ISME Journal 7(3):652-659.

Hodač L. (2016). Green algae in soil: assessing their biodiversity and biogeography with molecular-phylogenetic methods based on cultures. PhD thesis, Georg August University of Göttingen. In, 188.

Rindi F., Allali H.A., Lam D.W., López-Bautista J.M. (2009). An overview of the biodiversity and biogeography of terrestrial green algae. Biodiversity Hotspots (Rescigno V et al., eds), Nova Science Publishers, Inc., New York.

AUTORI

Veronica Malavasi (veronica.malavasi80@gmail.com), Ivana Černajová, Lucie Vančurová, Pavel Škaloud, Faculty of Science, Department of Botany, Charles University in Prague, Benatska 2, Prague 128 01, Czech Republic.
Autore di riferimento: Veronica Malavasi

The financial support of the Primus Research Programme of Charles University SCI/13 is gratefully acknowledged.

Phytoplankton and environmental drivers at an LTER-offshore station in the northern Adriatic Sea (1988-2018)

F. Neri, T. Romagnoli, S. Accoroni, A. Campanelli, M. Marini, F. Grilli, C. Totti

The Northern Adriatic Sea, the northernmost basin of the Mediterranean Sea represents one of the most productive areas of the Mediterranean Sea, due to the shallow depth and high riverine inputs. The Senigallia-Susak Transect (SST) is a Long-Term Ecosystem Research where physico-chemical parameters and phytoplankton abundances and biomass have been collected since 1988, with a monthly frequency and with several periods of interruption. The aim of this study was to analyse a long-term data set (from 1988 to 2018) referred to a station, located at 15 nM in the SST, beyond the border of the Western Adriatic Current, and therefore not directly affected by coastal nutrient input.
The mean annual cycle of the physical parameters revealed a marked seasonal behaviour of temperature and salinity. Regarding nutrients, Dissolved Inorganic Nitrogen showed a minimum in August, at the surface, and in April, at the bottom, whilst the maximum was found in October (surface) and August (bottom). Orthophosphate showed minimum values in May and maximum in August, at surface, and minimum in January and maximum in December, at bottom. Total phytoplankton showed maximum in June, and minimum in October-November, both at surface and bottom. Diatoms were observed to have a different behaviour at the surface (maximum in July and minimum in August) and at the bottom (maximum in February and minimum in November). Dinoflagellate abundances at surface and bottom showed minimum values in February and the maximum in June. The highest values of coccolithophores were observed in April and August (at surface and bottom, respectively), whilst the minimum was found in August and June, at the surface and bottom, respectively. Phytoflagellates' trend paralleled that of total phytoplankton.
The winter community, as highlighted by IndVal analysis, was characterized by taxa expressing a marked seasonal behaviour, such as the coccolithophore *Emiliania huxleyi*, the dictyochophyte *Octactis speculum* and the diatom *Skeletonema marinoi*, together with some large-sized diatom species, such as *Pseudosolenia calcar avis*, and *Dactyliosolen phuketensis*. Spring communities were dominated by phytoflagellates and only a few indicator taxa were observed. In summer, among the indicator species, small nanoplanktonic species (such as the chrysophyte *Calycomonas vangoori* and the prasinophyte *Pseudoscourfieldia marina*) coexisted with large diatoms (*Cerataulina pelagica* and *Proboscia alata*). In autumn, a number of taxa resulted as indicator species, including some typical autumn species, such as *Asterionellopsis glacialis* and *Chaetoceros curvisetus*.
The study of the interannual variability revealed some significant increasing (e.g. temperature and orthophosphate) and decreasing (e.g. silicates at the bottom) trends. We compared the abundances of main phytoplankton groups, between two periods (1988-2002 and 2013-2018): a significant decrease of dinoflagellates and coccolithophores was observed in winter at surface in the 2nd period. The comparison between dense and non-dense waters showed a significant lower silica content and diatom and dinoflagellate abundances in dense waters than non-dense ones.
Network analysis was used to study the relationships among the phytoplankton community. The study of the seasonal graphs highlighted that species not relevant following the IndVal analysis, such as *Chaetoceros curvisetus*, *C. affinis* and *Syracosphaera pulchra*, were the ones able to influence and affect the overall community (higher centrality values). Instead, seasonal indicator species, such as *Skeletonema marinoi* in the winter network, were observed to have lower number of interactions (degree values) with other species than the not indicator ones. These results confirm that indicator species are related to specific environmental condition of a certain season, whilst the others are homogeneously distributed throughout the year and therefore have more interactions among the community.

AUTORI

Francesca Neri (f.neri@pm.univpm.it), Tiziana Romagnoli, Stefano Accoroni, Cecilia Totti, Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, via Brecce Bianche, 60131 Ancona, Italy
Alessandra Campanelli, Mauro Marini, Federica Grilli, Consiglio Nazionale delle Ricerche, CNR-IRBIM, Largo Fiera della Pesca, 2, 60125 Ancona, Italy
Autore di riferimento: Francesca Neri

Sulfur interaction on chromium tolerance in the unicellular green alga *Scenedesmus acutus*: role of O-acetyl-Serine (Thiol) Lyase (OAS-TL)

G. Molinari, M. Marieschi, L. Martinez Bosch, R. Bolpagni, A. Torelli

In plant cells, an important role in heavy metals toxicity defense is played by sulfur pathway's terminal products in a process known as SED (sulfur enhanced defense). Among the heavy metal, chromium, not essential for plants, enters the cells as chromate exploiting the sulfate transporters. Previous experiments conducted in our laboratory showed a correlation between sulfate and chromium tolerance in two strains of the unicellular green algae *Scenedesmus acutus*, with different metal sensitivity: a wild type (wt) and a chromium tolerant strain (Cr-t). Both strains show an enhanced chromium tolerance after sulfur starvation, furthermore, the Cr-t shows higher cysteine levels than wt strain (Sardella et al. 2019). Whitin the sulfur pathway, the cysteine synthase complex (CSC), formed by the two enzymes Serine Acetyltransferase (SAT) and O-acetyl-Serine (Thiol) Lyase (OAS-TL), has a pivotal role. The free OAS-TL dimers synthetize cysteine from O-acetyl-serine (OAS) and sulfide while OAS complexed in the CSC plays a regulative function on SAT activity. The CSC is stabilized by sulfide and destabilized by OAS, its final product, which acts as a positive feedback regulator on sulfate uptake/assimilation pathway (Wirtz et al. 2006). Furthermore, OAS-TL has a regulative function on active sulfate uptake, interacting with the STAS domain of plasma membrane H^+/SO_4^2 transporters (Shibagaki et al. 2010). A databases search highlighted, thanks to a comparison between *Chlamydomonas reinhardtii* genes and the genome of *Tetradesmus. obliquus* (synonymous of *S. acutus*) recently sequenced, but not annotated yet, four *OAS-TL* isoforms. Phylogenetic analysis indicated that OAS-TL 2 is homologous to protein of prokaryotes and non-photosynthesizing eukaryotes, while the other three isoforms are present in both Clorophyceae and Trebouxiophyceae groups with the isoform OAS-TL 4 phylogenetically closer to terrestrial plants. The enzymatic assay showed a general increase of the OAS-TLs activity, measured as the quantity of cysteine produced, in response to sulfur deprivation, but not in response to chromium exposition. Differences between the two strains remain to be further evaluated. The expression analysis, conducted with competitive RT-PCR, highlighted differences in the basal levels of the four isoforms: OAS-TL2 appears to be the least, and OAS-TL 4 the most expressed, while OAS-TL 1 and 3 have intermediate and similar expression levels. Moreover, OAS-TL 1 and 3 undergo little expression changes whereas the isoforms 2 and 4 are significantly inducible by sulfur starvation. From these absolutely preliminary results, we can hypothesize a role of OAS-TLs in the transient tolerance increase induced in both strains by sulfur starvation, while their involvement in the different basal chromium sensitivity of the two strains remains to be investigated.

Letteratura citata

Sardella A., Marieschi M., Mercatali I., Zanni C., Gorbi G. (2019). The relationship between sulfur metabolism and tolerance of hexavalent chromium in *Scenedesmus acutus* (Spheropleales): Role of ATP sulfurylase. Aquatic Toxicology, 216: 105320.

Shibagaki N., Grossman A. G. (2010). Binding of Cysteine Synthase to the STAS Domain of Sulfate Transporter and its Regulatory Consequences. The Journal of Biological Chemistry, 285: 25094-25102.

Wirtz M., Rüdiger H. (2006). Functional analysis of the cysteine synthase protein complex from plants: Structural, biochemical and regulatory properties. Journal of Plat Physiology, 163: 273-286.

AUTORI

Giuseppe Molinari (giuseppe.molinari@unipr.it), Matteo Marieschi, Rossano Bolpagni, Anna Torelli, Dipartimento di Chimica, Scienze della Vita e della Sostenibilità Ambientale, Università di Parma, Viale delle Scienze 11/A, 43124 Parma, Italy

Lorena Martinez Bosch, Faculty of Sciences, Universitat de Girona (UdG), C/Maria Aurèlia Capmany, 69, 17003, Girona, Spain

Autore di riferimento: Giuseppe Molinari

Biodiversity and ecological significance of diatom community on seagrasses and corals from Saudi Arabian coasts of the Arabian Gulf

M. De Stefano, C. Pennesi, C. Auciello, C. Ciniglia, M. Iovinella, J.H. Moritz, M.A. Qurban, L.Rabaoui

In equatorial and tropical marine waters, the rates of primary production of microalgal communities associated with seagrasses and seaweeds are comparable or sometimes higher to those of the phytoplankton component. These benthic microalgal communities are mainly represented by a limited number of diatom genera, belonging to different growth forms that can be considered fully adapted to the epibenthic lifestyle. In spite of the important ecological role played in the food chain, the biodiversity of diatom communities on seagrasses and seaweeds is still poorly studied and highly underestimated while that on corals has been virtually neglected as there are only few studies on this topic in the literature. Miller et al. (1977) reported tens of diatom genera associated with hard corals in Florida, besides those associated with the co-occurring seagrass *Thalassia testudinium*. More recently, pennate diatoms were reported colonizing corals of the genus *Porites spp*. on the Australian Great Barrier Reef (Diaz-Pulido & McCook 2002).

Our study, entirely based on scanning electron microscopy (SEM) investigation of diatom communities in undisturbed conditions, present the first data of biodiversity of diatoms associated to phanerogams and hard corals along the Saudi Arabian coasts of the Arabian Gulf. Sampling campaign was based on two season (winter and summer) and stations were selected on the basis of the co-presence of the seagrass (*Halodula uninervis*, *Halophila ovalis*, *Halophila stipulacea*) and coral species (*Acropora* sp., *Porites* sp. and *Platygyra* sp.) selected as optimal substrates for benthic diatom communities. Preliminary results of SEM floristic and quantitative analysis confirm the presence of benthic diatom communities in both the substrates collected and in each of the two sampled seasons. Taxonomical analysis of winter season samples allow us to identify 38 diatom species in seagrasses and approximately 30 species in corals. Although the composition in diatom species does not vary significantly between phanerogams and corals within each sampling location, this is not true for their total cell abundances (cell/mm2), which vary greatly between the former and the latter respectively. Indeed, the total abundance values of diatom communities on seagrasses ranged from a minimum of 1618 to a maximum of 11863 cells/mm^2 while those found on corals do not exceed hundreds of cells/mm^2 thus resulting in 10 to 100 times lower. *Halodula uninervis* was generally the most epiphytized phanerogam species. More than 70% of diatom species appear to be present both on seagrasses and corals in sampling locations where the two substrates coexist. However of the approximately 38 species constituting the seagrasses diatom community, only those belonging to the genus *Cocconeis* (mainly *Cocconeis neothumensis var. marina, C. scutellum var. posidoniae, C. scutellum var. scutellum, C. stauroneiformis*) strongly dominate the communities in terms of abundance. *Cocconeis* dominance was indeed always manifested in the diatom communities of all *Halophila* species analyzed in each sampling sites reaching maximum values of over 10,000 cells/mm2, approximately one hundred times higher than those of other genera not exceeding all together 250-300 cell/mm2

In summer season samples we identified less than 20 diatom species in seagrasses and approximately 40 species in corals. The total abundance of diatom in seagrasses was much lower than the winter one in almost all locations ranging from a minimum of 260 to a maximum of 3200 cells/mm^2 while, on the contrary, that found in the corals was higher than the values recorded in winter, settling among 200 and 600 cells/mm^2. *Halodula uninervis* and H. stipulacea were the most epiphytized phanerogam species while among the corals *Acropora* was the most colonized genus. Compared to what observed in winter season, diatom community was still dominate by *Cocconeis* species (mainly *Cocconeis neothumensis var. marina*) only in seagrasses while in the corals most of the species belonged to genera characterized by erect and motile growth forms as *Lichmophora*, *Grammatophora*, *Fragilaria* and *Navicula* which were also responsible for the highest abundance values recorded. It is worth noting that these communities of erect diatoms colonize mainly the dead areas of the corals examined, making these organisms a more favorable biogenic substrate than seagrasses for colonization and proliferation of diatoms during the summer season.

AUTORI

Mario De Stefano (mario.destefano@unicampania.it), Auciello Concetta. Ciniglia Claudia, Department of Environmental, Biological and Pharmaceutical Sciences and Technologies, University of Campania "L. Vanvitelli", via Vivaldi 43, 81100 Caserta, Italy,

Manuela Iovinella, Department of Biology, University of York, YO105DD, York UK

Chiara Pennesi, Stazione Zoologica Anton Dohrn, Sede Calabria, Italy

Lotfi Rabaoui, Jeppe Hein Moritz and Mohamed Ali Qurban, Marine Studies Section, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia

Acclimation to low sulfate availability in marine phytoplankton

M. Bruno, C. Gerotto

Sulfur (S) is an essential macronutrient, acquired by cells as sulfate and assimilated as sulfide in an energy demanding reductive process. Despite the central role of S in multiple cellular processes, like electron transport and redox regulation of enzymes, our knowledge on S metabolism is still lacunose, particularly in the case of marine microalgae. Present oceans are characterized by the historically highest sulfate concentration of about 28 mM. The increase of oceanic sulfate concentrations occurred at the boundary between the Paleozoic and the Mesozoic eras and matched with a transition in the species dominance in marine phytoplankton. Green algae and cyanobacteria, characterized by relatively low S cell quota, were prominent when the S availability was lower (Paleozoic), whereas red lineage algae, with higher S cell quota, are more abundant in today´s oceans.
We here investigated how different marine phytoplanktonic species acclimated to low sulfate availability. Selected species were two green algae, *Tetraselmis suecica* and *Dunaliella salina*, and the diatom *Phaeodactylum tricornutum*, representative of species of different phylogeny and which evolved at different sulfate concentrations in the oceans. The diatom was the most affected in terms of growth reduction and changes in the cell macromolecular composition under sulfate limitation. Its maximal photosynthetic quantum yield was also slightly decreased compared to the sulfate replete culture, while photosynthesis in the green species analyzed was almost unaffected, despite the key role of S in electron transport. Results thus suggest the cultures successfully acclimated to the low sulfate availability by prioritizing the allocation of available S to core processes, like photosynthesis. Further, the stronger effect on growth and physiology of sulfate limitations in the diatom cells is in line with the sulfate facilitation hypothesis, which suggested the rise in oceans sulfate availability played a role in the rise to dominance of red lineage algae.

AUTORI

Maria Bruno, Caterina Gerotto (c.gerotto@univpm.it), Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Via Brecce Bianche, 60131 Ancona, Italia.
Autore di riferimento: Caterina Gerotto

Algal polysaccharides as inhibitors of biofilm formation

D. Spagnuolo, V. Zammuto, M. G. Rizzo, A. Spanò, A. Di Martino, S. Guglielmino, G. Calabrese, F. Capparucci, C. Gervasi, M. S. Nicolò, A. Manghisi, C. Gugliandolo, M. Morabito, G. Genovese

The use of some macroalgal biomass as a source of bioactive molecules could take place in the transformation from what is considered a waste into an economic resource. Various algal extracts can be used as a starting pool to obtain products used in many industrial sectors, even profoundly different from each other, from agriculture to pharmaceuticals. Polysaccharide extracts as a bactericidal or just to inhibit the biofilms are one of the most interesting and remunerative research line, also important to minimize the use of antibiotics and increasing that of natural substances (Rossiter et al. 2017).
In this study, polysaccharide extracts from genetically labelled macroalgae (DNA Barcode), *Chaetomorpha aerea* (Chlorophyta), *Agardhiella subulata* and *Hypnea cornuta* (Rhodophyta), sampled in Lake Ganzirri (Messina, Italy), were evaluated for their antimicrobial and antibiofilm effects on both human and animal pathogens, in particular on the human pathogens (HP), *Pseudomonas aeruginosa* ATCC 27853 and *Staphylococcus aureus* ATCC 29213, and on pathogens in aquaculture (AP), *Vibrio anguillarum*, *V. harveyi*, *V. parahaemolyticus* and *Photobacterium damselae* subsp. *piscicida*.
Each crude extract showed dose-dependent inhibitory activity on the biofilm formation on HP. The highest concentration (400 µg/ml) of *C. aerea* and *A. subulata* extracts strongly acted on the early adhesion of *P. aeruginosa* (53% and 45%, respectively), whereas extracts from *H. cornuta* and *A. subulata* greatly prevented the adhesion of *S. aureus* (59% and 50%, respectively). The addition of *A. subulata* and *C. aerea* extracts reduced the biofilm growth of *S. aureus* but did not affect its preformed biofilm. Differently, the extract from *A. subulata* was also able to reduce the biofilm growth of *P. aeruginosa* and its developed biofilm.
About AP at the highest concentration (400 µg/ml), the strongest reduction of biofilm formation was observed in the presence of *C. aerea* and *A. subulata* extracts against *V. harveyi* (59 and 53%, respectively), followed by the *H. cornuta* extract against *Photobacterium piscicida* (52%) and *V. parahaemolyticus* (28%). The extract from *A. subulata* was also active against the biofilm formation of *P. piscicida* (48%). All the extracts did not show any potential toxicity *in vivo* fish-embryo *Danio rerio* assays.
The HP tested in this study are found in chronic wounds and they are often nosocomial (DeLeon et al. 2014) these polysaccharides could be proposed to prevent the adhesion and to contrast the biofilm growth of *P. aeruginosa* and *S. aureus* in several medical applications. In others hands, AP affect many fish species with several associated diseases (Zhang et al. 2020); there are different ways to counter them, such as antibiotics and vaccines, but often they are not always effective (Kathleen et al. 2016).
Algal extracts may be used to prevent bacterial biofilm formation in aquaculture and in medical purposes.

References

DeLeon, S., Clinton, A., Fowler, H., Everett, J., Horswill, A.R. & Rumbaugh, K.P. 2014. Synergistic Interactions of *Pseudomonas aeruginosa* and *Staphylococcus aureus* in an In Vitro Wound Model. Infect. Immun. 82:4718–28.

Kathleen, M.M., Samuel, L., Felecia, C., Reagan, E.L., Kasing, A., Lesley, M. & Toh, S.C. 2016. Antibiotic Resistance of Diverse Bacteria from Aquaculture in Borneo. International Journal of Microbiology. 2016:1–9.

Rossiter, S.E., Fletcher, M.H. & Wuest, W.M. 2017. Natural Products as Platforms To Overcome Antibiotic Resistance. Chem. Rev. 117:12415–74.

Zhang, X.-H., He, X. & Austin, B. 2020. *Vibrio harveyi*: a serious pathogen of fish and invertebrates in mariculture. Mar Life Sci Technol. 2:231–45.

AUTHORS

Damiano Spagnuolo (dspagnuolo@unime.it), Vincenzo Zammuto, Maria Giovanna Rizzo, Antonio Spanò, Salvatore Guglielmino, Giovanna Calabrese, Fabiano Capparucci, Claudio Gervasi, Marco Sebastiano Nicolò, Antonio Manghisi, Concetta Gugliandolo, Marina Morabito, Giuseppa Genovese, Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Viale F. Stagno d'Alcontres 31, 98166, Messina, Italy.
Antonio Di Martino, Research School of Chemistry & Applied biomedical Sciences, Tomsk Polytechnic University, Lenin Avenue 43, 63400, Tomsk, Russian Federation.

Studio sperimentale sugli effetti della chiusura del MOSE sulla comunità microfitobentonica nella laguna di Venezia (nord Adriatico)

V. Natali, T. Cibic

Il MOSE (MOdulo Sperimentale Elettromeccanico) è costituito da 78 paratoie mobili installate alle tre bocche della laguna di Venezia. Questa opera ingegneristica è in grado di separare la laguna dal Mare Adriatico e isolarla temporaneamente durante le maree estreme. Per indagare come le diverse comunità lagunari bentoniche rispondano agli effetti della segregazione dall'acqua marina a breve e a lungo termine (4, 24, 28, 48 ore) in seguito alla chiusura del MOSE, nel luglio 2019 è stato condotto uno studio sperimentale nell'ambito del progetto Venezia 2021. In Palude di Cona, un'area lagunare soggetta a frequenti eventi di ipossia, sono stati posizionati 18 mesocosmi (~ 0,8 m^3 ciascuno) divisi in tre repliche sperimentali, al fine di isolare artificialmente piccole porzioni di basso fondale. In questo lavoro verranno presentati gli effetti dello studio di mesocosmo sulla comunità microfitobentonica (MPB). Considerando complessivamente i 5 tempi sperimentali, la comunità microfitobentonica è risultata dominata dal gruppo delle diatomee che hanno rappresentato una frazione variabile tra l'82.07% e il 98.03%, di cui i generi più abbondanti sono risultati *Tryblionella* e *Thalassiosira*. I fitoflagellati sono stati il secondo gruppo più abbondante, con un'abbondanza relativa massima (RA) del 14.67%, invece densità non trascurabili sono state evidenziate in altri 3 gruppi: stadi di resistenza, cianobatteri e clorofite (RA massimo: 2.78%, 2.74% e 1.46%, rispettivamente). È stata inoltre osservata un'abbondanza media (considerando le tre repliche sperimentali) inferiore al tempo T0 (48200±12019 cell cm^{-3}) rispetto agli altri tempi sperimentali, mentre l'abbondanza media maggiore è stata ottenuta al T4 (134250±4030 cell cm^{-3}). In termini di composizione specifica, al T0 (all'esterno dei mesocosmi) ha prevalso *Paralia sulcata*, una specie ticopelagica e non strettamente associata al sedimento; invece, dal T1 al T4 (all'interno dei mesocosmi) è stata evidenziata una dominanza di diverse specie appartenenti al genere *Tryblionella (T.* cf. *compressa*, *T.* cf. *acuminata*, *T.* cf. *apiculata*, *T. cf. navicularis*, *T.* cf. *hungarica*, *T.* cf. *coarctata*) che prediligono elevati carichi organici. L'analisi dei cluster e l'ordinamento n-MDS hanno evidenziato questo cambiamento dal T0 al T4, in cui si osserva chiaramente come diverse specie di *Tryblionella* aumentino in numero durante l'esperimento, prendendo il sopravvento all'interno della comunità. Al contrario, l'abbondanza di *Paralia sulcata* è stata influenzata dalle condizioni sperimentali iniziali e la sua densità cellulare è diminuita nell'arco dell'esperimento. Le curve di k-dominanza hanno messo in risalto una comunità MPB man mano più biodiversa durante il corso dell'esperimento e soprattutto al T4. I nostri risultati, assieme ai dati fisico-chimici ottenuti in acqua e nei sedimenti, suggeriscono che le condizioni di arricchimento organico instauratesi in seguito alla deposizione del particellato sospeso hanno stimolato la proliferazione del genere opportunista *Tryblionella*. Questi dati preliminari indicano che l'idrodinamismo inferiore indotto dalla chiusura del MOSE può influenzare la struttura della comunità microalgale bentonica, una comunità fondamentale per il funzionamento dell'ecosistema lagunare di Venezia.

AUTORI

Vanessa Natali (vnatali@inogs.it), Tamara Cibic, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS, Sezione di Oceanografia, via A. Piccard 54, 34151 Trieste, Italia
Autore di riferimento: Vanessa Natali

Functionalization of the frustules of *Staurosirella pinnata* for Ni adsorption from aqueous solutions

S. Savio, S. Farrotti, A. Di Giulio, S. Ceschin, N.T.W. Ellwood, R. Congestri

Diatoms produce silica cell walls, frustules, that exhibit species-specific porous patterns, and applications of these ordered structures as filters, molecular sieves, insulators, optical coatings, scaffolds, have been demonstrated (Rabiee *et al*., 2021). In addition, frustules can be functionalized, using coating agents able to incorporate thiol and amino groups, in order to increase their binding sites to immobilize target compounds.
In this work, frustules of a brackish strain of *Staurosirella pinnata* (VRUC 290) were obtained from the exhausted biomass after cascade extraction processing of cultures (Savio *et al*., 2020). The exhausted biomass was treated by different hot acids cleaning methods (H_2S0_4:HNO_3 3:1, HNO_3:H_2SO_4:H_20 2:1:1 and HCl 95% with sodium permanganate) to remove the organic matter and obtain "pure" frustules.
We developed an *ad-hoc* functionalization procedure starting from a published protocol (Zhang *et al.*, 2015), using the reagents 3-Mercaptopropyl-trimethoxysilane (MPTMS) and 3-aminopropyl-trimethoxysilane (APTMS).
Functionalization was tested in 37 experiments that differed in solvents, functionalization time and reagent concentrations. At the end of each functionalization experiment, frustules were analyzed by Scanning Electron Microscopy (SEM), after gold sputtering, to select the best set up allowing for homogeneity of the surface coating, preserving its porosity, and adequate dispersion of frustules on the stubs. The developed protocol was thus applied to a further set of frustules to evaluate the ability to remove nickel (Ni) from aqueous solutions at three pH conditions (4, 7 and 10) after 24 hrs treatment. Functionalized frustules were able to remove Ni more efficiently than raw frustules and independently from solution pH.

References

Rabiee N., Khatami M., Soufi G.J., Fatahi Y., Iravani S., Varma R.S. (2021). Diatoms with Invaluable Applications in Nanotechnology, Biotechnology, and Biomedicine: Recent Advances. ACS Biomaterials Science & Engineering, 7: 3053-3068.

Zhang J., Ding T., Zhang Z., Xu L., Zhang C. (2015). Enhanced adsorption of trivalent arsenic from water by functionalized diatom silica shells. PLoS One, 10.

Savio S., Farrotti S., Paris D., Arnaìz E., Díaz I., Bolado S., Munoz R., Rodolfo C., Congestri R. (2020). Value-added co-products from biomass of the diatoms *Staurosirella pinnata* and *Phaeodactylum tricornutum*. Algal Research, 47.

AUTORI

Saverio Savio (saverio.savio@gmail.com), Serena Farrotti, Roberta Congestri, Dipartimento di Biologia, Università degli Studi di Roma 'Tor Vergata', Via della Ricerca Scientifica snc, 00133, Roma; AlgaRes srl, Via Antonio Silvani 130, Roma.
Di Giulio Andrea, Ceschin Simona, Ellwood Neil Thomas William, Dipartimento di Scienze, Università degli Studi di Roma Tre, Viale Guglielmo Marconi 446, 00146 Roma

Biosynthesis of polyhydroxybutyrate (PHB) by Cyanobacteria for bio-plastic production

M. Simonazzi, L. Pezzolesi, P. Galletti, C. Gualandi, R. Pistocchi, N. De Marco, Z. Paganelli, C. Samorì

Polyhydroxyalkanoates (PHAs) are a class of biopolymers mainly produced by some heterotrophic bacteria under specific culture conditions, such as nutrient limitation, and serve as carbon storage for cellular metabolism. PHAs are bio-based and biodegradable compounds, whose chemical and physical characteristics can be modulated depending on the culture conditions and microorganism used, thus making them suitable candidates for the production of bio-plastic as an alternative to petroleum-based plastics. From a market perspective, global production of PHAs is almost entirely sustained by exploiting cultures of the gram-negative bacterium *Cupriavidus necator*. Only recently, the potential of Cyanobacteria as producer of PHAs has been investigated, finding mixotrophy as the best culture condition to boost the accumulation of these biopolymers. In this study, different strains of Cyanobacteria have been tested for their ability of accumulating the co-polymer polyhydroxybutyrate (PHB), under mixotrophic conditions. Among the tested strains, the best candidate for PHB accumulation was a cyanobacterium isolated from a local freshwater reservoir (Reno river, Emilia-Romagna, Italy), i.e. *Anabaena* sp., thus it was selected for further investigations to boost PHB cellular content. Several cultivation conditions were tested at laboratory scale (0.2 L) by varying the composition of growth medium (lack of nitrogen, phosphorus or both nitrogen and phosphorus), and the organic carbon source and concentration (sodium acetate, glucose). *Anabaena* sp. accumulated up to 40% PHB on biomass after 7 days of cultivation in a phosphorus-free medium with the addition of sodium acetate (5.0 g L^{-1}). Subsequently, these mixotrophic conditions were tested on a larger scale (10 L) to study the biochemical composition of the cyanobacterial biomass (PHB, proteins, polysaccharides, and lipids), and to extract and characterize the biopolymer produced after 3, 5 and 7 days of cultivation. The scaling-up process did not negatively influence the ability of *Anabaena* sp. to accumulate PHB, whose content was boosted up to 46% after 7 days, along with 6% of lipids, 12% of polysaccharides, and 28% of proteins. The extracted biopolymer had a high molecular weight (M_w: 3.0-3.1 MDa) and a low polydispersity index (PDI: 1.6-1.7) compared to PHB recovered from other Cyanobacteria, suggesting a long-chain biopolymer with a more homogeneous structure. On the contrary, the elemental composition in terms of carbon, hydrogen and nitrogen was similar to the one from commercial PHB, but with few traces of nitrogen especially for PHB collected after 3 days of cultivation. The recovered PHB showed a time-dependent coloration, from deep-green (day 3) to light pink (day 7), as a consequence of a possible pigment contamination. Although high PHB contents were here achieved, the recovery of the biopolymer from *Anabaena* sp. decreased over time, and likely due to a strong association between PHB granules and thylakoids membranes as observed for other Cyanobacteria.
In conclusion, the ability of the cyanobacterium *Anabaena* sp. to accumulate PHB under mixotrophic conditions was here confirmed, observing high productivity yields compared to other Cyanobacteria. More in-depth investigations should be addressed to the possible use of other carbon sources for the cultivation (e.g. CO_2) and to optimize the downstream process to reduce the issues related to the scarce recovery of the polymer.

AUTORI

Mara Simonazzi (mara.simonazzi2@unibo.it), Laura Pezzolesi, Rossella Pistocchi, Dipartimento di Scienze Biologiche, Geologiche ed Ambientali (BiGeA), Università di Bologna, via Sant'Alberto 163, 48123 Ravenna; Centro Interdipartimentale di Ricerca Industriale Fonti Rinnovabili, Ambiente, Mare ed Energia (CIRI-FRAME), Università di Bologna, via S. Alberto 163, Ravenna

Nicole De Marco, Zoe Paganelli, Dipartimento di Scienze Biologiche, Geologiche ed Ambientali (BiGeA), Università di Bologna, via Sant'Alberto 163, 48123 Ravenna

Paola Galletti, Chiara Samorì, Dipartimento di Chimica "Giacomo Ciamician", Università di Bologna, via S. Alberto 163, Ravenna; Centro Interdipartimentale di Ricerca Industriale Fonti Rinnovabili, Ambiente, Mare ed Energia (CIRI-FRAME), Università di Bologna, via S. Alberto 163, Ravenna

Chiara Gualandi, Centro Interdipartimentale di Ricerca Industriale Fonti Rinnovabili, Ambiente, Mare ed Energia (CIRI-FRAME), Università di Bologna, via S. Alberto 163, Ravenna; Centro Interdipartimentale di Ricerca Industriale (CIRI) Meccanica Avanzata e Materiali (CIRI-MAM) Università di Bologna, Viale Risorgimento 2, Bologna

Autore di riferimento: Mara Simonazzi

Macroalgal diversity response to climate extreme events

C. Giommi, G. Sarà, A.M. Mannino

Biodiversity-Ecosystem Function experimental studies focusing on marine systems are few and produce contrasting outcomes. Here, we provide experimental proofs on how communities, on a natural gradient of diversity, respond under stressful conditions in intertidal habitats.
In August 2017 a field experiment was performed in Western Sicily (Italy) in a site characterized by tidal pools whose biodiversity structure and composition change as a function of the distance from the low tide mark. The pools closer to the sea are more stable from a thermal and oxic point of view and characterized by high algal biodiversity. Those further from the sea are highly variable with extreme conditions and are poorer in species. We chose 12 pools – homogeneous in size and geometry – and, to know the environmental fluctuations, we measured, for 24 hours at minute resolution, the oxygen concentration (through an oximeter) and the temperature (using thermos-loggers). Then, we carried out a manipulative experiment, follow the same field procedures, to investigate effects of a climatic event (heat wave). We used the community metabolism (oxygen consumption, mg/L) as a proxy of functioning. At the end of the treatments, we characterized the biodiversity contained in each pool by scraping 3 quadrats 10 x 10 cm and related it to community metabolism.
No difference was observed in the metabolism between treated and controlled in high diversity pools; whilst significant differences have been found in low diversity pools for the climatic stressor. Interestingly, these results show that under the action of a disturbance, the functioning – as expressed by oxygen consumption – can be altered over time. The richer the community increases the ability to restore the control conditions, while the poorer pools were unable to do so.

AUTHORS

Chiara Giommi, (chiara.giommi@szn.it), Department of Integrative Marine Ecology (EMI), Stazione Zoologica Anton Dohrn, CRIMAC, Calabria Marine Centre, Amendolara, Italy.
Gianluca Sarà, Department of Earth and Marine Science, University of Palermo, Viale delle Scienze, Ed.16, 90128 Palermo, Italy.
Anna Maria Mannino, Department of Biological, Chemical and Pharmaceutical Sciences and Technologies, University of Palermo, Via Archirafi 28, 90132 Palermo, Italy.
Autore di riferimento: Chiara Giommi

Is the south-Mediterranean canopy-forming *Ericaria giacconei* (= *Cystoseira hyblaea*) a loser from ocean warming?

A. Falace, G. Marletta, G. Savonitto, F. Candotto Carniel, M. Srijemsi, S. Bevilacqua, M. Tretiach, G. Alongi

Canopy-forming brown algae support highly productive ecosystems whose decline has been attributed to the interplay of several anthropogenic disturbances. Climate change could have disruptive effects on the biology of these species, but the role of temperature in the development of early life stages is poorly understood.
The aim of this study was to assess the response of *Ericaria giacconei*, a winter-reproducing Southern-Mediterranean endemic species, to thermal stress by testing five temperatures (12, 15, 18, 24, 28 °C) on adults and early stages.
Chlorophyll a fluorescence of adult plants was measured at 0, 24, 72, and 120 hours on nine fronds in each of the three aquaria per treatment. To assess egg release, zygote settlement, and embryo growth rate, approximately 1200 receptacles were cultured on six Petri dishes per temperature treatment, and 10 random subsections of 2 x 2 mm were examined in three Petri dishes at 0, 20, 44, and 92 hours after fertilization.
Adult plants showed a plastic physiological response, and thermal stress had no significant effect on PSII efficiency. Embryos fully developed only at 12 and 15 °C. Mortality increased at 18 and 24 °C, and no zygotes survived at 28 °C.
In a scenario of further increasing temperatures, the effects of warming could affect the recruitment of *E. giacconei* and increase its vulnerability to further stresses. These effects on the survival of early stages, which are the bottleneck for the long-term survival of the species, should be taken into account in conservation and restoration measures to maintain canopy-forming macroalgal populations and associated biodiversity and ecosystem services.

AUTORI

Annalisa Falace (falace@units.it), Gilda Savonitto, Fabio Candotto Carniel, Marina Srijemsi, Stanislao Bevilacqua, Mauro Tretiach, Dipartimento di Scienze della Vita Università di Trieste Via L. Giorgieri 10, 34127 Trieste.
Giuliana Marletta, Giuseppina Alongi, Dipartimento di Scienze Biologiche, Geologiche e Ambientali sez. "Biologia Vegetale", Via Empedocle 58, 95128 Catania

Multi-gene phylogeny reveals a new genus and species of Hapalidiales (Rhodophyta) from Antarctica: *Thalassolithon adeliense* gen. et sp. nov.

R. Trentin, E. Moschin, A. Grapputo, F. Rindi, S. Schiaparelli, I. Moro

Over the last decade, the genetic diversity of coralline red algae has been gradually unraveled using DNA sequence data. This resulted in the discovery of many novel lineages and taxonomic reassessments at genus and species level. Despite this, our knowledge of the diversity of these organisms in some inaccessible regions of the planet, such as Antarctica, remains incomplete. In this study we examined crustose coralline algal specimens, collected in 2013 during the XXVIII Italian Expedition in Antarctica in Adélie Cove (Terra Nova Bay; Ross Sea) and maintained in the collections of the Italian National Antarctic Museum (MNA, Section of Genoa). The samples were characterized through a polyphasic approach combining DNA sequence data obtained for four genes (*psb*A, *rbc*L, 18S rRNA and *cox*1) with morpho-anatomical analyses and analyses of elemental composition of different parts of the thallus. Molecular data revealed that all specimens belonged to the same species. Phylogenetic reconstructions unambiguously recovered this alga as a member of the order Hapalidiales, but without any close relationship with any well-established genus of this order. Instead, it formed a well-supported lineage with specimens named Hapalidiales sp. ZH-Twist-2019, collected in New Zealand, for which no formal assignment at genus level has been proposed yet. Species delimitation methods (ABGD, PTP, GMYC) applied to the *psb*A dataset indicate that our Adélie Cove coralline alga is a distinct species from all other known hapalidiacean species. Based on our results, we establish for this lineage a new genus, *Thalassolithon* Trentin, Moschin & Moro, and describe the new alga as *Thalassolithon adeliense* Trentin, Moschin & Moro.

AUTHORS

Riccardo Trentin (riccardo.trentin.2@studenti.unipd.it), Emanuela Moschin, Alessandro Grapputo, Isabella Moro, Department of Biology, University of Padova, Italy;

Fabio Rindi, Department of Life and Environmental Sciences, Università Politecnica delle Marche, Italy;

Stefano Schiaparelli, Department of Earth, Environment and Life Sciences, University of Genoa, Italy; Italian National Antarctic Museum (MNA, Section of Genoa), University of Genoa, Genoa, Italy.

Luce e Silicizzazione: la luce è coinvolta nella deposizione di Si nel frustulo e nella capacità di affondamento di diatomee con diversa morfologia?

A. Petrucciani, A. Norici

Le diatomee sono microrganismi unicellulari importanti negli oceani odierni a causa del loro coinvolgimento nei cicli del carbonio e del silicio: è noto che partecipano a quasi il 20% della produzione primaria globale e ad una corrispondente precipitazione annuale di silice biogenica di 240 Tmol (Falkowski *et al*., 2007).
La luce è il motore cruciale nella distribuzione degli organismi fotosintetici attraverso la colonna d'acqua non solo in base ai parametri fotosintetici del fitoplancton ma anche perché è tra i fattori abiotici che influenzano il processo di silicizzazione. Alterando la deposizione di Si cellulare (Su *et al*., 2018), si suppone che la luce controlli la capacità di affondamento delle diatomee diversamente silicizzate e, di conseguenza, la loro distribuzione nella colonna d'acqua. Tuttavia, i risultati diretti sono ancora controversi.
Studi preliminari sulla capacità di affondamento e di buffer protonico sono qui condotti su varie diatomee esposte a due intensità luminose (180 e 60 µmol $m^{-2}s^{-1}$). Vengono inoltre eseguite analisi di crescita, quantificazione di C, N e Si su base cellulare e di volume, isotopi stabili di C, caratterizzazione morfologica. La tecnica di Dynamic Light Scattering, utilizzata per determinare il profilo di distribuzione dimensionale delle nanoparticelle in soluzione, viene qui applicata come strumento innovativo negli studi ecofisiologici per valutare direttamente la capacità di affondamento delle diatomee.
Le diatomee centriche mostrano un tasso di affondamento dipendente dalla luce ma non sempre correlato ad una diversa silicizzazione.

Letteratura Citata

Falkowski, P.G., Raven, J.A. (2007). Aquatic Photosynthesis. Vol. 2. Princeton University Press.
Su Y., Lundholm N., Ellegaard M. (2018). The effect of different light regimes on diatom frustule silicon concentration, Algal Research 29 (2018) 36–40.

AUTORI

Alessandra Petrucciani (a.petrucciani@pm.univpm.it), Alessandra Norici, Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Via Brecce Bianche, 60131 Ancona.

Phototrophic biofilms deteriorating stone monuments: characterization and development of innovative and sustainable control methods.

R. Ranaldi, L. Rugnini, F. Gabriele, N. Spreti, C. Casieri, L. Bruno

Biodeterioration is a well-known phenomenon in the cultural heritage field, often involving stone monuments. Cyanobacteria are the main component of phototrophic biofilms developing on the lithic surfaces exposed to natural or artificial light (Rugnini *et al*., 2020). Their presence can lead to a mechanical action that causes substrates' micro-decohesion and metabolic processes that can also induce chemical transformations of materials. These changes may be due to secretion of substances, waste by-products and extracellular enzymes, when organisms use the material for nutritional purposes. Furthermore, the pigmentation of biofilm-forming cyanobacteria can induce an aesthetic damage on substrates with the discoloration of the lithic surfaces. Techniques commonly used for the removal and eradication of these biological patinas from stone surfaces involve the use of physical and chemical methods. The former are mechanical brushes that remove the biofilms but can induce damages to the material by increasing its bioreceptivity; the latter are chemical methods including the use of biocides such as benzalkonium chloride, which kill microorganisms but are potentially toxic for operators and harmful to the environment. From these problems arose the need to develop innovative, eco-sustainable and safe solutions (Fidanza and Caneva, 2019).
In this study, the biocidal activities of essential oils (EOs) of *Lavandula angustifolia* and *Thymus vulgaris* against cyanobacterial biofilms were compared. Moreover, to find out a suitable method for *in situ* application, EO of *T. vulgaris* was encapsulated within a sodium alginate hydrogel (Gabriele *et al*., 2021) at diverse concentrations and applied at different time intervals on samples obtained from biofilms consisting of different genera of cyanobacteria isolated from confined environments and maintained in the Laboratory of Biology of Algae (LBA). The efficacy of the treatment was evaluated measuring the photosynthetic activity with a portable pulse amplitude modulated (Mini-PAM) fluorometer before and after the application of the EOs and with observations at light microscope to control the appearance of changes in morphology of the microorganisms treated. The results showed that both solutions have biocidal activity, but only the samples treated with *T. vulgaris*' EO showed complete inhibition of the cyanobacterial photosynthesis after 7 days. The encapsulation of EO in the hydrogel resulted particularly promising with the inhibition of photosynthetic activity at all the concentrations tested. Colonization tests on different stone materials have also been carried out giving useful information on the substrate colonization selectivity by cyanobacteria.

Letteratura citata.

Fidanza M.R., Caneva G. (2019). Natural biocides for the conservation of stone cultural heritage: A review. Journal of Cultural Heritage 38, 271-286.

Gabriele F., Tortora M., Bruno L., Casieri C., Chiarini M., Germani R., Spreti N. (2021). Alginate-biocide hydrogel for the removal of biofilms from calcareous stone artworks. Journal of Cultural Heritage 49, 106-114.

Rugnini L., Migliore G., Tasso F., Ellwood N.T.W., Sprocati A.R., Bruno L. (2020). Biocidal Activity of Phyto-Derivate Products Used on Phototrophic Biofilms Growing on Stone Surfaces of the Domus Aurea in Rome (Italy). Applied sciences 10, 6584.

AUTORI

Roberta Ranaldi (ranaldi.roberta@gmail.com), Laura Bruno, Lorenza Rugnini, LBA-Laboratory of Biology of Algae, Dept. Biology, University of Rome "Tor Vergata", Via Cracovia 1, 00133 Roma, Italy.

Nicoletta Spreti, Cinzia Casieri, Francesco Gabriele, Dept. Physical and Chemical Sciences, University of Aquila, Via Vetoio, Coppito, I-67100, L'Aquila, Italy.

Attività antifungina di estratti da macroalghe delle coste pugliesi

A. Mincuzzi, A. Lisco, N. Dipierro, A. Ippolito, A. Bottalico

I fungicidi convenzionali possono rappresentare un pericolo per la tutela della biodiversità, per l'ambiente e per la salute umana ed animale. Per questo motivo, negli ultimi anni, il settore agricolo si sta orientando verso prodotti più naturali, a ridotto impatto ambientale. Tra questi gli estratti macroalgali offrono nuove prospettive, nell'ottica di un'agricoltura sostenibile e di un approccio One Health. Le alghe, infatti, sono ricche di metaboliti secondari, tra cui i polifenoli, che svolgono un'importante attività antiossidante, antibatterica ed antifungina (Mincuzzi *et al.*, 2020).

L'obiettivo del presente lavoro è stato quello di saggiare l'attività antifungina di estratti ottenuti da tre specie di macroalghe delle coste pugliesi: le Rhodophyta *Halopithys incurva* (Hudson) Batters e *Laurencia majuscula* (Harvey) A.H.S. Lucas e l'alga verde *Codium vermilara* (Olivi) Delle Chiaje. Tutte le procedure di estrazione sono state eseguite in doppio secondo la metodica riportata in Brighenti *et al.* (2017). Si è, quindi, proceduto alla determinazione del contenuto di polifenoli totali (Dewanto *et al.*, 2002). Per valutare l'attività antifungina degli estratti algali sono stati allestiti saggi *in vitro* micro-spettrofotometrici in grado di stimare le variazioni della concentrazione conidica nel tempo (Broekaert *et al.*, 1990). Le specie fungine saggiate sono tipici patogeni postraccolta dei frutti di melograno: *Alternaria alternata* (Fr.) Keissl., *Coniella granati* (Sacc.) Petr. & Syd., *Colletotrichum acutatum sensu stricto* J.H. Simmonds, *Aspergillus welwitschiae* (Bres.) Henn. e *Penicillium glabrum* (Wehmer) Westling.

Il maggior contenuto in polifenoli totali è stato riscontrato in *H. incurva* (57 µg di equivalenti di acido gallico/ml di estratto), mentre valori più bassi sono stati ritrovati in *L. majuscula* e *C. vermilara* (12 e 3 µg di equivalenti di acido gallico/ml di estratto, rispettivamente). I saggi *in vitro* condotti sulle sospensioni monoconidiche hanno rivelato che i tre estratti, pur avendo un contenuto polifenolico diverso, inibiscono significativamente la crescita di tutte le specie, ad eccezione di *P. glabrum*. Questo risultato fa ipotizzare che l'azione inibitoria dei polifenoli possa essere di tipo qualitativo, piuttosto che quantitativo; pertanto sarà necessario caratterizzare chimicamente gli estratti e valutarne l'effetto dose in funzione dei diversi metabolismi fungini.

Letteratura citata

Brighenti V., Groothuis S.F., Prencipea F.P., Amir R., Pellati F. (2017). Metabolite fingerprinting of *Punica granatum* L. (pomegranate) polyphenols by means of high-performance liquid chromatography with diode array and electrospray ionization-mass spectrometry detection. Journal of Chromatography A, 1480: 20-31.

Broekaert W.F., Terras F.R.G., Bruno P.A., Vandedeyden C., Vandedeyden J. (1990). An automated quantitative assay for fungal growth inhibition. Microbiology Letters, 69: 55-60.

Dewanto V., Wu X., Adom K.K., Liu R.H. (2002). Thermal processing enhances the nutritional value of tomatoes by increasing total antioxidant activity. Journal of Agricultural and Food Chemistry, 50: 3010-3014.

Mincuzzi A., Ippolito A., Brighenti V., Marchetti L., Benvenuti S., Ligorio A., Pellati F., Sanzani S.M. (2020). The effect of polyphenols on pomegranate fruit susceptibility to *Pilidiella granati* provides insights into disease tolerance mechanism. Molecules 25: 515.

AUTORI

Annamaria Mincuzzi (annamaria.mincuzzi@uniba.it), Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti, Università degli Studi di Bari Aldo Moro, Via G. Amendola 165/A, 70126, Bari.

Anna Lisco, Nunzio Dipierro, Antonella Bottalico, Dipartimento di Biologia, Università degli Studi di Bari Aldo Moro, Via E. Orabona 4, 70125, Bari.

Antonio Ippolito, Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti, Università degli Studi di Bari Aldo Moro, Via G. Amendola 165/A, 70126, Bari.

Autore di riferimento: Annamaria Mincuzzi

Indice Autori