Possible role of bacteria in the degradation of macroalgae Desmarestia aniceps Montagne (Phaeophyceae) in Antarctic marine waters

Posible rol de las bacterias en la degradación de la macroalga Desmarestia aniceps Montagne (Phaeophyceae) en las aguas marinas antárticas

María L. Quartino\textsuperscript{a,b}, Susana C. Vazquez\textsuperscript{c,d}, Gustavo E.J. Latorre\textsuperscript{e}, Walter P. Mac Cormack\textsuperscript{a,d,*}

\textsuperscript{a} Instituto Antártico Argentino, Ciudad Autónoma de Buenos Aires, Argentina
\textsuperscript{b} Museo Argentino de Ciencias Naturales B. Rivadavia, Ciudad Autónoma de Buenos Aires, Argentina
\textsuperscript{c} Consejo Nacional de Investigaciones Científicas y Técnicas, Ciudad Autónoma de Buenos Aires, Argentina
\textsuperscript{d} Facultad de Farmacia y Bioquímica, Cátedra de Biotecnología e Instituto de Nanobiología UBA-CONICET, Universidad de Buenos Aires, Ciudad Autónoma de Buenos Aires, Argentina
\textsuperscript{e} Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina

Received 30 March 2015; accepted 23 April 2015
Available online 30 June 2015

Bacterioplankton is a relevant component of coastal marine food webs. In Antarctica, environmental conditions strongly limit the growth rates and metabolic activity of the biota. Macroalgae, such as the large perennial brown algae Desmarestia aniceps Montagne (Fig. 1), are one of the main primary producers in this environment. The organic matter released as a result of the death and decomposition of these macroalgae is considered a key event in the supply of nutrients to other components of the Antarctic marine biota. Some bacteria associate to algal debris and directly obtain from it inorganic and organic nutrients for their own growth. During this activity, significant amount of organic molecules (proteins, carbohydrates and organic acids) are released into the marine environment, constituting the dissolved organic matter (DOM) stock, which is unavailable to most marine organisms but can be used by a fraction of the bacterioplankton as a carbon and energy source. This trophic pathway is known as the “microbial loop” and allows dissolved organic carbon (DOC) to return to higher trophic levels via its incorporation into bacterial biomass. The microbial loop is coupled with the classic food chain formed by phytoplankton-zooplankton-nekton.

In Antarctic marine environments, the time for decomposition and the physical mechanisms required for an effective biodegradation of algal debris is not fully understood. However, the association of marine bacteria to

\textsuperscript{*} Corresponding author.
E-mail address: wmac@ffyb.uba.ar (W.P. Mac Cormack).

http://dx.doi.org/10.1016/j.ram.2015.04.003
0325-7541/© 2015 Published by Elsevier España, S.L.U. on behalf of Asociación Argentina de Microbiología. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Possible role of bacteria in the degradation of macro algae *Desmarestia aniceps* Montagne (Phaeophyceae)

**Figure 1** Huge mats of the dominant macroalgae *D. aniceps* inhabit the coastal rocky substrates of Potter Cove, 25 de Mayo (King George) Island, South Shetland Islands, Antarctica. Although the fate of the different fractions of the biomass flux released by senescent individuals of these macroalgae is not yet well known, it is likely that they greatly impact on nutrient cycling dynamics in Antarctic coastal marine ecosystems.

*D. aniceps* thallus can be clearly appreciated in the SEM images (Fig. 2) obtained from initial studies on bacteria-related algal degradation in the Potter Cove ecosystem. Preliminary results showed that viable heterotrophic bacterial numbers increased over time during algal degradation. Nevertheless, the time required for a significant microbial-mediated damage of extremely long thalli at the typical sea water temperatures of the Cove (∼1–2 °C) and its effectiveness closely depends on the prior mechanical breakdown mediated by icebergs and stones, which are driven by strong winds, currents and tides.

**Ethical disclosures**

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that no patient data appear in this article.

**Right to privacy and informed consent.** The authors declare that no patient data appear in this article.

**Acknowledgements**

This work was supported by grants PICTO 2010-0124 from the Agencia Nacional de Promoción Científica y Tecnológica (ANPCyT), PIP 0187 from CONICET and UBA 20020100100378.

**Figure 2** Bacteria associated to debris of macroalgae *D. aniceps*. Detail of different parts of thalli (a). Apical regions of *D. aniceps* thalli (b). When macroalgal thalli are mechanically damaged by the abrasion of sea ice and stones, the components of their cell walls are exposed (c) and the cavities of dead cells are colonized by a great number of bacteria, probably obtaining and releasing inorganic and organic nutrients from cell debris (d).

D. aniceps thallus can be clearly appreciated in the SEM images (Fig. 2) obtained from initial studies on bacteria-related algal degradation in the Potter Cove ecosystem. Preliminary results showed that viable heterotrophic bacterial numbers increased over time during algal degradation. Nevertheless, the time required for a significant microbial-mediated damage of extremely long thalli at the typical sea water temperatures of the Cove (∼1–2 °C) and its effectiveness closely depends on the prior mechanical breakdown mediated by icebergs and stones, which are driven by strong winds, currents and tides.
from Universidad de Buenos Aires. We thank the Carlini Station crew for their assistance.

References