Bioerosion: Seeing the invisible and touching the untouchable

Turicchia E[1], Summers AP[2], Bettuzzi M[3], Morigi MP[3], Abbiati M[4] & Ponti M[1]

[1] BiGeA Department, University of Bologna, Ravenna, Italy
[2] FHL, University of Washington, Friday Harbor, USA
[3] DiFA Department, University of Bologna, Bologna, Italy
[4] DBC, University of Bologna, Ravenna, Italy

53 OSTEND 17-21.09.18 EMBS EUROPEAN MARINE BIOLOGY SYMPOSIUM

Have you ever thought to 'hold' your underwater study site in your hands or to 'touch' a hole made by a boring sponge?

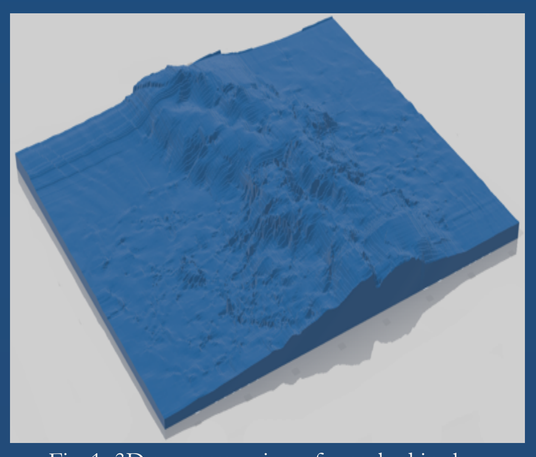

Fig. 1: 3D reconstruction of a seabed in the Northern Adriatic Sea (Italy, i.e. P204 study sites) with a z-axis exaggeration of 3 times

By combining acoustic and electromagnetic technologies, such as Computed Tomography (CT), sophisticated image analysis, three-dimensional (3D) modelling software, and the versatility of 3D printers, it is possible to have your site at the tip of your fingers!

Indeed, the model in Fig. 1 is an example of morphological reconstruction of a seabed from acoustic survey.

Bioerosion is a key process in mesophotic biogenic temperate reefs. It occurs in difficult to access places and act at many spatial and temporal scales. Investigation of bioerosion processes requires sampling species and analysing the shape of holes and cavities hidden inside the substrates, and the identification of the signs left by organisms, of which most of the tissue vanish after death. Computed Tomography combines the use of X-rays and computerised analysis of the images allowing 3D volume reconstruction of an object without destroy it. Three-dimensional printing technology enables then the physical reconstruction of negative volumes dug into the substrate.

Fig. 2: Experimental setup of travertine tiles

This technique has been used to analyse short and long-term (i.e., 3 and 12 years) bioerosion processes occurring in experimental travertine tiles (Fig. 2) deployed on 3 different typologies of mesophotic biogenic reefs in the northern Adriatic Sea (Ponti *et al.,* 2011 and Fava *et al.,* 2016; Fig. 3).

In this study case, CT has allowed for identify and measure every cavity inside the experimental tiles. The main borers were the sponges *Cliona viridis* (Fig. 4) and *Cliona rhodensis* (Fig. 5) and the bivalve *Rocellaria dubia* (Fig. 6), which eroding patterns are clearly recognisable both in the 3D images and printed models.

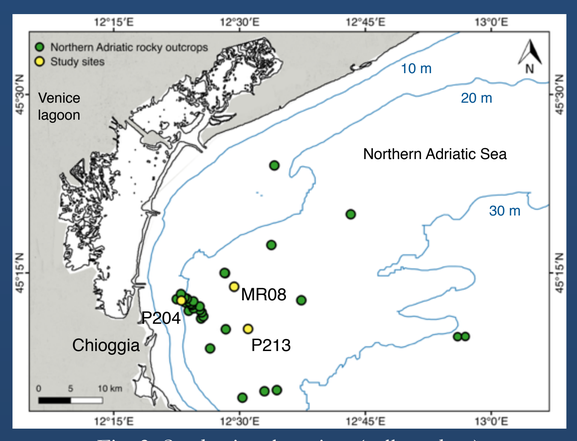

Fig. 3: Study sites location (yellow dots)

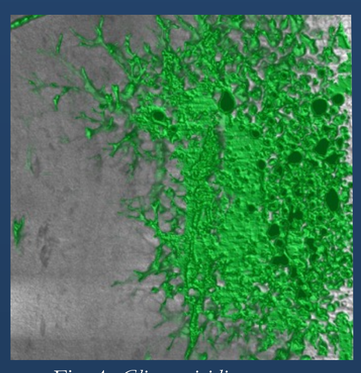

Fig. 4: *Cliona viridis* pattern

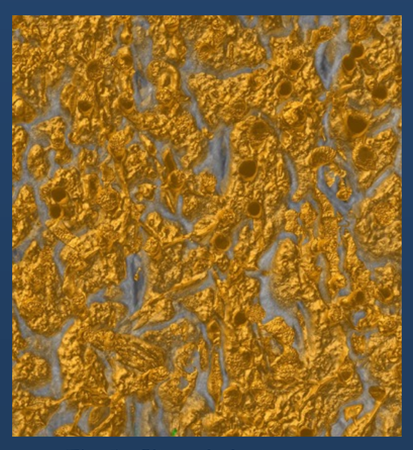

Fig. 5: *Cliona rhodensis* pattern

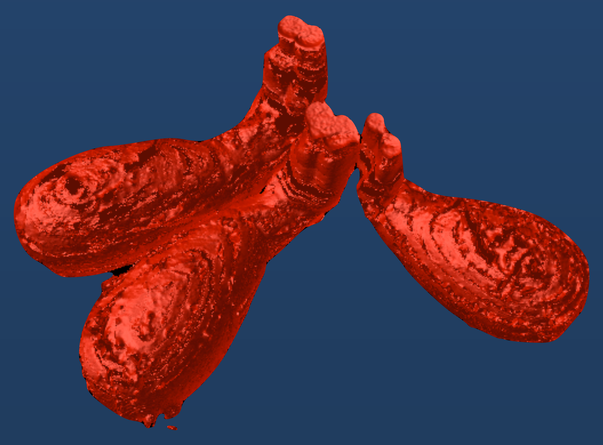

Fig. 6: *Rocellaria dubia* pattern

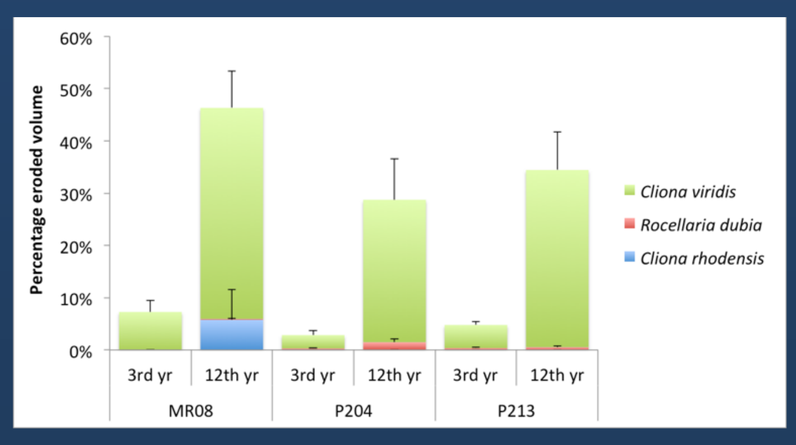

Fig. 7: Mean eroded volume (± s.e.)

In the travertine tiles deployed in the northern Adriatic Sea the volumes eroded by boring organisms varied among sites and with the exposure period, however the most effective borer was *C. viridis* at all study sites (Fig. 7). The volume eroded by *R. dubia* and its abundance were significantly different among sites. Overall, the mean erosion rate appeared to increase with time from 1.33% $yr.^{-1}$ in the 1st 3-year period to 3.04% $yr.^{-1}$ in the second 9-year period.

This is just an example how different technologies, like CT, echo sounding, image analysis, 3D modelling and printing can be combined together, offering new perspectives and insight in understanding and representing ecological processes. This is especially valuable for processes less evident due to the spatio-temporal scales or the places where they occur.

Ponti M, *et al.* (2011) Mar Biol 158: 1447-1459.
Fava F, *et al.* (2016) Plos One 11: 21.

Contact: Eva Turicchia
eva.turicchia2@unibo.it