long-term research collaborator James Murray, Bryan was the driving force behind the *Partula* conservation initiative and is greatly missed by all his programme colleagues.

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MARINE MATTERS

Living on the edge? State of vermetid crusts in the Maltese Islands (central Mediterranean Sea)

By Georg Küstner, Julian Evans & Patrick J. Schembri

Gregarious vermetid molluscs act as bioconstructors, forming crusts or reefs in the intertidal or shallow sublittoral zones of sub-tropical and warm-temperate waters (Fig. 1). Vermetid reefs are considered valuable habitats as they protect coasts from erosion, regulate sediment transport and accumulation, serve as carbon sinks, and also augment the species diversity found in the littoral fringe (Milazzo *et al*., 2014). In the Mediterranean, vermetid reefs are built through the synergistic action of the vermetid gastropods of the *Dendropoma petraeum s. l.* species complex (Fig. 2) and the coralline alga *Neogoniolithon brassica-florida* that grows between the gastropod shells and cements the reef, and triggers vermetid settlement (Chemello & Silenzi, 2011). The largest and best developed reefs occur in the eastern parts of the Mediterranean, but such bioconstructions are also common in the central-southern area in places where the winter temperature of surface coastal waters does not fall below 14 °C. The Maltese Islands represent the southernmost point of occurrence of vermetid reefs in the central Mediterranean (Chemello & Silenzi, 2011) and here these bioconstructions take the form of thin to moderately thick crusts covering the calcareous rock at and just below mean sea level (Azzopardi & Schembri, 1997).

The reefs' position on the edge of the shore renders them susceptible to regression caused by anthropogenic impacts (Chemello, 2009). Vermetid reefs are therefore considered to be endangered habitats and have been listed in the Mediterranean Red Data Book (UNEP/IUCN/GIS POSIDONIE, 1990). They are also included in the reference list of priority habitats to guide selection of sites of conservation interest within the purview of the Barcelona Convention (UNEP-MAP-RAC/SPA, 2006). In addition, *D. petraeum s. l.* is listed in Annex II (Endangered or Threatened Species) of the Protocol for Specially Protected Areas and Biodiversity in the Mediterranean (SPABIM Protocol of the Barcelona Convention) given that living populations of this vermetid are necessary to maintain the structure and functioning of the reefs.

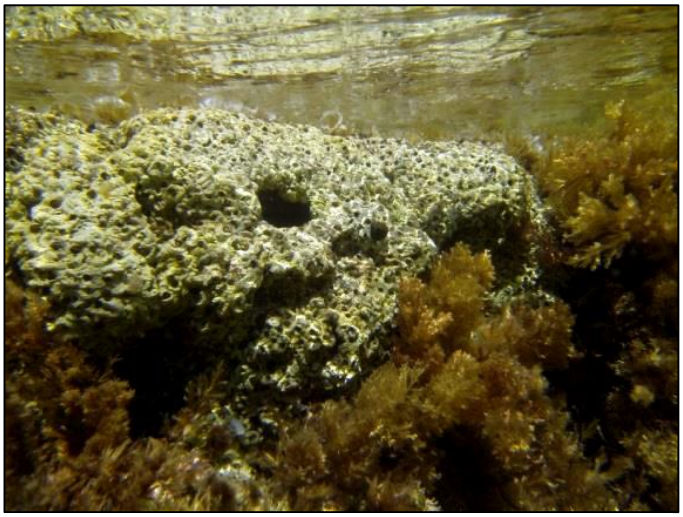

Fig. 1. Underwater view of the seaward edge of a vermetid crust at Marsascala, Malta. (Photo: Georg Küstner)

The future seems bleak for vermetid reefs in the southeast Levantine Sea. Degradation of these reefs was noted as early as 1961, and although patches with live individuals of *D. petraeum s. l.* were still present up to around 10 years ago, recent surveys indicated that the vermetid populations have declined drastically, if not disappeared entirely (Galil, 2013). This was mainly due to direct impact of urban development on reefs, or due to suffocation of vermetids by algal overgrowth as a consequence of organic loading of the water (Galil, 2013). The situation is somewhat better in Sicily, where crusts and reefs are degraded along "only" 40 % of the coastline where they occur (Chemello, 2009). However, Milazzo *et al*. (2009) indicated that the arrival of the invasive alien mussel *Brachidontes pharaonis* may represent a direct threat to vermetid reefs, causing negative effects on the coverage and density of *D. petraeum*.

Fig. 2. Close-up view of a vermetid crust showing several live individuals of *Dendropoma petraeum.* (Photo: Georg Küstner)

Given the evident regression of vermetids elsewhere in the Mediterranean, including in neighbouring Sicily, an intensive survey of the coastline around the Maltese Islands was initiated to assess the condition of vermetid crusts in this area. Special attention was given to the occurrence of two invasive alien species, the aforementioned *B. pharaonis* and the alga *Caulerpa cylindracea*, both of which have become common inhabitants of the lower mediolittoral to upper infralittoral regions on Maltese shores. These two species are able to form dense aggregations, and therefore have the propensity to negatively impact *D. petraeum* reefs.

This survey has indicated that there is at least one location where a vermetid crust has been extensively degraded as a consequence of coastal development. On the other hand, most of the surveyed locations where vermetid bioconstructions were known to occur still harbour thriving crusts, while several new areas with such crusts have been mapped. The coverage of *B. pharaonis* or *C. cylindracea* associated with the crusts was relatively low and these had no discernible impact on the populations of *D. petraeum*, the peak abundance of which exceeded 2000 individuals/m^2 in nearly all the surveyed locations. Therefore, it appears that in Malta *D. petraeum* is not living on the edge of extirpation, but on the edge of the shore, where it continues to contribute to the formation and existence of vermetid crusts.

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Cone snails open a door to early conservation initiatives

By Howard Peters, Bethan C. O'Leary, Julie P. Hawkins & Callum M. Roberts

The cost of contributing to the IUCN Red List can often be daunting, in particular review workshops where experts from around the world must be brought together for a week or more of deliberation (Rondinini *et al*., 2014). With funding scarce and most often directed at new candidate species, important decadal re-assessments may be left languishing on the back burner, depriving the Red List of critical new data and weakening its authority. To reduce the overall costs of investigation but at the same time sound preliminary warnings for species approaching at-risk status, we have taken a broad-brush GIS-based approach that targets species based on individual range size coupled with a composite score of environmental threat (Peters *et al*., 2015).

Using the recent Red List assessment of over 630 species of the marine gastropod genus *Conus* (Peters *et al*., 2013), we sought to identify species that are range-restricted and subject to high anthropogenic pressure. The results not only confirmed many of the findings of the Red List assessment, but more importantly highlighted potentially at risk species overlooked by the Red List.

We used global spatial data of current anthropogenic threats to the marine environment including ocean based pollution, nutrient loading, artisanal fisheries, species invasions, etc., taken from Halpern *et al*. (2008). Additionally we used forward projections to 2030 and 2050 of thermal stress and ocean acidification from Burke *et al*. (2011). The threats were gridded to 1° geographical cells and mapped against the bathymetrically corrected areas of occupancy for each *Conus* species. The results showed not only individual species at greatest risk, but those biogeographical regions containing the highest concentrations of endemic and range-restricted species where all, or a very high percentage of their range occurs in areas of greatest human impact.

Although there will always be specific threats applicable to individual species that require detailed assessment, this holistic approach is particularly relevant to species-rich groups of sessile or sedentary animals, especially non-migratory taxa such as invertebrates, including molluscs – whether marine, freshwater or terrestrial – where confined distribution coupled with potential loss of habitat and other risks can be quickly identified through the application of spatial data. Used in conjunction with the Red List, the results can contribute to a reduction in data deficiency and add to the rationale for determining the categories and criteria of a standard assessment.

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