Oceanography and Marine Biology: An Annual Review, 2018, **56**, 237-310

Taylor & Francis

THE CARBON DIOXIDE VENTS OF ISCHIA, ITALY, A NATURAL SYSTEM TO ASSESS IMPACTS OF OCEAN ACIDIFICATION ON MARINE ECOSYSTEMS: AN OVERVIEW OF RESEARCH AND COMPARISONS WITH OTHER VENT SYSTEMS

SHAWNA ANDREA FOO[1]*, MARIA BYRNE[2], ELENA RICEVUTO[3] & MARIA CRISTINA GAMBI[3]

[1]Department of Global Ecology, Carnegie Institution for Science, Stanford, CA, United States
[2]School of Medical Sciences and School of Life and Environmental Sciences, The University of Sydney, Sydney, New South Wales, Australia
[3]Stazione Zoologica Anton Dohrn, Department of Integrative Marine Ecology, Villa Dohrn-Benthic Ecology Center, Ischia, Italy
**Corresponding author: Shawna Andrea Foo*
e-mail: sfoo@carnegiescience.edu

Abstract

As the ocean continues to take up carbon dioxide (CO_2), it is difficult to predict the future of marine ecosystems. Natural CO_2 vent sites, mainly of volcanic origin, that provide a pH gradient are useful as a proxy to investigate ecological effects of ocean acidification. The effects of decreased pH can be assessed at increasing levels of organisation, from the responses of individuals of a species up through populations and communities to whole ecosystems. As a natural laboratory, CO_2 vent sites incorporate a range of environmental factors, such as gradients of nutrients, currents and species interactions that cannot be replicated in the laboratory or mesocosms, with the caveat that some vent systems have confounding factors such as hydrogen sulphide and metals. The first CO_2 vent sites to be investigated in an ocean acidification context were the vents at the Castello Aragonese on the island of Ischia, Italy. The gas released is primarily CO_2 with no evidence of toxic substances. They have been the focus of a wealth of studies, which are reviewed here and in context with research at other vent systems. Investigations of the species that occur along the pH gradients at Ischia show that, as the pH decreases, there is a reduction in calcifying species, reflecting the trends seen at other vent systems and in laboratory studies. The species assemblages at the Castello vents living at near future (2100) ocean acidification conditions (mean pH 7.8), show the resilience of many species to elevated CO_2, including many calcifying species (e.g. sea urchins, serpulids, bryozoans, foraminifera and corals). These taxa show different physiological and ecological mechanisms for acclimatisation and adaptation to low pH. As the oceans continue to acidify to pH levels <7.8, species assemblages are likely to become dominated by fleshy algae and smaller-bodied, generalist invertebrates. These observations suggest that ocean acidification will result in a simplification of marine food webs and trophic complexity.