Vol. 37: 121–122, 2008
doi: 10.3354/cr00770

CLIMATE RESEARCH
Clim Res

Published October 21

Contribution to CR Special 18 'Effects of climate change on marine ecosystems'

PREFACE

Effects of climate change on marine ecosystems

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The Earth's climate is currently undergoing rapid change, and the rate of this change is expected to accelerate. The majority of the scientific community believes that this change is largely caused by human activity. Such changes are leading to myriad environmental alterations, affecting a broad spectrum of marine (and other) habitats. In addition to changing temperatures in the world's oceans, changes are also occurring in CO_2 concentrations, pH levels and solar radiation (including UV radiation), all of which can have effects on the ecology of marine ecosystems. This CR Special is made up of contributions from the 2nd Inter-Research Symposium, held in conjunction with the 42nd European Marine Biological Symposium (EMBS) (27 to 31 August 2007, Kiel, Germany), on the effects of climate change on marine ecosystems.

Hawkins et al. (2008) provide a review of the climate-driven range shifts observed during the last 60 yr on rocky shores of the NE Atlantic. Their paper demonstrates the value of long-term data, which the authors use in forecasting and predicting future structural changes in the rocky shore marine communities, a system which, they argue, will serve as an ideal model for exploring the ecological effects of climate change.

Pehlke & Bartsch (2008) repeat a 1970 study of depth distribution and biomass of sublittoral seaweeds in the North Sea, and by so doing, they observe some clear changes in species distributions and species dominance. Such tracking of community changes over time, in light of environmental changes that have occurred, provide important insights into the impacts of climate change.

Barnes & Peck (2008) summarize new evidence showing, somewhat unexpectedly, that bathymetric and geographic distribution ranges encompass localities with elevated but varying temperatures such as the intertidal zone of the shelf of South Georgia. These shelf communities are some of the least-understood ecosystems, and thus are all the more likely to provide us with surprises, as the Barnes & Peck (2008) article exposes. The authors call for more comprehensive comparisons between communities in temperature-variable and those in temperature-stable sites if we are to better predict the ecological responses to future climate change. Kaiser & Barnes (2008) provide a sequel paper on the response of the Southern Ocean deep-sea marine community to climate change. They emphasise the need for new sampling in order to reveal features such as patch size and spacing under climate change.

Sokolova & Lannig (2008) summarize information showing how various external factors (metal pollution and changing temperature) may affect the physiology of marine organisms non-additively: temperature might be acting directly on the physiology of the organism as well as changing the organism's susceptibility to other abiotic stressors. Similarly, Müller et al. (2008) summarize information showing how UV radiation and temperature act non-additively. Together, these two papers emphasise the necessity of recognizing that climate change may have some unexpected cascading effects on biological systems. Beesley et al. (2008) show how increasing CO_2 levels might affect the biology of *Mytilus edulis*, and thus make the species more vulnerable to climate change—again a non-additive effect of changing environmental conditions. Wittmann et al. (2008) provide yet another example of such non-additive effects.

Neumann et al. (2008) consider the effect of extreme climate conditions (such as cold weather) on an epibenthic community in the Berman Bight. In their study, they show how climate-driven changes at the community level may operate through changes in the recruitment, survival and migration of individual species.

Pörtner et al. (2008), in the final paper of this CR Special, focus upon how cod *Gadus morhua* is affected by

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climate changes along a clinal gradient, and by so doing provide a physiological basis for understanding how climate change might affect marine biological systems. This paper provides a mechanistic basis on how marine organisms and populations might respond to climate change.

This CR Special brings together a broad spectrum of approaches toward understanding how the marine system might respond to climate change. It is my hope that these studies will help us to hone our ability to predict the responses of various marine communities to climate change.