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Contribution to the Theme Section 'Evolution and ecology of marine biodiversity'

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Introduction

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ABSTRACT: The Theme Section on marine ecology and evolution resulted from a special symposium honouring Roger N. Hughes for his highly significant contributions as a scientist and teacher in the field of marine research. Contributions to this collection focus on evolution, animal behaviour, and population and community ecology, i.e. those areas to which Roger Hughes has contributed most notably.

KEY WORDS: Evolution · Ecology · Biodiversity

In the current scientific world obsessed with metrics such as citation indices, it might be more accurate to use an index of the 'reach' of a person's influence on the wider scientific community. This Theme Section was generated in tribute to the contribution and influence of Roger Hughes in the field of marine ecology. Roger has always described himself as a naturalist. As a small boy in Lancashire, he wandered the neighbouring fields, streams and ponds, observing wildlife. In his professional life, he has remained an observer of whole animals, with feeding behaviour a special interest. A wide range of taxa have been brought under the spotlight, including molluscs, crabs, bryozoans, fishes, and onychophorans. Evolutionary principles have inspired the major thrust of his work encompassing life-history and behavioural ecology, molecular biogeography, and phylogeny.

The papers collected in this Theme Section are diverse and reflect the extent of Roger Hughes' interests and the manner in which he has inspired former students and colleagues to pursue different avenues of specialisation. The papers within this Theme Section can be defined around the following key areas: evolutionary ecology, animal behaviour population, and community ecology, ranging from theoretical studies to the application of ecology for the management of natural resources.

Evolutionary studies

Roger Hughes' research has focussed on evolutionary processes, primarily using marine organisms as model subjects (and particularly those that are clonal). Shell shape has important implications for survival in relation to predation and physical processes such as wave action. Here, Walker & Grahame (2011) studied the relationship between shell shape and fitness in relation to brood size and found that subtle variation in shell shape is a potential predictor of fitness. Using another model organism, cyclostome bryozoans, Pemberton et al. (2011) examined the phenomenon of polyembryony (the splitting of a single sexually produced embryo into many clonal copies). They investigated the possibility that sperm limitation reduced female reproductive success at low population density using local colony density as a proxy for sperm supply. However, for colonies with broods, a score of colony weight and density suggested that sperm supply does not influence female reproductive success. Cannicci et al. (2011) extend the focus on evolutionary processes with a meta-analysis that investigates the current hypothesis that terrestrialisation of crabs from a water to a more land-based existence is reflected in the evolutionary tendency towards larger egg size and small brood size. They found no consistent evidence to sup-

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port this theory and instead hypothesise that major evolutionary steps at each ontogenetic stage are necessary to enable such a transition. Okamura et al. (2011) studied the variation in bryozoan zooid size in relation to fluctuations in temperature. The advantage of using modular organisms is that the response to temperature can be considered to be more consistent among replicates that are cloned and therefore genetically identical. Okamura et al. (2011) show how use of an index that relates zooid size to temperature can usefully inform palaeoecological studies that aim to gain insights into past temperature fluctuation.

Animal behaviour

A key area of Roger Hughes' interest was the study of how animal behaviour influences community structure. This is picked up in a number of contributions. Davenport et al. (2011a) studied the diet selection of sessile intertidal anemones that are ubiquitous on many rocky intertidal shores. Often cited as sessile predators or consumers of dissolved organic material, Davenport et al. (2011a) demonstrate that anemones consume a considerable amount of carrion that is dislodged or advected into the intertidal zone through wave action. Murray et al. (2011) investigated the factors that determine foraging decisions in the top predator in the system (humans). They studied the behaviour of a fishing fleet that targeted static benthic prey (scallops) and show how the fleet rapidly depleted the scallop population at the beginning of the fishing season and then adjusted its fishing behaviour to maintain catch rates. Davenport et al. (2011b) used the physics of fluid mechanics and direct observation to propose a physical mechanism that explains how emperor penguins exit seawater with sufficiently high velocity to propel them onto land. They propose that the air release from beneath the penguin's plumage reduces drag and hence increases velocity at the critical stage of ascent. Understanding animal movement and behaviour is particularly important in the context of fisheries management. Dando (2011) reports on a tagging study of flounder, a species that is assuming much greater commercial importance in inshore UK fisheries. The study demonstrated a surprisingly high level of site fidelity. Tagged fish made migrations up to 35 km west of their home estuary and then returned post-spawning. Gibson et al. (2011) examined depth fidelity in juvenile plaice *Pleuronectes platessa* and found a strong relationship between size and depth, such that smaller plaice occupy the shallowest depths. The study raises questions regarding the mechanism by which the fish are able to discriminate habitat characteristics at such a high resolution. Manríquez & Castilla (2011) studied the behaviour of competent larvae of the gastropod *Concholepas concholepas* and provide important insights into their larvae transport. The larvae display diurnal behavioural patterns and use byssus threads to attach themselves to buoyant particles in the water column or to air bubbles, or could utilise surface tension to maintain their position. Larvae become highly aggregated within surface foam slicks that form at fronts — areas of enhanced food supply.

Population and community ecology

Empirical studies of the importance of keystone species and the loss of biodiversity are important for improving our understanding of the role of species in ecosystem processes. Effects of biodiversity loss have been shown in a number of empirical studies (e.g. Emmerson et al. 2001) to be idiosyncratic. Crowe et al. (2011) demonstrated how the effect of removal of grazing and ecosystem engineering species is highly context dependent, which confirms the emerging view that environmental context is a key factor in the interpretation of such studies. Species invasions are another important process by which ecosystems can be modified. McGaw et al. (2011) report on the population demographics of green crabs — which have invaded many parts of the world through larvae transported in ship ballast water or via transfers of species used in aquaculture — in British Columbia, an area which they have recently invaded. The body size attained by the individuals was much larger than for populations elsewhere. This is likely explained by competitive release in the new environment. In their study of the impact of fishing on seabed habitats and associated biota off the coast of South Africa, Atkinson et al. (2011) found that fishing disturbance was linked to changes in community structure. Species that characterised the more heavily fished areas tended to be more mobile and smaller in body size than species from less intensively fished areas. Fishing disturbance has very negative influences on biogenic reefs, but our understanding of the ecological importance and temporal variability of such features is poor. In this theme, Hughes et al. (2011) have studied the taphonomy of serpulid worm tube reefs, which are a habitat subject to protection under European Union conservation legislation. The study revealed that the biogenic remains of the worm reef complex provide an important substratum for associated fauna. This material persists for periods in excess of 5 years. Hughes et al. (2011) hypothesise that these worm reefs can be ephemeral on a decadal timescale. Finally, Hart & Pearson (2011) focus on one of the most sensitive habitats in the world oceans, namely seamounts. They studied speciation on seamounts

across the globe. Poor sampling made it impossible to test the relationship between endemism and seamount age, although they did find that species number had a domed functional response to seamount age. They hypothesise that island biogeography provides a robust framework for constructing future sampling regimes for seamounts.

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