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Extending the generality of ecological models to artificial floating habitats

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Abstract

Marine assemblages on natural hard substrata are generally different from those on artificial habitats. There is, however, the potential for certain ecological processes to operate on both types of structures. On the sides of floating pontoons in Sydney Harbour, there were strong patterns of vertical distribution of sessile epibiotic organisms and molluscan grazers across relatively small spatial scales (in three defined zones, namely splash, shallow and deep). Patterns of vertical distribution of the tubeworms *Hydroides* spp. were reversed depending on the cover of mussels. A manipulative experiment was done to test if patterns of vertical distribution of *Hydroides* spp. were due to (1) the functioning of mussels or (2) the structure provided by mussels. Neither the functioning nor structure of mussels accounted for the patterns of distribution of *Hydroides* spp. Mussels increased recruitment of *Hydroides* spp., in the shallow and deep zones, and this was not due to increased surface area of the mussel shells. Manipulation of numbers of grazers and covers of sessile epibiota showed that the observed negative relationship between grazers and epibiota was due to grazers reducing recruitment of epibiota and epibiota decreasing survival of grazers. Most importantly, processes that accounted for

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patterns of distribution of mobile and sessile organisms on artificial floating structures were similar to those repeatedly shown to create such patterns on natural rocky shores.

Keywords: Artificial habitats; Fouling organisms; Gastropods; Mussels; Polychaetes; Pontoons; Recruitment; Sydney Harbour; Vertical distribution

1. Introduction

Pontoons, pilings and seawalls are common structures in urbanised waterways of coastal cities and they are often covered by marine organisms, commonly referred to as ''fouling organisms''. Early studies of the organisms on urban structures related to concerns about fouling of boats, pilings and other equipment (e.g., Coe, 1932). The subtidal assemblages on pilings and pontoons have been useful for developing general ecological models regarding succession and stability (e.g., Sutherland, 1974, 1981; Sutherland & Karlson, 1977). In recent years various urban structures have been considered as relatively novel marine habitats, in that they support subtidal assemblages that are significantly different from those on nearby natural surfaces (see review Glasby & Connell, 1999; Holloway & Connell, 2002). Despite large differences in assemblages, there are some component species that are common to natural and artificial structures and thus there is clearly the potential for similar ecological processes to operate on the different surfaces.

On natural shores, patterns of vertical distribution and the processes that create such patterns have long been of interest to intertidal ecologists (e.g., Dayton, 1971; Lewis, 1964; Menge & Sutherland, 1976; Ricketts, Calvin, & Hedgpeth, 1968; Underwood, 1978). Although the intertidal assemblages on natural hard substrata have been shown to differ from those on artificial seawalls (Chapman & Bulleri, 2003), the patterns of vertical distribution of animals on the vertical sides of pontoons appear to be analogous to those on intertidal rocky shores. The distributions of organisms on pontoons are, however, far more ''compressed''. Hence, the abundances of organisms on the sides of pontoons vary (in a vertical direction) at scales of centimetres (Cole, 2002) compared to natural rocky shores that typically vary on larger scales with respect to the height of the tide (e.g., Little & Smith, 1980; Menge & Sutherland, 1976; Underwood, 1980). This is due to the fact that vertical surfaces provide a much smaller area of intertidal habitat than gently sloping, natural intertidal shores (Chapman, 2003; Chapman & Bulleri, 2003). Furthermore, pontoons are floating on the surface of the water with no effect of the tide.

In our initial studies of pontoons in Sydney Harbour we quantified patterns of vertical distribution of (1) tubiculous polychaetes (*Hydroides* spp., primarily *H. elegans* and *H. ezoensis*) relative to mussels (*Mytilus galloprovincialis*) and (2) grazing molluscs relative to assemblages of sessile epibiota in three zones on the sides of pontoons (splash, shallow and deep; Fig. 1). Pontoons with large covers of mussels had