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Effects of Artificial Illumination on Intertidal Communities As A Consequence of Coastal Urbanisation

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Abstract

Coastal urbanization is often accompanied by the replacement of natural substrata by artificial structures, which causes coastal habitat modifications, losses of species richness, diversity and microhabitats diversity and favours the settlement of non-native species. The impact that coastal defence structures cause in the intertidal community is further favoured by the anthropic pressures produced in heavily populated areas (such as pollution or the collection of intertidal organisms). Among these, the effect of artificial lights on intertidal communities is practically unknown, even though that the behaviour of many intertidal vagile organisms is synchronized with circatidal and circadian rhythms. Considering that large areas of natural and artificial habitats are exposed to artificial illumination, this review exposes the current knowledge in this matter in order to evaluate the importance of this disregarded impact. Nocturnal lighting can increase stress in intertidal communities, modifying the predation rates and community dynamics. Likewise, lights may favour visual foragers and favour crepuscular behaviours. In consequence, light pollution should be considered in future conservation strategies and more ecological coastal structure designs.

Keywords: Coastal urbanization; Artificial lights; Intertidal community; Anthropic pressures; Vagile benthos

Introduction

Coastal modification is one of the principal sources of impact on intertidal communities around the world [1]. Usually, the alterations include punctual perturbations, such as the construction and reparation of coastal defence structures, and permanent and more deleterious long term perturbations, such as the replacement of the natural rocky intertidal with artificial substrata. And the colonization of the new surfaces by the marine benthic species is usually slowed and limited by the design of these structures, which usually have a lower microhabitat diversity than natural nearby areas [1,2]. Also, these modified coastlines are often heavily populated, which means increased collection rates and pollution. Among the different sources of stress affecting intertidal communities, the illumination from adjacent urban areas and roads has been largely unattended [3]. Light pollution is a global environmental issue and large areas of natural and artificial habitats are exposed to artificial lighting [4]. In this matter, the recent popularization of low-consumption LEDs (light-emitting diodes) will increase the amount of artificial light emitted nearshore in the 479nm spectrum, which is used by the majority of bioluminescent organisms [4-6].

The increased intensity of artificial light as compared to moonlight can also favour crepuscular foraging behaviours in beach ecosystems [7], affect the activity of birds [3] and alter the settlement of sessile organisms larvae [6,8] and the foraging behaviour of vagile organisms [9]. Endogenous and exogenous circadian rhythms have been observed in many intertidal vagile organisms and activity peaks are usually synchronized by circatidal and circadian cycles [10]. Some endangered species within the intertidal have a regular feeding activity also during the night [11], being more sensitive to alterations in food intake by light pollution with relevant implications in conservation biology. Furthermore, some intertidal and subtidal species use lighting clues to determine the timing of larvae release, which could increase their sensitivity to nocturnal lighting stresses [12,13]. Therefore, light pollution influences the behaviour of coastal communities at multiple levels and, depending on intensity and spectrum, can interfere more or less severely in ecological processes and community structuring [3-5]. The effect on intertidal and subtidal benthic communities is largely unknown and biological responses of flora and fauna should

be considered in future studies [5,9]. Above all, light pollution should be taken into account and minimized in future actuations and coastal structures designs in order to decrease stress in coastal areas.

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