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Experimental evaluation of the feeding rate, growth and fertility of the sea urchins *Paracentrotus lividus*

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ABSTRACT

The trophic ecology of the sea urchin *Paracentrotus lividus*, a key species in several shallow benthic communities, has been intensively studied, but the role of various foods in the processes of growth and gonadal maturation is still scarcely understood. This research assessed the effects of two fundamental food items for wild specimens of the sea urchin *Paracentrotus lividus*, the tissues of the seagrass *Posidonia oceanic*a and of the green alga *Ulva rigida*, compared to the effect of a commercial compound feed on the somatic growth, gonad development, fertilization success and post-embryonic development. Consumption rates along with the C/N ratios were measured in the feeds and in the faecal pellets. We demonstrated that feeding for three months on *U. rigida* and *P. oceanica* did not affect growth and gonadal index of adults, fertilization processes and first cleavage and development, as well as field-collected animals. In contrast, a diet based on formulated pellets triggered a significant increase of gonadal index, but lack of gamete production, due to a follicular hyperthrophy. Our work will be useful for the definition of optimal diets for the production of mature broodstocks of an ecologically important marine model organism.

Impact statement

– We aim at defining the daily feeding rate of the sea urchin P. lividus
– P. lividus represents a key species in various benthic communities.
– Feeds are important in the processes of growth and gonadal maturation of sea urchins.
– Several factors influence sea urchin feeding rates.

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Introduction

Paracentrotus lividus is a species of sea urchin belonging to the family *Parechinidae* within the large phylum *Echinodermata* (Pawson 2007). This species widely occurs in different marine environment, such as the Mediterranean Sea and the Eastern Atlantic Ocean from western Scotland and Ireland to the Azores, Canary Islands and Morocco (Boudouresque and Verlaque 2001).

In the Mediterranean sea, this sea urchin is considered to be a key species for several coastal communities associated to vegetated ecosystems, thanks to its role in their food webs (Zupo and Fresi 1984). It is an important consumer of plant tissues (Boudouresque et al. 2007), and it is also a well-established model organism for eco-toxicological and physiological studies. In addition, the gonads of *P. lividus* are considered a gastronomic delicacy and consequently its market demand has significantly increased since the early 1970s, causing a depletion of this species in different site of the Mediterranean (Guidetti et al. 2004; Lawrence 2001). In fact, harvesting of *P. lividus* is reflected in population structures from fished and control locations: since humans selectively collect the largest sea urchins (>4 cm), large-sized *P. lividus* were rare at the exploited locations (Guidetti et al. 2004).

Several attempts have been applied to identify effective formulated diets with the aim to promote body growth and gonadal maturation of adults in land based systems (Caltagirone et al. 1992; Fabbrocini et al. 2012). An extensive literature investigates the effect of diets on growth of *P. lividus*, as well as dietary effects on reproductive success (Bayed et al. 2005; Frantzis and Gremare 1993; Carboni et al. 2012; Lawrence 2013). However, some key issues still limit its industrial exploitation.

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