The prevalence of parasitic pea crab Afropinnotheres monodi in mussels depending on the degree of exposure of habitats: implications for mussel culture

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Introduction

As many other Pinnotherid crabs, the African pea crab Afropinnotheres monodi live in association with the mantle cavity of different bivalve species. This pea crab causes a significant reduction of the condition index of the mussel Mytilus galloprovincialis. The greatest effects brought about for the infestation with soft females (larger size and obligatory parasitism) and/or multiple infestation (two or three pea crab inside the same host); whereas erosion of the gills and mantle of hosts have been also observed in mussels and cockles (Cerastoderma edule) infested by hard females and males which have smaller size than soft females and are facultative parasites (Perez-Miguel et al. 2018).

To test the hypothesis that the prevalence of this pea crab in subtidal mussels depends on the degree of exposure/shallowness of their habitats and consequently of the coexistence of hosts of all crab demographic categories in a reduced area, in this study we assess the prevalence and demographic structure of A. monodi in the subtidal mussels attached to the submerged chains of the navigational buoys (lateral marks) of the Port Authority located along the navigable channel of the bay of Cadiz.

Material and Methods

Mussels were collected by hand (scuba diving) from the submerged chains of five of the buoys used as lateral marks of the navigable channel of the Bay of Cadiz. The sampled buoys were selected along a gradient of exposure to tidal currents and with different distance to the intertidal populations of bivalves that we know are currently hosting the different demographic categories of A. monodi in this area. Buoys were seasonally sampled from each of the buoys number 2 (B2), 4 (B4), 8 (B8), 10 (B10) and 12 (B12) in August 2017 (summer), November 2017 (autumn), February 2018 (winter) and May 2018 (spring). The buoy most external to the bay is number 2 and the innermost one is number 12.

Results and Discussion

The size of mussels sampled in this study was very homogeneous regardless of the buoy considered and of if they were hosting or not the pea crab. On average, 43.3% of mussels examined during this study hosted the African pea crab A. monodi. When the whole period is considered, the maximal average prevalence corresponded to B10, with 74.5% of mussels hosting crabs and the minimal to B2 where only 17.0% of mussels hosting crabs. Results of χ2 tests indicated that these inter-buoy differences in the annual pea crab prevalence were statistically significant (p < 0.01) among the three inner buoys (B12, B10 and B8) and the two
outer buoys (B4 and B2), as well as among the two inner buoys (B12, B10) and the intermediate buoy (B8; Figure 1).

Fig. 1. - Prevalence of parasitic pea crab Afropinnotheres monodi inside the mussels (Mytilus galloprovincialis) at the 5 different submerged chains of the navigational buoys in the bay of Cádiz. The letters indicate indicated the differences in the annual pea crab prevalence were statistically significant (p < 0.01). At the top of the error bars, it shows the percentage of mussels who were infested by just 1 crab.

When the whole period of study was considered, the significant differences in prevalence were observed among the inner and outer buoys (especially B2 and B4 [inners ones] versus B10 and B12 [outers ones]). Furthermore, with the exception of a very small crab found inside one mussel of B2, the relatively large size of male and hard female crabs hosted by subtidal mussels indicates that they have been previously using other hosts, as expected from the asymmetrical use that the different demographic categories of this species make of their different hosts. All these features suggest that, as in the case of intertidal mussels of Bay of Cadiz, the infestation of subtidal mussels has as main source the males and hard females of A. monodi hosted primarily by the intertidal populations of cockles and clams. Thus, the lower infestation of mussels from the outer buoys (B2 and B4) and the higher infestation of mussels from the inner buoys (B10 and B12) could be reflecting the mayor and minor distance, respectively, to the Rio San Pedro Inlet, the area of the bay in which are located the largest natural beds of cockles (Cerastoderma edule and C. glaucum) and the clam Scrobicularia plana; in fact, the higher prevalence of A. monodi was just found in mussels from B10 (74.5%, on average) which is the buoy located the closest to this main source of the pea crabs that infest subtidal mussels of the Bay of Cadiz.

The similar environmental conditions between the bay of Cádiz and Galician habitats (almost in summer), where the farms’ mussels coexist with the neighboring natural bed of the cockle Cerastoderma edule, suggest that this crab could cause economic problems in the Galician mussel industry, one of the most important in the world. The deleterious effects of the pea crabs on the commercial production of mussels can be direct by a condition loss and/or growth reduction of mussels or indirect, because its presence in the shell cavity of fresh mussels may cause consumer complaints. Also, the removal of crabs can considerably increase the duration of the mussels canning process, increasing in a 33% the time in the scallop industrial process; a more recent and extreme case, the high infestation (up to 100% sometimes) of Cerastoderma spp. by A. monodi in some areas of the Algarve (South of Portugal) has made that a canning company has closed the canning line of cockles due to economic losses (Cuesta, pers. comm.).
**Conclusion**

In this work, it is revealed for the first time the possibility that A. monodi infects subtidal mussels, in the similar conditions as the cultured mussels in rafts. This shows up the risk of an infestation by the parasitic pea crab Afropinnotheres monodi in the economically relevant for the culture of mussels. According to our results, for reducing at least partially the negative effects of these parasites, moving mussel farms offshore, when possible, has the potential to reduce the prevalence and the deleterious effects of pea crabs in mussels.

**Figure 1**

![Graph](image)

**References**