LIVE SEAFOOD IMPORTATION AS A POTENTIAL VECTOR FOR ALIEN INTRODUCTION IN THE TARANTO SEAS (SOUTHERN ITALY, MEDITERRANEAN SEA)

E. Cecere [1], M. Belmonte [1], G. Portacci [1], F. Rubino [1]* and A. Petrocelli [1]
[1] CNR-IAMC - rubino@iamc.cnr.it

Abstract
Importation of edible molluscs represents one of the main cause of introduction of alien species throughout the world. Intervalvar water and shells of mollusc imported to the Taranto market were investigated to assess the presence of alien micro- and macroalgae. Up to now, only one alien species was found, and this confirms that the risk of possible future introduction is still lurking.

Keywords: Alien species, Bivalves, Mediterranean Sea, Algae, Ionian Sea

Introduction
The use of exotic seafood in the human diet, mainly bivalve molluscs, is well-established throughout the world nowadays, and has historical basis [1]. Generally, it was started to cover some shortage of the local aquaculture production or even to diversify market supply. However, up to the second half of the last century, there was no idea of the possible damages caused by such an activity [1]. That way, the translocation of these organisms led to the introduction of several alien species, which caused environmental and health harms of different extent [2]. Therefore, localities where seafood importation is massive, are particularly exposed to this hazard. At Taranto, in 2014, about 1,200 tons of molluscs were imported [3]. Here we report the results of a research carried out on molluscs imported to the Taranto market for consumption, to detect possible alien hitchhikers.

Materials and methods
Three specimens of: *Crassostrea gigas* Thunberg, 1793 from France and Spain, respectively, *Venerupis phillippinarum* A. Adams & Reeve, 1850 from the Venice Lagoon, *Mytilus galloprovincialis* (Lamarck, 1819) from Spain and *Modiolus barbatus* Linnaeus, 1758 from Greece, were collected directly from trucks, before arriving to distribution centres. Once in the laboratory, firstly, the intervalvar water was removed from the molluscs, and analysed. Successively, three shells for each batch were put into culture cells, and maintained in seawater for three months with plain air bubbling, in order to assess the presence of epibionts. Periodically, the culture medium was completely and warily changed. At the end of the culture time, each shell was observed under a stereomicroscope to detect all the possible developed epibionts.

Results and Discussion
The analysis of the intervalvar water showed the presence of six different taxa (Tab. 1). Cells of the diatom *Gyrosigma* sp. and the adult of an unidentified copepod were found in *C. gigas* from France. Cells of the potentially toxic dinoflagellate *Prorocentrum* cf. *micans*, cysts of *Alexandrium* sp. and an unidentified ciliate were found in the intervalvar water of *M. barbatus*. Cells of the diatom *Licmophora* sp. and an unidentified ciliate were observed in the intervalvar water of M. galloprovincialis.

Tab. 1. List of micro-and macroalgae found in and on analysed bivalves, respectively. F= France, S=Spain. * alien species

	C. gigas F	*C. gigas* S	*V. philippinarum*	*M. galloprovincialis*	*M. barbatus*
Microalgae					
Alexandrium sp. (cyst)	-	-	-	-	+
Gyrosigma sp.	+	-	-	-	-
Lichmophora sp.	-	-	-	+	-
Prorocentrum cf. *micans* Ehrenberg	-	-	-	-	+
Macroalgae					
**Asparagopsis taxiformis* (Delile) Trevisan de Saint-Léon	-	-	-	-	+
Bryopsis sp.	+	-	-	-	-
Chaetomorpha sp.	+	-	-	-	-
Cladophora sp.	-	+	-	-	-
Dictyota sp.	+	-	-	-	-
Ectocarpus sp.	-	-	+	-	-
Hincksia ovata (Kjellman) P.C.Silva	+	-	-	-	-
Lomentaria clavaeformis Ercegovic	+	-	-	-	-
Polysiphonia subulata (Ducluzeau) Kützing	-	+	-	-	-
Pterothamnion plumula (J. Ellis) Nägeli	+	-	-	-	-
Stylonema cornu-cervi Reinsch	+	-	-	-	-
Ulva sp.	+	+	-	-	-
Total	**8**	**3**	**1**	**1**	**3**

Concerning shell analysis, they appeared uncolonised to the naked eye, but at the end of the culture period, eight thalli of macroalgae were detected developed on *C. gigas* from France, three on *C. gigas* from Spain, one on *V. philippinarum* and one on *M. barbatus.* No epibionts were found on *M. galloprovincialis*. All the thalli were very small, and in most cases sterile, so that their taxonomical identification was performed only to the genus level. In case of fertile thalli, species identification was possible (Tab. 1). From those observations, *C. gigas* confirms to be the mollusc *par excellence* for the settlement of macroalgae on its shells. Indeed, as already observed in previous studies in other Transitional Water Systems in Italy [4], and elsewhere [5], its rough surface holds sediment particles and propagules, favouring the species settlement. Concerning aliens, in our study, only one species, i.e. the tetrasporic phase of *Asparagopsis taxiformis* (Delile) Trevisan de Saint-Léon, was detected on bivalve shells. This phase, previously known as a distinct species, i.e. *Falkenbergia hillebrandii* (Bornet) Falkenberg, was recently reported in the Mar Piccolo of Taranto, but no hypothesis about the vector of introduction was formulated [6]. Since in Taranto, notwithstanding the rules in force, imported molluscs are often improperly stored into the sea up to the sale, and their shells are jettisoned after consumption onto the bottom [3], it is most likely that *A. taxiformis* was introduced through live seafood. Therefore, it is necessary to be always vigilant. Indeed, even though in intervalvar water and on the other mollusc surfaces no alien was detected, the continuous importation of live seafood, the presence of viable microalgal cells in the intervalvar water and of macroalgal propagules on shell surface, and the capacity of the developed thalli to form reproductive structure, are all factors predisposing to the introduction of aliens.

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