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Rapid Communication

The ivory barnacle *Amphibalanus eburneus* (Gould, 1841) (Arthropoda: Hexanauplia: Sessilia) in Albania (Adriatic Sea)

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Abstract

The ivory barnacle *Amphibalanus eburneus* (Gould, 1841), native to the Western Atlantic, is a worldwide invader whose spread has been facilitated by shipping and shellfish culture. During a rapid assessment survey held in August 2018, several juvenile and adult barnacles were found among fouling communities of native mussel farms from Lake Butrint (Albania, Adriatic Sea). The majority of these barnacles were subsequently identified as *A. eburneus*. The present record fills a gap in the global invasive distribution of this taxon and represents the first record of the species from Albania. The appearance of *A. eburneus* in this novel location is most likely due to secondary spreading via shipping and/or fouling or introduction via shellfish culture. Barnacles, in general, can have adverse effects on native ecosystems and biota by competing for space and food and contributing to biofouling on ships/vessels and anthropogenic structures. Therefore, future studies may focus on the possible impacts of *A. eburneus* on the local native mussel economy and native biota.

Key words: Mediterranean Sea, bioinvasions, Cirripedia, fouling communities, mussel farms

Introduction

The semi-enclosed Mediterranean Sea offers a wide range of climate, hydrology, and habitat niches that have historically contributed to the co-occurrence and survival of both temperate and subtropical organisms (Coll et al. 2010). However, a large number of marine species have been transported into and within the area by anthropogenic activities (e.g. hull fouling, ballast water, navigation canals, aquaculture, and fisheries), thus reaching biogeographic provinces beyond their native dispersal potentials (Bax et al. 2003; Katsanevakis et al. 2013).

The ivory barnacle *Amphibalanus eburneus* (Gould, 1841), a cirriped species of the family Balanidae Leach, 1817, is one such marine species transported globally via anthropogenic means. This taxon is usually found in estuarine habitats, tolerates considerable salinity variations extending from near full-salinity waters to nearly fresh waters, and avoids strong currents, living mainly attached to immobile objects (e.g. mollusk shells,

rocks, harbor installations, and artificial substrates) in areas protected from wave action (Henry and McLaughlin 1975; Dineen and Hines 1994). The species can grow up to 40 mm in diameter and 30 mm in height and is characterized by a shell with a conic/cylindrical aspect, variable in shape according to the amount of crowding, with a toothed and almost pentagonal orifice (Henry and McLaughlin 1975). The wall of the shell is composed of six plates, which narrow and become thick and rough towards the top, with longitudinal spaces. The scutum has strong longitudinal striae and small teeth on the occluding margin, and the tergum has protuberant carinal margin and no distinct longitudinal furrow (Henry and McLaughlin 1975).

Amphibalanus eburneus, native to the Western Atlantic (Fofonoff et al. 2018), has been widely introduced worldwide through shipping (Aladin et al. 2002; Carlton et al. 2011; Jaberimanesh et al. 2019) and has been found throughout the Mediterranean and the Black Sea since the 19th century, where it is now well established with multiple records from several countries (Relini 1969; Zenetos et al. 2017; Spagnolo et al. 2019). However, its distribution in the Mediterranean basin remains patchy, presumably due to the absence of field research and taxonomic experts. Here, we report the presence of *A. eburneus* in Albania found during a rapid assessment survey in August 2018.

Materials and methods

On August 11th, 2018, one of us (F.C.) performed a visual survey of the marine fouling community attached to stones and aquaculture ropes at the tidal level in Lake Butrint, Albania (~ 39.783742°; 20.031894°), a nationally important native mussel (*Mytilus galloprovincialis* Lamarck, 1819) farm. Lake Butrint is a salt lagoon south of Saranda connected to the Ionian Sea by the Vivari Channel. The maximum depth of the lake is ~ 20 m, and water salinity usually fluctuates between ~ 20 and 40 psu (Moisiu et al. 2016). Collected species were identified according to specialist taxonomic guides; cirripeds, in particular, were visually identified following Relini (1980). The material was fixed in 100% ethanol and is stored in the private collection of Fabio Crocetta (Stazione Zoologica Anton Dohrn, Naples, Italy).

Results

The analysis of tide level and mussel ropes communities revealed the presence of several alien and native taxa (Figure 1). The most common species encountered at tide level were the alien serpulid *Hydroides* cf. *elegans* (Haswell, 1883), the native bivalves *Mytilaster lineatus* (Gmelin, 1791) and *Mytilus galloprovincialis*, and the alien cirriped *Amphibalanus eburneus*. The most common species encountered among material detached from the mussel ropes were the cirripeds *Amphibalanus amphitrite* (Darwin,

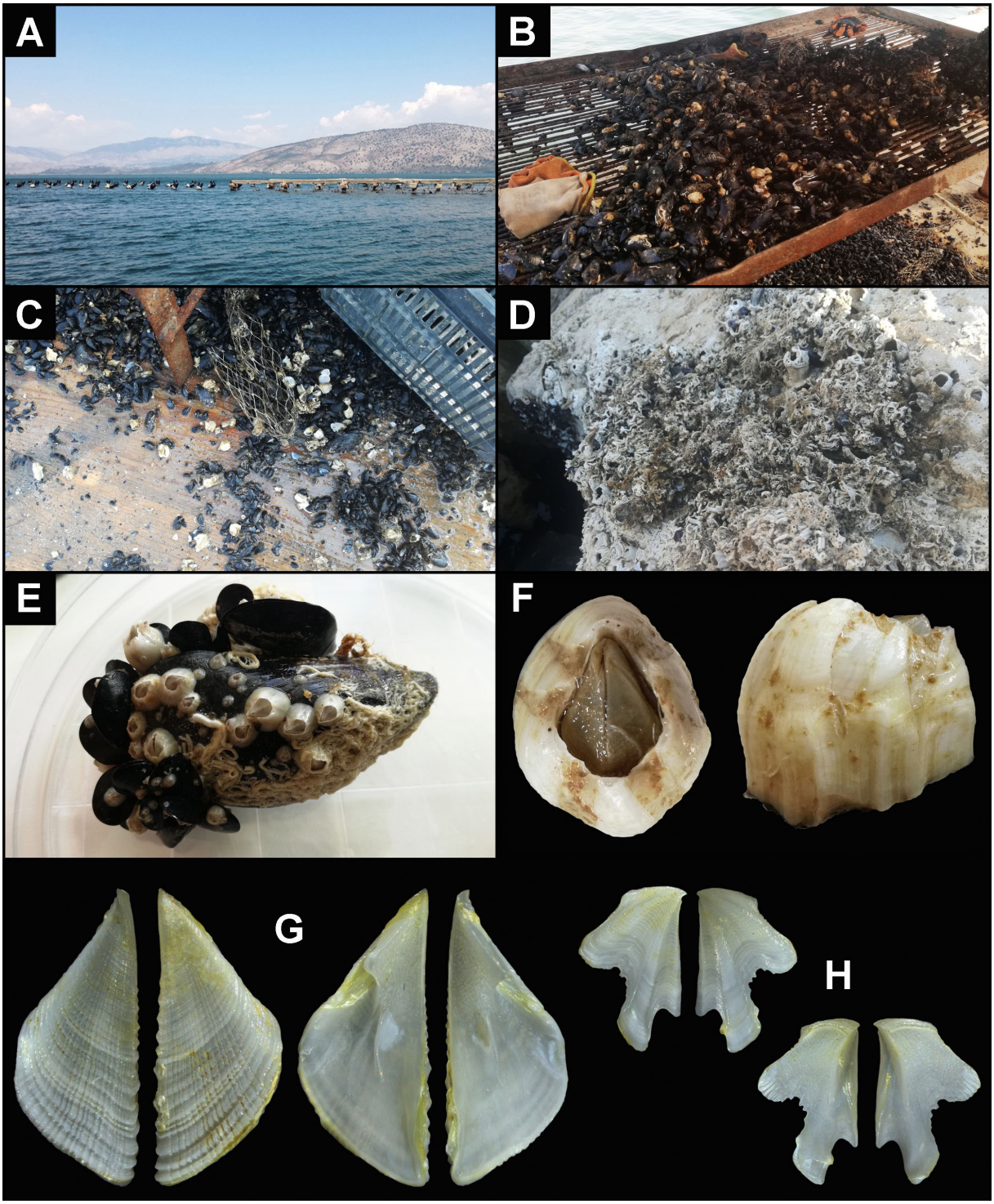

Figure 1. *Amphibalanus eburneus* (Gould, 1841) collected from Lake Butrint (Albania) in August 2018. A. The local mussel farm. B–C. Material detached from aquaculture ropes (the white barnacles are mostly *A. eburneus*). D. Tide level fouling communities. E. An adult specimen of *Mytilus galloprovincialis* Lamarck, 1819 almost completely fouled by juvenile specimens of *A. eburneus*. F. An adult specimen of *A. eburneus* (22.5×18.2 mm). G. Scutum, external and internal surface (10.5×4.5 mm). H. Tergum, external and internal surface (8×5 mm). Photographs by Fabio Crocetta and David Osca.

1854) and *A. eburneus* (native and alien, respectively), the alien serpulid *Hydroides* cf. *elegans*, the native polyclad *Imogine mediterranea* (Galleni, 1976), and the alien ascidian *Styela plicata* (Lesueur, 1823). On the basis of our bibliographic research (see below), this is the first report of the alien species *A. eburneus* from Albania.

Discussion

To the best of our knowledge, the present record constitutes the first sighting of *Amphibalanus eburneus* in Albania and fills a gap in the known distribution of this alien species in the Mediterranean and Adriatic Sea (for a recent review of alien species in Albania see Zenetos et al. 2011). In fact, this taxon has already been recorded in Italy, Montenegro, and Croatia over the past several decades (e.g. Igić 1983, 2007; Zavodnik and Igić 1968; Innocenti 2006; Servello et al. 2019; Spagnolo et al. 2019) and may have easily gone unnoticed in Albania due to the absence of targeted field studies and taxonomic specialists. This may be the case, as the *A. eburneus* collected in this study were fairly common and dominated in number and biomass over other native and invasive taxa. In addition, *A. eburneus* juveniles were also fairly common throughout the sample and attached to the mussel ropes, suggesting successful breeding and establishment in the area (see Figure 1E for a native mussel almost completely fouled by *A. eburneus* juveniles). Indeed, the invasive potential of the family Balanidae is well known, with a substantial number of alien species found globally, several of which have adverse effects on native ecosystems and biota (Carlton et al. 2011; Jaberimanesh et al. 2019; Tempesti et al. 2020; Spagnolo et al. 2019). *Amphibalanus eburneus*, in particular, is a common fouling organism that adversely affects molluscs and hydroids in the Caspian Sea due to competition for space and planktonic food (White and Wilson 1996; Zaitsev and Ozturk 2001) and coral reefs in Micronesia and Hawaiian Islands (Paulay et al. 2002; Coles et al. 1999, 2004). In addition, like the majority of barnacles, *A. eburneus* is a major contributor to the biofouling of various anthropogenic structures, with costly impacts for the shipping industry due to increased fuel costs, decreased maneuverability, and the clogging of internal seawater piping (Visscher 1927; Haderlie 1984). Like previous reports of this species throughout the Mediterranean and Adriatic Sea, we found *A. eburneus* in Albania as part of fouling communities of a mussel farm within a lagoon. Currently, the impact of this invader on Albania's mussel aquaculture is unknown; therefore, future studies may focus on the possible impacts of *A. eburneus* on the local mussel economy and native biota.

There are several hypotheses concerning the possible vector transporting *A. eburneus* to Albanian coasts. In general, barnacle larvae are usually meroplanktonic and stay suspended in the plankton for only a restricted period of time (usually up to a maximum of 4 weeks) before settlement (Chan and William 2003). This suggests that vectors transporting reproducing adults, such as shipping, fouling, or shellfish culture, are the most probable vectors. Recreational boating is a major vector that spreads invasive organisms via hull fouling throughout small to medium spatial scales (e.g. Savini et al. 2006; Ferrario et al. 2015; Ulman et al. 2019). In addition, barnacle species attach to and foul anthropogenic litter (i.e., European aquaculture activities or other floating items), which can be transported

great distances by currents (e.g. Southward et al. 2004; Rech et al. 2018). Finally, the introduction of species via shellfish culture (together with stocks of commercial species) constitute a major problem worldwide (Minchin 2007; Marchini et al. 2015). However, given the continuous distribution of this species in the Adriatic Sea, we also cannot fully discard a natural range expansion from other nearby populations.

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