

[단보, Short communication]

REPORT OF *Malleus regula* (FORSSKÅL IN NIEBUHR, 1775) (BIVALVIA: MALLEIDAE) IN KOREA

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ABSTRACT

The bivalve *Malleus regula* (Forsskål in Niebuhr, 1775) is reported for the first time from Korea. This is the second species of Malleidae reported from this country. Since the species is quite variable, comparisons were made with the original description and descriptions in the literature; some taxonomic comments were also made. Global warming and possible changes in the northward-flowing Tsushima Current may account for the addition of new mollusk species to the island's fauna.

Key words: *Malleus regula*, Malleidae, Bivalve, Mollusca, Jeju Island

INTRODUCTION

Jeju Island, situated about 80 km south of the Korean Peninsula, is Korea's largest and southernmost island. Because of the warm, northward-flowing Tsushima Current, the island possesses a warm maritime climate with mild winters and hot, humid summers. Over 1,000 mollusk species are presently recorded from this Island, probably because of a combination of warm-temperate and tropical-subtropical species (Noseworthy *et al.*, 2007).

Extensive surveys have been conducted to examine the biodiversity, biogeography, and ecology of the marine organisms including the mollusk fauna. Also, a study of the spread of the scleractinian coral *Alveopora japonica* Eguchi, 1968 along the coasts of Jeju Island has resulted in a large number of mollusk species being obtained from this environment. As a result,

several new species records have been recently reported (Noseworthy and Choi, 2010; Noseworthy *et al.*, 2012; Noseworthy *et al.*, 2014).

The family Malleidae, which belongs to the Pteriomorpha, consists of about 10 species, and most occur in tropical waters. Shells belonging to this family are subequivalve to inequivalve, somewhat compressed, irregular in form and more or less strongly elongated dorsoventrally. The dorsal margin is straight, and often produced at both ends into long, wing-like ears, although some species have no dorsal extensions. The interior possesses a relatively small, often well-defined, nacreous area situated dorsally (Gurumayum, 2015). At present, one malleid species, *Malleus malleus* Linnaeus, 1758 (띠조개), has been reported from Korea (Lee, 2015). The discovery of *Malleus regula* (Forsskål in Niebuhr, 1775), the first record of this species for Korea, is reported here.

MATERIALS AND METHODS

On July 15, 2013 a mollusk survey was conducted at Gwakji, on the northwest coast of Jeju Island (Fig. 1). Four dead specimens, approximately 1 cm in shell length, three single valves and one complete specimen of *M. regula*, were obtained from the driftline at

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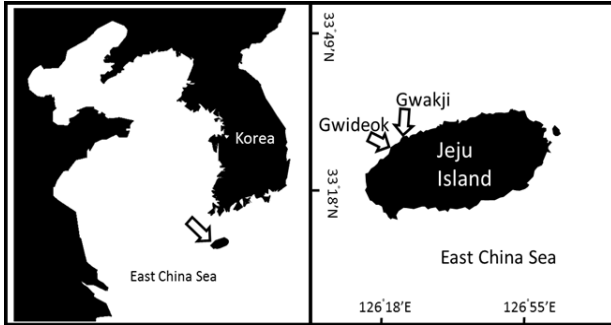


Fig. 1. Sampling site of specimens of *Malleus regula*.

Gwakji Beach. The specimens were dried and kept in the collection of the first author. On January 13, 2015 a survey was conducted at Guideok, on the northwest coast of Jeju Island (Fig. 1). Several colonies of the scleractinian coral *Alveopora japonica* Eguchi, 1968 occurred on rocky substrate, at a depth of 15 m. This sampling area, a moderately high-energy rocky coast, faces the East China Sea. One live specimen of *Malleus regula* (Forsskål in Niebuhr, 1775), a live small individual (22 mm in shell length), was obtained from the underside of colonies of the coral. The specimen was placed in 70% ethanol for preservation, and stored at the Shellfish and Aquaculture

Laboratory, Jeju National University.

Identification of the specimen from Gwideok was made by morphological observation. The Gwakji specimens were conspecific with the Gwideok material. The original description of *M. regula* (Forsskål in Niebuhr, 1775), a description of *M. regula* in Reeve (1858), the original description of *M. maculosus* (Reeve, 1858) (a synonym of *M. regula* (Fig 2), and Hayami (2000) were also consulted.

RESULTS AND DISCUSSION

SYSTEMATICS

Subclass: Pteriomorpha Beurlen, 1944

Order: Pterioidea Newell, 1965

Family: Malleidae Lamarck, 1818 (귀조개과)

Genus: *Malleus* Lamarck, 1799 (귀조개속)

Malleus regula (Forsskål in Niebuhr, 1775) (신칭: 작은티조개)

Ostrea regula Forsskål in Niebuhr, 1775. 124

Ostrea valsella Gmelin, 1791, 3333

Himantopoda truncata Schumacher, 1817, 110

Malleus decurtatus Lamarck, 1819, 145

Malleus vulsellatus Lamarck, 1819, 145

Vulsella nuttalli Conrad, 1837, 257, pl. 20, fig. 10

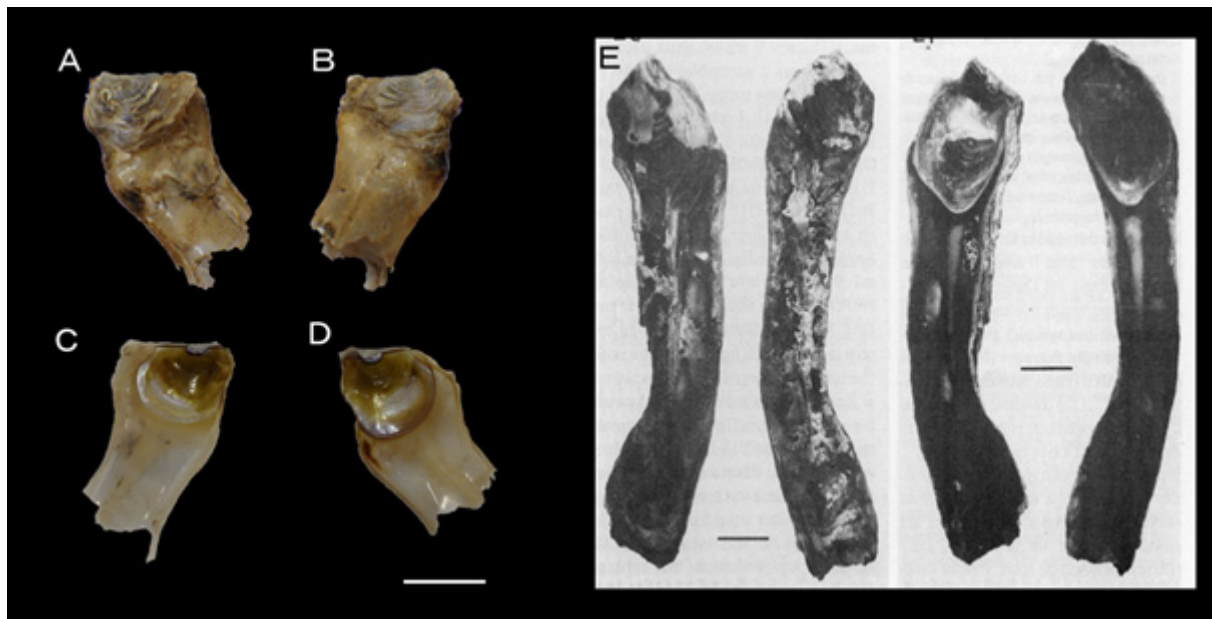


Fig. 2. *Malleus regula* (subadult). Gwideok, Jeju Island, Korea. **A.** exterior, left valve; **B.** exterior, right valve; **C.** interior, right valve; **D.** interior, left valve. **E.** *Malleus regula*. Lectotype; exterior view (left), interior view (right)(scale bar 1 cm) (Yaron *et al.*, 1986).

Malleus aquatilis Reeve, 1858, pl. 3, sp. 11
Malleus maculosus Reeve, 1858, pl. 3, sp. 9
Malleus rufipunctatus, 1858, pl. 3, sp. 8
Malleus solitarius, 1858, pl. 3, sp. 12
Malleus vesiculatus Reeve, 1858, pl. 3, sp. 12
Malleus panamensis Mörch, 1861, 209
Malleus obvolutus de Folin in de Folin and Perier, 1867. 65.
Fundella lioyi Gregorio, 1884, 73

Parimalleus cursor Iredale, 1931, 205
Pinna aenigmatica Turton, 1932, 219, pl. 56, fig. 1521
Pinna saccata Turton, 1932, 218, pl. 56, pls. 1517, 1518

Type locality: Suez, Gulf of Suez, Egypt (Yaron *et al.*, 1986)

Material examined: Gwakji, Jeju Island, 33° 27' 05" N, 126° 18' 21" E; July 15, 2013 (four juvenile specimens); Guideok, Jeju Island, 33° 14' 42" N, 126° 23' 22" E, January 13, 2015 (one subadult specimen) (Fig. 2).

Dimensions: Gwideok specimen: length 22 mm; width 13.5 mm (right valve); length 21 mm; width 11.5 mm (left valve). Gwakji specimens: length 6-10 mm; width 7-10 mm (single valves); length 5 mm; width 6 mm (complete specimen)

Description: Quite variable. Small to medium-sized, thin, weakly convex, irregular in shape, dorsal margin short, with small squarish to rectangular nacreous area; outer layer irregularly lamellate, extending only ventrally with growth. Exterior purplish-brown to yellowish-brown with irregular undulations. Central ridge dividing interior which is tinged with purple.

Habitat: Byssally attached to rocks and boulders, and in coral crevices, below low tide line to depth of 70 m (Huber, 2010). Often in dense colonies, sometimes forming mixed natural beds with *Isognomon isognomum*, a species also occurring in Jeju Island (Poutiers, 1998).

Distribution: Korea (Jeju Island) and southern Japan to tropical Panpacific, Mediterranean (Huber, 2010)

Remarks: Although a subadult, the Gwideok specimen agrees well with the original description of *Ostrea regula* (Forsskål in Niebuhr, 1775) although an illustration was not provided. In this paper, the species was described as rather flat, linear, and “nearly angulated”, with a “small and squarish body cavity” (nacreous area); the live specimen of our study is slightly curved, dorsally extended, and roundly

angulated anteriorly. Almost all the specimens, juvenile and subadult, have the anterior and dorsal sides of the nacreous area somewhat straight, the posterior side gently rounded, and the ventral area more deeply so. In the original description the shell is also described as being very brittle; the calcareous extension of the Gwideok specimen is also very brittle, the ventral area being damaged during removal from the coral and the opening of the valves. However, Forsskål describes the interior of the nacreous area as bluish white, while the nacreous interior of the Gwideok and Gwakji specimens is dark or medium brown dorsally and light brown or pearly white ventrally. According to the original description, the adult shell is (76.2 mm) long (“larger than a finger”) with a dark reddish-brown color. The Gwideok subadult specimen is 22 mm and light brown in color, probably because the specimen was a young individual.

In this study, both Gwideok and Gwakji specimens exhibit varying degrees of concentric lamellae, being smaller, somewhat straighter and lighter in color, usually whitish or brownish, with irregular concentric lamellae on the exterior nacreous area, and blister-like laminations on the calcareous extension. It appears that this morphological form of the species is close to “*M. maculosus* Reeve, 1958”, which is one of the synonyms of *M. regula*, because of the following reasons; Reeve (1858) described and figured several species of *Malleus*, including a re-description of *M. regula*. Among new species, Reeve described *M. maculosus*, now regarded as a synonym of *M. regula*. He mentions that the thin prolonged exterior laminae on the calcareous extension appear “almost bladder like”. On the left valve of the subadult specimen, near the nacreous area, there appear to be similar laminations (Fig. 2). A later, detailed diagnosis of *M. maculosus* (Rehder, 1980; Raines and Huber, 2012) also mentions what he describes as “blisterlike laminations, similar to the sculpture on the extension of the subadult, the somewhat swollen areas being adjacent to the nacreous area. Internally, Rehder (1980) mentions the raised margin of the nacreous area and an internal rib in both valves. Those features are present in the interior of the Gwideok specimen:

Yonge (1968), in his exhaustive treatment of this species, gives a description of the internal rib and the distinct nacreous rim, both present in the Gwideok subadult. Dautzenberg and Bavay (1912) stated that *M. regula* is easily recognized by this “internal longitudinal ridge” on the calcareous part of the shell, and also added that the ridge is present even in young shells, which is the case in the subadult Gwideok specimen (Fig. 2). Thus the presence of the internal rib appears to be characteristic of this species. Another feature which may also help to identify *M. regula* (= *M. maculosus*), and mentioned by Reeve (1858), is the presence of the “bladderlike” laminations, a characteristic also observed by Rehder (1980), who describes them as “blisterlike”.

Yaron *et al.* (1986) reviewed Forsskal's taxon, discussed available type material, and selected a lectotype (Fig. 3) of “*Ostrea regula*”. They also designated the type locality, by inference from the original publication, as Suez, Gulf of Suez, Egypt.

M. regula is a very variable species, and Forsskal (1775), which is the original description of *Ostrea regula*, mentions that the species is “polymorphic”, and this is evidenced by the 17 different synonyms assigned to it. The specimens obtained are close to *M. maculosus* Reeve, 1858, a synonym of *M. regula*.

Of interest is the fact that the Gwakji area has been extensively surveyed by the first author since 2001; the first *Malleus* specimens not being found until 2013. Furthermore, the Gwideok area has been surveyed before on two different occasions, 2013 and 2014. At that time, no species of *Malleus* were obtained from the rather large samples of *Alveopora japonica*. The presence of only juvenile specimens and one subadult in the present samples suggests that this species is becoming newly established in this area.

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