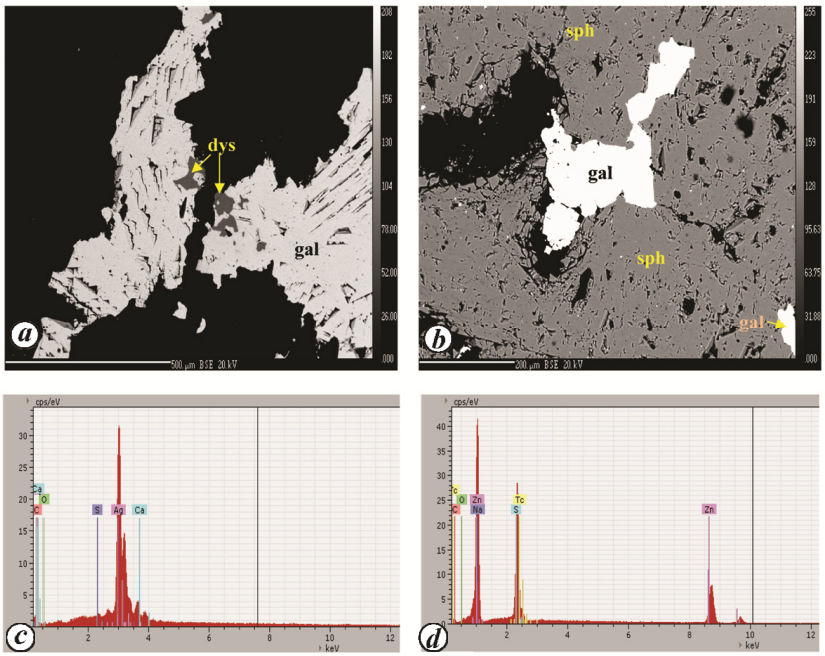

Figure 3 ***a–d.*** EPMA studies of galena and sphalerite. ***a***, BSE image of galena and dyscrasite in Dolomite, Zawar Mine.; ***b***, BSE image showing occurrence of green sphalerite and galena; ***c***, Spectrum of Ag (dyscrasite). ***d***, Spectrum of Zn (sphalerite).

belts of India and Zawar Belt in particular. The green colour of sphalerite is due to the presence of trace amounts of Co and Fe in it. The typical properties of sphalerite, viz. translucent light green colour and very high dispersion make it a worthy gem stone. Therefore, further search for this variety of sphalerite may be given priority in the Zawar Belt. This study appears to be the first report revealing the presence of dyscrasite in Zawar Belt of Udaipur district.

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Invasion of living fossil bivalve, *Dosinia japonica* (Reeve, 1850) along the Indian coast

Phylum Mollusca is the second largest group of invertebrates and comprises soft-bodied animals. They occur in diverse habitats such as freshwater, estuarine, marine, terrestrial and arboreal. Benthic organisms are living on or in the substratum of water bodies. Many organisms are permanently attached to the bottom. Among molluscan species, bivalves are larger and thus more visible. They exhibit a variety of body shapes, reproductive modes and feeding styles[1]. Bivalves are filter-feeding organisms and can purify silted marine waters[2]; they form an important link between the consumers and primary detritus and thus play significant role in nutrient recycling.

Invasive species have been a growing problem around the world since several decades[3]. They have an impact on the new environment, such as importing new diseases and competing with native organisms for space and food[4]. Venerid clams are suspension filter-feeders. They live buried in shallow marine waters and are common along the mainland coasts, but less abundant in the islands. According to Rao[5], Veneridae is a large family consisting of 172 genera and approximately 800 of venerid clams thus far. Among these, 82 species are placed under 25 living genera in India. Under genus *Dosinia* around 15 subgenera are recognized, but the distinguishing characters are not yet clear[5]. Rao[5] also described seven *Dosinia* spp., namely *Dosinia bruguieri*, *D. cretacea*, *D. fibula*, *D. histrio*, *D. prostrate*, *D. tranquebarica* and *D. tumida* which are found in India. Distribution of *D. japonica* is also confined to coastal waters of Malaysia and Indonesia, Korean peninsula, Japan and Russia[6]. In Japan, this species was reported in an extensive geographic

range in Pleistocene deposits[7]. It occurs with molluscan assemblages of still-living species, which is suggestive of a provincial Pleistocene era. The present study provides a taxonomic description of *D. japonica* which is an alien bivalve.

The study site, Padukere beach, located near the mouth of River Udyawara, Udupi district, Karnataka (13°20′51.80″N, 74°41′30.92″E) (Figure 1) was surveyed monthly (February 2009 to April 2010) during low tides for 1.3 years. Near this sampling site, there is a group of four small islands collectively known as St Mary's Island, spreading over a distance of about 4 km from north to south, parallel to the mainland of Udupi district.

Dosinia species (dosinids) were collected by hand-picking from intertidal regions at approx. 0.8 m depth during low tide. Specimens were washed using sea water to remove the debris, and then transferred to clean plastic bags. Thereafter, they were brought to the laboratory, photographed and identified up to species level using standard taxonomic keys of Rao[5], Oliver[8], Huber[9], Huber *et al.*[10] and Natural History Museum Rotterdam (Mollusca) (https://www.nmr-pics.nl/). Classification and scientific names were referred from the World Register of Marine Species (WoRMS) (http://www.marinespecies.org). In the laboratory, morphological features of each specimen were studied, including umbo, radial ribs, posterior slope, lunule, escutcheon, ligament and hinge. Cardinal teeth and growth lines were carefully studied. Later the specimen (M.2098) was deposited at the Marine Biology Regional Centre, Zoological Survey of India (ZSI) in Chennai.

Classification:
Phylum: Mollusca Linnaeus, 1758
Class: Bivalvia Linnaeus, 1758
Order: Venerida Gray, 1854
Family: Veneridae Rafinesque, 1815
Genus: *Dosinia* Scopoli, 1777
Species: *japonica* Reeve 1850
Dosinia japonica (Reeve, 1850)

1850. *Artemis japonica* Reeve, Conch. Icon. *Artemis* sp. 17, pl. 3, fig. 17.
1862. *Dosinia japonica* (Reeve), Roemer, Monogr. Molluskengatt. *Dosinia*, p. 60, pl. 11, figs. 4, 4a, 4b.
1933. *Dosinia* (*Phacosoma*) *japonica* (Reeve), Kuroda, Cat. Mollusca, Fukui Pref., no. 369, p. 201.
1951. *Dosinia* (*Phacosoma*) *japonica* (Reeve), Habe. Genera of Japanese shell, no. 1, Pelecypoda, p. 169, text-fig. 384.
1961. *Dosinia japonica* (Reeve), Iwai, Saito Ho-on Kai Mus., Res. Bull., no. 30, pl. 1, figs. 7a-c.
1965. *Dosinia japonica* (Reeve), Iwai, Bull. Educ. Fac., Hirosaki Univ., no. 15. p. 41, pl. 18. figs. 5-6.
1971. *Dosinorbis* (*Phacosoma*) *japonicus* (Reeve), Kuroda *et al.*, The Sea Shells of Sagami Bay, p. 649. p. 421, pl. 91, Fig. I.
1977. *Phacosoma japonicum* (Reeve), Habe, Bivalvia and Scaphopoda. p. 260, pl. 55, fig. 1.
1981. *Dosinia* (*Phacosoma*) *japonica* (Reeve), Ogasawara, Saito Ho-on Kai Mus., Res. Bull., no. 49. pl. 1, fig. 12.

Synonymized name: *Artemis japonica* Reeve, 1850

Material examined: 126 numbers (living specimens) collected and studied near the mouth of River Udyawara, Padukere (Karnataka, India).

Description: Shell is nearly orbicular and maximum distance between ventral

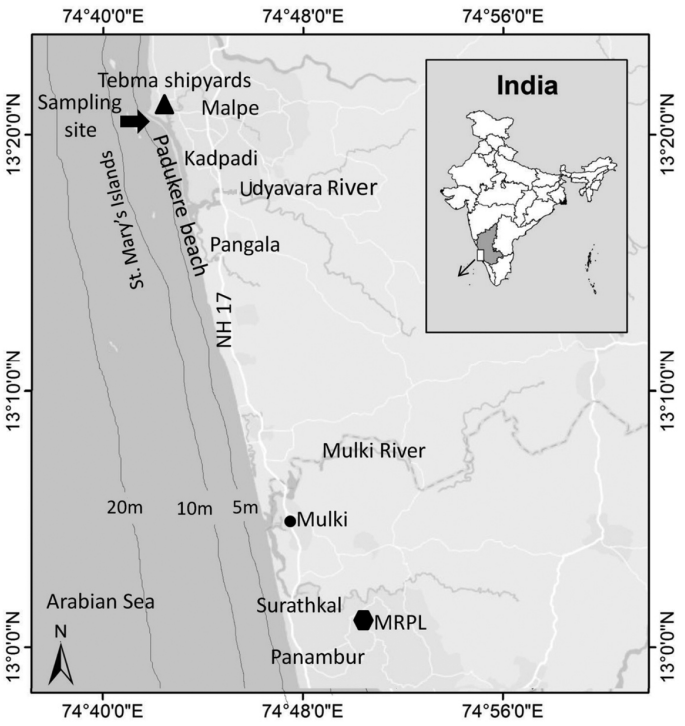

Figure 1. Location of study site in Padukere beach, Karnataka, southwest coast of India.

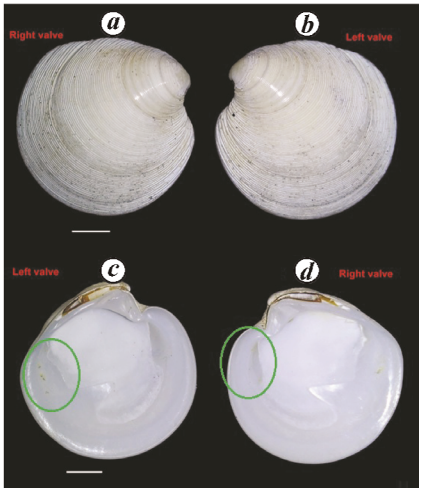

Figure 2. ***a***, Right valve of *Dosinia japonica*. ***b***, Left valve; scale bar = 5 mm. ***c***, Posterior adductor muscle scar (green circle). ***d***, Anterior adductor muscle scar (green circle).

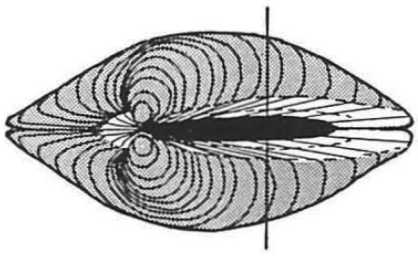

Figure 3. Escutcheon of *D. japonica* (source: Takagi[7]).

Table 1. Comparison of *Dosinia tumida* (India), *D. japonica* (India) and *D. japonica* (Japan)

Species	*Dosinia tumida* (India)	*D. japonica* (India)	*D. japonica* (Japan)
Shell shape	Orbicular	Orbicular	Orbicular
Umbo	Prominent and pointed obliquely towards anterior end	Prominent and pointed obliquely towards anterior end	Prominent and pointed obliquely towards anterior end
Lunule	Heart shaped and black	Large lunule and distinct. Lunule cordate and impressed. Most of the specimens have a moderately wide–long lunule	Large lunule and distinct. Most of the specimens have a moderately wide–long lunule
Internal shell	Smooth and white	Smooth and white	Smooth and white
Adductor impression (muscle scar)	Almost of same size	Adductor muscle scars large, oblong, distinctly defined; posterior one somewhat larger than anterior one	Large, oblong, distinctly defined; posterior one somewhat larger than anterior one
Escutcheon	*D. tumida* escutcheon is narrow and its shell is smooth	Escutcheon is prominent and broader compared to *D. tumida*. Shell is slightly smooth	Escutcheon is prominent and broader. Shell is slightly smooth

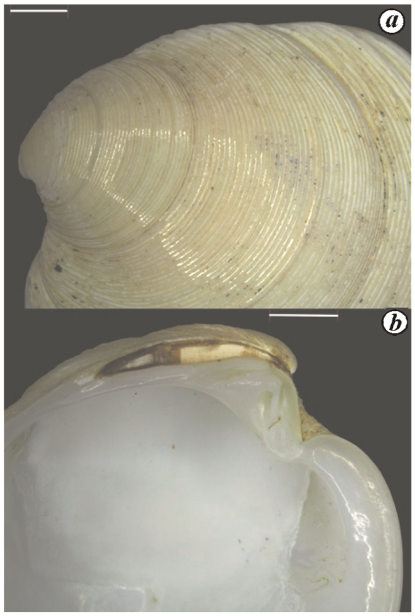

Figure 4. ***a***, Sraie of left valve; scale bar = 1.95 mm. ***b***, Teeth and hinge; scale bar = 2.31 mm.

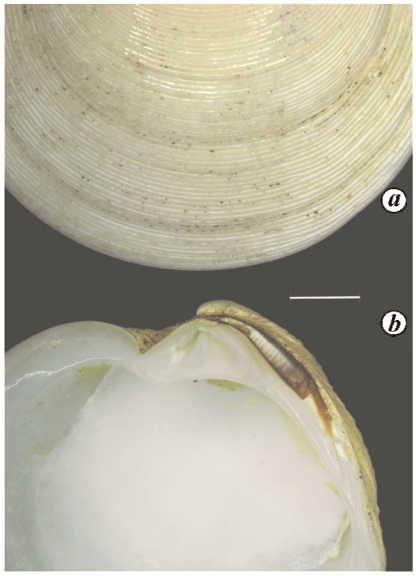

Figure 5. (***a***) Unsmooth surface and (***b***) teeth of right valve; scale bar = 2.32 mm.

and umbo is high, concentrically finely elevated, striated (Figure 2 *a* and *b*). Adductor muscle scars large, oblong, distinctly defined; posterior one somewhat larger than anterior one (Figure 2 *c* and *d*). Surface sculptured throughout with concentric striae, which become little stronger and raised on the posterior margin giving it a crested look and obscured spinose along the edge; lunule is large and distinct. Lunule cordate and impressed. Most of the *D. japonica* specimens have a moderately wide–long lunule. The pallial sinus of *D. japonica* is moderately wide, triangular and rounded. This is characterized by a distinct, wide and V-shaped escutcheon and a short ligament (Figure 3). The ligament shape is closely interrelated with its escutcheon; the wider is the ligament, wider the escutcheon, and the wide ligament favours easier opening of both valves. Antero-lateral tooth of left valve is large, elevated; posterior cardinal tooth is rather low (Figure 4) and slender; median cardinal teeth broad and strong. Median cardinal teeth distinctly elevated; rather deep and oblong pit at the upper end of posterior lateral socket distinctly defined. Hinge broad (Figure 5).

Remarks: Pallial sinus is considered to be one of the most specific and important characters for taxonomic separation. It is triangular and rounded. The characters of ligament and escutcheon are important for taxonomic separation at the species level. This clam can be separated from the others by comparing a wide, distinct and V-shaped escutcheon with a short ligament. Boominathan *et al.*[11] reported only one species, i.e. *Dosinia tumida* from estuarine areas of Karnataka. *D. tumida* escutcheon is narrow and its shell is smooth, whereas *D. japonica* does not display these characters (Table 1).

Habitat: *D. japonica* was found throughout the year in the present study. This dosinid inhabits intertidal zone to muddy sediments of shallow coastal waters[12]. It occurred in the very fine sandy beach located near the mouth of River Udyawara[13]. These common intertidal and inshore bivalves are used as food by local fishermen.

Geological range: Pleistocene–Recent[7].

Distribution: Singapore, Malaysia, Chinese Taipei, Japan, China, Australia (https://www.gbif.org), India (present study). The given global distribution record is based on previous published records. They inhabit a wide variety of substrates, but are often an important part of the fauna of sand flats and the more consolidated sediments offshore[8]. A recent study on the invasion of bivalves was carried out by Jayachandran *et al.*[14] from the Arabian Sea. Invasion of bivalves probably occurs in India due to transportation by means of ships and release of ballast waters in the Arabian Sea.

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