

# Three newly recorded molluscan species from Korea: *Pteria penguin* (Bivalvia: Pteriidae), *Turritatus turritus* (Gastropoda: Fasciolaridae), and *Rotaovula septemmacula* (Gastropoda: Ovulidae)

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## ABSTRACT

Three newly recorded mollusks, *Pteria penguin* (Bivalvia: Pteriidae), *Rotaovula septemmacula* (Gastropoda: Fasciolaridae), and *Turritatus turritus* (Gastropoda: Ovulidae) are described from Jeju Island, Korea. *P. penguin* is characterized by its large, black, wing-shaped valves. *T. turritus* resembles *T. nagasakiensis* in morphology but can be distinguished by its well-developed black axial ribs and low spire in height. *R. septemmacula* is notable for its kite-rhomboidal shell shape, with seven distinct thick brown spots on the dorsal surface. The genus *Rotaovula* C. N. Cate & Azuma, 1973 is rare worldwide, representing the first record of this genus from Korea. Diagnoses, remarks, and color plates are provided for each species. In addition, to perform molecular species identification, we compared intraspecific and interspecific genetic variation based on two mitochondrial genetic markers: the 16S rRNA gene for *P. penguin* and the COI gene for *T. turritus*. The results showed few intraspecific sequence differences, but more notable congeneric sequence differences. Maximum likelihood trees revealed that the two species are closely related to other individuals of the same species, respectively, indicating that their morphology-based species identifications are reliable.

**Keywords:** New records, *Pteria penguin*, *Turritatus turritus*, *Rotaovula septemmacula*, gastropods, Korea

## INTRODUCTION

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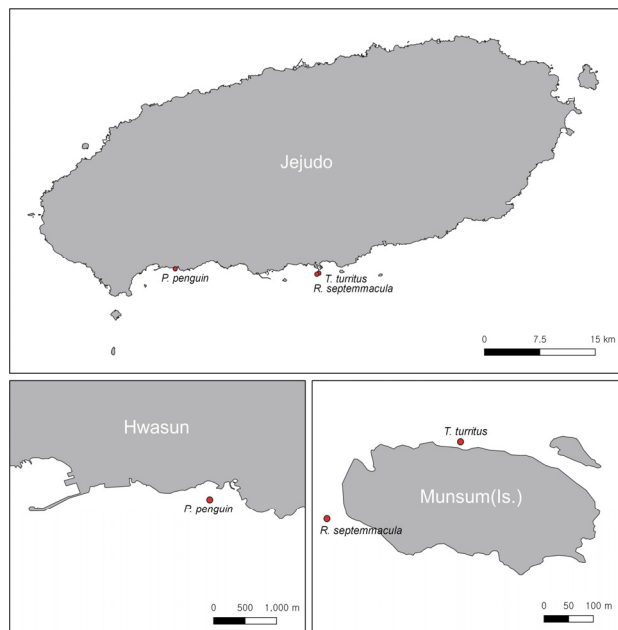
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*Pteria* Scopoli, 1777 is distinctively characterized by its strong wing-like projections and typically lives on branches of gorgonian or antipatharian corals. There are forty species worldwide, three of which have been found in Korean waters: *P. maura*, *P. gregata*, and *P. heteroptera* (Min *et al.*, 2004; NIBR, 2024; MBRIS, 2024). *Turritatus* Vermeij & M. A. Snyder, 2006 is a small genus with nine valid species known worldwide, and only one species of *Turritatus nagasakiensis*, has been reported in Korea (NIBR, 2024). With the discovery of the present species, there are now two species of the genus *Turritatus*

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**Fig. 1.** Locality map of collection sites.

in Korea. One specimen was found on the rocky substrate at a depth of 10 m underwater of Munseom, Jeju Island. *Rotaovula* C. N. Cate & Azuma is a rare genus with only two species recorded worldwide, and it is reported for the first time in Korea. The present species, *R. septemmacula* is a warm-water species primarily distributed in tropical seas, including South Africa, Mauritius, Philippines, Papua New Guinea, Solomon Islands, Vanuatu, and Japan (Okinawa) (MolluscaBase eds., 2024B). It is found only in Korea (Jeju Island) and Japan (Sagami Bay) in the temperate waters of Northeast Asia. In this study, a single specimen was collected from a branch of a sea fan (genus *Bebryce*) at a depth of 30 m underwater of Munseom, Jeju Island. During a project entitled “Discovery of Islands and Coastal Indigenous Species Korea” in 2022, one bivalve species and two gastropod were found to be new to Korea. This paper provides descriptions of these three previously unrecorded species.

## MATERIALS AND METHODS

Mollusk specimens studied in this work were collected from the subtidal zone to a depth of thirty

meters between May and November 2022 in Korea.

*T. turritus* was collected from the rocky substrate, while *P. penguin* and *R. septemmacula* were obtained from branches of gorgonian or antipatharian corals. All three species were collected from the underwater environment of Jeju Island (Fig. 1). Species identification was conducted based on the works of Azuma (1974; 1988), Cate (1964; 1970; 1973; 1975), Oukutani (2000), and Huber (2010). The terminology for morphological characters follows Cate (1973), Okutani (2000), and Son (2017). Classification and scientific names were based on MolluscaBase eds. (2024A; 2024B; 2024C). Mollusk specimens were fixed in 99.0% ethanol. Specimen observation was carried out under a dissecting microscope (Nikkon SMZ 745T; Nikon, Tokyo, Japan), and photographs were taken with a digital camera (Olympus TG5; Olympus, Tokyo, Japan). The specimens were deposited in the Honam National Institute of Biological Resources, Korea. Genomic DNA was extracted from the adductor muscle of *P. penguin* and the foot tissue of *T. turritus* using the DNeasy Blood & Tissue Kit (Qiagen, California, USA), following the manufacturer’s guidelines. The mitochondrial 16S rRNA and COI genes were amplified using the following primers: 16Sar-L and 16Sbr-H (Palumbi, 1996) for partial 16S rRNA gene, and LCO1490 and HCO2198 (Folmer *et al.*, 1994) for partial COI gene. The partial gene sequences obtained were deposited in the NCBI GenBank database (accession numbers PQ774881 and PQ799799). Genetic distances were calculated using the Kimura 2-parameter (K2P) distance model (Kimura, 1980) implemented in MEGA 11 software (Tamura *et al.*, 2021). In addition, through the IQ-TREE web server (<http://iqtree.cibiv.univie.ac.at/>) (Trifinopoulos *et al.*, 2016), we reconstructed maximum likelihood trees based on 16S rRNA gene for the genus *Pteria* and COI gene for the genus *Turritatirus*. The retrieved sequences and the present data were aligned using BioEdit (Hall, 1999) and trimmed. The final lengths of sequence alignments employed for phylogenetic analyses were 587 bp for 16S rRNA gene and 459 bp for COI gene. The used best-fit models were



Fig. 2. Photographs of *Pteria penguin*. A. Right valve; B. Left valve (scale: 50 mm).

HKY+F+G4 and TPM3+F+G4 in order.

Class Bivalvia Linnaeus, 1758 이매패강  
 Order Ostreoida A. Férussac, 1822 굴목  
 Family Pteriidae J. E. Gray, 1847 (1820) 진주조개과  
 Genus *Pteria* Scopoli, 1777 진주조개속

***Pteria penguin* (Röding, 1798) 큰산호살이조개 (신칭)**  
**(Figs. 2A-B; Table. 1)**

*Pinctada penguin* Röding, 1798, 167.

*Avicula macroptera* Lamarck, 1819: 147.

*Avicula radiata* Pease, 1863: 244.

*Austropteria perscitula* Iredale, 1939: 329, figs 6-6a.

*Pteria penguin*: Okutani, 2000: 879; Huber, 2010: 169.

**Type locality.** Unknown.

**Distribution.** South Africa (Natal), Mozambique, Kenya (Kistie Marine National Park, Mombasa), Madagascar, Djibout (Gulf of Aden), Saudi Arabia (Red Sea), Oman (Gulf of Oman), India (Andaman and Nicobar Islands), Thailand (Phuket), Indonesia,

Table 1. Uncorrected *p*-distances (%) of *Pteria* species based on the partial 16S rRNA gene sequences

No.	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	GenBank accession No.	References
1	<i>P. penguin</i>	-													PQ799799	This study
2	"	0.00	-												KT205284	Unpublished
3	"	0.21	0.20	-											AB591841	Masaoka <i>et al.</i> , 2011
4	"	0.21	0.20	0.41	-										KT205283	Unpublished
5	"	0.87	0.83	0.83	1.04	-									EF031242	"
6	<i>P. lata</i>	15.47	14.99	15.23	14.73	15.78	-								KT205286	"
7	"	15.51	15.02	15.26	14.76	15.78	0.00	-							HQ329435	Tëmkin <i>et al.</i> , 2010
8	<i>P. avicular</i>	15.71	15.45	15.69	15.19	16.26	12.25	12.28	-						KT205287	Unpublished
9	"	17.98	17.35	17.60	17.08	18.17	10.64	10.64	12.40	-					HQ329434	Tëmkin <i>et al.</i> , 2010
10	<i>P. loveni</i>	17.60	16.97	17.21	16.69	17.78	10.21	10.21	10.90	9.50	-				HQ329436	"
11	<i>P. colymbus</i>	18.40	18.02	18.27	18.02	18.86	17.32	17.32	19.96	28.57	18.50	-			HQ329432	"
12	<i>P. hirundo</i>	18.90	17.99	17.99	17.99	18.77	23.26	23.26	21.11	22.93	24.56	21.72	-		HQ329433	"
13	"	19.05	17.90	18.07	17.90	18.77	23.15	23.20	21.01	22.87	24.50	21.67	0.00	-	DQ280031	Giribet <i>et al.</i> , 2006

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Malaysia, Philippines, Papua New Guinea, Australia (Northern Territory, Queensland), Solomon Islands, New Caledonia, Vanuatu, Fiji, China (Hainan, Kwangdong), Hong Kong, Japan (Kii Peninsula).

**Specimen examined.** South Korea: 1 specimen, Jeju-do, Seogwipo-si, Andeok-myeon, Gamsan-ri, Baksookijung, 19 XI 2022, J. Lee (HNIBRIV2431). On a branch of *Myriopathes* species (15-20 m in depth).

**Measurement.** Shell height 130 mm; length 185 mm; width 56 mm.

**Diagnosis.** Shell big, glossy black, oblique oval. Left valve convexed, more inflated than right one. Umbo raised low, located anteriorly. Dorsal margin straight. Ventral margin round, protrudes posteroventrally, and extends wide. Anterior ear short and tapered triangular. Posterior ear narrow, long, wing-shaped, spread toward posterior margin from byssal notch. Growth lines concentric, changing into scales and overlapping in plate-like shapes at marginal areas.

**Remark.** This species resembles two of Korean *Pteria gregata* and *Pteria heteroptera* (Min *et al.*, 2004; MBRIS, 2024; NIBR, 2024). However, it differs from those species in that *P. penguin* is much larger, glossy black, and has a roundly and widely protruded ventral margin. The specimen was attached to a branch of black coral, *Myriopathes* Opresko, 2001 at a depth of 15 to 20 meters. The uncorrected pairwise genetic distances were calculated based on partial

mitochondrial 16S rRNA gene sequences from a total of thirteen individuals of *Pteria*, including one individual analyzed in this study and twelve sequences from the NCBI GenBank database (Table. 1). The intraspecific *p*-distances within *P. penguin* ranged from 0.0% (between an individual from this study and KT205284) to 1.04% (between EF031242 and KT205283). In contrast, the *p*-distances to congeners ranged from 14.73% (between *P. penguin* and *P. lata*; KT205283 and KT205286) to 19.05% (between *P. penguin* from Korea and *P. hirundo*; PQ799799 and DQ280031). The unrooted ML tree based on 16S rRNA gene (Fig. 5) showed that all members of *P. penguin* are grouped together, indicating its species identification is correct.

Class Gastropoda Cuvier, 1797 복족강  
Order Neogastropoda Wenz, 1938 신복족목  
Family Fasciolaridae Gray, 1853 긴고둥과  
Genus *Turritulus* Vermeij & M. A. Snyder, 2006  
나가사키긴빨고둥속

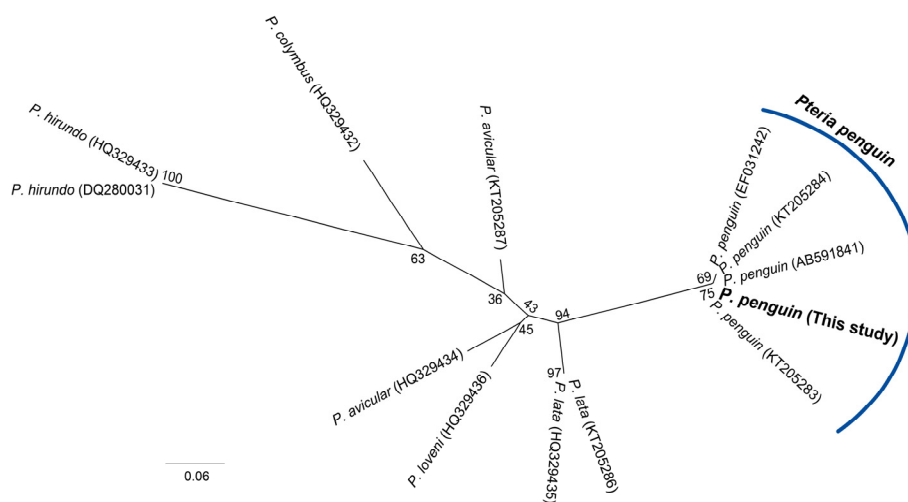
***Turritulus turritus* (Gmelin, 1791) 흑색껍질긴고둥 (신칭) (Figs. 3A-B; Table. 2)**

*Voluta turrita* Gmelin, 1791: 3456.

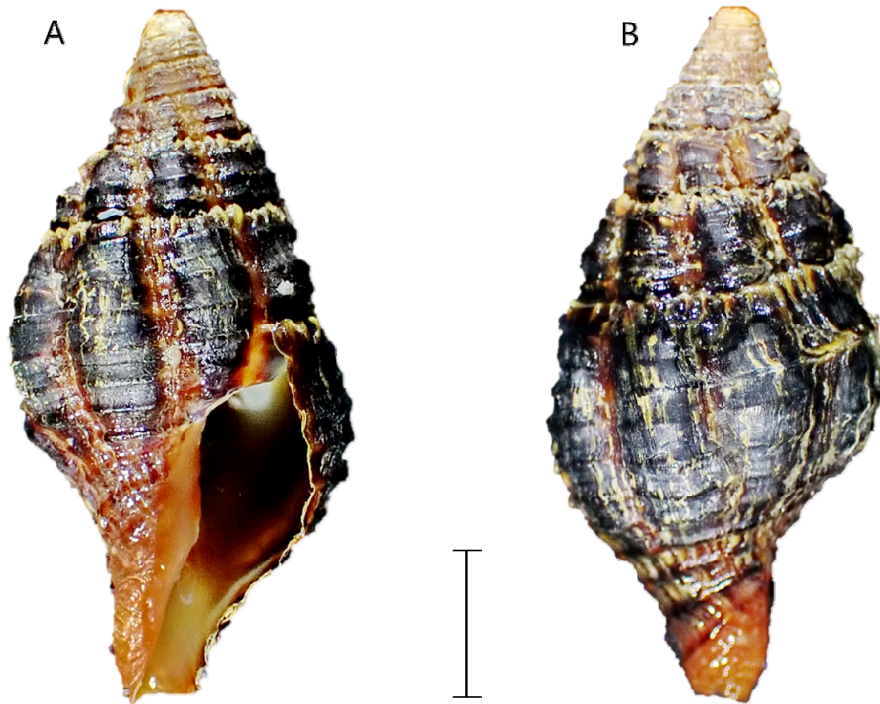
*Latirulus turritus*: Okutani, 2000, 511.

*Turbinella teniata* Deshayes, 1833: 66, figs 7-8.

**Type locality.** Unknown.



**Fig. 5.** A maximum likelihood tree of the genus *Pteria* based on partial 16S rRNA gene sequences.



**Fig. 3.** Photographs of *Turrilatirus turritus*. **A.** Ventral view; **B.** Dorsal view (scale: 5 mm).

**Distribution.** South Africa (Natal), Mozambique, Mauritius, Egypt (Hurghada), Eritrea, Israel, Jordan, Saudi Arabia (Red Sea), Djibouti (Gulf of Aden), Maldives, Sri Lanka, Brunei, Indonesia, Philippines,

Timor-Leste, Papua New Guinea, Australia (Northern Territory, Queensland), Solomon Islands, New Caledonia, Vanuatu, Fiji, Kiribati, United Kingdom (Pitcairn Islands), Taiwan, Japan (Okinawa, Ogasawara, Hachijo).

**Table 2.** Uncorrected *p*-distances (%) of the subfamily Peristerniinae based on the partial COI gene sequences

No.	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	GenBank accession No.	References
1	<i>Turrilatirus turritus</i>	-																PQ774881	This study
2	"	1.85	-															MZ560428	Plaisance <i>et al.</i> , 2021
3	"	1.91	0.33	-														HQ401585	Puillandre <i>et al.</i> , 2011
4	"	2.19	0.61	0.66	-													KT753981	Couto <i>et al.</i> , 2016
5	"	2.36	2.49	2.53	2.50	-												MZ560603	Plaisance <i>et al.</i> , 2021
6	"	2.37	2.12	2.19	2.12	0.32	-											KU496559	Al-Rshaidat <i>et al.</i> , 2016
7	"	2.53	2.65	2.36	2.66	0.15	0.48	-										KU496557	"
8	"	2.71	2.49	2.53	2.50	0.30	0.32	0.46	-									KU496558	"
9	"	2.88	2.97	3.05	2.98	0.46	0.80	0.61	0.77	-								KU496560	"
10	"	3.06	3.14	3.23	3.15	0.92	0.97	1.08	1.23	1.08	-							KT753900	Couto <i>et al.</i> , 2016
11	<i>Leucozonia ocellata</i>	9.35	9.64	9.54	9.49	10.18	9.22	10.36	10.18	10.36	10.18	-						KT753978	"
12	<i>Turrilatirus craticulatus</i>	10.83	10.65	11.23	10.69	11.03	11.04	11.21	11.03	11.21	10.65	12.72	-					KT753920	"
13	<i>Latirus pictus</i>	11.24	11.20	11.62	11.06	12.50	12.00	12.69	12.50	12.50	11.76	11.86	14.86	-				KT753967	"
14	<i>Benimakia lanceolata</i>	11.25	12.32	11.83	12.36	12.51	12.40	12.32	12.89	13.08	12.51	11.64	14.88	11.46	-			KT753959	"
15	<i>Leucozonia cerata</i>	11.28	11.43	11.47	11.66	12.97	12.24	13.17	12.97	13.17	12.97	8.79	15.96	12.97	14.92	-		KT754008	"
16	<i>Latirus vischii</i>	11.83	11.92	11.80	11.42	12.85	12.58	13.04	13.23	12.85	12.85	12.14	14.99	11.98	11.30	15.24	-	KT753913	"



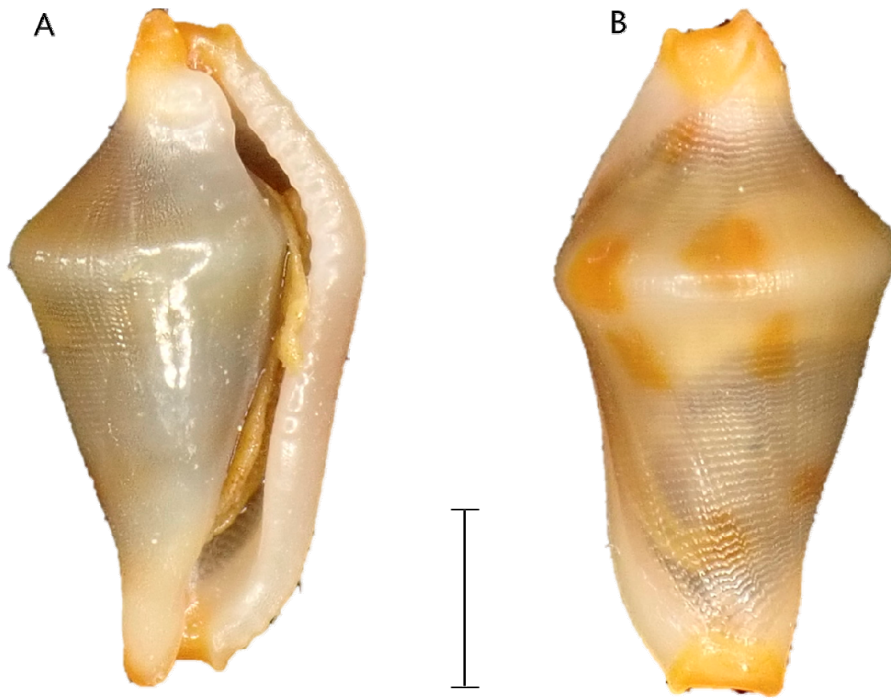


Fig. 4. Photographs of *Rotaovula septemmacula* A. Ventral view; B. Dosal view (scale: 2 mm).

Order Littorinimorpha A. N. Golikov & Starobogatov, 1975 총알고둥목

Family Ovulidae J. Fleming, 1822 개오지불이과

Genus *Rotaovula* C. N. Cate & Azuma, 1973

바퀴토끼고둥속 (신칭)

*Rotaovula septemmacula* (M. Azuma, 1974)

반점바퀴토끼고둥 (신칭) (Figs. 4A-B)

*Dentiovula septemmacula* Azuma, 1974: 70-71, figs 10-12; 1988: 257.

*Crenovolva* (*Crenovolva*) *conspicua* Cate, 1975: 258, fig 9.

*Primovolva* (*Crenovolva*) *septemmacula*. Okutani, 2000: 217.

**Type locality.** Kirimezaki, Kii peninsula, Japan.

**Distribution.** South Africa (Natal), Mauritius, Philippines (Sulu Sea), Papua New Guinea (Bismarck Sea), Solomon Islands, Vanuatu, Japan (Okinawa Islands to Sagami Bay).

**Specimen examined.** South Korea: 1 specimen, Jeju-do, Seogwipo-si, Seogwi-dong, Munseom, 24 VIII 2022, J. Lee (HNIBRIV2429). On a branch of malacalyoncean coral, *Bebryce* species (30 m in depth).

**Measurement.** Shell length 7.5 mm; width 3.8 mm.

**Diagnosis.** Shell glossy, small, pale brown, and kite-rhomboidal shape with seven distinct thick brown spots, and transversely fine incised striations on dorsal surface. Shoulder rounded, with angular ridge. Aperture narrow, bow-shaped, and widened abapically. Outer lip denticulate. Inner lip smooth, with one funiculum adapically. Both terminal endings thick brown, open with two pointed protrusions.

**Remark.** This species resembles *Rotaovula hirohitoi*, which has an angular ridge on the shoulder and an arched narrow aperture. However, it differs in the absence of rotary humps on the shoulder and protruding digital appendages at the outer lip (Cate, 1973). The species of *Cuspivolva tigris*, known to be found in Korea, is similar to the specimen in this study but lacks the thick brown color with two projections at both terminal ends and does not exhibit the seven thick brown spots on the dorsal surface (Okutani, 2000; Min *et al.*, 2004).

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## REFERENCES

- Al-Rshaidat, M. M., Snider, A., Rosebraugh, S., Devine, A. M., Devine, T. D., Plaisance, L., Knowlton, N., Leray, M. (2016) Deep COI sequencing of standardized benthic samples unveils overlooked diversity of Jordanian coral reefs in the northern Red Sea. *Genome*, **59**: 724-737.
- Azuma, M. (1974) Systematic studies on the recent Japanese family Ovulidae (Gastropoda)-I. On the genus *Dentiovula* Habe, 1961, with descriptions of two new species. *Venus*, **33**: 65-73.
- Azuma, M. (1988) Systematic studies on the recent Japanese family Ovulidae (Gastropoda)-XII. supplement. *Venus*, **47**: 255-260.
- Cate, C. N. (1964) A new species of *Primovula* from the Philippines (Mollusca: Gastropoda). *The Veliger*, **7**: 102.
- Cate, C. N. (1970) A new species of Japanese Ovulidae. *The Veliger*, **13**: 181.
- Cate, C. N. (1973) A systematic revision of the recent cypraeid family Ovulidae. *The Veliger*, **15** (supplement): 1-117.
- Cate, C. N. (1975) New cypraeacean species (Mollusca : Gastropoda). *The Veliger*, **17**: 255-261.
- Couto, D. R., Bouchet, P., Kantor, Y.I., Simone, L.R., Giribet, G. (2016) A multilocus molecular phylogeny of Fasciolariidae (Neogastropoda: Buccinoidea). *Molecular Phylogenetics and Evolution*, **99**: 309-322.
- Deshayes, G. P. (1833). [Coquilles de la Mer Rouge] *In*: L. de Laborde, Voyage de l'Arabie Pétrée par Léon de Laborde et Linant. pp. 87, Giard, Paris.
- Folmer, O., Black, M., Hoeh, W., Lutz, R. and Vrijenhoek, A. R. (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. *Molecular Marine Biology and Biotechnology*, **3**: 294-299.
- Giribet, G., Okusu, A., Lindgren, A. R., Huff, S. W., Schrödl, M., Nishiguchi, M. K. (2006) Evidence for a clade composed of molluscs with serially repeated structures: monoplacophorans are related to chitons. *Proceedings of the National Academy of Sciences*, **103**: 7723-7728.
- Gmelin, J. F. (1791) Vermes. *In*: Gmelin J.F. (Ed.) Caroli a Linnaei Systema Naturae per Regna Tria Naturae, Ed. 13. Tome 1(6). pp. 3021-3910, G.E. Beer, Lipsiae.
- Hall, T. A. (1999) BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. *Nucleic Acids Symposium Series*, **41**: 95-98.
- Huber M. (2010) Compendium of Bivalves. pp. 169, ConchBooks, Harxheim.
- Iredale, T. (1939) Mollusca. Part I. *Scientific Reports of the Great Barrier Reef Expedition 1928-1929*, **5**: 209-425.
- Kimura, M. (1980) A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. *Journal of Molecular Evolution*, **16**: 111-120.
- Lamarck J.-B. M. de. (1819) Histoire naturelle des animaux sans vertèbres. Tome 6(1). pp. 343, Paris.
- Masaoka, T., Fujiwara, A., Kobayashi, T. (2011) 愛媛県宇和海で採集されたウグイスガイ科貝類の種判別-マベガイの分布域北上の可能性-. *DNA多型*, **19**: 120-125.
- MBRIS. (2024) Marine Bio-Resource Information System. [Internet], <https://www.mbris.kr>.
- Min, D.-K., Lee, J.-S., Koh, D.-B., and Je, J.-G. (2004) Mollusks in Korea. pp. 1-566, Min Molluscan Research Institute, Seoul.
- MolluscaBase eds. (2024A) MolluscaBase. *Pteria penguin* (Röding, 1798). Accessed at: <https://www.molluscabase.org>.
- MolluscaBase eds. (2024B) MolluscaBase. *Rotaovula septemmacula* (M. Azuma, 1974). Accessed at: <https://www.molluscabase.org/aphia.php?p=taxdetails&id=430690>.
- MolluscaBase eds. (2024C) MolluscaBase. *Turriturritus turritus* (Gmelin, 1791). Accessed at: <https://www.molluscabase.org/aphia.php?p=taxdetails&id=489066>.
- NIBR. (2024) National list of species of Korea. National Institute of Biological Resource, Accessed at <http://kbr.go.kr>.
- Okutani, T. (2000) Marine mollusks in Japan. pp. 1-1173, Tokai University Press, Tokyo.
- Palumbi, S. R. (1996) Nucleic Acids II: The polymerase chain reaction. *In*: Hillis DM, Moritz C & Mable BK, eds. Molecular Systematics Second Edition. pp. 205-247, Sinauer, Sunderland.
- Pease, W. H. (1863) Description of new species of marine shells from the Pacific Islands. *Proceedings of the Zoological Society of London*, **1862**: 240-243.
- Plaisance, L., Matterson, K., Fabricius, K., Drovetski, S., Meyer, C., Knowlton, N. (2021) Effects of low pH on the coral reef cryptic invertebrate communities near CO2 vents in Papua New Guinea. *PLoS One*, **16**: e0258725.
- Puillandre, N., Kantor, Y. I., Sysoev, A., Couloux, A., Meyer, C., Rawlings, T., Todd, J. A., Bouchet, P. (2011) The dragon tamed? A molecular phylogeny of the Conoidea (Gastropoda). *Journal of Molluscan Studies*, **77**: 259-272.
- Röding, P. F. (1798) Museum Boltenianum sive catalogus cimeliorum e tribus regnis naturæ quæ olim collegerat Joa. Friedl Bolten, M. D. p. d. per XL. annos proto physicus Hamburgensis. Pars secunda continens Conchylia sive Testacea univalvia, bivalvia & multivalvia. pp. 199, Trapp., Hamburg.
- Son, M. H., (2017) Visual dictionary for Korean molluscs, External Morphology. pp. 1-179, The Malacological

Society of Korea.

- Tamura, K., Stecher, G. and Kumar, S. (2021) MEGA11: molecular evolutionary genetics analysis version 11. *Molecular Biology and Evolution*, **38**: 3022-3027.
- Tëmkin, I. (2010) Molecular phylogeny of pearl oysters and their relatives (Mollusca, Bivalvia, Pterioidea). *BMC Evolutionary Biology*, **10**: 342.
- Trifinopoulos, J., Nguyen, L. T., von Haeseler, A., Minh, B. Q. (2016) W-IQ-TREE: a fast online phylogenetic tool for maximum likelihood analysis. *Nucleic Acids Research*, **44**: W232-W235.

