Korean J Biol Sci 1: 281-296, 1997

Description of Muricid Species (Gastropoda: Neogastropoda) Collected from the Coastal Areas of South Korea

Byung Lae Choe and Joong-Ki Park[1]*

Department of Biology, College of Sciences, Sungkyunkwan University, Suwon 440-746, Korea;
[1]Department of Biology and Museum of Zoology, University of Michigan, Ann Arbor, MI 48109, U.S.A.

Key Words:
Muricidae
Taxonomy
Korea

The muricid species collected from 49 localities (72 sites) of Korean coast were examined. The Korean muricid fauna was recognized as 26 species of 15 genera in consequence of the present study along with the reviews of the previous records. Among the species examined, 5 of *Mancinella echinata* (Blainville, 1832), *Morula spinosa* (A. Adams, 1853), *Boreotrophon paucicostatus* Habe and Ito, 1965, *Boreotrophon cymatus* Dall, 1902, and *Boreotrophon alaskanus* Dall, 1902 were not reported in the Korean fauna previously. Korean muricids are suggested as subtropical, temporal, and boreal species distributed throughout the coastal areas of Korea with their own ranges.

The family Muricidae has been considered to be the most primitive within neogastropod mollusks (Thiele, 1929; Wenz, 1941; Taylor and Sohl, 1962). As a result of its world-wide adaptive radiation, more than 2,500 species have been reported in the world (Vokes, 1964; Radwin and D'Attilio, 1976). A total of 21 muricid species have been recorded (Schrenck, 1867; cited from Lischke, 1869; Smith, 1879; Hirase, 1907; Nomura and Hatai, 1928; Shiba, 1934; Yoo, 1959; Kim and Rho, 1969; Kang et al., 1971; Kwon et al., 1993), ever since Adams and Reeve reported three muricid species in 1848. Most of the previous taxonomic works, however, were devoid of descriptive requirments for the species. Therefore, many taxonomic problems such as misidentifications or the use of the synonymous names were included.

This study provides newly refined taxonomic data on the Korean muricid species by examining the collections from 49 localities (72 sites; Fig. 1) of Korean coast with the reviews of the previous works. In addition, the keys to the Korean muricid species and illustrations for the shells and radulae are given in the present study.

Materials and Methods

Specimens were collected from 72 sites of Korean coast from October 1963 to April 1996 by using SCUBA diving (about 30 m in depth) or fishing net, followed by fixing in 70% ethanol or narcotizing prior to the fixation in 5% $MgCl_2$ sea water solution.

For morphological preparations, specimens were observed with the aid of a stereomicroscope. Radulae were prepared, according to the method of Choe et al. (1995), by buccal mass extracting and reducing, ultrasonic cleaning, alcohol dehydration, critical point drying, stub mounting, and sputter coating for scanning electron microscopy (SEM; JEOL EM-ASID-4D).

Results

Throughout this study, 26 muricid species of 15 genera including the previous records were identified from the Korean coastal areas. Of them, 5 species were new to the Korean fauna and marked with asterisks in the list.

List of Species

Family Muricidae Rafinesque, 1815
Subfamily Muricinae Rafinesque, 1815
Genus *Haustellum* Schumacher, 1817
1. *Haustellum sobrinus* (A. Adams, 1863)
Genus *Chicoreus* Montfort, 1810
2. *Chicoreus asianus* Kuroda, 1942
Genus *Homalocantha* Mörch, 1852
3. *Homalocantha anatomica* (Perry, 1811)
Subfamily Rapaninae Gray, 1853
Genus *Rapana* Schumacher, 1817
4. *Rapana bezoar* (Linné, 1767)
5. *Rapana venosa* (Valenciennes, 1846)
6. *Rapana venosa pechiliensis* Grabau and King, 1928
Genus *Thais* Röding, 1798
7. *Thais clavigera* (Küster, 1858)
8. *Thais bronni* (Dunker, 1860)
9. *Thais luteostoma* (Holten, 1803)
Genus *Mancinella* Link, 1807

* To whom correspondence should be addressed.
Tel: 82-331-290-7002, Fax: 82-331-290-7018

[1]곤봉뿔소라, [2]뿔소라, [3]은행잎뿔고둥, [4]좀피뿔고둥, [5]피뿔고둥, [6]황해피뿔고둥, [7]대수리, [8]두드럭고둥, [9]뿔두드럭고둥

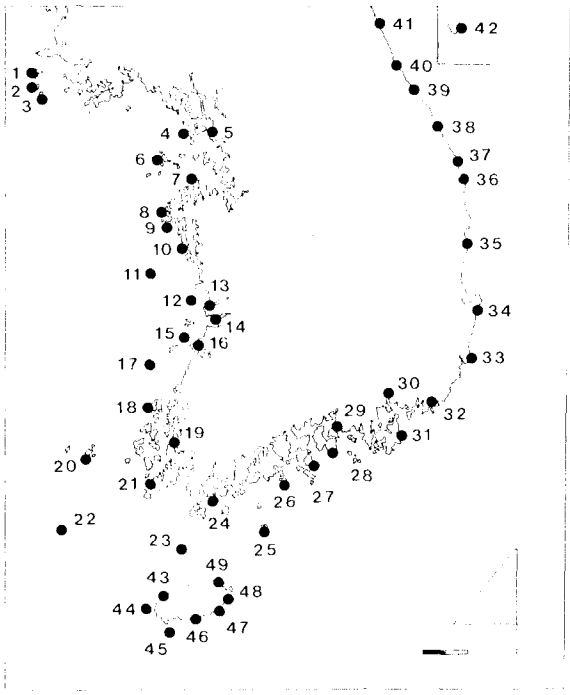

Fig. 1. The map showing the collecting localities of the present study. 1. Paengnyŏng I., 2. Taech'ŏng I., 3. Soch'ŏng I., 4. Yongyu I., 5. Chakyak I., 6. Tŏkchŏk Is. (Munkap I., Kulŏp I., Tŏkchŏk I., Sŏnkap I., Soya I.), 7. Taenanji I., 8. Taean (Ch'ŏnllip'o, Mallip'o, Pado), 9. Sŏsan, (Anhŭng, Ch'ŏngp'odae), 10. Anmyŏn I. (Kotchi), 11. Oeyŏn I., 12. Oshik I., 13. Kunsan, 14. Okku-gun, 15. Pian I., 16. Pyŏnsan (Kyŏkp'o, Komso), 17. Anma Is. (Songi I., Anma I., Sangnakwŏl I.), 18. Chaewon, 19. Mokp'o, 20. Taehŭksan I., 21. Chindo I. (Imhae-myŏn), 22. Sohŭksan Is., (Kukhŭl I.), 23. Ch'uja Is. (Mangwol I., Chikku I., Hoenggan I.), 24. Wando I., 25. Kŏmun I., 26. Oenaro I. (Pongho-ri), 27. Tolsan I., 28. Namhae I. (Sangju, Mijo), 29.. Samch'ŏnp'o (Shinsu I.), 30. Masan (Sujŏng), 31. Changsŭngp'o (Kujora), 32. Pusan (Ch'ŏngsap'o), 33. Ulsan (Chuchŏn, Tangsa), 34. Kuryongp'o (Kuman), 35. Kangku, 36. Changho, 37. Samch'ŏk (Hujin), 38. Tonghae-shi (Chuam), 39. Ch'umunjin (Sach'ŏn), 40. Sokch'o (Yŏngkŭmjŏng, Ch'ŏnjin, Taep'o Harbour), 41. Hwajinp'o, 42. Ullŭng Is. (Chŏdong, Kulam, T'onggumi, Naesujŏn, Hyŏlam, Taepungch'wi), 43. Hyŏpjae, 44. Ch'agwi I., 45. Mara I., 46. Sŏgwip'o (Munsŏm I., Pŏmsŏm I., Supsŏm I.), 47. Pyosŏn, 48. Sŏngsan (Udo I.), 49. Sehwa. Scale bar=25 km.

*10. *Mancinella echinata* (Blainville, 1832)
Genus *Morula* Schumacher, 1817
*11. *Morula spinosa* (H. and A. Adams, 1853)
Subfamily Ocenebrinae Cossmann, 1903
Genus *Ocinebrellus* Jousseaume, 1880
12. *Ocinebrellus aduncus* (Sowerby, 1834)
13. *Ocinebrellus inornatus* (Re'cluz, 1851)
Genus *Pteropurpura* Jousseaume, 1880
14. *Pteropurpura plorator* (Adams and Reeve, 1848)
Genus *Nucella* [Röding, 1798]
15. *Nucella freycineti* (Deshayes, 1839)
Genus *Ceratostoma* Herrmannsen, 1846
16. *Ceratostoma rorifluum* (Adams and Reeve, 1848)
17. *Ceratostoma burnetti* (Adams and Reeve, 1848)
18. *Ceratostoma fournieri* (Crosse, 1861)
Genus *Genkaimurex* Kuroda, 1953
19. *Genkaimurex varicosus* Kuroda, 1953
Subfamily Ergalataxinae Kuroda, Habe and Oyama, 1971
Genus *Ergalatax* Iredale, 1931
20. *Ergalatax contractus* (Reeve, 1846)
Genus *Bedevina* Habe, 1946
21. *Bedevina birileffi* (Lischke, 1871)
Subfamily Trophoninae Cossmann, 1903
Genus *Boreotrophon* Fischer, 1844
22. *Boreotrophon candelabrum* (Reeve, 1848)
*23. *Boreotrophon paucicostatus* Habe and Ito, 1965
*24. *Boreotrophon alaskanus* Dall, 1902
25. *Boreotrophon xestra* Dall, 1918
*26. *Boreotrophon cymatus* Dall, 1902

Identification keys to the genera of the Muricidae from Korean coast

1. Operculum ovate 2
Operculum D-shaped 12
2. (1) Axial varices foliaceous or rounded with spines 3
Axial varices lamellous or rounded without spine··· 5
3. (2) Shell club-shaped; siphonal canal very long (more than a half of shell height), slender, straight ..... *Haustellum*
Shell fusiform; siphonal canal short to medium (less than a half of shell height), rather wide, slightly bent 4
4. (3) Suture deeply impressed; operculum with subterminal nucleus ..... *Chicoreus*
Suture obscured by succeeding whorl; operculum with lateral nucleus ..... *Homalocantha*
5. (2) Siphonal canal fused 6
Siphonal canal open 9
6. (5) Axial sculpture ridged form ..... *Genkaimurex*
Axial sculpture wing or lamellous form 7
7. (6) Bears more than 5 lamellous varices per whorl ..... *Ocinebrellus*
Bears 3 winged varices per whorl 8
8. (7) Outer apertural lip with a labial tooth near base of aperture ..... *Ceratostoma*
Outer apertural lip without a labial tooth near base of aperture ..... *Pteropurpura*
9. (5) Operculum with terminal nucleus ·· *Boreotrophon*
Operculum with subterminal nucleus 10
10. (9) Inner surface of outer apertural lip without denticles ..... *Nucella*
Inner surface of outer apertural lip with denticles 11
11. (10) Columellar lip smooth ..... *Bedevina*
Columellar lip plicated ..... *Ergalatax*
12. (1) Shell surface ornamented with simple, axial and

[10]가시두드럭고둥 (신칭), [11]가시뿔고둥 (신칭), [12]날개뿔고둥, [13]어깨뿔고둥, [14]맵시날개고둥, [15]팽이옆주름고둥, [16]맵사리, [17]입뿔고둥, [18]세뿔고둥

[19]주름뿔고둥, [20]탑뿔고둥, [21]입주름뿔고둥, [22]지느러미뿔고둥, [23]지느러미뿔고둥붙이 (신칭), [24]알라스카지느러미고둥 (신칭), [25]긴입술지느러미뿔고둥, [26]북방지느러미고둥 (신칭)

spiral ribs ..... *Rapana*
Shell surface ornamented with tubercles 13
13. (12) Tubercles on shell surface rounded ..... *Thais*
Tubercles on shell surface spinose 14
14. (13) Aperture narrow; inner surface of outer lip with 3-5 strong denticles ..... *Morula*
Aperture wide; inner surface of outer lip with numerous weak lirae ..... *Mancinella*

Systematic Accounts

Phylum Mollusca Linné, 1758
Class Gastropoda Cuvier, 1797
Order Neogastropoda Wenz, 1938
Family Muricidae Rafinesque, 1815
Subfamily Muricinae Rafinesque, 1815
Genus *Haustellum* Schumacher, 1817

Haustellum sobrinus (A. Adams, 1863)
(Fig. 2A)

Murex sobrinus A. Adams, 1863, p. 370; Radwin and D'Attilio, 1976, p. 70 (in part), pl. 13, fig. 2.
Haustellum sobrinus: Ponder & Vokes, 1988, p. 101, figs. 51, 52, 79b, 89d.

Material examined: 1 ind., Sŏgwip'o, Oct. 13, 1963; 1 ind., Sŏgwip'o, Jan. 20, 1997.

Habitat: Sandy bottoms between 50-100 m in depth.

Type locality: Japan (Satanomosaki, Goto Island, Kurosima).

Previous collection records: 127°40′E, 33°42′N (Smith, 1879).

Distribution: Korea, Japan (Satanomosaki, Goto, Kurosima, Honshu, Shikoku, Kyushu).

Remarks: Club-shaped shell bears 3 rounded longitudinal varices in each whorl and spines are remarkably peaked at the peripheries of penultimate and body whorls. Although this species is generally similar to *H. rectirostris*, it differs, however, in having a longer spine on the shoulder of body whorl and being confined to the Korean and Japanese sea areas in the distributional range.

Genus *Chicoreus* Montfort, 1810
Chicoreus asianus Kuroda, 1942

Chicoreus asianus Kuroda, 1942, pp. 80-81, new name for *Murex elongatus* Lamarck, 1822 (non Lightfoot, 1786); Kuroda et al., 1971, pp. 212 (in Japanese), 139 (in English), pl. 40, fig. 1; Radwin and D'Attilio, 1976, p. 32, pl. 6, fig. 8.
Murex elongatus Lamarck, 1822, Anim. s. Vert., 7, p. 161 (non Lightfoot, 1786) (cited from Kuroda et al., 1971).
Murex sinensis Reeve, 1845, *Murex*, sp. 25, pl. 6, fig. 25 (non Gmelin, 1791).

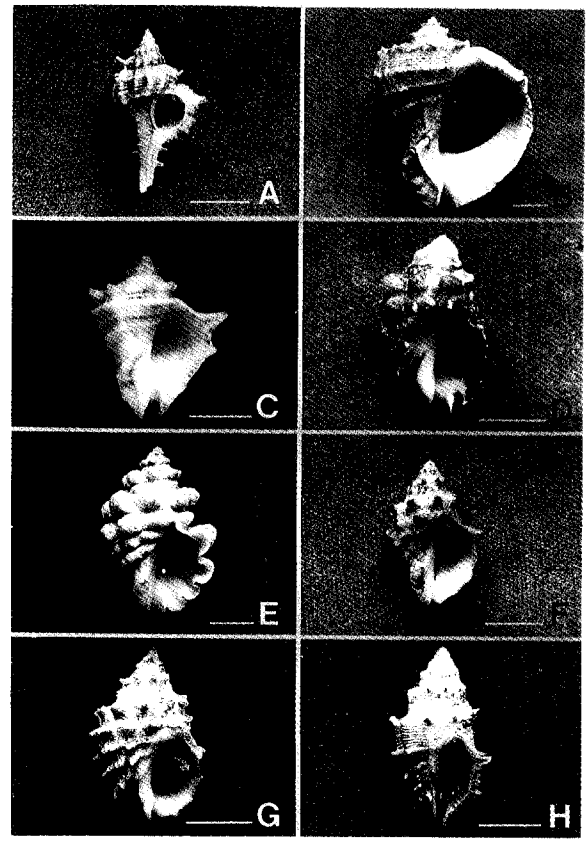

Fig. 2. The shells of Korean muricid species. A, *Haustellum sobrinus*. B, *Rapana venosa*. C, *Rapana venosa pechiliensis*. D, *Thais clavigera*. E, *Thais bronni*. F, *Thais luteostoma*. G, *Mancinella echinata*. H, *Morula spinosa*. Scale bars=10 mm (A, D, E, F, H) and 20 mm (B, C, G).

Habitat: On the rocks between 5-20 m in depth.

Type locality: China.

Distribution: Korea, Japan [Honshu (Boso Peninsula as northern limit), Shikoku, Amami Islands], Hong Kong, Taiwan. Also in the Western Pacific region.

Remarks: No information pertained to descriptions, illustrations, or collection records for this species was given in any publication by the previous authors (Lee, 1956b; Kang et al. 1971; Yoo, 1976), since Shiba (1934) had recognized it under the name of *Murex elongatus*.

Genus *Homalocantha* Mörch, 1852
Homalocantha anatomica (Perry, 1811)

Hexaplex anatomica Perry, 1811, Conch., or the Nat. Hist. Shells, London (Wm. Miller). pp. 1-4, pl. 8, fig. 2 (cited from Radwin and D'Attilio, 1976).
Homalocantha anatomica: Radwin & D'Attilio, 1976, p. 52, pl. 8, figs. 6-10.

Habitat: On the rocks from the tide mark to 20 m in depth.

Type locality: East Indies.

Distribution: Korea, Japan (Honshu, Shikoku, Kyushu, Amami Islands), Taiwan, China, Fiji Islands, Moluccas Island, Philippine Islands, Hawaiian Islands, Eastern Africa and the Indian Ocean.

Remarks: Only the name, *Homalocantha anatomica,* appeared in the nominal list of Kang et al. (1971) without any description for this species and no additional collection records from Korean waters were provided thereafter.

Subfamily Rapaninae Gray, 1853
Genus *Rapana* Schumacher, 1817

Identification Keys to the Species of Genus *Rapana* from Korean Coast

1. Scabrous, reticulate sculptures developed on shell surface by crossing axial ridges with spiral ribs ..... *R. bezoar*
   Scabrous, reticulate sculptures not developed, only spiral ribs rather prominent 2
2. (1) Tubercles on shoulder of body whorl scabrous, 11-12 in number ..... *R. venosa*
   Tubercles on shoulder of body whorl pointed, spinose, 8-9 in number ..... *R. venosa pechiliensis*

Rapana bezoar (Linné, 1767)

Buccinum bezoar Linné, 1767, Syst. Nat., ed. 12, p. 1204 (cited from Kuroda et al., 1971).
Rapana bezoar: Kira, 1962, p. 62, pl. 24, fig. 5; Kuroda et al., 1971, pp. 219 (in Japanese), 143 (in English), pl. 42, fig. 2.

Habitat: Sandy or muddy bottoms between 10-50 m in depth.

Type locality: Unknown (Kuroda et al., 1971).

Distribution: Korea, Japan (Nagasaki, Simoda, Yokohama, Hakodate, Southern Hokkaido, Honshu, Shikoku, Kyushu), Hong Kong, Taiwan, China, Philippines. Also in the Indo-Pacific region.

Remarks: Only the name, *Rapana bezoar,* appeared in the nominal list of Kang et al. (1971) without any description for this species and no additional collection records from Korean waters were provided thereafter.

Rapana venosa (Valenciennes, 1846)
(Fig. 2B and Fig. 5A-C)

Purpura venosa Valenciennes, 1846, Voy. Venus, Atlas Zool. Moll., pl. 7, fig. 1 (cited from Habe, 1969).
Rapana venosa: Habe, 1969, p. 110, figs. 1, 2; Kuroda et al., 1971, pp. 219 (in Japanese), 144 (in English), pl. 42, figs. 4, 5.
Pyrula bezoar: Reeve, 1847, *Pyrula*, sp. 15, pl. 4, figs, 15 a, c only (non Linné, 1758).
Rapana bezoar japonica Dunker, 1882, p. 42.

Material examined: 55 inds., Chakyak I., Oct. 19, 1967; 1 ind., Anhŭng, Jul. 24, 1979; 8 inds., Anmyŏn I., Jul. 25, 1979; 24 inds., Kunsan, Jul. 29, 1979; 27 inds., Komso, Jul. 29, 1979; 7 inds., Tŏkchŏk Is. (Munkap I., Sŏnkap I., Soya I.), Aug. 5, 1982; 20 inds., Okku-gun, May, 26, 1983; 39 inds., Pian I., Jul. 6, 1984; 4 inds., Sangju, Namhae I., May, 18, 1985; 2 inds., Samch'ŏnp'o, Aug. 18, 1985; 1 ind., Mokp'o, Aug. 22, 1985; 9 inds., Chaewon, Aug. 27, 1986; 3 inds., Paengnyŏng I., Jul. 27, 1987; 65 inds., Oshik I., Sep. 27, 1987; 2 inds., Songi I., Aug. 15, 1989; 3 inds., Oeyŏn I., Aug. 16, 1989; 5 inds., Anma I., Aug. 20, 1989.

Habitat: Sandy or muddy bottoms from the tide mark to 20 m in depth.

Type locality: Unknown (Kuroda et al., 1971).

Previous collection records: Hamkyŏngnam-do, Kyŏng sangnam-do, Chŏllamam-do, Kyŏnggi-do, Hwanghae-do, P'yŏnganbuk-do (Nomura and Hatai, 1928); Inch'ŏn (Kamita and Sato, 1941); Kŏje I., T'ongyŏng (Lee, 1956b); Sŏnch'on, Soya I. (Choe and Kwon, 1982); Sagot, Paengnyŏng I. (Kim and Choe, 1988); Anma Is. (Songi I., Odo I., Anma I., Sosŏkman I.) (Choe and Kim, 1989).

Distribution: Korea, Japan (Southern Hokkaido, Honshu, Shikoku, Kyushu), Taiwan, North China.

Remarks: Color patterns of the shell are variable, brown to grayish brown with dark brown spots on the spiral ribs. The shoulder margin of the body whorl angled and encircled by 12 scabrous spines in common, but the number and strength of spines is variable according to the individuals. The radula has a tricuspidate rachidian, with blunt-ended marginal edge. The lateral cusp is sloped down to the marginal edge and 9 minute outer denticles serrated on the marginal area.

Rapana venosa pechiliensis Grabau and King, 1928
(Fig. 2C)

Rapana venosa pechiliensis Grabau and King, 1928, Shells of Peitaiho, p. 202, pl. 8, fig. 62 (cited from Habe, 1969).
Rapana venosa forma *pechiliensis*: Habe, 1969, p. 111.

Material examined: 2 inds., Ch'ŏngp'odae, Sŏsan, Feb. 3, 1994.

Habitat: Sandy or muddy bottoms from the tide mark to 20 m in depth.

Type locality: China.

Previous collection records: Western coast of Korea (Kwon et al., 1993).

Distribution: Korea, Japan (Sagami Bay), China.

Remarks: Shell morphology of this species is very similar to that of *Rapana venosa* but distinguishable from it by the number (8-9) and sculpture (more pointed and longer) of the spines on the shoulder of body whorl.

Genus *Thais* Röding, 1798

Identification Keys to the Species of Genus *Thais* from Korean Coast

1. Tubercles ornamented on body whorl rather pointed and spinose ..... *T. luteostoma*
   Tubercles ornamented on body whorl rounded ··· 2
2. (1) Shell grayish brown to blackish brown-colored; spiral groove obscured ..... *T. clavigera*
   Shell yellowish white to white-colored; spiral groove deeply impressed ..... *T. bronni*

Thais clavigera (Küster, 1858)
(Fig. 2D, Fig. 5D-F)

Purpura clavigera Küster, 1858, p. 186, pl. 31a, fig. 1.
Reishia clavigera: Kira 1962, p. 62, pl. 24, fig. 1; Kuroda et al., 1971, pp. 224 (in Japanese), 147 (in English), pl. 42, fig. 8.
Thais clavigera: Habe and Ito, 1979, p. 40, pl. 12, fig. 4.
Purpura problematica Baker, 1891, Proc. Rochester Acad. Sci., 1, p. 135, pl. 11, figs. 2, 3 (cited from Kuroda et al., 1971).

Material examined: 14 inds., Taenanji I., Jun. 7, 1970; 3 inds., Sangju, Namhae I., Jun. 8, 1979; 2 inds., Anhŭng, Jul. 24, 1979; 190 inds., Pyŏnsan, May, 13, 1982; 4 inds., Kuryongp'o, Jul. 11, 1982; 129 inds., Tŏkchŏk Is. (Munkap I., Kulŏp I., Soya I., Tŏkchŏk I.), Aug. 3, 1982; 76 inds., Okku-gun, Aug. 9, 1982; 8 inds., Changho, Aug. 15, 1982; 9 inds., Sŏgwip'o, Aug. 22, 1982; 97 inds., Tolsan I., Jun. 10, 1983; 19 inds., Sŏngsan, Aug. 7, 1983; 25 inds., Anmyŏn I., Oct. 5, 1983; 44 inds., Pian I., Jul. 6, 1984; 1 ind., Ch'um-unjin, May, 31, 1985; 9 inds., Samch'ŏnp'o, Jul. 18, 1985; 27 inds., Sujŏng, Masan, Jul. 19, 1985; 22 inds., Changsŭngp'o, Jul. 20, 1985; 34 inds., Ch'ŏnllip'o, Jul. 29, 1985; 50 inds., Oenaro I., Aug. 18, 1985; 10 inds., Wando I., Aug. 20, 1985; 79 inds., Chaewon, Nov. 15, 1986; 2 inds., Pian I., Nov. 19, 1986; 8 inds., Kunsan, Apr. 5, 1987; 11 inds., Samch'ŏk, May, 9, 1987; 5 inds., Paengnyŏng I., Jul. 26, 1987; 11 inds., Hwajinp'o, Aug. 26, 1987; 31 inds., Oshik I., Sep. 2, 1987; 2 inds., Taech'ŏng I., Oct. 3, 1987; 2 inds., Soch'ŏng I., Oct. 4, 1987; 6 inds., Yongyu I., Oct. 1, 1988; 15 inds., Kyŏkp'o, May, 7, 1989; 67 inds., Sohŭksan Is. (Sohŭksan I., Kukhŭl I.), Jul. 1, 1989; 39 inds., Ullŭng Is. (Hyŏlam, Kulam, Taepungch'wi), Jul. 14, 1989; 1 ind., Pŏmsŏm I., Aug. 10, 1989; 17 inds., Songi I., Aug. 15, 1989; 22 inds., Oeyŏn I., Aug. 16, 1989; 6 inds., Sangnakwŏl I., Aug. 17, 1989; 22 inds., Anma I., Aug. 17, 1989; 41 inds., Ch'uja Is. (Mangwol I., Chikku I., Hoenggan I.), Jul. 23, 1990.

Habitat: On the rocks of supralittoral or intertidal zone (less than 1 m in depth).

Type locality: Nagasaki (Japan).

Previous collection records: Inch'ŏn (Kamita and Sato, 1941); Pusan (Lee, 1956a); Pusan, T'ongyŏng, Wando I., Kŏje I., Ch'uja I., Pangŏchin (Lee, 1956b); Sang-ch'uja I. (Kim and Rho, 1969); Hanrim, Sŏgwip'o (Kim and Rho, 1971); Pichin I., Hong I., Kuk I., Kal I., Haekŭmkang (Off Kŏje I., Kim et al., 1979); Sŏdo I., Tokdo I. (Kim and Choe, 1981); Munkap I., Sŏnkap I., Chinri, Tŏkchŏk I. (Choe and Kwon, 1982); Nop I., Maan I., Pogil I., Chakae I., Yŏsŏ I. (Kim and Kwon, 1982); Ch'ukhang I., Ch'ŏngdeŭng I., Kwansa I., Kalmok I., Nulok I. (Kim and Kwon, 1983); Aninjin (Kim et al., 1983); Taesambu I., Sangpaek I., Kŏmun I. (Kim and Kim, 1985); Sasu I., Hoengkan I., Sangch'uja I. (Kim and Kim, 1986); Yeri, Ch'ŏch'onri, Taehŭksan I., Oeyŏngsan I., Yŏsan I., Sohŭksan I., Taedun I. (Kim and Kwon, 1987); Hwadong, Paengnyŏng I., Okch'ukp'o, Taech'ŏng I., Yedong, Soch'ŏng I. (Kim and Choe, 1988); Oeyŏn I., Hoenggyŏn I., Odo I., (Choe and Yum, 1989); Songi I., Anma I., Sangnakwŏl I. (Choe and Kim, 1989).

Distribution: Korea, Japan (Nagasaki, Southern Hokkaido, Honshu, Shikoku, Kyushu, Amami Islands, Okinawa), Taiwan, China.

Remarks: The shell sculptures of this species, in general, consist of 4 rows of round, blackish-brown tubercles on the body whorl and a few of interstitial white threads ornamented spirally in every space of the tubercles. But, in some other individuals, tubercles are highly variable from less developed to rather pointed in shape according to the local populations. The radula has a pentacuspidate rachidian, with a wide cental cusp. The lateral cusp bears an inner and 3-4 outer denticles.

Thais bronni (Dunker, 1860)
(Fig. 2E, Fig. 6A-C)

Purpura bronni Dunker, 1860, p. 235.
Reishia bronni: Kira, 1962, p. 62, pl. 24, fig. 6; Kuroda et al., 1971, pp. 224 (in Japanese), 146 (in English), pl. 42, fig. 7.
Thais bronni: Habe and Ito, 1979, p. 40, pl. 12, fig. 3.

Material examined: 2 inds., Kŏmun I., Aug. 8, 1965; 3 inds., Taenanji I., Jun. 7, 1970; 11 inds., Kuryongp'o, Aug. 10, 1982; 3 inds., Changho, Aug. 15, 1982; 5 inds., Sehwa, Aug. 5, 1983; 3 inds., Udo I., Aug. 6, 1983; 6 inds., Sŏngsan, Aug. 7, 1983; 6 inds., Pyosŏn, Aug. 9, 1983; 3 inds., Tolsan I., Jun. 28, 1984; 6 inds., Samch'ŏnp'o, Jul. 16, 1985; 4 inds., Changsŭngp'o, Jul. 20, 1985; 2 inds., Chuchŏn, Ulsan, Jul. 22, 1985; 5 inds., Samch'ŏk, May, 9, 1987; 4 inds., Hwajinp'o,

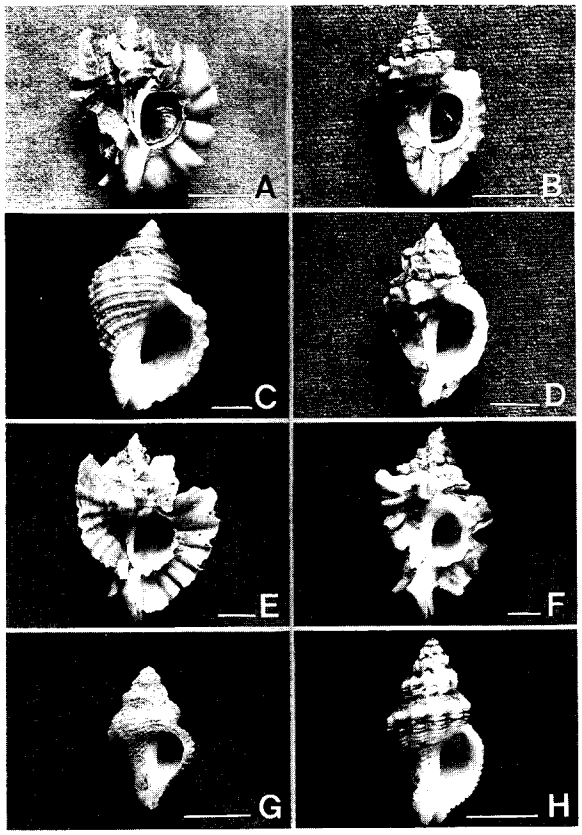

Fig. 3. The shells of Korean muricid species. A, *Ocinebrellus aduncus*. B, *Ocinebrellus inornatus*. C, *Nucella freycineti*. D, *Ceratostoma rorifluum*. E, *Ceratostoma burnetti*. F, *Ceratostoma fournieri*. G, *Genkaimurex varicosus*. H, *Ergalatax contractus*. Scale bars=10 mm (B, C, D, F, G, H) and 20 mm (A, E).

Aug. 26, 1987; 7 inds., Sangju, Namhae I., May, 15, 1988; 1 ind., Hyŏpjae, Jul. 22, 1988; 8 inds., Sŏgwip'o, Feb. 13, 1989; 1 ind., Munsŏm I., Feb. 18, 1989; 42 inds., Kukhŭl I., Sohŭksan I., Jul. 1, 1989; 25 inds., Ullŭng Is. (T'onggumi, Naesujŏn, Hyŏlam, Taepung-ch'wi), Jul. 14, 1989; 35 inds., Ch'uja Is. (Mangwol I., Chikku I., Hoenggan I.), Jul. 23, 1990.

Habitat: On the rocks of intertidal zone (less than 5 m in depth).

Type locality: Dejima, Nagasaki City.

Previous collection records: Inch'ŏn (Kamita and Sato, 1941); Taehŭksan I., Kŭmun I., Ch'uja I., Pangŏchin, Cheju I. (Lee, 1956b); Sangch'uja I. (Kim and Rho, 1969); Sŏgwip'o (Kim and Rho, 1971); Pichjin, Kuk I., Kal I., Haekŭmkang (Off Kŏje I., Kim et al., 1979); Sŏdo I., Tokdo I., Sadong, Ullŭng I. (Kim and Choe, 1981); Wando I., Nop I., Maan I., Chakae I., Yŏsŏ I. (Kim and Kwon, 1982); Hajo I., Ch'ŏngdeŭng I. (Kim and Kwon, 1983); Taesambu I., Sangpaek I., Kŏmun I. (Kim and Kim, 1985); Sasu I., Hoengkan I., Sangch'uja I. (Kim and Kim, 1986); Chinri, Yeri, Ch'ŏnch'onri, Taehŭksan I., Yŏngsan I., Sohŭksan I. (Kim and Kwon, 1987); Songi I., Odo I., Anma I., Sosŏkman I. (Choe and Kim, 1989).

Distribution: Korea, Japan (Nagasaki, Tatiyama, Dejima, Southern Hokkaido, Honshu, Shikoku, Kyushu), Taiwan, China.

Remarks: The sculpture of the shell is characterized by 4 spiral rows of round, whitish tubercles and deepened interstitial spiral grooves on the body whorl. In some individuals, however, the tubercles show the great variabilities in their strength and shape. The radula has a pentacuspidate rachidian, similar to the allied species of the genus *Thais*. The lateral cusp bears an inner denticle fused in the inner side, and 7-8 minute outer denticles serrated in the marginal area.

Thais luteostoma (Holten, 1803)
(Fig. 2F, Fig. 6D-F)

Buccinum luteostoma Holten, 1803, p. 52.
Thais luteostoma: Habe, 1964, p. 81, pl. 26, fig. 8.
Reishia luteostoma: Kuroda et al., 1971, pp. 223 (in Japanese), 146 (in English), pl. 42, fig. 6.

Material examined: 2 inds. Munsŏm I., Sep. 19, 1995; 1 ind., Chuam, Tonghae-shi, Aug. 2, 1995.

Habitat: On the rocks of intertidal zone (less than 5 m in depth).

Type locality: South Sea and Coast of China.

Previous collection records: Hamkyŏngnam-do, Kyŏngsangnam-do, Kangwon-do, Kyŏnggi-do, P'yonganbuk-do (Nomura and Hatai, 1928); Pusan (Lee, 1956a); Mosŭlp'o (Kim and Rho, 1971); Hoengkan I. (Kim and Kim, 1986).

Distribution: Korea, Japan (Hakodate, Jedo, Dejima, Tsu-sima, Tatiyama, Southern Hokkaido, Honshu, Shikoku, Kyushu), Hongkong, China, Southeast Asia.

Remarks: This species is very close to *T. bronni* (Dunker) and *T. clavigera* (Küster) not only in general characteristics of the shell but also in the radula morphologies. But, it is distinguishable from the two by having blackish spinose tubercles and white, thick apertural lip and outer six denticles of the lateral cusp.

Genus *Mancinella* Link, 1807
**Mancinella echinata* (Blainville, 1832)
(Fig. 2G, Fig. 7A-C)

Purpura echinata Blainville, 1832, Ann. Mus. Hist. Nat. Paris, 1(2), p. 222, pl. 11, fig. 2 (cited from Kuroda et al., 1971).
Mancinella echinata: Kuroda et al., 1971, pp. 222 (in Japanese), 145 (in English), pl. 42, fig. 3.

Habitat: On the rocks from the low tidal zone to 20 m in depth.

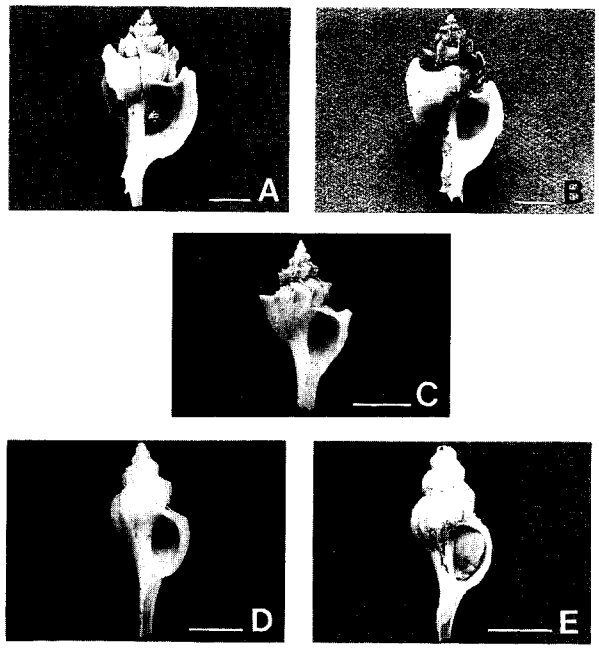

Fig. 4. The shells of Korean muricid species. A, *Boreotrophon candelabrum*. B, *Boreotrophon paucicostatus*. C, *Boreotrophon alaskanus*. D, *Boreotrophon xestra*. E, *Boreotrophon cymatus*. Scale bars=10 mm.

Material examined: 1 ind., Munsŏm I., Dec. 11, 1994.

Type locality: Unknown (Kuroda et al., 1971).

Distribution: Korea (Munsŏm I., Cheju Is.), Japan (Honshu, Shikoku, Kyushu), Philippines.

Remarks: The shell is very thick and solid. The sculpture of the body whorl is characterized by 4 spiral rows of spinose tubercles and fine, interstitial spiral lines between the rows. The outer lip is white, lustered in the inner side and crenated weakly at the edge, corresponding to the external pattern of spiral lines. The collumella lip is white and heavily calloused. The radula of this species is characterized by a tricuspidated rachidian, with an abruptly hooked central and 2 minute, pimple-like lateral cusps. The lateral cusp is sloped down to the marginal edge without any denticles.

Genus *Morula* Schumacher, 1817
**Morula spinosa* (H. and A. Adams, 1853)
(Fig. 2H, Fig. 7D-F)

Murex spinosus A. Adams, 1853, p. 268.
Morula spinosa: Kay, 1979, p. 248, fig. 87-h.
Spinidrupa spinosa: Springsteen and Leobrera, 1986, p. 142, pl. 39, fig. 7.

Material examined: 3 inds., Munsŏm I., Dec. 11, 1994.

Habitat: On the rocks of between 20-30 m in depth.

Type locality: Not mentioned by the author.

Distribution: Korea, Japan (Southern part of Boso Peninsula), Philippines, Indo-Pacific region, Hawaii.

Remarks: The shell is small to medium sized, and spindle-shaped. Each whorl bears a spiral row of spines on the shoulder, rendered by crossing the spiral with axial ribs. The body whorl is sculptured with 3 spiral rows of the spines of which the one on the shoulder is most prominent and consists of 8 spines. The aperture is purple-colored, elongated narrowly with a deep anal sulculus and bears 5 small denticles in the outer lip. The central cusp of the rachidian tooth rather short. An inner lateral denticle separated with lateral cusp is eyetooth-shaped. Three to four small outer denticles are present between the lateral and marginal cusps. The number of spines on the shoulder of body whorl, described by the previous authors was not consistent with each other [6 by Adams (1853); 8-10 by Kay (1979); 9-10 by Springsteen and Leobrera (1986), respectively]. In the present study for Korean collections, 7-8 spines on the shoulder were observed. For the number of spiral rows in the body whorl, in addition, Korean collections showed only 3 rather than 4, described by Springsteen and Leobrera (1986) and 5, by Kay (1979).

Subfamily Ocenebrinae Cossmann, 1903
Genus *Ocinebrellus* Jousseaume, 1880

Identification Keys to the Species of Genus *Ocinebrellus* from Korean Coast

Axial varices on body whorl wing-like, 5 in number ..... *O. aduncus*
Axial varices on body whorl lamellous, 6-8 in number ..... *O. inornatus*

Ocinebrellus aduncus (Sowerby, 1834)
(Fig. 3A, Fig. 8A-C)

Murex aduncus Sowerby, 1834, *Murex*, pl. 62, fig. 35.
Ocinebrellus aduncus: Hall, 1959, p. 432, pl. 2, figs. 1-3.
Ocenebrellus aduncus: Kuroda et al., 1971, pp. 226 (in Japanese), 147 (in English), pl. 40, figs. 3-5.
Pteropurpura adunca: Radwin and D'Attilio, 1976, p. 129, pl. 22, fig. 10.
Murex falcatus Sowerby, 1834, *Murex*, pl. 62, fig. 31.
Murex eurypteron Reeve, 1845, *Murex*, sp. 176, pl. 34, fig. 176.
Murex speciosus A. Adams, 1855, p. 121.
Murex expansus Sowerby, 1860, p. 428, pl. 49, fig. 5.
Phyllonotus acanthophorus A. Adams, 1863, p. 372.
Pteropurpura plorator: Yoo, 1976, p. 71, pl. 12, fig. 6 (misidentification of *falcatus*).

Material examined: 4 inds., Kuman, Kuryongp'o, Aug. 12, 1982; 2 inds., Ch'umunjin, Mar. 18, 1990; 10 inds., Taep'o Harbour, Sokch'o, Mar. 17, 1995; 1 ind., Taep'o Harbour, Sokch'o, Apr. 18, 1995.

Habitat: Sandy and gravelled bottoms between 10-50 m in depth.

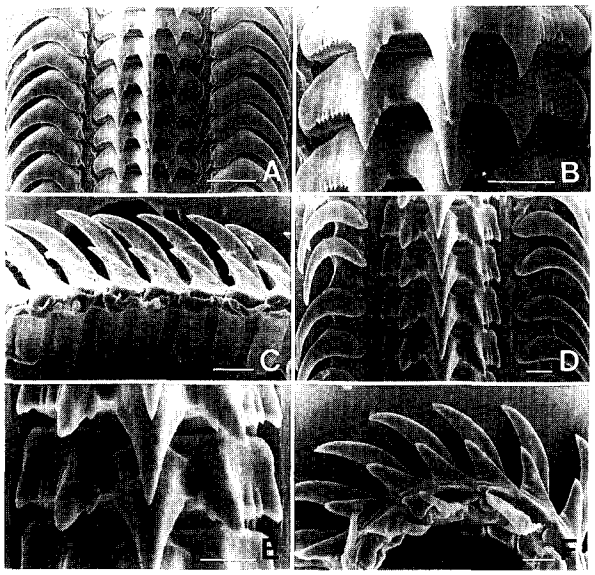

Fig. 5. Scanning electron micrographs of the radulae. A-C, *Rapana venosa*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Thais clavigera*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=20 μm (D, E, F), 50 μm (B, C), and 100 μm (A).

Type locality: Japan.

Previous collection records: Sangch'uja I. (Kim and Rho, 1969); Sŏgwip'o (Kim and Rho, 1971); Aninjin (Kim et al., 1983); Sangch'uja I. (Kim and Kim, 1986).

Distribution: Korea, Japan (Southern Hokkaido, Honshu, Shikoku, Kyushu, Satanomosaki, Tusaki, Tatiyama, Mino-Sima), Taiwan, China.

Remarks: This species is characterized by the body whorl bearing 5 wing-like axial varices of which the one adhered to the outer lip is most widely developed and prominent. The longitudinal varices are erected upwards and slightly recurved backwards. Five spiral cords sculptured on the body whorl make the wrinkles in each varix. The radula has a pentacuspidate rachidian tooth with lateral cusps bearing an inner denticle fused in the inner side, and 4 outer denticles serrated in the marginal area.

Ocinebrellus inornatus (Re'cluz, 1851)
(Fig. 3B, Flg. 8D-F)

Murex inornatus Re'cluz, 1851, p. 207. figs. 7, 8.
Ceratostoma inornatum: Radwin and D'Attilio, 1976, p. 113, pl. 18, figs. 10-12.
Murex crassus A. Adams, 1853, p. 269.
Murex japonicus Dunker, 1860, p. 230.
Ocenebra japonica: A. Adams, 1863, p. 373; Habe and Ito, 1979, p. 38, pl. 11, figs. 6, 7.
Ocenebra (Ocenebrellus) japonica: Kira, 1962, p. 65, pl. 25, fig. 7.
Ocenebra (Ocenebrellus) japonica endermonis: Kira, 1962, p. 65, pl. 25, fig. 1.
Murex (Cerastoma) endermonis Smith, 1875, p. 420.
Ocenebra endermonis: Habe & Ito, 1979, p. 39, pl. 11, fig. 8.
Ocinebra monoptera Pilsbry, 1904, p. 17, figs. 32, 32a.
Murexul cirrosa (misidentification of *japonica*): Yoo, 1976, p. 71, pl. 12, fig. 7; Kwon et al., 1993, pp. 77 (fig. 35-6), 286.

Material examined: 11 inds., Taenanji I., May, 16, 1965; 2 inds., Tolsan I., May, 23, 1967; 8 inds., Imhae-myŏn, Chindo I., Jul. 31, 1979; 3 inds., Kuryongp'o, Aug. 11, 1982; 18 inds., Anmyŏn I., Oct. 27, 1983; 24 inds., Sangju, Namhae I., May, 17, 1985; 2 inds., Sujŏng, Masan, May, 19, 1985; 1 ind., Kujora, Changsŭngp'o, Jul. 20, 1985; 1 ind., Chuchŏn, Ulsan, Jul. 22, 1985; 4 inds., Ch'ŏnllip'o, Jul. 29, 1985; 112 inds., Tŏkchŏk I., May, 23, 1986; 21 inds., Paengnyŏng I., Jul. 25, 1987; 4 inds., Taech'ŏng I., Oct. 3, 1987; 21 inds., Imhae-myŏn, Chindo I., Jan. 18, 1995; 17 inds., Pado, Taean, Feb. 28, 1995.

Habitat: On the rocks of inter- and sub-tidal zone (less than 20m in depth)

Type locality: Corée.

Previous collection records: Inch'ŏn (Kamita and Sato, 1942); Pangŏchin, T'ongyŏng, Pusan (Lee, 1956b); Paeka I., Munkap I. (Choe and Kwon, 1982); Pogil I. (Kim and Kwon, 1982); Tumujin, Hwadong, Yongkip'o, Paengnyŏng I., Okch'ukp'o, Satandong, Taech'ŏng I., Yedong, Soch'ŏng I. (Kim and Choe, 1988).

Distribution: Korea, Japan (Honshu, Kyushu, Shikoku), China (Huanghai, Bohai), the coasts of Oregon, Washington and British Columbia.

Remarks: The shell is greatly variable in color patterns and shell sculptures. The number of axial varices is variable 6 to 8. The inner surface of the outer apertural lip, in general, bears 6-8 small denticles of which the one near the base of aperture is developed into a small labial tooth; in some population, however, individuals lacking denticles occur too. Shell color is grayish brown to dark brown or with brown band on the periphery of each whorl. The radula morphologies of this species are so similar to those of *O. aduncus* (Sowerby) that it is difficult to recognize the differences between them.

Genus *Pteropurpura* Jousseaume, 1880
Pteropurpura plorator (Adams and Reeve, 1848)

Murex plorator Adams and Reeve, 1848, p. 38, pl. 8, figs. 3a, b.
Ceratostoma plorator: Hall, 1959, p. 431.
Pteropurpura plorator: Habe, 1964, p. 84, pl. 27, fig. 17; Kuroda et al., 1971, pp. 227 (in Japanese), 148 (in English), p. 41, fig. 3; Radwin and D'Attilio, 1976, p. 132, pl. 22, fig. 8.

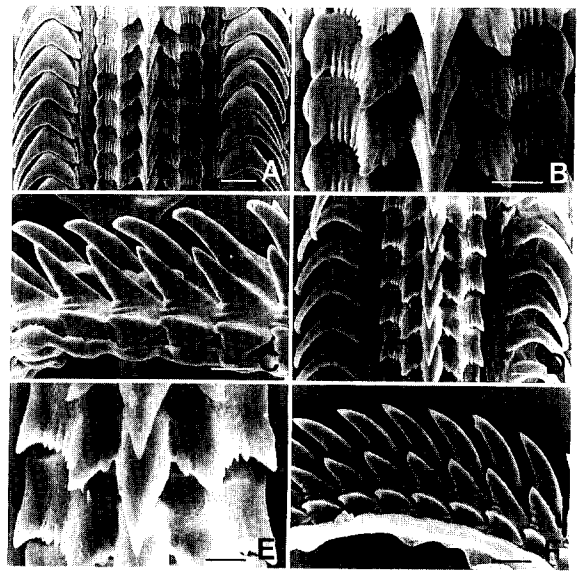

Fig. 6. Scanning electron micrographs of the radulae. A-C, *Thais bronni*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Thais luteostoma*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=10 μm (E), 20 μm (D, F), 30 μm (B, C), and 50 μm(A).

Pteronotus brachypteron A. Adams, 1863, p. 371.

Habitat: Sandy and gravelled bottoms between 50-200 m in depth.

Type locality: Korea.

Previous collection records: Sangch'ŭja I. (Kim and Kim, 1986).

Distribution: Korea, Japan [Honshu (Boso peninsula as north limit), Shikoku, Kyushu, Japan Sea], Taiwan.

Genus *Nucella* (Röding, 1798)
Nucella freycineti (Deshayes, 1839)
(Fig. 3C, Fig. 9A-C)

Purpura freycinetii Deshayes, 1839, Rev. Zool. Soc. Cuv., 1839, p. 360 (cited from Dall, 1915).
Purpura freycinetii: Reeve, 1845, *Purpura*, sp. 51, pl. 10, fig. 51.
Purpura freycinetii var. *alabaster* Pilsbry, 1907, p. 246, pl. 20, fig. 2.
Thais (Nucella) freycinetii: Dall, 1915, p. 571.
Nucella freycineti: Habe, 1964, p. 81, pl. 26, fig. 10; Habe and Ito, 1979, p. 41, pl. 12, fig. 6.
Purpura heyseana Dunker, 1882, p. 40, pl. 13, figs. 10, 11.

Material examined: 1 ind., Komso, Jul. 29, 1979; 11 inds., Samch'ŏk, May, 9, 1987; 1 ind., Ch'umunjin, Mar. 18, 1990; 1 ind., Taep'o Harbour, Sokch'o, Apr. 15, 1990; 2 inds., Taep'o Harbour, Sokch'o, May, 12, 1990; 7 inds., Samch'ŏk, May, 15, 1990; 58 inds., Sokch'o (Yŏngkŭmjŏng, Ch'ŏnjin) Jan. 5, 1995.

Habitat: Sandy bottoms or on the rocks of inter- and sub-tidal zone (less than 20 m in depth).

Type locality: Unknown.

Previous collection records: Kangwon-do (Nomura and Hatai, 1928); Pangŏchin (Lee, 1956b) (*N. heyseana*); Aninjin (Kim et al., 1983) (*N. freycineti*).

Distribution: Korea, northern Japan, the Kuril Islands, the southern and western coasts of the Okhotsk Sea, Sakhalin Island.

Remarks: The shell sculpture consisits of numerous spiral cords ornamented alternately in thickness and prominence. The axial rib forms wavy sculptures by crossing with spiral cords on the surface. Shell color is variable from light-yellow to dark brown; in some individuals, however, the shells with the brown bands encircling both around the periphery and base of the body whorl occur. The rachidian tooth of radula is similar to that of *Thais*.

Genus *Ceratostoma* Herrmannsen, 1846

Identification Keys to the Species of Genus *Ceratostoma* from Korean Coast

1. Body whorl sculptured with 4 rounded axial ribs ..... *C. rorifluum*
   Body whorl sculptured with 3 wing-like axial varices 2
2. (1) Intervarical knob on shoulder of body whorl less prominent and rounded ..... *C. burnetti*
   Intervarical knob on shoulder of body whorl more prominent and pointed ..... *C. fournieri*

Ceratostoma rorifluum (Adams and Reeve, 1848)
(Fig. 3D, Fig. 9D-F)

Murex rorifluus Adams and Reeve, 1848, p. 38, pl. 8, figs. 2a, b.
Ceratostoma rorifluum: Hall, 1959, p. 430, pl. 1, figs. 9-11; Kira, 1962, p. 65, pl. 25, fig. 8; Radwin and D'Attilio, 1976, p. 114, pl. 18, fig. 13.
Murex monachus Crosse, 1862, p. 55.
Ocenebra japonica: Yoo, 1976 (in part), pl. 12, fig. 9 only (misidentification of *rorifluum*).

Material examined: 5 inds., Mallip'o, May, 23, 1967; 13 inds., Taenanji I., Jun. 7, 1970; 3 inds., Anhŭng, Jul. 24, 1979; 7 inds., Imhae-myŏn, Chindo I., Jul. 30, 1979; 2 inds., Pyŏnsan, May, 13, 1982; 2 inds., Kyŏkp'o, Jul. 19, 1982; 13 inds., Okku-gun, Aug. 6, 1982; 30 inds., Kuryongp'o, Aug. 11, 1982; 1 ind., Kangku, Aug. 13, 1982; 2 inds., Changho, Aug. 15, 1982; 11 inds., Tolsan I., Jun. 10, 1983; 3 inds., Hyŏpjae, Jul. 25, 1983; 2 inds., Pyosŏn, Aug. 9, 1983; 3 inds., Pian I., Jul. 6, 1984; 37 inds., Namhae I. (Sangju, Mijo), May, 18, 1985; 3 inds., Shinsu I., Samch'ŏnp'o, Jul. 18, 1985; 30 inds., Sujŏng, Masan, Jul. 19, 1985; 33 inds.,

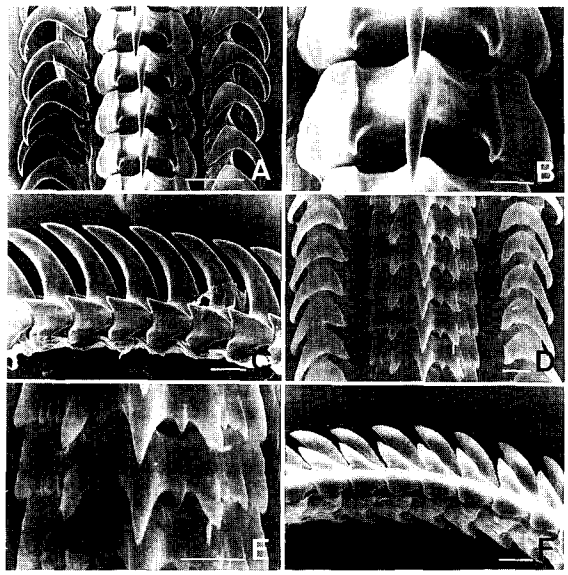

Fig. 7. Scanning electron micrographs of the radulae. A-C, *Mancinella echinata*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Morula spinosa*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=10 μm (D, E, F), 30 μm (B), 50 μm (C), and 100 μm (A).

Kujora, Changsŭngp'o, Jul. 20, 1985; 10 inds., Ch'ŏngsap'o, Pusan, Jul. 21, 1985; 1 ind., Ch'ŏnllip'o, Jul. 29, 1985; 61 inds., Wando I., Aug. 20, 1985; 8 inds., Mokp'o, Aug. 22, 1985; 110 inds., Tŏkchŏk I., May, 23, 1986; 13 inds., Paengnyŏng I., Jul. 25, 1987; 3 inds., Yongyu I., Oct. 1, 1988; 3 inds., Taehŭksan I., Jun. 30, 1989; 24 inds., Hujin, Samch'ŏk, May, 13, 1990; 3 inds., Hoenggan I., Ch'uja Is., Jul. 23, 1990; 37 inds., Kotchi, Anmyŏn I., Jan. 23, 1995; 30 inds., Pado, Taean, Dec. 9, 1995.

Habitat: On the rocks of inter- and sub-tidal zone (less than 20 m in depth).

Type locality: Korea.

Previous collection records: Hamkyŏngnam-do, Kangwon-do, Kyŏnggi-do (Nomura and Hatai, 1928); Pusan, T'ongyŏng, Taehŭksan I., Kŏmun I., Pangŏchin, Pichin I., Taepyŏn (Lee, 1956b); Sangch'uja I. (Kim and Rho, 1969); Pichin I. (Kim et al., 1979); Nop I., Maan I., Chakae I., Soan I., Yŏsŏ I., Pogil I., Yejak I. (Kim and Kwon, 1982); Hajo I., Ch'ukhang I., Ch'ŏngdeŭng I., Kwansa I., Kalmok I., Nulok I. (Kim and Kwon, 1983); Aninjin (Kim et al., 1983); Sangch'uja I. (Kim and Kim, 1986); Chinri, Yeri, Ch'ŏnch'onri, Taehŭksan I., Oeyŏngsan I., Sohŭksan I., Taedun I. (Kim and Kwon, 1987); Tumujin, Hwadong, Paengnyŏng I. (Kim and Choe, 1988); Oeyŏn I., Hoenggyŏn I., Taech'ŏng I. (Choe and Yum, 1989).

Distribution: Korea, Japan (Nagasaki, Kyushu, Shikoku, Tsu-sima, Japan Sea), China.

Remarks: The shell bears 4 low, rounded axial ribs rotating down continuously from the apex. But, they are not so prominent as those of the other species of genus *Ceratostoma* especially in the developmental stage forming no wing-like varices. Intervarical knobs at the shoulder of body are globular and less prominent. The inner surface of the outer apertural lip bears 5-6 denticles of which the one near the base of aperture is developed with a small labial tooth. Shell color is variable, from white to dark brown. Some shells have the blackish brown band. The central cusp of the rachidian tooth is rather long and slender. The lateral denticle bears an eyetooth-shaped inner denticle and 3 outer denticles in the marginal area.

Ceratostoma burnetti (Adams and Reeve, 1848)
(Fig. 3E, Fig. 10A-C)

Murex burnetti Adams and Reeve, 1848, p. 38, pl. 8, figs. 4a, b.

Ceratostoma burnetti: Hall, 1959, p. 430, pl. 3, figs. 2, 4, 6; Habe, 1964, p. 85, pl. 27, fig. 20; Radwin and D'Attilio, 1976, p. 111, pl. 18, figs. 6, 7.

Murex coreanicus Adams, 1854, p. 72.

Material examined: 1 ind., Tolsan I., May, 23, 1967; 1 ind., Tŏkchŏk I., Jun. 10, 1976; 3 inds., Taep'o Harbour, Sokch'o, Aug. 18, 1981; 15 inds., Kuryongp'o, Aug. 11, 1982; 3 inds., Kangku, Aug. 13, 1982; 1 ind., Shinsu I., Samch'ŏnp'o, Jul. 18, 1985; 1 ind., Paengnyŏng I., Jul. 27, 1987; 6 inds., Taep'o Harbour, Sokch'o, Aug. 18, 1988; 4 inds., Sohŭksan I., Jul. 3, 1989; 9 inds., Hujin, Samch'ŏk, May, 13, 1990; 1 ind., Ch'uja Is., Jul. 22, 1990; 3 inds., Sangju, Namhae I., May, 14, 1991; 12 inds., Ch'ŏnjin, Sokch'o, Jan. 5, 1995; 15 inds., Tangsa, Ulsan, Feb. 15, 1995; 11 inds., Chuam, Tonghae-shi, Oct. 20, 1995.

Habitat: On the rocks between 5-30 m in depth.

Type locality: Korea.

Previous collection records: Kyŏngsangnam-do, Kangwon-do (Nomura and Hatai, 1928); Pusan (Lee, 1956a); T'ongyŏng, Pangŏchin, Pusan, Cheju-do, Pangŏchin (Lee, 1956b); Kal I. (Kim et al., 1979); Kŏmun I. (Kim and Kim, 1985); Sangch'uja I. (Kim and Kim, 1986); Yongkip'o, Paengnyŏng I. (Kim and Choe, 1988).

Distribution: Korea, Japan (Hakodate, the western coast of Japan), U.S.S.R.

Remarks: The shell bears 3 well-developed wing-like axial varices rotating down continuously from the apex. Major spiral cords sculptured on the body whorl make 6-7 ruffles in each varix by crossing each other. The outer apertural lip is coarsely serrated and the second from the base of the aperture is particularly so large that it forms a long, spinous labial tooth. The radula morphologies of this species are nearly same as those of *C. rorifluum* (Adams and Reeve) and *C. fournieri* (Crosse). The lateral tooth of the rachidian bears an

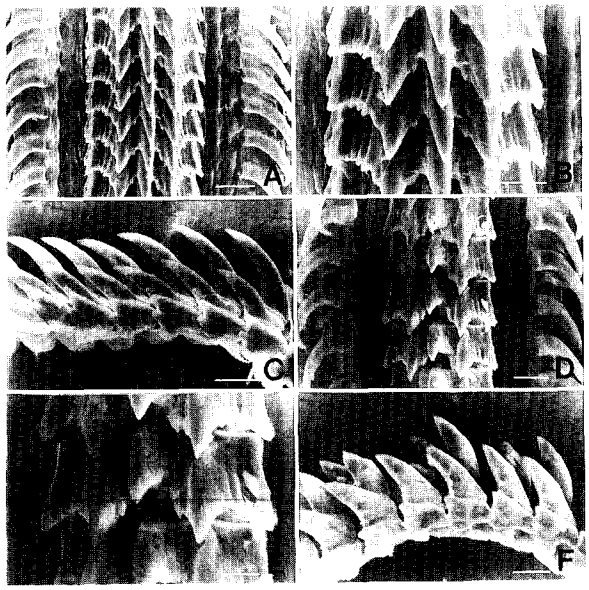

Fig. 8. Scanning electron micrographs of the radulae. A-C, *Ocinebrellus aduncus*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Ocinebrellus inornatus*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=20 μm (B, C, D, E, F) and 30 μm (A).

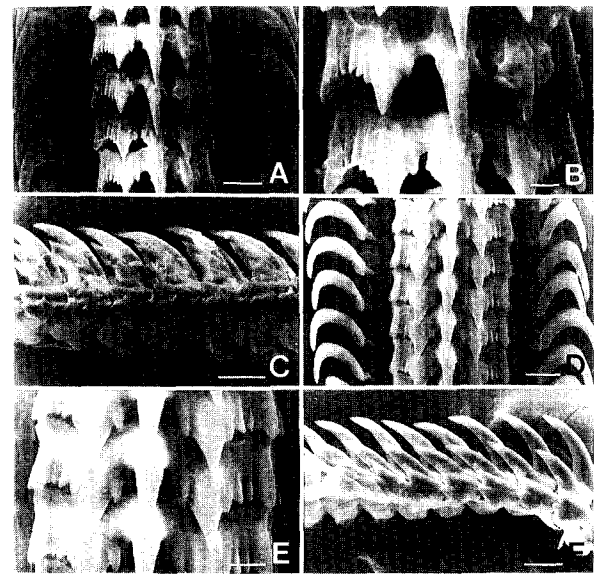

Fig. 9. Scanning electron micrographs of the radulae. A-C, *Nucella freycineti*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Ceratostoma rorifluum*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=10 μm (B, E), 20 μm (D, F), and 30 μm (A, C).

acute inner denticle and 4 outer denticles in the marginal area.

Ceratostoma fournieri (Crosse, 1861)
(Fig. 3F, Fig. 10D-F)

Murex fournieri Crosse, 1861, p. 352, pl. 16, fig. 7.
Ceratostoma fournieri: Hall, 1959, p. 429, pl. 1, figs. 5-7; Kira, 1962, p. 66, pl. 25, fig. 14; Kuroda et al., 1971, pp. 228 (in Japanese), 149 (in English), pl. 41, fig. 4; Radwin and D'Attilio, 1976, p. 112, pl. 18, fig. 8.
Murex emarginatus Sowerby, 1841, *Murex*, sp. 61, fig. 100.

Material examined: 5 inds., Sŏgwip'o, Aug. 23, 1982; 3 inds., Sŏgwip'o, Feb. 13, 1989; 3 inds., Supsŏm I., Jan. 11, 1990; 1 ind., Munsŏm I., Oct. 27, 1990; 6 inds., Pŏmsŏm I., Oct. 21, 1991; 13 inds., Ch'agwi I., Oct. 23, 1991; 1 ind., Sŏngsan, Oct. 24, 1991; 2 inds., Mara I., Oct. 25, 1991; 7 inds., Ch'agwi I., Sep. 16, 1995; 4 inds., Munsŏm I., Apr. 11, 1996.

Habitat: On the rocks between 5-30 m in depth.

Type locality: Japan.

Previous collection records: Sŏgwip'o (Kim and Rho, 1971).

Distribution: Korea, Korean Straits, Japan [Nagasaki, Dejima, Goto Island, Honshu (Boso peninsula as north limit), Shikoku, Kyushu, Japan sea], Taiwan, China.

Remarks: The shell bears 3 crenated axial varices rotating down continuously from the apex. The intervaricel knobs at the shoulder of body whorl are more prominent than those of *C. rorifluum* (Adams and Reeve) and *C. burnetti* (Adams and Reeve). The inner surface of the outer apertural lip bears 5 crenations, corresponding to the ruffled varices, of which the second from the base of aperture is developed with an acute spiny process. Shell color is variable from white to pale brown. The radula morphologies are nearly the same as those of *C. burnetti* (Adams and Reeve).

Genus *Genkaimurex* Kuroda, 1953
Genkaimurex varicosus (Kuroda, 1953)
(Fig. 3G)

Coralliophila (*Genkaimurex*) *varicosa* Kuroda, 1953, pp. 120 (in English), 127 (in Japanese), text figs. 7, 8.
Genkaimurex varicosa: Kira, 1962, p. 69, pl. 26, fig. 17.

Material examined: 1 ind., Pongho-ri, Oearo I., Aug. 18, 1983.

Habitat: Sandy bottoms between 50-100 m in depth.

Type locality: Japan (Genkai Sea, off Fukuoka, Kyushu).

Previous collection records: Eastern coast of Korea (Kwon et al., 1993).

Distribution: Korea, Japan (Northern Kyushu).

Remarks: The shell sculpture generally consists of numerous, dense spiral cords and nearly 11 longitudinal ribs in each whorl and the outer lip is widely

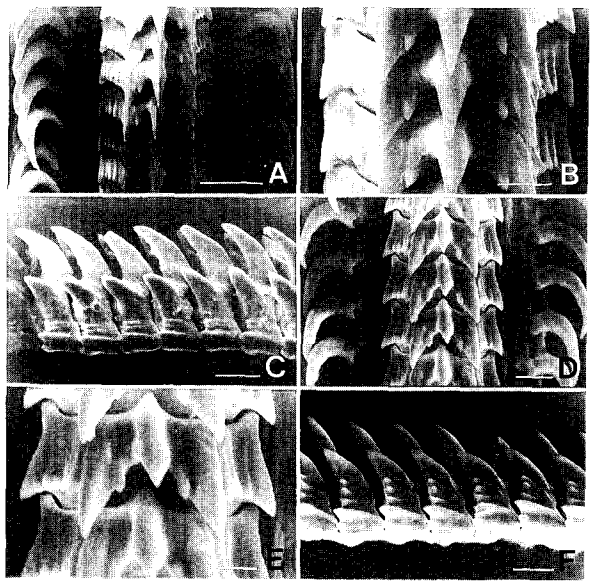

Fig. 10. Scanning electron micrographs of the radulae. A-C, *Ceratostoma burnetti*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Ceratostoma fournieri*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=10 μm (E), 20 μm (B, D, F), 30 μm (C), and 50 μm (A).

marginated by a fin-like appendage. In the collections of the present study, however, shell sculpture is rather obscure for the abrasion.

Subfamily Ergalataxinae Kuroda, Habe and Oyama, 1971

Genus *Ergalatax* Iredale, 1931

Ergalatax contractus (Reeve, 1846)

(Fig. 3H, Fig. 11A-C)

Buccinum contractum Reeve, 1846, *Buccinum*, sp. 53, pl. 8, fig. 53.

Ergalatax contractus: Kuroda et al., 1971, pp. 230 (in Japanese), 150 (in English), pl. 43, figs. 12, 13.

Ergalatax contracta: Radwin and D'Attilio, 1976, p. 48, pl. 2, figs. 10-12, pl. 19, figs. 13, 18.

Murex calcarius Dunker, 1860, p. 230.

Urosalpinx innotabilis Smith, 1879, p. 201, pl. 20, fig. 32.

Material examined: 1 ind., Sŏgwip'o, Aug. 21, 1982; 2 inds., Udo I., Aug. 6, 1983; 4 inds., Sŏngsan, Aug. 7, 1983; 1 ind., Munsŏm I., Feb. 18, 1989; 8 inds., Pŏmsŏm I., Aug. 10, 1989; 5 inds., Supsŏm I., Aug. 11, 1989; 10 inds., Pŏmsŏm I., Oct. 22, 1991; 1 ind., Mara I., Oct. 25, 1991; 27 inds., Munsŏm I., Dec. 11, 1994; 2 inds., Tangsa, Ulsan, Feb. 15, 1995; 22 inds., Ch'agwi I., Sep. 16, 1996; 17 inds., Munsŏm I., Apr. 11, 1996.

Habitat: On the rocks or sandy bottoms between 5-30 m in depth.

Type locality: Samar Island, Philippines (*B. constractus*); Dejima, Nagasaki City, Kyushu (*M. calcareus*); North Kyushu (*U. innotabilis*).

Distribution: Korea, Japan [Honshu (Boso Peninsula as northern limit), Shikoku, Amami Islands, Kyushu, Kii Peninsula], Taiwan, China, Philippines. Australia (New South Wales), New Caledonia, East Africa (Zanzibar). Also in the Central and Western Pacific regions.

Remarks: The shell sculpture consists of numerous, fine spiral cords and nearly 11 rope-like axial ribs. The subsutual region of each whorl sloped down to the periphery at an angle of about 45°. The outer apertural lip bears 7 denticles and the anterior part of columellar lip bears 2 faint folds. The radula has a tricuspidate rachidian tooth. A small, eyetooth-like inner denticle is separately situated near the base of lateral cusp. Sometimes, however, 2-3 inner denticles can be observed even in the same radula ribbon. The outer marginal area of the lateral cusp is smooth and more or less straight.

Genus *Bedevina* Habe, 1946

Bedevina birileffi (Lischke, 1871)

Trophon birileffi Lischke, 1871, p. 39.

Bedevina birileffi: Habe, 1964, p. 84, pl. 27, fig. 10; Kuroda et al., 1971, pp. 229 (in Japanese), 150 (in English), pl. 43, figs. 10, 11.

Bedeva birileffi: Radwin and D'Attilio, 1976, p. 27, pl. 2, fig. 6.

Fusus pachyraphe Smith, 1879, p. 205, pl. 20, figs. 37, 37a.

Habitat: Sandy bottoms between tide mark to 20 m in depth.

Type locality: Japan (Dejima, Nagasaki city, Kyushu).

Previous collection records: Aninjin (Kim et al., 1983).

Distribution: Korea, Japan [Honshu (Boso Peninsula as northern limit), Shikoku, Kyushu, Goto Island], Taiwan.

Remarks: This species was recorded only by the previous literatures (Kuroda et al., 1971; Kim et al., 1983), without additional collections in the present study.

Subfamily Trophoninae Cossmann, 1903

Genus *Boreotrophon* Fischer, 1844

Identification Keys to the Species of Genus *Boreotrophon* from Korean Coast

1. Lamellous axial varices well developed, raised upwardly at shoulder of each whorl 2
   Lamellous axial varices simple, less developed, not raised upwardly at shoulder of each whorl 4
2. (1) Distal part of axial varices spinose, with pointed end; outer apertural lip not turned outside ..... *B. alaskanus*
   Distal part of axial varices fin-like, with blunt end;

outer apertural lip turned outside 3
3. (2) Left side of base compressed abruptly ..... *B. paucicostatus*
Left side of base not compressed abruptly ..... *B. candelabrum*
4. (1) Shoulder of each whorl angulated slightly; siphonal canal rather straight ..... *B. xestra*
Shoulder of each whorl rounded; siphonal canal bent toward left ..... *B. cymatus*

Boreotrophon candelabrum (Reeve, 1848)
(Fig. 4A, Fig. 11D-F)

Fusus candelabrum Reeve, 1848, *Fusus*, sp. 79, pl. 19, fig. 79.
Boreotrophon candelabrum: Kuroda et al., 1971, pp. 223 (in Japanese), 152 (in English), pl. 41, fig. 10.
Trophon subclabatus Yokoyama, 1922, p. 64, pl. 3, fig. 2.

Material examined: 1 ind., Kuryongp'o, Aug. 11, 1982; 1 ind., Taep'o Harbour, Sokch'o, Aug. 19, 1988; 1 ind., Chŏdong, Ullŭng, Jul. 16, 1989; 1 ind., Sach'ŏn, Ch'u-munjin, Nov. 18, 1990; 7 inds., Taep'o Harbour, Sokch'o, Feb. 25, 1995; 35 inds., Taep'o Harbour, Sokch'o, Mar. 17, 1995; 21 inds., Taep'o Harbour, Sokch'o, Apr. 27, 1996.

Habitat: Sandy or gravelled bottoms between 30-200 m in depth.

Type locality: Unknown.

Previous collection records: Aninjin (Kim et al., 1983).

Distribution: Korea, Japan [Honshu (Sagami Bay as southern limit), Hokkaido, Tsusaki], China, southern part of the Okhotsk Sea.

Remarks: This species is characterized by the body whorl bearing nearly 7-8 fin-like axial varices of which the ends are erected upwards at the shoulder. The rachidian tooth bears a small, eyetooth-like inner denticle located separately near the base of lateral cusp, and the outer marginal area of the lateral cusp is smooth. The outline between the central and lateral cusp shows rather rounded and elliptical base.

Boreotrophon paucicostatus Habe and Ito, 1965
(Fig. 4B, Fig. 12A-C)

Boreotrophon paucicostatus Habe and Ito, 1965, pp. 18 (in Japanese), 32 (in English), pl. 2, fig. 10; Egorov, 1993, p. 16, figs. 9, 31-I, J.

Material examined: 2 inds., Taep'o Harbour, Sokch'o, Mar. 17, 1995.

Habitat: Sandy or gravelled bottoms between 30-200 m in depth.

Type locality: Off Etrofu, Kuriles.

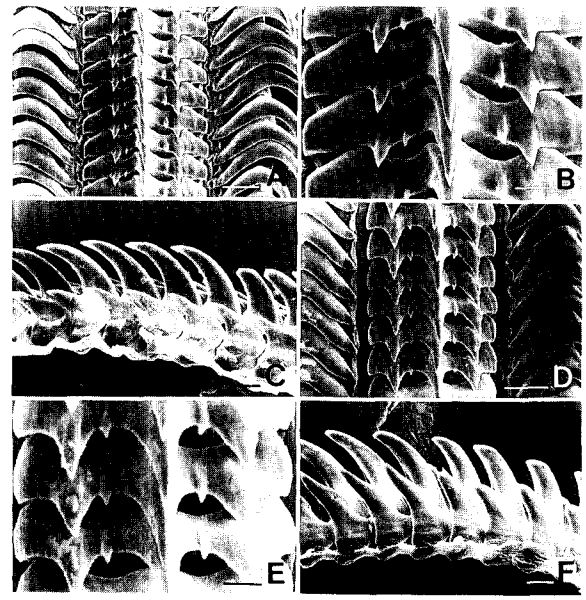

Fig. 11. Scanning electron micrographs of the radulae. A-C, *Ergalatax contractus*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Boreotrophon candelabrum*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=20 μm (B, C, E, F) and 50 μm (A, D).

Distribution: Northeastern sea of Korea. From the Kuril Islands to northern Japan.

Remarks: This is similar with *B. candelabrum* (Reeve) in the shape of the shell and radula. This shell is distinguishable from *B. candelabrum* (Reeve) in the number of fin-like axial varices. Those are 6-7 in number, less than 7-8 of *B. candelabrum* (Reeve). The varices of this species are inwardly rolled at the margin and the left side of the base become abruptly narrowed in width.

Boreotrophon alaskanus Dall, 1902
(Fig. 4C)

Boreotrophon alaskanus Dall, 1902, p. 545; Habe and Ito, 1979, p. 35, pl. 10, figs. 5, 12, 16, 17.

Material examined: 1 ind., Taep'o Harbour, Sokch'o, Feb. 25, 1995.

Habitat: Sandy or gravelled bottoms between 50-200 m in depth.

Type locality: Bering Sea.

Distribution: Northeastern Sea of Korea. From Bering Sea to southern Okhotsk Sea.

Remarks: The body whorl bears nearly 10 axial varices of which the ends are sharply pointed at the shoulder. It had been known that this boreal species is restricted from Bering and Okhotsk seas to nothern Hokkaido in the distributional range (from 60°N to 43°N). Considering the fact that Korean collection from

Sokch'o (128°30′~128°45′E, 38°15′~38°00′N)) was identified by the present study, it seems that this species may be distributed northwards of 38°N of East Sea of Korean Peninsula.

Boreotrophon xestra Dall, 1918
(Fig. 4D, Fig. 12D-F)

Boreotrophon xestra Dall, 1918, p. 232; Habe and Ito, 1979, p. 35, pl. 10, fig. 4.
Trohonopsis (Boreotrophon) xestra: Kira, 1962, p. 65, pl. 25, fig. 2.

Material examined: 1 ind., Taep'o Harbour, Sokch'o, Mar. 17, 1995.

Habitat: Sandy or gravelled bottoms between 30-200 m in depth.

Type locality: Off Sado Island (Japan).

Previous collection records: Eastern coast of Korea (Kwon et al., 1993).

Distribution: Northeastern sea of Korea, Japan (central and northern parts of Honshu, Hokkaido).

Remarks: The number of longitudinal varices at the body whorl is so variable that it differs greatly from the reports by the previous authors; 16 (Dall, 1918), 12-13 (Kira, 1962), and 8-10 (Habe and Ito, 1979). Eleven axial varices was observed in the Korean collection of the present study. The radula has a pentacuspidate rachidian tooth with the elongated, attenuating central cusp. A small, eyetooth-like inner denticle is separetely located near the base of lateral cusp and the outer marginal area of the lateral cusp is smooth.

Boreotrophon cymatus Dall, 1902
(Fig. 4E, Fig. 13A-C)

Boreotrophon sepula cymatus Dall, 1902, p. 548.
Boreotrophon cymatus: Egorov, 1993, p. 16, figs. 10, 31-E, F.

Material examined: 5 inds., Taep'o Harbour, Sokch'o, Mar. 17, 1995.

Habitat: Sandy or gravelled bottoms between 100-200 m in depth.

Type locality: Bering Sea.

Distribution: Northeastern sea of Korea. Japan (Northern sea of Hokkaido), Okhotsk Sea.

Remarks: This is similar with *B. xestra* Dall in the morphologies of the shell and radula. This shell is, however, distinguishable from it in that the shoulder of each whorl is rather round, and that siphonal canal is slightly bent toward left.

Discussion

The total number of muricids reported from the Korean waters is 26 species in 15 genera as a result of the present study. Among them, 5 species reported previously (*Chicoreus asianus, Homalocantha anatomica, Rapana bezoar, Pteropurpura plorator, Bedevina birileffi*), however, could not be ascertained in this study, since the previous works did not provide verifiable descriptive treatments such as descriptions, collection records, and illustrations for the species.

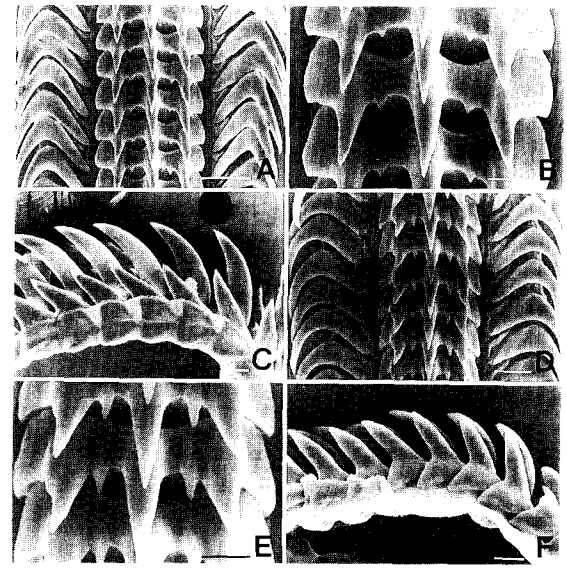

Fig. 12. Scanning electron micrographs of the radulae. A-C, *Boreotrophon paucicostatus*. A, Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. D-F, *Boreotrophon xestra*. D, Central and lateral teeth. E, Central tooth. F, Lateral view of central tooth. Scale bars=10 μm (E, F), 20 μm (B, C, D), and 50 μm (A).

Some of zoogeographic suggestions can be drawn from this study: considering the occurrences of not only the subtropical and temporal muricid species such as *Morula spinosa, Haustellum sobrinus, Mancinella echinata* and *Ergalatax contractus* from Cheju Island but also the boreal *Boreotrophon* species from Sokch'o (128°30′~128°45′E, 38°15′~38°00′N) of Korea, we can suggest that subtropical, temporal, and boreal muricid species are distributed throughout the Korean coast with their own ranges. All of the subtropical Korean muricid species were particularly confined to the southern part of Cheju Island (33°30′N) in their distributional ranges, as the northern limit.

Considering the morpholgical studies of radulae of the muricid species from the coastal areas of Korea makes us possible to infer that they consist of multiple triseriate and transverse rows of teeth, which contain a three- or five-cusped rachidian tooth and two flanking sickle-like horn-shaped lateral teeth.

Acknowledgements

This study was supported by the Korea Science and Engineering Foundation (KOSEF 95-0401-04-01-3).

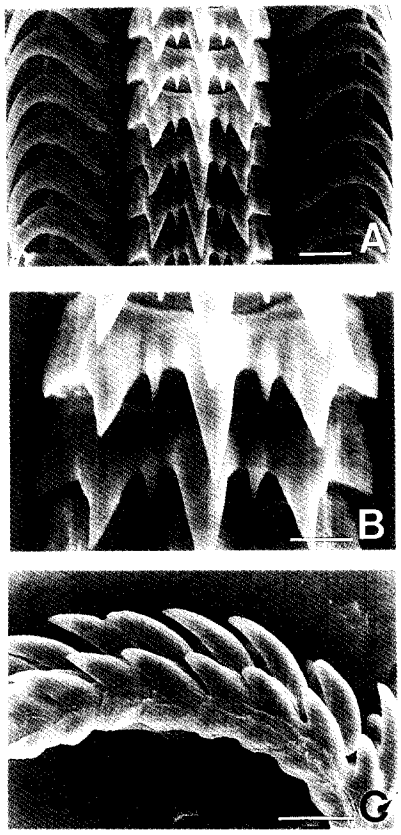

Fig. 13. Scanning electron micrographs of the radulae of *Boreotrophon cymatus*. A. Central and lateral teeth. B, Central tooth. C, Lateral view of central tooth. Scale bars=10 μm (B) and 20 μm (A, C).

References

Adams A (1853) Descriptions of several new species of *Murex*, *Rissoina*, *Planaxis*, and *Eulima*, from the Cumingian collection. *Proc Zool Soc London* 19: 267-279.

Adams A (1854) Descriptions of new shells from collection of H. Cuming Esq. *Proc Zool Soc London* 21: 69-74.

Adams A (1855) Descriptions of two new genera and several new species of Mollusca from the collection of H. Cuming Esq. *Proc Zool Soc London* 23: 119-124.

Adams A (1863) On the species of Muricinae found in Japan. *Proc Zool Soc London* 31: 370-376.

Adams A and Reeve L (1848) Mollusca. In: Adams A (ed), The Zoology of the Voyage of H. M. S. Samarang: under the Command of Captain Sir Edward Belcher, C. B., F. R. A. S., F. G. S. during the Years 1843-1846. Reeve, Benham and Reeve, London, pp 1-87.

Choe BL and Kim YJ (1989) Marine invertebrate fauna of Anma Islands. *Rep Surv Nat Envir Korea* 9: 239-276.

Choe BL and Kwon DH (1982) The marine invertebrate fauna from Deogjeog Islands. *Rep Surv Nat Envir Korea* 1: 251-263.

Choe BL and Yum SS (1989) Marine invertebrate fauna of Oeyŏn Islands. *Rep Surv Nat Envir Korea* 8: 257-278.

Choe BL, Je JG and Jeong HS (1995) Classification of superfamily Buccinoidea, Volutoidea and Cancellarioidea (Gastropoda: Mollusca) from Korean sea waters. *Korean J Malacol* 11: 93-122.

Crosse H (1861) Description de deux *Murex* nouveaux. *J Conchyl* 9: 351-354.

Crosse H (1862) Description d'espèces marines rècueillies par M. G. Cuming dans le nord de la Chine. *J Conchyl* 10: 51-57.

Dall WH (1902) Illustrations and descriptions of new, unfigured, or imperfectly known shells, chiefly American, in the U. S. National Museum. *Proc U S Nat Mus* 24: 499-566.

Dall WH (1915) Notes on the species of the molluscan subgenus *Nucella* inhabiting the northwest coast of America and adjacent regions. *Proc U S Nat Mus* 49: 557-572.

Dall WH (1918) Notes on *Chrysodomus* and other mollusks from the north Pacific Ocean. *Proc U S Nat Mus* 54: 207-234.

Dunker W (1860) Neue japanische Mollusken. Malakol Blätt 6: 221-240.

Dunker W (1882) Index Molluscorum maris Japonici. Sumptibus Theodori Fischer, Cassellis Cattorum, pp 1-301.

Egorov RV (1993) Trophoninae (Muricidae) of Russian and adjacent waters. *Ruthenica* Suppl 1: 1-48.

Habe T (1964) Shells of the Western Pacific in Color. Hoikusha, Osaka, Vol 2, pp 1-233.

Habe T (1969) A Nomenclatorial note on *Rapana venosa* (Valenciennes). *Venus* 28: 109-111.

Habe T and Ito K (1965) New genera and species of shells chiefly collected from the North Pacific. *Venus* 24: 16-45.

Habe T and Ito K (1979) Shells of the World in Colour. The Northern Pacific. Hoikusha, Osaka, Vol 1, pp 1-176.

Hall CA, Jr (1959) The gastropod genus *Ceratostoma*. *J Paleontol* 33: 428-434.

Hirase Y (1907) On Japanese marine Mollusca. Conchol Mag 1: 55-73.

Holten HS (1803) Enumeratio Systematica Conchyliorum beat. J. H. Chemnitzii.

Kamita T and Sato TN (1941) Marine fauna at Jinsen bay, Corea. *J Chosen Natural Hist Soc* 8: 51-53.

Kang YS (1971) Nomina Animalium Koreanorum. Hyang Moon Co, Seoul, Vol 3, pp 1-180.

Kay EA (1979) Hawaiian Marine Shells. Reef and Shore Fauna of Hawaii, Section 4: Mollusca. Bishop Museum Press, Honolulu, pp 1-653.

Kim HS and Choe BL (1981) The fauna of marine invertebrate in Ulreung Is. and Dogdo Is. *Rep Korean Asso Conserv Nat* 19: 193-200.

Kim HS and Choe BL (1988) Marine benthic fauna of Paengnyŏng-Do, TaechŏngDo and Sochŏng-Do. *Rep Surv Nat Envir Korea* 7: 355-396.

Kim HS and Kim IH (1985) Marine invertebrate fauna of Kŏmundo, Taesambudo and Sangpaekdo. *Rep Surv Nat Envir Korea* 4: 181-206.

Kim HS and Kim IH (1986) Marine invertebrate fauna of Chu'jado Islands. *Rep Surv Nat Envir Korea* 5: 309-332.

Kim HS and Kwon DH (1982) Marine invertebrate fauna in the vicinity of Wando Island. *Rep Surv Nat Envir Korea* 2: 187-206.

Kim HS and Kwon DH (1983) Marine invertebrate fauna in the vicinity of Jindo Island. *Rep Surv Nat Envir Korea* 3: 313-336.

Kim HS and Kwon DH (1987) Marine invertebrate fauna of Hŭksan Islands. *Rep Surv Nat Envir Korea* 6: 285-314.

Kim HS, Lee IK, Koh CH, Kim IH, Suh YB, and Sung NK (1983) Studies on the marine benthic communities in inter- and subtidal zones. 1. Analysis of benthic community structures at Aninjin, eastern coast of Korea. *Proc Coll Nat Sci Seoul Nat'l Univ* 8: 71-108.

Kim HS and Rho BJ (1969) The seashore marine fauna of Chuja Island, Korea. In: A Report on the Floral and Faunal Survey of Chuja Island. Office of Cultural Properties, Korea Ministry of Culture and Information, Seoul, pp 67-108.

Kim HS and Rho BJ (1971) On the distribution of the benthic animals of Korean coastal seas. 1. Cheju Island region. *Rep Intn Biol Prog Korea* 5: 1-21.

Kim HS, Rho BJ, Hong SY, Kim IH, Shin S, and Han CH (1979) The marine invertebrate fauna in the southern part of Geoje Island and its adjacent five islands. *Rep Korean Asso Consev Nat* 14: 103-126.

Kira T (1962) Shells of the Western Pacific in Color. Hoikusha, Osaka, Vol 1, pp 1-224.

Kuroda T (1942) Two Japanese murices whose names have

been preoccupied. *Venus* 12: 80-81.
Kuroda T (1953) New genera and species of Japanese Rapidae. *Venus* 17: 117-129.
Kuroda T, Habe T, and Oyama K (1971) The Sea Shells of Sagami Bay. Maruzen Pub Co, Tokyo, pp 1-235.
Küster HC (1858) Die Gattungen *Buccinum, Purpura, Concholepas* und *Monoceras*. In: Kobelt W and Küster HC (eds), Systematisches Conchylien-Cabinet von Martini und Chemnitz. Bauer & Raspe, Nuremberg, pp 1-229.
Kwon OK, Park GM, and Lee JS (1993) Coloured Shells of Korea. Academy Pub Co, Seoul, Korea, pp 1-445.
Lee BD (1956a) Catalogue of molluscan shells in Pusan region. *Euhwa* 1: 1-17.
Lee BD (1956b) The catalogue of molluscan shells of Korea. *Bull Fish Coll* 1: 53-100.
Lischke, CE (1869) Japanische Meers-Conchylien. Ein Beitrag zur Kenntniss der Mollusken Japan's mit besonderer rücksicht auf die geographische Verbreitung derselben. Theodor Fischer, Cassel, Vol 1, pp 1-192.
Lischke CE (1871) Diagnosen neuer Meeres-Conchylien von Japan. *Malakol Blätt* 18: 39-45.
Nomura S and Hatai K (1928) On the distribution of Mullusca from Korean coast. *J Chosen Nat Hist Soc* 6: 92-100.
Pilsbry HA (1904) New Japanese marine Mollusca: Gastropoda. *Proc Acad Nati Sci Phila* 56: 3-37.
Pilsbry HA (1907) New and little-known shells from northern Japan and the Kuril islands. *Proc Acad Nat Sci Phila* 59: 243-246.
Ponder WF and Vokes EH (1988) A revision of the Indo-West Pacific fossil and recent species of *Murex* s.s. and *Haustellum* (Mollusca: Gastropoda: Muricidae). *Rec Aus Mus Suppl* 8: pp 1-160.
Radwin GE and D'Attilio A (1976) *Murex* Shells of the World, an Illustrated Guide to the Muricidae. Stanford Univ Press, Stanford, pp 1-284.
Re'cluz MC (1851) Description de quelques Coquilles nouvelles. *J Conchyl* 2: 194-216.
Reeve LA (1845) Monograph of the genera *Murex, Purpura*. In: Conchologia Iconica or Illustrations of the Shells of Molluscous Animal. London, Vol. 3.
Reeve LA (1846) Monograph of the genus *Buccinum*. In: Conchologia Iconica or Illustrations of the Shells of Molluscous Animal. London, Vol. 3.
Reeve LA (1847) Monograph of the genus *Pyrula*. In: Conchologia Iconica or Illustrations of the Shells of Molluscous Animal. London, Vol. 4.
Reeve LA (1848) Monograph of the genus *Fusus*. In: Conchologia Iconica or Illustrations of the Shells of Molluscous Animal. London, Vol. 4.
Shiba N (1934) Catalogue of the Mollusca of Chosen (Corea). *J Chosen Nat Hist Soc* 18: 6-31.
Smith EA (1875) A list of the Gastropoda collected in the Japanese seas by Commander H. S. St. John. *Ann Mag Nat Hist Ser 4* 15: 414-427.
Smith EA (1879) On a collection of Mollusca from Japan. *Proc Zool Soc London* 47: 181-218.
Sowerby GB (1834-1841) The Conchological Illustrations, *Murex*. London, Sowerby.
Sowerby GB (1860) Descriptions of new shells in the collection of H. Cuming. *Proc Zool Soc London* 27: 428-429.
Springsteen FJ and Leobrera FM (1986) Shells of the Philippines. Carfel Seashell Museum, Manila, pp 1-154.
Taylor DW and Sohl NF (1962) An outline of gastropod classification. *Malacologia* 1: 7-32.
Thiele J (1929) Handbuch der Systematischen Weichtierkunde. Part 1. Fischer, Jena, pp 1-376.
Vokes EH (1964) Supraspecific groups in the subfamilies Muricinae and Tritonaliinae (Gastropoda: Muricidae). *Malacologia* 2: 1-41.
Wenz W (1941) Prosobranchia. In: Schindewolf OH (ed), Handbuch der Paläozoologie, Part 5, Gebrüder Borntraeger, Berlin, Vol 6, pp 961-1200.
Yokoyama M (1922) Fossils from the upper Musashino of Kazusa and Shimosa. *J Coll Sci Tokyo Imp Univ Tokyo* 44: 200.
Yoo JS (1959) Description of unrecorded species of molluscan shells in Korea. *Korean J Zool* 2: 29-33.
Yoo JS (1976) Korean Shells in Colour. Iljisa Co, Seoul, pp 1-196.

[Received April 7, 1997; accepted May 19, 1997]