
To a species composition of subfamily Moelleriinae Hickman et McLean, 1990 (Mollusca: Gastropoda: Colloniidae) in the northwestern Pacific

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ABSTRACT. Two species of the subfamily Moelleriinae Hickman et McLean, 1990 – *Moelleria costulata* (Møller, 1842) and *Spiromoelleria quadrae* (Dall, 1897) – have been reported from the northwestern Pacific so far. The present paper clarifies their distribution in the region based on the museum collections and newly obtained material from the northwestern Pacific. Also, one more species, *Spiromoelleria maculata* (Golikov et Gulbin, 1978), which previously had been considered as a member of the genus *Homalopoma* Carpenter, 1864 (subfamily Coloniinae), is here suggested to be a member of Moelleriinae.

moelleria Baxter et McLean, 1984 differ from *Homalopoma* in its having an operculum with a multispiral pattern on its exterior surface, and having the operculum unable to retract deeper than flush with the apertural margin [Baxter, McLean, 1984] (compare Figs 1 A, E and Figs 2 A-B). In accordance with this, the species, which was earlier described as *Homalopoma maculata* Golikov et Gulbin, 1978 (Figs 2 C-D), should be removed from the genus *Homalopoma*, because its operculum has a multispiral pattern of the inner side, and it is unable to retract beyond the aperture.

The spiral sculpture of *Homalopoma maculata* is characteristic for *Spiromoelleria*, and *Homalopoma maculata* does not have the typical feature of the genus *Moelleria* – the coalescing axial sculpture (compare Figs 1 A, B and Figs 2 C-D). So in this paper we place *Homalopoma maculata* in the genus *Spiromoelleria*. Additionally, based on the new findings in the Sea of Japan, Okhotsk, Bering and Chukchi seas we clarify the distribution of the species of the subfamily Moelleriinae in the NW Pacific.

Introduction

Only three species had been known in the subfamily Moelleriinae Hickman et McLean, 1990 – *Moelleria costulata* (Møller, 1842), *Spiromoelleria quadrae* (Dall, 1897) and *Spiromoelleria kachemakensis* Baxter et McLean, 1984. Two of them have been reported from the northwestern Pacific so far – *Moelleria costulata* and *Spiromoelleria quadrae* [Golikov, Gulbin, 1978; Kantor, Sysoev, 2006; Sirenko *et al.*, 2013].

All these species have a calcareous operculum and rhipidoglossate radula, as do the members of the genus *Homalopoma* Carpenter, 1864 (prior to the present work, the latter genus was placed in the subfamily Colloniinae Cossmann, 1916 [Schroeder, 2012]). But *Moelleria* Jeffreys, 1865 and *Spiro-*

Materials and methods

The material described in the article is housed in the collections of the Zoological Institution of the Russian Academy of Sciences, Saint-Petersburg (ZISP) and was collected off eastern Kamchatka in

2013 and 2014 by R/V “MRTK-316”, in the Chukchi Sea in 2004 and 2012 by R/V “Professor Khromov”, in the Sea of Okhotsk in 2013 and 2014 by R/V “TINRO”, “Professor Probatov” and “Professor Kizevetter” and in the Barents Sea in 2008, 2009, 2012 by R/V “Dalnie Zelentsy” and “Viking-2”.

The shells were studied using MSP-2 stereomicroscope with DCM-130 digital camera. Scanning electronic microphotographs of the radulae were taken with a FEI SEM Quanta 250. Radulae were cleaned from tissues with a water solution of sodium hypochlorite and then were washed with distilled water.

Abbreviations used: H – shell height;

KB PGI – Kamchatka Branch of Pacific Geographical Institute, Russian Academy of Sciences;

LMBI – Laboratory of Macroecology and Biogeography of Invertebrates, Saint-Petersburg State University;

USNM – National Museum of Natural History, Smithsonian Institution, Washington DC;

ZISP – Zoological Institute, Russian Academy of Sciences, Saint-Petersburg, Russia;

ZMUC – Zoological Museum of the University of Copenhagen, Denmark.

Taxonomic description

Class Gastropoda

Subclass Vetigastropoda

Superfamily Phasianelloidea Swainson, 1840

Family Colloniidae Cossmann, 1916

Subfamily Moelleriinae

Hickman et McLean, 1990

Genus *Moelleria* Jeffreys, 1865

Type species: *Margarita costulata* Møller, 1842 (by monotypy).

Moelleria costulata (Møller, 1842)

(Figs 1 A-C, Fig. 3 (squares))

Margarita costulata Møller, 1842: 83; Schiøtte, Warén, 1992: 8, figs 27-29.

Moelleria costulata. – Abbott, 1974: 61, fig. 501; Baxter, McLean, 1984: 221, figs 2, 4 (bibliography); Hickman, McLean, 1990: figs 15A, 16B; Kantor, Sysoev, 2006: 39, pl. 18 B; Sirenko *et al.*, 2013: 152.

Type material: Syntypes: ZMUC GAS-24, GAS-25, GAS-26.

Type locality: West Greenland: “Baals River”,

Julianehaab [Schiøtte, Warén, 1992].

Material studied: **The Sea of Okhotsk**, ZISP 54252/60, near Sakhalin Island, 49°01.0'N, 144°41.5'E, 75 m, R/V “Toporok”, st. 82, 02.12.1947, 2 alive. KB PGI, 57°39.4'N, 155°57.6'E, 100 m, R/V “Professor Probatov”, st. 63, 15.08.2013, 3 alive. **Southeast Kamchatka**, KB PGI, 52°11.5'N, 158°49.6'E, 258 m, R/V “MRTK-316”, 06.06.2014, st. 25, 1 alive. KB PGI, Kamchatka Bay, 55°10.0'N, 162°2.1'E, 200 m, R/V “MRTK-316”, 07.06.2013, st. 5, 2 alive. KB PGI, Kamchatka Bay, 55°30.0'N, 162°0.5'E, 250 m, R/V “MRTK-316”, 05.06.2013, st. 11, 1 alive. **The Bering Sea**, ZIN 46303/53, Korfa Bay, 16 m, R/V “Raduga”, SCUBA, 27.07.1975, 1 alive. **The Chukchi Sea**, ZIN 60807/62, 70°45.58'N, 175°32.0'W, 71.8 m, R/V “Professor Khromov”, st. 106, 18.08.2004, 1 alive. ZIN 60808/63, 71°23.73'N, 174°54.7'W, 69.7 m, R/V “Professor Khromov”, st. 62B, 21.08.2004, 1 alive. ZIN 61938/64, 68°20.804'N, 167°10.089'W, 30 m, R/V “Professor Chromov”, st. CS-17, 01.09.2012, 1 dead. **The Barents Sea**, LMBI, Murman Coast, Dolgaya Inlet, 69°10.23'N, 34°57.39'E, 13 m, R/V “Dalnie Zelentsy”, st. 5S-2, 29.05.09, 19 alive (radula of 1 spec. studied with SEM); LMBI, Murman coast, Yarnyshnaya Inlet, 69°07.64'N, 36°02.01'E, 73 m, M/S “Viking-2”, st. 5-2, 19.09.12, 1 alive (radula studied with SEM); LMBI, Svalbard, Hopen, 76°11.042'N, 23°11.776'E, 49 m, R/V “Dalnie Zelentsy”, st. 20-2, 21.08.08, 24 alive (radula of 2 spec. studied with SEM).

Remarks. We observed the same variability in the shell sculpture of this species as MacGinitie [1959], who reported shell variation for individuals collected off Point Barrow, Alaska, the Chukchi Sea. Baxter and McLean [1984] wrote that the number of spiral cords on shell base varies from 0 to 9.

Distribution. Circumpolar in the Arctic Ocean. In the Atlantic distributed south to Maine, Greenland, Iceland, and Morocco. Alaskan distribution from Attu, Aleutian Islands, to Turner Bay, Taku Inlet, southeastern Alaska [Baxter, McLean, 1984]. The species was found in the northern-west Bering Sea (Korfa Bay) for the first time.

Genus *Spiromoelleria*

Baxter et McLean, 1984

Type species: *Moelleria quadrae* Dall, 1897 (by original designation).

Spiromoelleria quadrae (Dall, 1897)

(Figs 1 D-F, Fig. 3 (triangles))

Molleria quadrae Dall, 1897: 15, pl. 1, figs 14, 14a.

Moelleria quadrae. – Abbott, 1974: 61; 183;

Moelleria quadre (sic). – Golikov, Gulbin, 1978: 183.

Spiromoelleria quadrae. – Baxter, McLean, 1984: 223, figs 5,

(Facing page.) РИС. 1. *Moelleria costulata* и *Spiromoelleria quadrae*. **A-C.** *Moelleria costulata*. **A.** ZISP 46303/53, Берингово море, залив Корфа, 16 м, НИС “Радуга” SCUBA, 27.07.1975, H=1.9 мм. **B.** LMBI, Мурманское побережье, губа Ярнышная, 69°07.64'N, 36°02.01'E, 73 м, судно “Викинг-2”, ст. 5-2, 19.09.12, H=5.3 мм; **C.** LMBI, Мурманское побережье, губа Долгая, 69°10.23'N, 34°57.39'E, 13 м, НИС “Дальние Зеленцы”, ст. 5S-2, 29.05.09, радула; **D-F.** *Spiromoelleria quadrae*. **D.** ZISP 58632/1, залив Качемак, 59°20.0'N, 151°36.0'W, 0-46 м, 1957-1979. H= 1.8 мм и 1.4 мм, соответственно. **E.** ZISP 27600/1, о-в Симушир, Красноватые скалы, 20 м, зверобойная шхуна “Крылатка”, ст. 247, проба 608, 07.09.1970. H=1.5 мм. **F.** О-в Юкон, залив Качемак, литораль, радула [из: Baxter, McLean, 1984: 221, рис. 3].

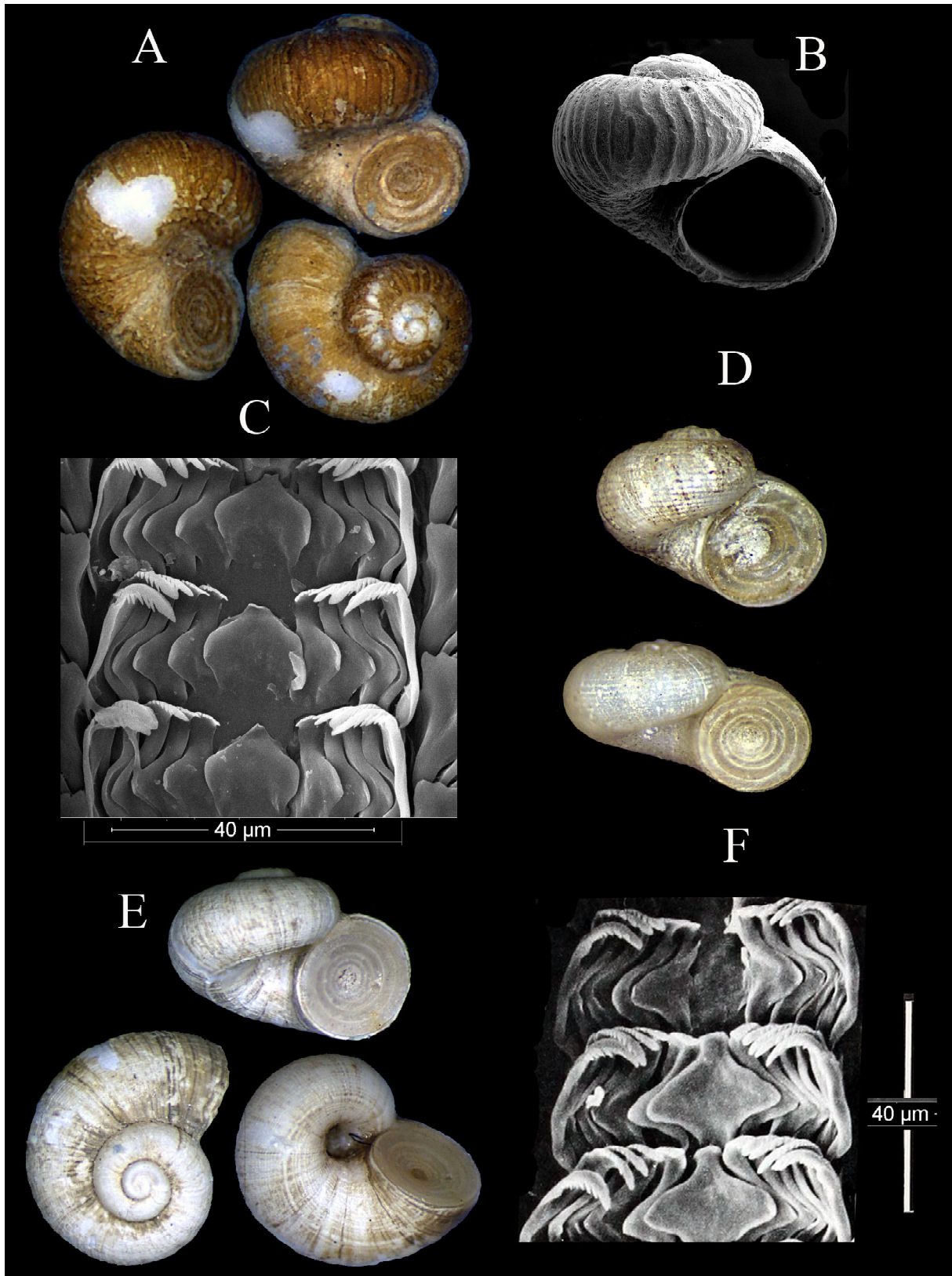


FIG. 1. *Moelleria costulata* and *Spiromoelleria quadrae*. A-C. *Moelleria costulata*. A. ZISP 46303/53, Bering Sea, Korfa Bay, 16 m, R/V "Raduga", SCUBA, 27.07.1975, H=1.9 mm. B. LMBI, Murman coast, Yarnyshnaya Inlet, 69°07.64'N, 36°02.01'E, 73 m, M/S "Viking-2", st. 5-2, 19.09.12, H=5.3 mm; C. LMBI, Murman Coast, Dolgaya Inlet, 69°10.23'N, 34°57.39'E, 13 m, R/V "Dalnie Zelentsy", st. 5S-2, 29.05.09, radula; D-F. *Spiromoelleria quadrae*. D. ZISP 58632/1, Kachemak Bay, 59°20.0'N, 151°36.0'W, 0-46 m, 1957-1979. H = 1.8 mm and 1.4 mm, respectively. E. ZISP 27600/1, Simushir Island, Krasnovataiy rocks, 20 m, sealer "Krilatka", st. 247, sample 608, 07.09.1970. H=1.5 mm. F. Yukon Island, Kachemak Bay intertidal, radula [from: Baxter, McLean, 1984: 221, fig. 3].

7, 8 (bibliography); Hickman, McLean, 1990: figs 15B, 16A; Kantor, Sysoev, 2006:39, pl. 18A; Sirenko *et al.*, 2013: 152.

Moelleria drusiana Dall, 1919: 358 (fide Baxter, McLean, 1984).

Type material: Syntypes: USNM 107441 and Canadian Geological Survey Museum.

Type locality: western Canada, Cumshewa Inlet, Queen Charlotte Islands.

Material studied: Kurile Islands, ZIN 27600/1, Simushir Island, Krasnovatay rocks, 20 m, sealer "Krilatka", st. 247, sample 608, 07.09.1970, 1 alive. H=1.5 mm. Alaska, ZIN 58632/1, Kachemak Bay, 59°20.0'N, 151°36.0'W, 0-46 m, 1957-1979, 74 alive, from Los Angeles County Museum.

Remarks. Baxter and McLean [1984] wrote that "spiral sculpture of variable number (49-77 of fine, narrow cords; spiral cords present throughout, from suture to umbilical walls, stronger on base, with wider interspaces on base". The examined 74 specimens from Kachemak Bay showed more variability in high of shell (Fig. 1D) and especially in spiral sculpture of shells. One part of the specimens have spiral cords only in base of their shells, other part of specimens have spiral cords throughout, and one specimen has no spiral cords. These specimens probably were extracted from different samples, collected in different places. Unfortunately we do not know exactly the depth where the specimens were collected, depth range was recorded as 0-46 m.

Distribution. *Spiromoelleria quadrae* was collected near Middle Kurile Islands, Simushir Island, near Aleutian Islands, Attu and Amchitka Islands, near Kodiak Island, in Kachemak Bay, Prince William Sound, and Cumshewa Inlet, British Columbia [Baxter, McLean, 1984; Sirenko *et al.*, 2013].

Spiromoelleria maculata
(Golikov et Gulbin, 1978) **comb. nov.**
(Figs 2 C-F, Fig. 3 (circles))

Homalopoma maculata Golikov, Gulbin, 1978: 181, fig. 7; Kantor, Sysoev, 2006:42, pl. 18 G-G'; Gulbin, Chaban, 2012: 13; Sirenko *et al.*, 2013: 152.

Type material: Holotype ZISP 27608/1.

Type locality: Pacific ocean, middle Kurile Islands, Ekarma Island, 1.5 nautical mile to the west of Cape Krugliy, 20 m, sealer "Krilatka", st. 341, sample 898, 16.10.1971.

Material studied: The holotype. **The Sea of Okhotsk,**

ZISP 38068/15, Shelikhova Bay, 100 m, R/V "Baidar", st. 61, grab, 27.08.1964, 1 dead. KB PGI, Near northwest Kamchatka, 359 m, R/V "TINRO", st. 83, sample 3 11.08.2013, 1 alive. KB PGI, Near northwest Kamchatka 364 m, R/V "TINRO", st. 75, sample 2, 11.08.2013, 1 alive. KB PGI, 57°27.0'N, 155°10.2'E, 253 m, R/V "Professor Probatov", st. 75, sample 2, 15.08.2013, 1 alive. KB PGI, 58°12.6'N, 156°03.0'E, 359 m, R/V "Professor Probatov", st. 83, sample 3, 11.08.2013, 1 alive. KB PGI, 55°14.4'N, 154°47.7'E, 101 m, R/V "Professor Probatov", st. 17, 01.08.2013, 1 alive. KB PGI, 57°58.5'N, 154°46.6'E, 384 m, R/V "Professor Kizevetter", st. 80, 29.06.2014, 1 alive. KB PGI, 57°27.0'N, 155°10.0'E, 384 m, R/V "TINRO", st. 66, 01.07.2015, 2 alive. **Kurile Islands,** ZISP 27603/4, Simushir Island, Broutona Bight, 15 m, sealer "Krilatka", st. 209, sample 488, 25.08.1970, 2 alive. ZISP 27604/5, Simushir Island, Broutona Bight, 15 m, sealer "Krilatka", st. 209, sample 490, 25.08.1970, 2 alive. ZIN 27601/2, Simushir Island, Sredniy Bight, 15 m, sealer "Krilatka", st. 255, sample 630, 09.09.1970, 1 alive. ZISP 27602/3, Simushir Island, Sredniy Bight, 20 m, sealer "Krilatka", st. 256, sample 632, 09.09.1970, 3 alive. ZISP 27606/7, Simushir Island, 3 nautical mile to north-east from Cape Poliynskiy, 15 m, sealer "Krilatka", st. 284, sample 673, 09.09.1970, 1 alive. ZISP 27607/8, Makanrushi Island, 1 nautical mile to south from Cape Vecherniy, 20 m, sealer "Krilatka", st. 325, sample 858, 10.09.1971, 1 alive. **The Sea of Japan,** ZISP 35905/11, Moneron Island, Chuprova Bight, 15-17 m, R/V "Maiskoe", st. 4, 22.08.1972, 1 alive. ZIN 35906/12, Moneron Island, Kologerasa Bight, 50-70 m, R/V "Maiskoe", st. 17, 25.08.1972, 1 alive. ZISP 35907/13, Moneron Island, 46°15.5'N, 141°15.6'E, 65-70 m, R/V "Maiskoe", st. 34, 27.08.1972, 1 alive. ZISP 35908/14, Moneron Island, 46°16.7'N, 141°10.6'E, 115 m, R/V "Maiskoe", st. 42, 30.08.1972, 1 alive. **The Bering Sea,** ZISP 48575/16, Commander Islands, Bering Island, 55°17.6'N, 166°37.8'E, 130-150 m, R/V "Rakitnoe", st. 174, 21.09.1973, 1 alive. ZISP 33718/10, Kamchatka Peninsula, Olutorskiy Bay, 116 m, R/V "Raduga", grab "Ocean" N2, 25.07.1975, 1 alive. ZISP 62086/17, Bering Strait, 65°50.20'N, 169°10.0'W, 44 m, R/V "Akademik Korolev", st. 78, 16.08.1988, 1 dead.

Description. We are giving a translation from Russian of the original description [Golikov, Gulbin, 1978] with additional comment on the operculum:

"Shell small, low conical, with three quickly growing, prominent, rounded whorls, divided with distinct depressed suture. Spire low, crowded. Last whorl most prominent, evenly rounded and occupy 18/19 of shell height. Color of shell not uniform: spots and strips (often vertical) from light brown to dark brown on dirty-grey ground. Axial sculpture consists of irregularly placed deep growth lines. Spiral sculpture consists of distinct, slightly flattened ribs, interspaces as wide as the ribs. Ribs arranged more compactly on the shell base. There are about 20 ribs on the last whorl. Aperture round-

(Facing page.) РИС. 2. *Homalopoma amussitatum* (Gould, 1861) и *Spiromoelleria maculata*. А-В. *Homalopoma amussitatum* ZISP 1739/26. Японское море, залив Посьет, 5-7 м, 8.10.1965. А. раковина, Н=7 мм. В. Крышечка этого же экземпляра. С-Е. *Spiromoelleria maculata*. С. Голотип *Homalopoma maculata*, ZISP 27608/1, Н=2 мм. D. ZIN 62086/17, Берингов пролив, 65°50.2'N, 169°10.0'W, 44 м, НИС "Академик Королев", ст. 78, 16.08.1988, Н=1,8 мм. Е. 57°58.5'N, 154°46.6'E, 384 м, НИС "Профессор Кизеветтер" ст. 80, 29.06.2014, Н=2,4 мм. F. KB PGI, 57°39.4'N, 155°57.6'E, 100 м, НИС "Профессор Пробатов", ст. 63, 15.08.2013, радула.

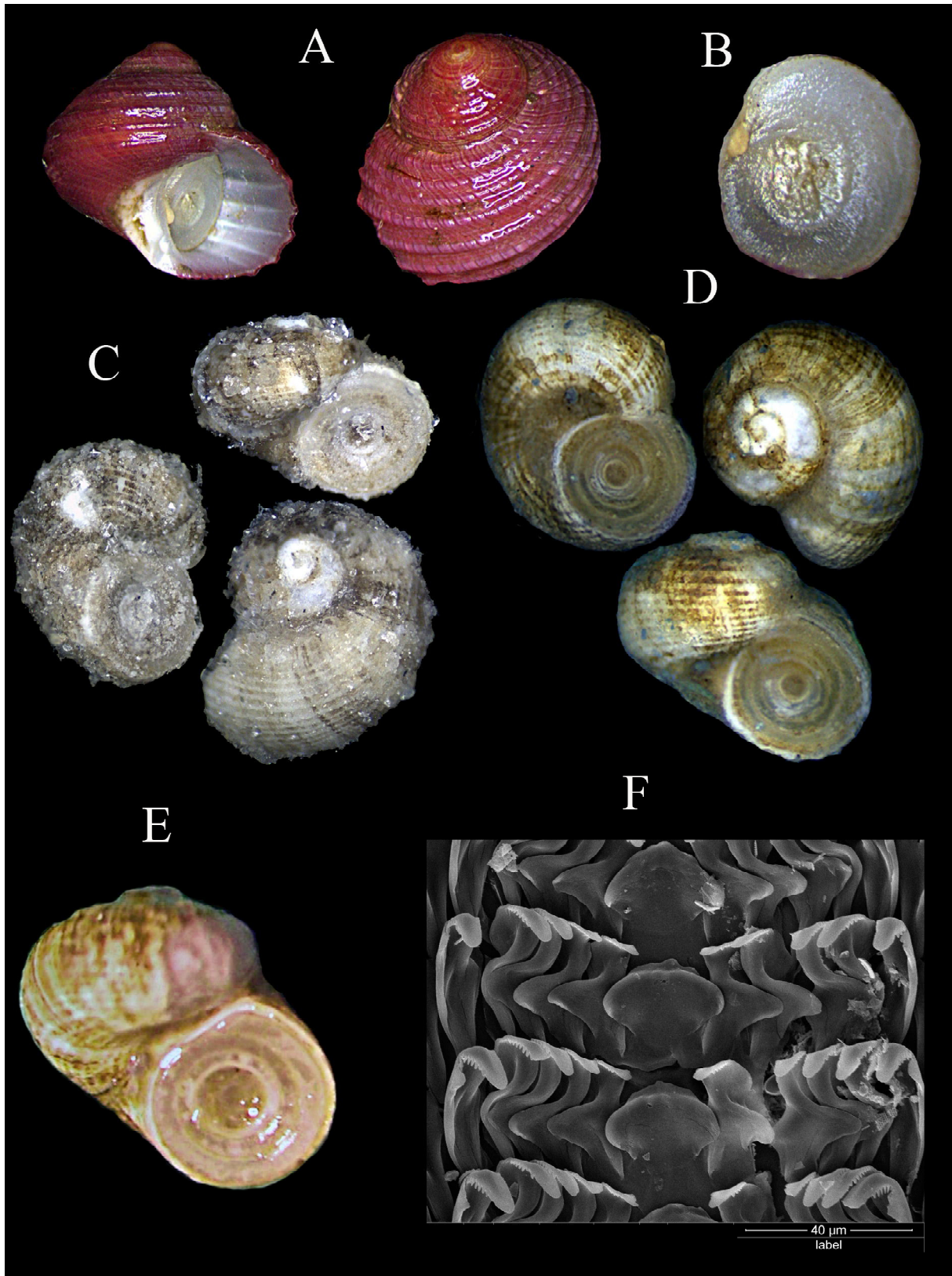


FIG. 2. *Homalopoma amussitatum* (Gould, 1861) and *Spiromoelleria maculata*. A–B. *Homalopoma amussitatum* ZISP 1739/26. Japan Sea, Posjet Bay, 5–7 m, 8.10.1965. A. shell, H= 7 mm. B. Operculum of the same exemplar. C–E. *Spiromoelleria maculata*. C. Holotype of *Homalopoma maculata*, ZISP 27608/1, H= 2 mm. D. ZISP 62086/17, Bering Strait, 65°50.2'N, 169°10.0'W, 44 m, R/V “Akademik Korolev”, st. 78, 16.08.1988, H= 1.8 mm. E. 57°58.5'N, 154°46.6'E, 384 m, R/V “Professor Kizevetter”, st. 80, 29.06.2014, H= 2.4 mm. F. KB PGI, 57°39.4'N, 155°57.6'E, 100 m, R/V “Professor Probatov”, st. 75, sample 2, 15.08.2013, radula.

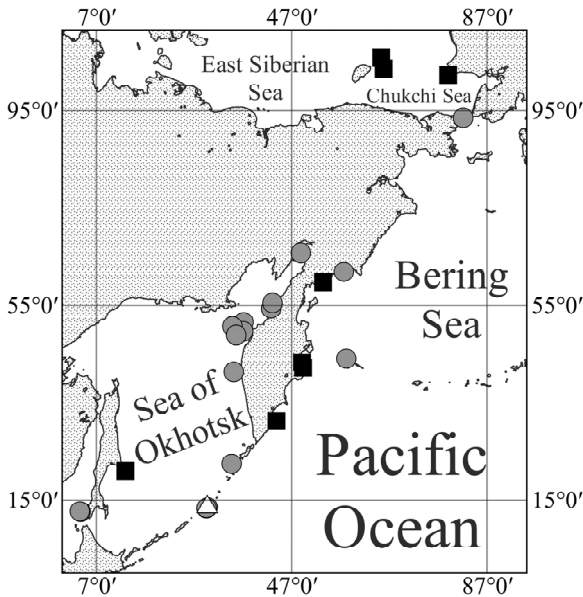


FIG. 3. Distribution of the species of the subfamily Moelleriinae in the northwestern Pacific: Squares – *Moelleria costulata*; Circles – *Spiromoelleria maculata*; Triangle – *Spiromoelleria quadrae*.

РИС. 3. Распространение представителей подсемейства Моеллериинае в северо-западной части Тихого океана: квадраты – *Moelleria costulata*; круги – *Spiromoelleria maculata*; треугольник – *Spiromoelleria quadrae*.

ed, with closed peristome. Inner and outer lips of aperture thin, evenly rounded, imperceptibly transfer to each other. Umbilicus semicircular, wide, but not deep. Height of shell of holotype 2.0 mm, height of aperture 1.45 mm, width of aperture 1.4 mm. Largest specimen, collected near Simushir Island in Broutona Bight at depth 15 m, on sandy and stony bottom with shell, having 2.5 mm in height, diameter of last whorl 3.1 mm, height of last whorl 2.25 mm, height of aperture 1.75 mm, width of aperture 1.65 mm.

Rachidian tooth of radula wide, almost square. Five lateral teeth; length of their blades increases from the middle of radula to edges. About 20 marginal teeth.”

Comparison of radulae of three species (Fig. 1C, F, 2F) shows some similarities and differences. Radulae of *Moelleria costulata* (Fig. 1C) and *Spiromoelleria quadrae* (Fig. 1F) have rachidian teeth with narrowed appendix in center of the top, whereas rachidian teeth of *Spiromoelleria maculata* (Fig. 2F) have no appendix. Lateral teeth of *Moelleria costulata* and *Spiromoelleria quadrae* have sharp distal part, whereas *Spiromoelleria maculata* has lateral teeth without distal part like *Homalopoma luridum* (Dall, 1885) [Hickman, McLean, 1990, Fig. 20A]. Fide Hickman and McLean [1984] the main difference of radulae of Coloniinae from Moel-

leriinae is the presence of secondary flap on the rachidian tooth. Operculum not retractable, tightly fit to aperture margin, interior surface of operculum flat, multispiral exterior surface slightly concave.

Remarks. Careful examination of the type material of *Homalopoma maculata* revealed a mistake in the generic position of the species. It has a multispiral operculum, which is typical character for the subfamily Moelleriinae, but not of the subfamily Colloniinae which includes genus *Homalopoma*. Taking into consideration the multispiral operculum and spiral sculpture of *H. maculata*, we suggest it to be a member of *Spiromoelleria*.

Spiromoelleria costulata is very similar to Alaskan *S. kachemakensis* Baxter et McLean, 1984, but differs from it by having 20 spiral ribs on the last whorl (vs. 35–50 ribs in *S. kachemakensis*). Probably *S. kachemakensis* is endemic to the Gulf of Alaska, because Baxter and McLean [1984] reported that this species is absent near Kodiak Island and to the west.

Distribution. Previously *Spiromoelleria maculata* was collected in the Sea of Japan (near Moneiron Island), near Middle Kurile Islands (Simushir, Ekarma, Makanrushi and Rasshua Islands), and near Commander Island [Golikov, Gulbin, 1978: 181–182; Kantor, Sysoev, 2006: 42; Gulbin, Chaban, 2012: 13; Sirenko *et al.*, 2013: 152]. The species is mentioned for the first time from the Sea of Okhotsk and the Bering Sea (Olutorskiy Bay and the Bering Strait).

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К видовому составу подсемейства Moelleriinae Hickman et McLean, 1990 (Mollusca: Gastropoda) в северо-западной Пацифике

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РЕЗЮМЕ. В северо-западной Пацифике ранее были известны только два представителя подсемейства Moelleriinae Hickman et McLean, 1990 – *Moelleria costulata* (Møller, 1842) и *Spiromoelleria quadrae* (Dall, 1897). В данной работе на основании изучения коллекционного материала и новых сборов произведено уточнение ареала этих видов, и в состав подсемейства Moelleriinae включен еще один вид – *Spiromoelleria maculata* (Golikov et Gulbin, 1978), который ранее считался представителем рода *Homalopota* Carpenter (подсемейство Coloniinae), 1864.

