ISSN 1063-0740, Russian Journal of Marine Biology, 2013, Vol. 39, No. 6, pp. 403–412. © Pleiades Publishing, Ltd., 2013.
Original Russian Text © N.A. Pisareva, N.G. Klochkova, 2013, published in Biologiya Morya.

ALGOLOGY

Two New Species of the Genus *Neoabbottiella* (Rhodophyta, Halymeniales) from the Russian Far Eastern Seas

N. A. Pisareva[a] and N. G. Klochkova[b]

[a] *Kamchatka Branch of the Pacific Institute of Geography, Far East Branch, Russian Academy of Sciences, Petropavlovsk-Kamchatsky, 683000 Russia*

[b] *Kamchatka State Technical University, Petropavlovsk-Kamchatsky, 683003 Russia*

e-mail: miranda-n@yandex.ru; ninakl@mail.ru

Received November 11, 2012

Abstract—The results of taxonomic revision of the red algal genus *Neoabbottiella* from the Russian Far Eastern seas are presented and the differences of *Neoabbottiella* from the other blade-like red algae are discussed. Descriptions of three species are given, including *N. araneosa* (type species) and two newly described species, *N. valentinae* sp. nov. and *N. decipiens* sp. nov. The newly described species differ from *N. araneosa* in morphogenesis, structure, and localization of gonimoblasts on the blade, as well as some features of vegetative anatomy. A key to the species of *Neoabbottiella*, illustrations of their external and internal structures and some data on their distribution and ecology are given.

Keywords: division Rhodophyta, genus *Neoabbottiella*, *N. valentinae*, *N. decipiens*, gonimoblasts, taxonomic revision, Far Eastern seas, southeastern Kamchatka

DOI: 10.1134/S1063074013060072

The genus *Neoabbottiella* was originally described by L.P. Perestenko under the name *Abbotia* in her revision of the division Rhodophyta from the Russian Far Eastern seas [5] and included a single species, *Abbotia araneosa* Perestenko. The name's etymology reflected an important morphological character observed in the mature female plants, viz., the arrangement of gonimoblasts in the form of stars with multiple rays, forming a web-like pattern. It is noteworthy that this unique character is absent in the other red algal genera. Another peculiar character of *Abbotia* was the presence of large refractive needle-shaped or stellate cells that looked significantly different from those found in the other blade-like red algal genera. As well, *Abbotia* had peculiar cortical filaments.

Later, Perestenko reported that the generic name *Abbotia* was a later homonym, already occupied by the angiosperm genus from the family Juncaginaceae [20]. Therefore, she renamed the genus *Abbottia* [6]; however this name was also occupied by the angiosperm genus in the family Rubiaceae [19]. Therefore, she again renamed the genus *Neoabbottiella* [7].

In 1982, I.A. Abbott, whose name was given to the discussed genus, studied the specimen of *A. araneosa* from the Kuril Islands and suggested assigning this species to the genus *Neodilsea* with a new taxonomic name, *Neodilsea araneosa* (Perestenko) Abbott (=*Abbotia araneosa* Perestenko) [9]. Perestenko did not agree, however, because despite certain similarities of the internal structures between *N. araneosa* and members of the genus *Neodilsea* they differed considerably in the organization of the female reproductive structures [7]. S. Lindstrom studied the holotype and other specimens of *N. araneosa* from the Komarov Botanical Institute herbarium (LE), supporting Perestenko's opinion [16]. She also reported that while changing the generic name from *Abbottia* to *Neoabbottiella*, Perestenko did not formalize the new taxonomic name according to the rules of botanic nomenclature; therefore Lindstrom corrected the nomenclature and nominated herself in the species authority (i.e., *Neoabbottiella araneosa* (Perestenko) Lindstrom).

While determining the family for *N. araneosa*, Perestenko included this species in Dilseaceae from the order Cryptonemiales [5]. Abbott attributed *Neoabbottiella* to the family Dumontiaceae [9] and Lindstrom assigned it to Cryptonemiaceae from the order Gigartinales based of the structures of the carpogonial and auxiliary systems [16]. It is noteworthy that the views on the validity and taxonomic position of the families Dumontiaceae and Cryptonemiaceae changed repeatedly in the scientific works published at the end of the last century. Some researchers pointed out the uniformity in the formation of cell fusions and the participation of carpogonial and auxiliary systems in these processes in Cryptonemiaceae and Dumontiaceae [5, 10, 12]. In recent years, Cryptonemiaceae is not defined within the taxonomic system of Rhodophyta.

Sufficiently similar orders Cryptonemiales and Gigartinales to which different authors attributed the genus *Neoabbottiella* differ in the type of auxiliary system [15].

Later, these orders were merged into Gigartinales [13] and then again divided on the basis of molecular and ultrastructural analyses [21]. Many families and genera formerly included in Cryptonemiales were assigned to Halymeniales. The taxonomic status of the abovementioned orders is still ambiguous [14, 18, 22]. According to AlgaeBase, the genus *Neoabbottiella* belongs to Halymeniaceae, which is the type family of the order Halymeniales [11].

The genus *Neoabbottiella* is still considered monotypic. We examined herbarium collections of the red algae from the Russian Far Eastern seas and found unusual blade-like algae with the arrangement of gonimoblasts and the entire internal structure corresponding to the description of *Neoabbottiella*. However, these specimens were significantly different from a single member of the genus, *N. araneosa*, in several anatomical and morphological characters. Comparison between the specimens showed that the genus in question includes three species, instead of the previously known one species. The present paper describes these new species and discusses the differences between the genus *Neoabbottiella* and other blade-like red algal genera from the Russian Far Eastern seas.

MATERIAL AND METHODS

The investigated plants of *Neoabbottiella* were mainly collected from the southeastern coast of Kamchatka during different seasons in 2004–2012. Specimens collected from the other regions of the Russian Far Eastern seas in 1970–1990 and held in Kamchatka State Technical University and Komarov Botanical Institute (LE) were also examined.

The algal anatomy was studied with Olympus BX40 and Olympus CX31 microscopes. Fresh plants and rehydrated herbarium specimens were cross-sectioned with a razor blade and preserved as water/glycerine and glycerine/gelatin permanent slides.

Microphotographs were captured using ScopePhoto and Infinity camera software and the most typical sections were used to illustrate the species anatomy. Internal structure was studied in 67 plants listed after the species descriptions. To understand the phenological development and also the morphogenesis and ecology of the species, additional algal samples were collected. Most specimens used in this study are held in Kamchatka State Technical University.

RESULTS

In the paper containing the original description of *Neoabbottiella araneosa* [5], Perestenko did not provide the Latin diagnosis of the genus *Neoabbottiella*. She provided the first description in her monograph on the red algae from the Russian Far Eastern seas and only in the Russian language, and mainly described the female reproductive system and its development after the fertilization [8]. In the light of our new findings, it is necessary to expand the genus diagnosis.

Genus *Neoabbottiella* Perestenko

Perestenko, 1982, p. 30 [7].—Abbotia araneosa Perestenko, *Perestenko, 1975, p. 1686 [5].*

Diagnosis

Gametophyte blades entire or dissected, 120–1000 mm in thickness, with or without perforations, attached by a small disc. Lobes, if any, spherical or cuneate, can extend up to the base of the blade. Medulla consisting of anticlinal and periclinal filaments formed with short and long rod-shaped cells, and with refractive needle-shaped, stellate or dendroid-shaped cells among them. Subcortex of one to five cell layers, with cells becoming smaller in size towards the blade's surface. Cortex with two to five layers of cell filaments. Carpogonial and auxiliary branches curved, formed at the boundary of the medulla and subcortex, consist of 12 (15) cells and with two to four lateral cells. Nurse and auxiliary cells intercalary. Gonimoblasts submerged, with or without pericarp and liberation exits, developing on both sides of the blade at the boundary of subcortex and medulla or in the medulla; located on the blade's surface so that they form a web-like pattern, with nodules looking like stars with multiple rays. One ray is formed with two to ten or more gonimoblasts positioned in a row. Spermatia in small clusters on the blade's surface. Tetrasporangia unknown.

Description

Gametophyte blades are entire or dissected, 120–1000 μm in thickness, with or without perforations, attached by a small disc. Lobes, if any, are spherical or cuneate, can extend up to the base of the blade. Medulla consists of anticlinal and periclinal filaments formed with short and long rod-shaped cells; among these cells refractive needle-shaped, stellate or dendroid-shaped cells are found. Subcortex is formed with one to five layers of cells, which become smaller in size towards the blade's surface. Cortex is formed with two to five layers of cell filaments. Carpogonial and auxiliary branches are curved, formed at the boundary of the medulla and subcortex, consist of 12 (15) cells and with two to four lateral cells. Nurse and auxiliary cells are intercalary; the auxiliary cell, which is the fourth cell from the distal end of the branch, is not different from other cells in shape and size; however it becomes larger after fusion with the connecting filament. Gonimoblasts are submerged, with or without pericarp and liberation exits, developing on both

sides of the blade at the boundary of subcortex and medulla, or in the medulla. Gonimoblasts are located on the blade's surface forming a web-like pattern, with nodules looking like stars with multiple rays. One ray is formed with two to ten or more gonimoblasts positioned in a row. Spermatia are formed in small clusters on the blade's surface. Tetrasporangia were not found in our samples.

Key to the species of Neoabbottiella

I. Mature blades roundish or with small spherical lobes. Gonimoblasts up to 280 μm in size, located distantly from each other, rising above the blade's surface, forming a distinct stellate web-like pattern formed with 4–10 gonimoblasts. Refractive cells numerous 1–2

1. Star-like pattern formed with large gonimoblasts distantly located from each other. After gonimoblast liberation, large perforations develop in these areas. Smaller gonimoblasts that do not form star-like pattern are disorderly scattered among the large ones ..... *N. decipiens*

2. Stars formed with gonimoblasts are located close to each other, covering almost the entire blade's surface with web-like pattern. All gonimoblasts contribute to the formation of star-like pattern ....*N. araneosa*

II. Blades deeply dissected into linear-cuneate lobes. Gonimoblasts up to 155 μm in size, locate close to each other, not rising above the blade's surface, forming a web-like pattern with rays composed of two to four gonimoblasts. Distinct web-like pattern absent. Refractive cells rare ....*N. valentinae*

Neoabbottiella araneosa (Perestenko) Lindstrom
(Figs. 1A, B, C; 2)

Lindstrom, 1985, p. 264 [16]. – Neoabbottiella araneosa Perestenko, *Perestenko, 1982, p. 30 [7]. – Abbotia araneosa* Perestenko, *Perestenko, 1975, p. 1686 [5].*

Description

Mature blades are burgundy red or reddish-chestnut in color, sometimes almost black on the edges, 8–30 cm long, 7–50 cm wide, 190–650 μm thick in the sterile basal part, 200–600 μm thick on the edges and up to 820 μm thick in the gonimoblast-bearing part. Young blades are entire, roundish, cuneate or irregular-shaped. Upon further growth, folds and perforations develop and the blades become dissected into spherical or cuneate lobes. The blade's margins are often roundish, straight or wavy, sometimes with proliferations. The blade's basal part is narrow-cuneate or heart-shaped. The plant is attached by a disc on a short flat stipe. Sometimes the blade's basal part is not distinct and the stipe is absent. Dried plants have opaque, rough and sometimes filmy surface.

Medulla is formed with anticlinal and periclinal filaments formed with rod-shaped cells 2–9 × 10–67 μm in size connected in a chain, with transparent walls. Refractive cells of different shapes and sizes are abundant. The refractive cells can be long needle-shaped (2–25 × 30–275 μm in size), short club-shaped (5–10 × 17–30 μm in size), dendroid-shaped (3–13 × 18–225 μm in size), or stellate (4–20 μm in diameter with 30–250 μm long rays). In basal part of the blade, medulla is dense, becoming loose towards the blade's edges and in the fertile parts. Subcortex is not well defined, composed of one to two layers of oval cells; in different plants the width of these cells is different, from 4 to 13 μm. However, cells of the outer and inner layers have almost the same size. Cortex is formed with the filaments composed of three to six cells of 2–8 × 2–10 μm in size with thickened mucous walls, without cuticle.

Auxiliary branches are branched, curved, composed of 8–11 cells, laterals are formed with one to four cells. Mature gonimoblasts are 125–215 × 130–280 μm in size, spherical or shapeless, submerged in the medulla, with convex pericarp visibly rising above the blade's surface. The liberation exit does not form above the pericarp. Gonimoblasts develop on both sides of the blade, covering its entire surface, except for the basal part. They distribute in groups, looking like stars with multiple rays and forming a web-like pattern on the blade's surface. Mature carpospores are spherical or irregular in shape, 8–22 × 10–35 μm, densely pigmented. Spermatia and tetrasporangia were not found in our samples.

The morphology of *N. araneosa* is most similar to *N. decipiens*. However, in the latter species the fragments of web-like pattern formed on the blade's surface by the stars of gonimoblasts are located distantly from each other and surrounded by the ring of gonimoblasts. In *N. araneosa*, the web-like pattern formed on the blade's surface by the stars of gonimoblasts is rather even and its fragments are merged into a single pattern. Moreover, these species differ in the frequency of occurrence of stellate refractive cells, which are frequently occurring in *N. araneosa* and are rare in *N. decipiens*.

Specimens studied. Southeastern Kamchatka, Avachinsky Inlet: Starichkov Is., 14–16 m, Aug. 5, 2009, coll.: N. Sanamyan, 1 ♀; Starichkov Is., 18 m, Aug. 19, 2008, coll.: N. Sanamyan, 8 ♀, four ster. (hereafter, [ster.] sterile plant); Starichkov Is., 20–22 m, Aug. 2, 2012, coll.: N. Sanamyan, two ster.; Starichkov Is., 21–24 m, boulders, Aug. 15, 2012, coll.: N. Sanamyan, A. Ryabets, 1 ♀, one ster.; Starichkov Is., 22 m, Oct. 2, 2012, coll.: N. Sanamyan, two ster. Kuril Islands: Simushiru Is., Aug.1980, cast ashore, coll.: unknown, 2 ♀. Sea of Okhotsk: near Alexander Cape,

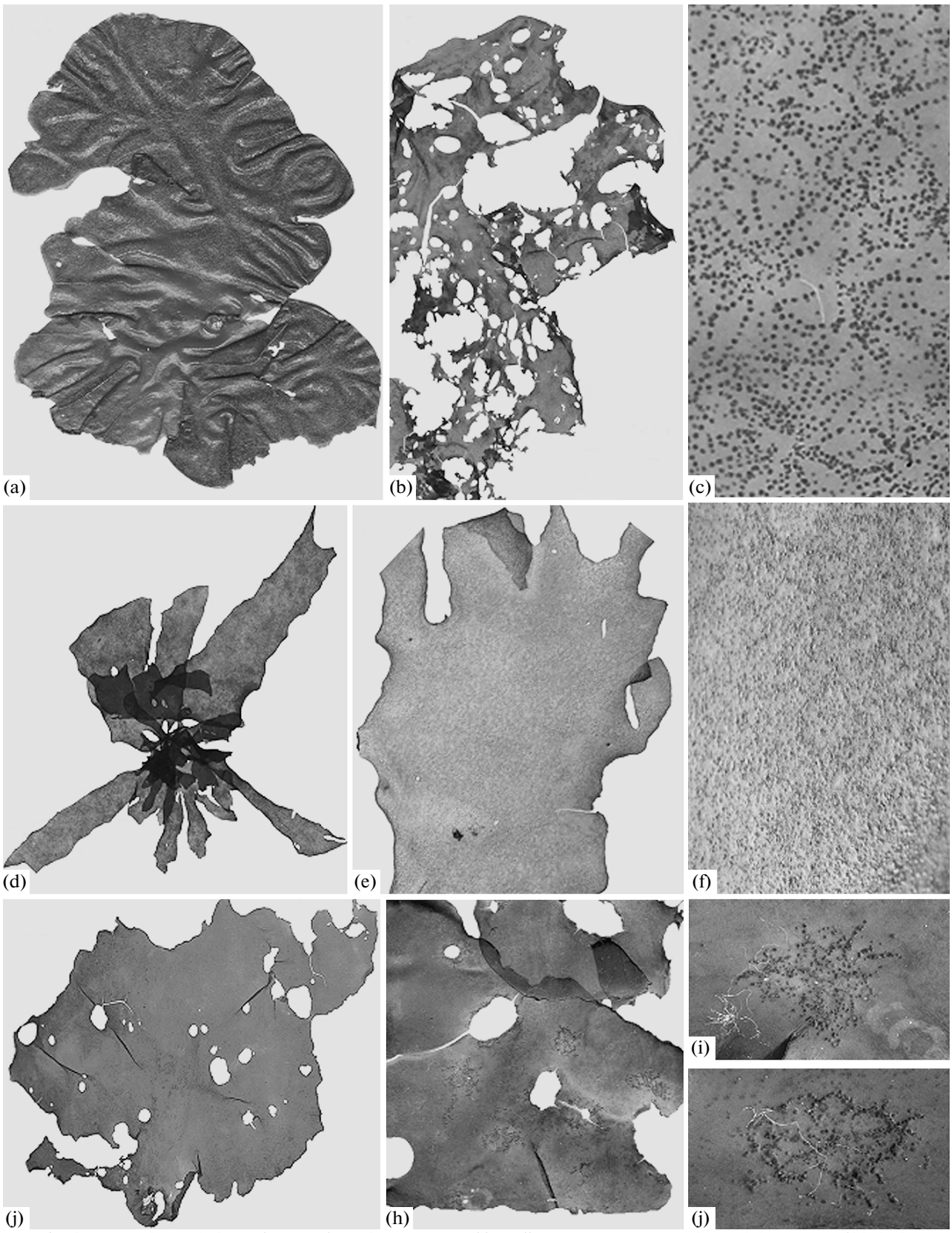

Fig. 1. The external morphology of species from the genus *Neoabbottiella*. *N. araneosa*: external view (A), portion of blade disintegrating after carpospore liberation (B), and enlarged portion of blade showing web-like pattern with nodules looking like stars with multiple rays (C); *N. valentinae*: external view of the type species (D), magnified image of the blade's lobe (E), and enlarged portion of blade showing rarely occurring stars between gonimoblasts (F); *N. decipiens*: external view (G), portion of the type species (H), and enlarged images of stars with multiple rays formed by gonimoblasts (I, J).

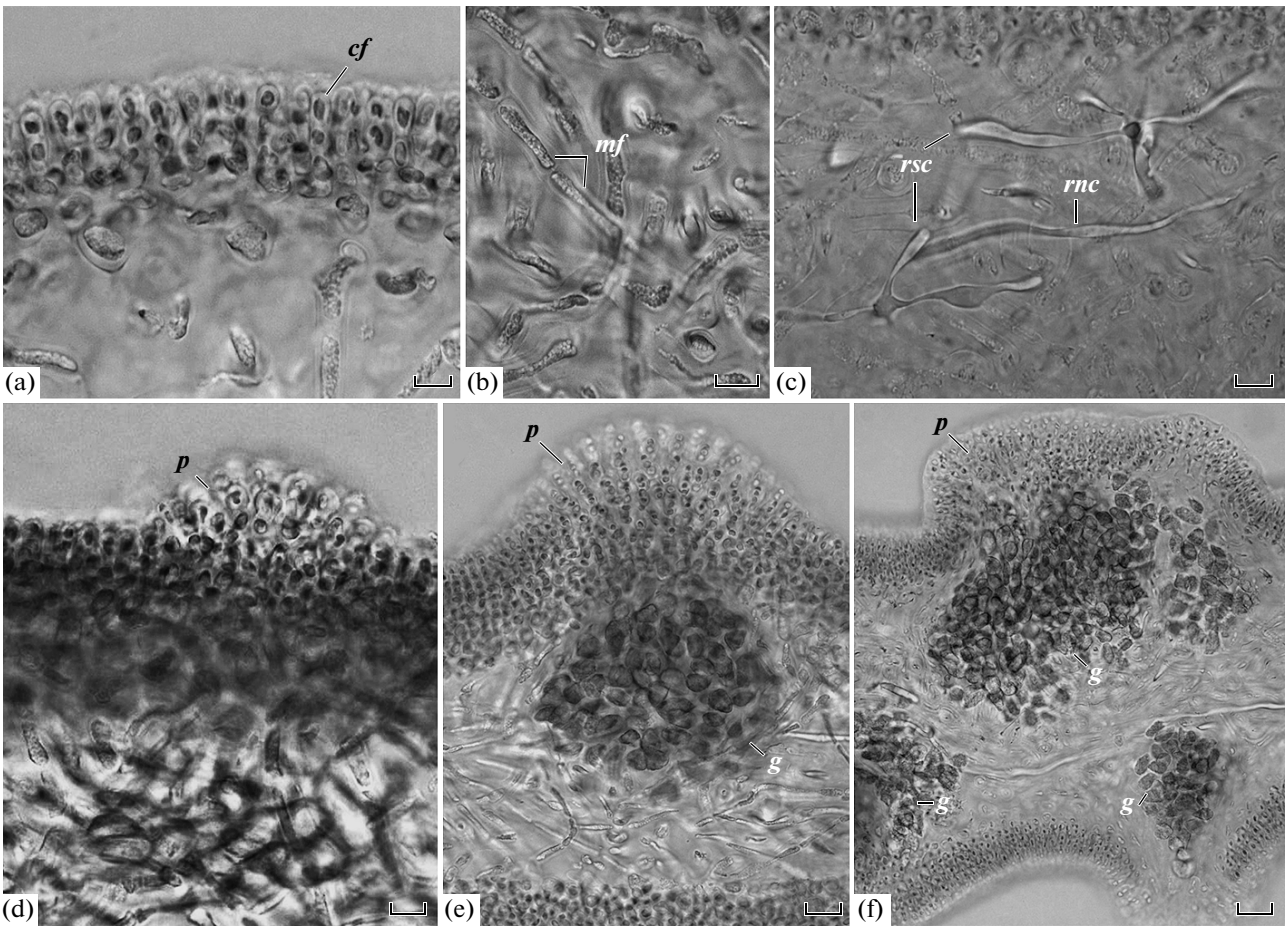

Fig. 2. The internal structure of *Neoabbottiella araneosa*. (A), (B), (C) cross-sections of the sterile plants; (D), (E), (F) cross sections of gonimoblasts: (D) formation of pericarp, (E) gonimoblast on one side of the blade, (F) gonimoblasts on two sides of the blade. Abbreviations: (*cf*) cortical filaments, (*g*) gonimoblast, (*mf*) medullar filaments; (*p*) pericarp, (*rnc*) refractive needle-shaped cell, and (*rsc*) refractive stellate cell. Scale bars: (A, D) 15 μm, (B) 12 μm, (C, F) 30 μm, (E) 25 μm.

70 m, trawl, June 7, 1972, coll.: A. Potehina, 3 ♀. Sea of Japan: northern Primorye, station 813, 14 m, July 17, 1985, coll.: unknown, 2 ♀.

Specimens from the Sea of Japan had smaller and entire blades of lighter reddish-pink color. The gonimoblasts were smaller than in the plants collected from Kamchatka, i.e., 100–160 × 150–200 μm in size. As well, a web-like pattern formed with stars with multiple rays was more evenly distributed in the plants from the Sea of Japan.

Our observations showed that *N. araneosa* is a perennial plant. Both juvenile and mature blades with gonimoblasts were found in August. Upon maturation of the gonimoblasts, the blade of *N. araneosa* grew intensively along one margin. At the end of carpospore liberation, the fertile part of the blade looked like a shabby net. During the next vegetation season, gonimoblasts developed and matured on the newly grown part of the blade. Therefore, only the lower part of the blade and the discoid holdfast are perennial in this species.

Neoabbottiella valentinae Klochkova et Pisareva sp. nov. (Fig. 1D, E, F; 3)

Diagnosis

Mature blades reddish-chestnut or light chestnut in color or become discolored, 10–25 cm long and 8–20 cm wide, 275–450 μm thick in the sterile basal part, 215–350 μm thick on the edges and up to 550 μm thick in the gonimoblast-bearing part; wide cuneate or irregular shaped, often dissected into several linear-cuneate lobes almost to the basal part, attached by a disc on a short flat stipe. The blade's margins slightly serrated, straight or wavy; basal part narrow-cuneate or heart-shaped. Surface of dried plants smooth and slightly shining. Medulla dense in the blade's basal part and becoming loose towards the edges and in fertile parts, consisting of thin-walled rod-shaped cells 2–8 × 12–65 μm in size connected in a chain and forming anticlinal and periclinal filaments. Thin needle-shaped and curved dendroid-shaped refractive

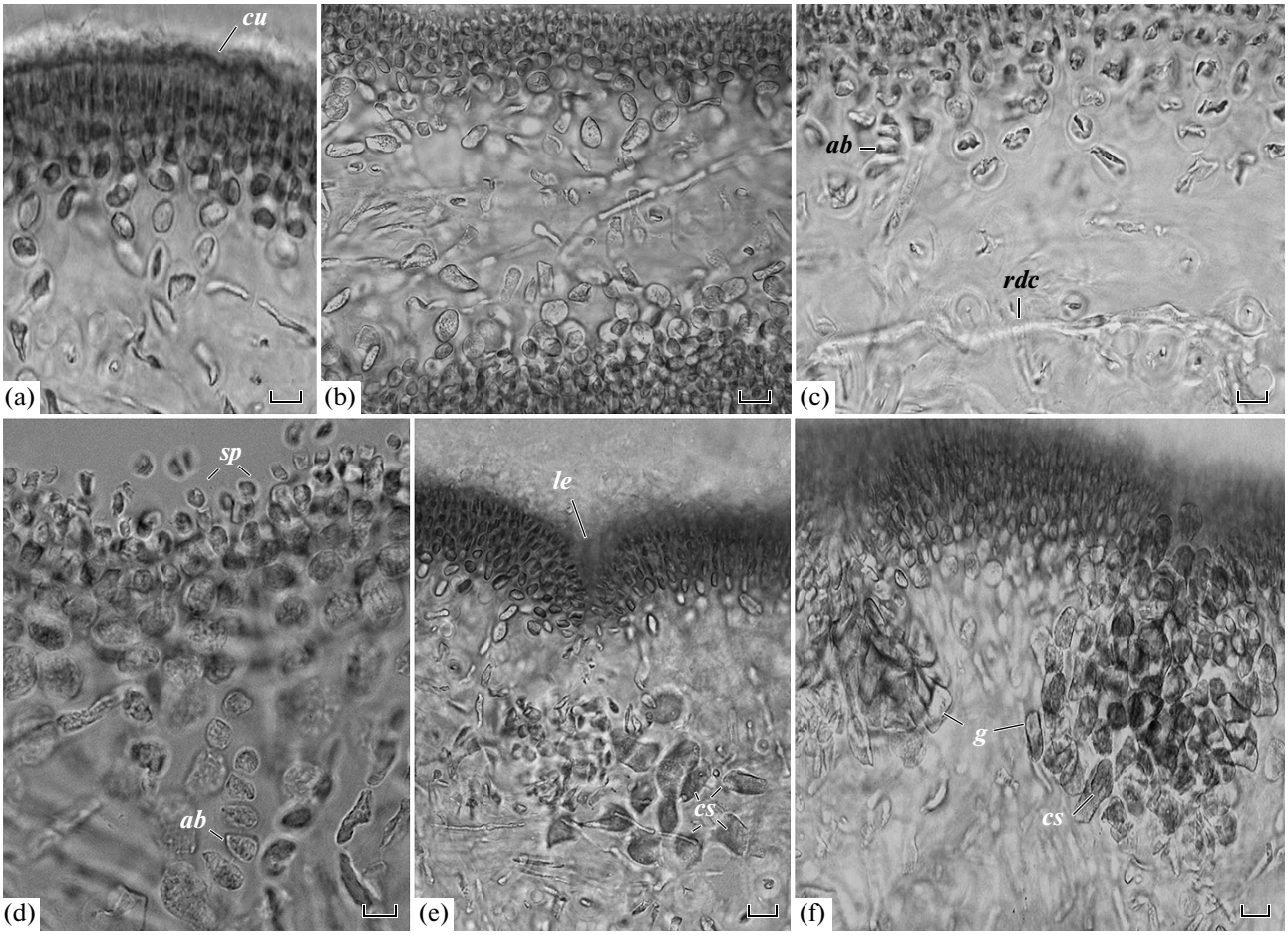

Fig. 3. The internal structure of *Neoabbottiella valentinae*. (A), (B) cross sections of the sterile plants; (C) refractive dendroid-shaped cell in cross-section of fertile plant; (D), (E), (F) cross-sections of fertile plants: (D) monoecious plant, (E–F) gonimoblasts. Abbreviations: (*ab*) auxiliary branch, (*cu*) cuticle, (*cs*) carpospores, (*g*) gonimoblast, (*mf*) medullar filaments, (*le*) liberation exit, (*rdc*) refractive dendroid-shaped cell, (*sp*) spermatia. Scale bars: (A, D, F) 12 μm, (B) 20 μm, (C, E) 15 μm.

cells 2–3 × 38–60 μm and 4–5 × 115–144 μm in size, respectively, occur rarely. Subcortex of one to two layers of large oval cells 8–12 × 13–20 μm in size and two to four layers of oval cells 5–11 × 10–15 μm in size, becoming smaller towards the blade's surface. Cortex of four to five layers of very small elongated cells 2–6 × 4–8 μm in size; however, not forming vertical filaments. Auxiliary branches consisting of 8–11 cells 5–8 × 8–10 μm in size. Carpogonial branches in the initial stage of development curved, composed of four flattened cells. Terminal cell of caprogonial branch 6 × 9 μm in size and underlying cells 2–4 × 4.5–11 μm in size. Mature gonimoblasts irregularly spherical, submerged, without pericarp, 85–128 × 112–155 μm in size, developing on both sides of the blade at the border of subcortex and medulla. Upon gonimoblast maturation, cortex becomes concave and liberation exits develop in the areas of carpospores discharge. Gonimoblasts on both sides of the blade, covering entire surface, except for the basal part, relatively similar in size, distributed disorderly, sometimes looking like stars with a few rays; one ray with two to four gonomoblasts, often positioned asymmetrically. Distinct web-like pattern absent. Mature carpospores irregular in shape, different in size, 6–15 × 10–38 μm, slightly pigmented. Spermatia 5–6 μm in size, developing in two on the mother cell. Plants monoecious. Tetrasporangia not found.

Type: Southeast Kamchatka, Avachinsky Inlet, Spaseniya Bay, littoral zone, Aug. 2, 2004, coll.: Pisareva N.A. Type specimen was deposited in LE herbarium of Komarov Botanical Institute of the Russian Academy of Sciences (St. Petersburg, Russia). Type specimen is a plant bearing gonimoblasts and spermatia.

Specimens studied. Southeastern Kamchatka, Avachinsky Inlet: Spaseniya Bay, middle intertidal, stones, Aug. 2, 2004, coll.: N. Pisareva, 6 ♀ and 2 monoecious; Spaseniya Bay, middle intertidal, stones, May 26, 2005, coll.: N. Pisareva, 2 monoecious; Spaseniya Bay, middle intertidal, stones, Aug. 2, 2012,

Table 1. Internal structure of *Neoabbottiella* species

Species	Total thickness of the blade (μm)	Cell size (μm); number of subcortical cell layers	Shape of refractive cells	Size of refractive cells (μm)	Pericarp	Size of gonimoblasts and carpospores (μm)
N. araneosa	190–820	4–8 × 6–13; 1–2	Needle-, dendroid–shaped, claviform and stellate	4–30 × 18–225(275)	Present	125–215 × 130–280, 8–22 × 10–35
N. valentinae	215–550	7–11 × 10–20; 2–1	Needle- and dendroid-shaped, curved	2–4 × 38–55(144)	Absent	85–128 × 112–155, 6–15 × 10–38
N. decipiens	210–1000	4–10 × 5–15; 1	Claviform and needle-shaped	3–15 × 20–175(232)	Present	150–200 × 200–250, 13–30 × 20–40

Table 2. Vegetative anatomy of *Neoabbottiella* and its comparison with the other blade-like red algal genera from the Russian Far Eastern seas

Genus	Glandular cells in the cortex	Maximum cell sizes in the subcortex (μm)	Cell shapes in the medulla	Refractive cells in the medulla
Neoabbottiella	Absent	20	Rod-shaped	Thin elongated and stellate dendroid-shaped
Neodilsea	Absent	60	Extended, thin	Stellate and elongated, or absent
Opuntiella	Present	50	Extended, thin, and isodiametric	Absent
Schizymenia	Present	20	Rounded, rarely stellate	Absent
Turnerella	Present	84	Extended, thin	Absent
Kallymeniopsis	Absent	84	Extended, thin, and isodiametric	Dendroid-shaped and needle-shaped
Velatocarpus	Absent	67	Extended, thin	Absent
Hommersandia	Absent	200	Extended, thin	Absent
Beringia	Absent	14	Rounded and oval	Stellate
Crossocarpus	Absent	50	Rounded, oval, elongated, and angular	Angular and needle-shaped

coll.: N. Pisareva, 2 ♀. Sea of Japan: Amursky Bay, beach zone in Vladivostok city, 1 m, July 29, 1949, coll.: E. Kardakoffa, 2 ♀.

Etymology: Named after Dr. Valentina A. Berezovskaya who studied ecological state of macrophytobenthos of Avacha Bay.

At any age, *N. valentinae* differs significantly from the other *Neoabbottiella* species in the color, deeply dissected blade, and the absence of web-like pattern made with gonimoblasts and pericarps above them. Its deeply dissected blades and linear lobes make it look somewhat similar to the species of *Kallymeniopsis*. However, it is obviously different from *Kallymeniopsis* in the anatomy. In *N. valentinae*, spermatia were found in the plants that had mature auxiliary and carpogonial branches, and gonimoblasts developed asynchronically.

Neoabbottiella decipiens Klochkova et Pisareva sp. nov.

(Fig. 1G, H, I, J; 4)

Diagnosis

Mature blades 9–35 cm long and 10–45 cm wide, reddish-chestnut or brownish-chestnut in color or become discolored, with perforations, 350–1000 μm thick in the basal part, 210–700 μm thick on the edges and up to 1000 μm thick in the gonimoblast-bearing part, attached by a disc. Young blades roundish, lobed or irregular-shaped, becoming dissected with age into cuneate or irregular-shaped lobes, with perforations. Basal part of the blade wide-cuneate or heart-shaped or sometimes shapeless; lacerations almost to the basal part. Margins of the blade irregular, wavy or folded, rarely with proliferations. Surface of dried young plants opaque, smooth and filmy; surface of dried old plants rough and leathery. Medulla consisting of anticlinal and periclinal filaments formed with rod-shaped or curved cells of 2–8 × 12.5–90 μm in size, more or less dense in the basal part and becoming loose towards the middle part and edges of the blade. Short club-shaped and long needle-shaped refractive cells of 9–15 × 20–52 μm and 3–10 × 60–232 μm in size,

Table 3. Structure of female reproductive system in the blade-like red algal genera from the Russian Far Eastern seas, which are related to the genus *Neoabbottiella*

Genus	Total number of cells in the reproductive system	Shape of cells composing carpogonial branch	Sizes (μm)		
			cells of carpogonial branch	diameter of gonimoblasts	carpospores
Neoabbottiella	30	Spherical and oval	5.5–14 × 8.4–14	85–215 × 112–280	6–30 × 10–40
Neodilsea	7–15	Spherical and oval	8.4 × 8.4	120–190	26–15 × 20–33
Kallymeniopsis	8–12	Lobe-shaped and topshaped	5–30 × 22–68	500–2000	11–22 × 20–12
Velatocarpus	10–12	Lobe-shaped, topshaped, and triangular	3–5.5 × 5.5–9.8	1500–1700	11–14 × 17–22

respectively, occur frequently. Stellate refractive cells of 4–12 μm in diameter, with short rays 2–40 μm long, occur rarely. Subcortex with two to three cell layers, not well defined. Cortex with three to five layers of oval or round cells of 4–8 × 4–8.5 μm in size, with thickened mucous walls. Fertile areas of the blade are not covered with cuticle; however it is sometimes visible in sterile areas of the blade. Mature gonimoblasts 150–200 × 200–250 μm in size, extended or shapeless, inserted in the medulla, with convex pericarp rising above the blade's surface. No liberation exits develop upon maturation of the gonimoblasts. Large gonimoblasts in groups and at a distance from each other, looking like stars with multiple rays; smaller gonimoblasts disorderly scattered among the large ones. Mature carpospores 13–30 × 20–40 μm in size, irregular or roundish in shape, highly pigmented, reddish in color. Carpogonial and auxiliary cells, spermatia and tetrasporangia were not found in our samples.

Type: Southeast Kamchatka, Avachinsky Inlet, Starichkov Is., 15–16 m, Nov. 7, 2008, coll.: Sanamyan N.P. Type specimen was deposited in LE herbarium of Komarov Botanical Institute of the Russian Academy of Sciences (St. Petersburg, Russia). Type specimen was a plant bearing gonimoblasts.

Specimens studied. Southeastern Kamchatka, Avachinsky Inlet: Starichkov Is., 7 m, June 24, 2009, coll.: N. Sanamyan, two ster.; Razdelny Cape, capes on the coasts of Zhirovaya and Vilyuchinskaya bays, 6–7 m, July 9, 2012, coll.: A. Ryabets, one ster.; Starichkov Is., rocks, 15–16 m, July 17, 2012, coll.: A. Ryabets, 3 ♀; Bezymyannaya Bay, 5–7 m, Sept. 16, 2011, coll.: N. Sanamyan, three ster.; Starichkov Is., boulders, Nov. 7, 2008, coll.: N. Sanamyan, 15–16 m: 2 ♀, eight ster.; 9–10 m: 6 ♀, three ster.

Etymology: From the word "deceiving," i.e., a species closely resembling another. Herein, we considered particular characteristics of the structure and development of gonimoblasts in this species.

N. decipiens differs from the other *Neoabbottiella* species in darker brown color of the blade, as well as in characters discussed in the diagnoses of the other two species.

Based on the observations of our specimens, we presume that *N. decipiens* lives for at least two growth seasons. Appearance of the juvenile plants continues until late autumn. Formation and maturation of the gonimoblasts occurs throughout a prolonged period of time and apparently in different months in various coastal regions. For example, plants collected near Starichkov Is. in the middle of July began to develop auxiliary branches, whereas in early November they already had gonimoblasts with carpospores at different stages of maturation. However, plants collected in September in Bezymyannaya Bay were sterile. It's noteworthy that mature plants of *N. decipiens* had red and green algal endophytes and even diatoms, especially in the areas around and inside the gonimoblasts.

DISCUSSION

Revision of the genus *Neoabbottiella*, which was initiated as a part of a larger research on the systematics and developmental biology of the red algae from Kamchatka, showed that this genus, previously considered monotypic, in fact includes three species that are well distinguished by their morphologies (Fig. 1). The most significant differences include the shapes of lobes in the mature plants, depth of blade dissection, as well as the sizes and arrangement of stars formed with gonimoblasts. In *N. valentinae*, blades become dissected almost to the basal part during the juvenile stage. Growing lobes extend and become linear or cuneate-linear in shape, often with the dissections of the second order. Species *N. araneosa* and *N. decipiens* have fan-shaped lobes, even when they are deeply dissected. An interesting characteristic of latter species is the appearance of jagged margins on the blades, which form when small slit-like perforations developing at the very edge of the blade are torn apart.

In each species, gonimoblasts are arranged in a particular manner, due to their different sizes and patterns that they form on the blade's surface. In *N. decipiens*, gonimoblasts are very large, protrude over

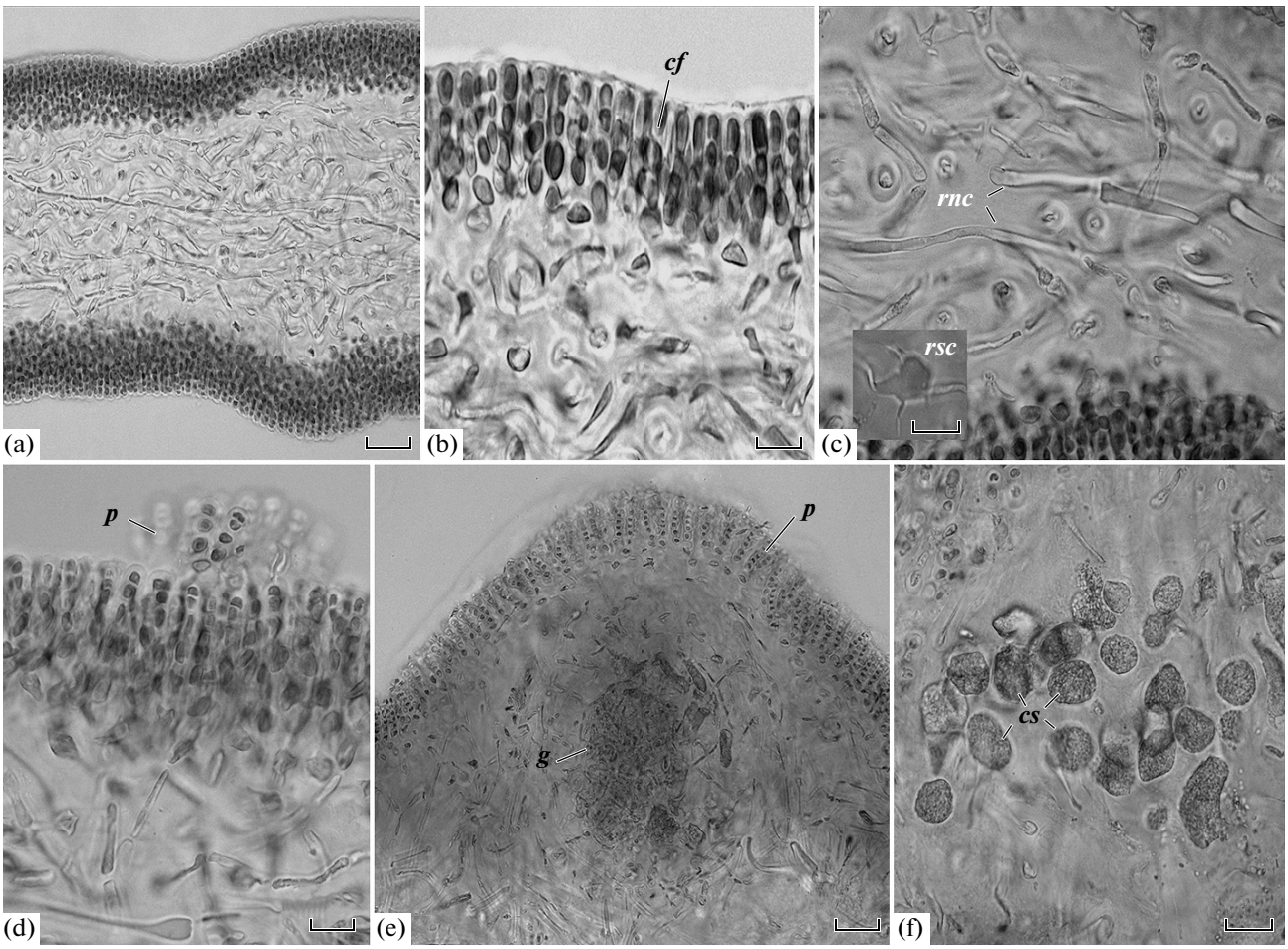

Fig. 4. The internal structure of *Neoabbottiella decipiens*. (A), (B), (C) cross-sections of the sterile plants; (D) formation of pericarp; (E) mature gonimoblast (scale 50 μm); (F) mature carpospores. Abbreviations as in Figs. 2 and 3. Scale bars: (A) 60 μm, (B) 20 μm, (C) 15 μm, (D) 30 μm, (E) 50 μm, (F) 25 μm.

the blade's surface; stars formed by gonimoblasts do not fuse and are often surrounded with the gonimoblast ring (Fig. 1J). In *N. araneosa*, mature gonimoblasts are also very large and protrude over the blade's surface; the rays of stars fuse and form a specific web-like pattern. Species *N. valentinae* has the smallest gonimoblasts, arranged close to each other and submerged into the blade; stars are rare in this dense gonimoblast mass and consist of two to three(four) short rays of different length.

The three *Neoabbottiella* species also differ in the internal structure (Table 1). First, gonimoblasts of *N. valentinae* lack pericarp. Refractive cells occur very rarely and include only extended needle-shaped or dendroid-shaped cells. Unlike in *N. valentinae*, gonimoblasts of *N. araneosa* and *N. decipiens* usually have pericarp. These species differ in the sizes and shapes of gonimoblasts (i.e., they are rounded in *N. araneosa* and extended in *N. decipiens*) and in the frequency of occurrence of stellate refractive cells (see Key to the species of *Neoabbottiella*).

Finding of the two new species of *Neoabbottiella* does not extend the original geographic distribution of this genus, as they fall within the range of the type species distribution. Species *N. decipiens* is only found near the southeastern coast of Kamchatka, but *N. valentinaå* also occurs in the Peter the Great Bay (Sea of Japan) and does not differ much from the specimens found in Kamchatka.

The species of *Neoabbottiella* live under different ecological conditions. *N. valentinaå* is found only in the shallow waters, such as the intertidal zone with strong waving, middle intertidal, subtidal fringe and subtidal zones at the depths not exceeding 1 m. Species *N. decipiens* and *N. araneosa* are deep-water and distribute from 6–7 m to the lower horizons of the phytal zone, at the depth of 20 m or deeper.

Members of the genus *Neoabbottiella* have highly varied morphology. Sterile specimens are similar to the other blade-like red algae in the external morphology, but their internal structure is different (Tables 2 and 3). Tables 2–3 present the data collected by us and also

data by the other authors [1–4, 8, 17]. These data show that members of the genera *Opuntiella, Turnerella* and *Schizymenia* lack the refractive cells in the medullar layer, which are typical for *Neoabbottiella*, but they have glandular cells in their cortex, which are absent in *Neoabbottiella* (Table 2). *Neoabbottiella* also differs from *Hommersandia* with the smaller cells of the subcortex. Finally, it differs from *Beringià* and *Crossocarpus* in the shape of the medullar cells. Members of the genera *Neodilsea, Kallymeniopsis*, and *Velatocarpus* are very similar to *Neoabbottiella* species in vegetative anatomy, but they are distinctly different in reproductive structures (Table 3). Among the reproductive anatomy characters, the number and shape of female reproductive cells are the most important. The biggest number of cells composing the reproductive structures is found in *Neoabbottiella* (Table 3). As well, the genus *Neoabbottiella* differs from other blade-like red algal genera in the shape and pigmentation of carpospores and peculiar shape of cells forming cortical filaments. Members of this genus have shapeless granular carpospores, whereas in other blade-like red algal genera the carpospores are spherical and have dense homogenous content. The cortical cells of *Neoabbottiella*, especially apical and subapical, have thick cell walls and form chains of vertical filaments.

ACKNOWLEDGMENTS

We thank Drs. N.P. Sanamyan and K.E. Sanamyan (Kamchatka Branch of the Pacific Institute of Geography, FEB RAS) for collecting the deep-water specimens of *Neoabbottiella* used in this study. We honor the memory of Dr. L.P. Perestenko, who gave us the opportunity to examine *Neoabbottiella* specimens from the Komarov Botanical Institute herbarium. We also thank Dr. T.A. Klochkova (Kongju National University, South Korea) for her helpful comments and translation of the diagnoses.

REFERENCES

1. Vinogradova, K.L., About taxonomic position of *Neodilsea integra* (Dumontiaceae, Rhodophyta), *Bot. Zh.*, 1996, vol. 81, no. 1, pp. 103–109.
2. Zinova, A.D. and Gussarova, I.S., Members of the Genus *Kallymeniopsis* Perest. (Crossocarpaceae, Rhodophyta) near Urup and Simushir islands (Kuril Islands), *Nov. Sist. Nizshikh Rast.*, 1977, vol. 14, pp. 24–28.
3. Klochkova, N.G., *Flora vodoroslei-makrofitov Tatarskogo proliva i osobennosti ee formirovaniya* (The Marine Algae Flora of Tatar Strait (Sea of Japan) and History of Its Formation), Vladivostok: Dalnauka, 1996.
4. Klochkova, N.G., Korolyova, T.N., and Kusidi, A.E., *Atlas vodoroslei-makrofitov prikamchatskikh vod. T. 2. Krasnye vodorosli* (Marine Algae of Kamchatka and Surrounding Areas. Vol. 2. Red Algae), Petropavlovsk-Kamchatsky: KamchatNIRO, 2009.
5. Perestenko, L.P., Red algae of the Far Eastern seas of the USSR. Foliose cryptonemiacean algae (Order Cryptonemiales, Rhodophyta), *Bot. Zh.*, 1975, vol. 60, no. 12, pp. 1676–1689.
6. Perestenko, L.P., Some changes to the genera *Abbotia* Perest. and *Kallymeniopsis* Perest., Bot. Zh., 1977, vol. 62, no. 3, pp. 397–398.
7. Perestenko, L.P., *Neoabbottiella* Perest.—A new genus name, *Nov. Sist. Nizshikh Rast.*, 1982, vol. 19, p. 30.
8. Perestenko, L.P., *Krasnye vodorosli dal'nevostochnykh morei Rossii* (Red Algae of the Far Eastern Seas of Russia), Saint-Petersburg: Ol'ga, 1994.
9. Abbott, I.A., On *Abbotia* Perestenko, 1975 (Rhodophyta), *Taxon*, 1982, no. 31, pp.?300–302.
10. Chiang, Y.-M., Morphological studies of red algae of the family Cryptonemiaceae, *Univ. Calif. Publ. Bot.*, 1970, no. 58, pp. 1–83.
11. Guiry, M.D. and Guiry, G.M., AlgaeBase, World-wide electronic publication, National University of Ireland, Galway, 2012. http://www.algaebase.org
12. Hommersand, M.H. and Ott, D.W., Development of the carposporophyte of *Kallymenia reniformis* J. Ag., *J. Phycol.*, 1970, vol. 6, no. 4.
13. Kraft, G.T. and Robins, P.A., Is the order Cryptonemiales (Rhodophyta) defensible?, *Phycologia*, 1985, vol. 24, pp. 67–77.
14. Kraft, G.T. and Saunders, G.W., Bringing order to red algal families: taxonomists ask the jurists 'Who's in charge here?', *Phycologia*, 2000, vol. 39, pp. 358–361.
15. Kylin, H., *Die Gattungen der Rhodophyceen*, Lund: CWK Gleerups, 1956.
16. Lindstrom, S.C., Nomenclatural and taxonomic notes on *Dilsea* and *Neodilsea* (Dumontiaceae, Rhodophyta), *Taxon*, 1985, vol. 34, pp. 260–266.
17. Lindstrom, S.C., *Dilsea* and *Neodilsea, Biology of Economic Algae*, The Hague: Academic Publishing, 1994, pp. 77–94.
18. Masuda, M., Abe, T., Kawaguchi, S., and Phang, S.M., Taxonomic notes on marine algae from Malaysia I. Six species of Rhodophyta, *Bot. Mar.*, 1999, vol. 42, pp. 449–458.
19. Müller, F.J.H. von, *Fragmenta Phytographiae Australiae*, Melbourne, 1875, vol. 9.
20. Rafinesque, C.S., *New Flora and Botany of North America. Part I: Introduction, Lexicon, Monographs*, Philadelphia, 1836.
21. Saunders, G.W. and Kraft, G.T., Small-subunit rRNA gene sequences from representatives of selected families of the Gigartinales and Rhodymeniales (Rhodophyta). II. Recognition of the Halymeniales ord. nov., *Can. J. Bot.*, 1996, vol. 74, pp. 694–707.
22. Silva, P.S., Comments on the commentary by Kraft and Saunders [Phycologia 39: 258–261 (2000)], *Phycologia*, 2002, vol. 41, pp. 99–100.

Translated by N.V. Miroshnikova

SPELL: 1. Enoplida