Age variability in the shell of *Scaphander punctostriatus* (Mighels et C.B. Adams, 1842) (Gastropoda: Heterobranchia: Cephalaspidea) as revealed by specimens from the Russian part of the Barents Sea

Возрастная изменчивость раковины *Scaphander punctostriatus* (Mighels et C.B. Adams, 1842) (Gastropoda: Heterobranchia: Cephalaspidea) на примере экземпляров из российских вод Баренцева моря

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The shell sculpture and morphology of the radula and gizzard plates of juvenile specimens of *Scaphander punctostriatus* from the Russian part of the Barents Sea is described for the first time and compared with those of adult specimens; the shell morphology is discussed and illustrated for the first time.

Впервые приведена скульптура раковины и морфология радулы и жевательных пластинок ювенильных экземпляров *Scaphander punctostriatus* из российских вод Баренцева моря в сравнении с половозрелыми особями; форма раковины обсуждается и впервые иллюстрирована.

Key words: shell sculpture, morphology, ontogeny, Cephalaspidea, Scaphandridae, *Scaphander*

Ключевые слова: скульптура раковины, морфология, онтогенез, Cephalaspidea, Scaphandridae, *Scaphander*

INTRODUCTION

Age-specific changes in the shell shape and sculpture are well known among many molluscan taxa. The differences between the protoconch and the adult shells are widely used for taxonomic purposes. The changes between the different stages of teleoconch development are usually poorly known, whereas failure to take them into account may lead to dramatic misunderstandings (Sirenko, 1993). In opisthobranchs with involute shell, perceptible changes in both shape and sculpture of the teleoconch occur during ontogeny and represent a significant source of taxonomic errors, e.g., the cephalaspidean *Scaphander punctostriatus* Mighels et Adams, 1842 was mistakenly redescribed twice based on subadult specimens.

During a cruise in the southern part of the Barents Sea, occasional specimens with a minute *Cylichna*-like shell sculptured with spirally arranged micropits were found. A similar shell from the bathyal off the Faroe Islands was depicted by Ohnhenser and Malaquas (2013) as a philinid (*Philine* sp. 3: 319, Figs 32 A–C). The characters of both radula and gizzard plates observed in the specimen from the Barents Sea show that

it undoubtedly belongs to Scaphandridae. The aim of this communication is to describe the morphology of both the shell and the soft parts of this specimen.

MATERIAL AND METHODS

Four samples containing different-sized specimens of *Scaphander punctostriatus* from the Barents Sea were studied:

One juvenile specimen, shell height of 2.3 mm – 19.08.2007, 70°00′N 33°30′E, 146 m, silty substrate with stones, R/V Dalnie Zelentsy st. 2; 1 subadult specimen, shell height of 3.5 mm – 03.03.2007, Varangerfjorden 69°52′01′′N 31°49′48′′E, sand, stones, R/V Dalnie Zelentsy st. 18; 7 adult specimens with shell height of 29–33 mm – 12.07.1955, 68°25′N 38°29′E, 50 m, rocky substrate with shelly ground, R/V "Diana".

The material examined is stored in the collections of the Zoological Institute, Russian Academy of Sciences (ZIN) and in the private collection of the second author.

Scanning electron microscopy images (SEM) were taken using an FEI SEM Quanta-250. The radula and gizzard plates were examined using Leica DM LS2, Leica DME and (Zeiss) Opton light microscopes.

RESULTS

Order **CEPHALASPIDEA**

Family **SCAPHANDRIDAE**

Genus ***Scaphander*** Montfort, 1810

Scaphander punctostriatus
(Mighels et C.B. Adams, 1842)
(Figs 1a–i, 2a–j, 3a–e)

Bulla puncto-striata Mighels et Adams, 1842: 43, pl. 4, fig. 10.

Scaphander punctostriatus: Herzenstein, 1885: 706; Derjugin, 1915: 544; Golikov, 1987: 143–144; 1995: 57, fig. 139 A, B; Eilertsen & Malaquias, 2013a: 410–411, figs 3, 5–8, 9a–h, 10a–d (redescription and synonymy); 2013b: 515–525 (diet specialisation).

Adult specimens description. Shell oval with rounded periphery, with bright-coloured yellow or orange periostracum. Shell height of studied specimens up to 33 mm, but Eilertsen & Malaquias (2013a) refers to a maximum height of 41.2 mm. Spire submerged, apex not perforated. Aperture wide, upper edge of outer lip with rounded angle and located above the apex. Inner lip S-shaped, callus poorly marked, umbilicus absent. Spiral sculpture consists of elongated, usually unconnected micropits. Animal can withdraw into shell. Head shield large, without posterior lobes; parapodial lobes present.

Gizzard plates large, calcified; paired plates tetragonal, length of 8.5 mm and width of 6.8 mm; unpaired one very narrow, its height and width 6.8 and 5.6 mm, respectively for specimen with shell height 32 mm. Radula 21 x 1.1(0).1, brownish, lateral teeth large, with irregular edge without visible denticles; rachidian teeth thin, small, almost tetragonal with tapered edges, central part of anterior edge with visible irregular small denticles. Rachidians present only in posterior half of radular rows. Copulatory apparatus consisting of elongated penis sheath and prostate gland. Secular prostate connected with distal part of elongated penis sheath by relatively long duct. Internal structure of penis sheath consisting of numerous longitudal folds, most coarse of which enclosing seminal groove.

Juvenile specimen description. Shell cylindrical-oval, involute, semi-transparent, white, coloured periostracum not marked, height of 2.3 mm and width of 1.4 mm. Spire submerged, apex perforated. Aperture wide, upper edge of outer lip slightly towering over apex. Inner lip S-shaped; parietal callus and columelar fold absent; columellar umbilicus closed. Embryonic shell heterostrophic, consisting of little more than 1.5 whorls. Its surface having no visible sculpture under stereomicroscope. First definitive cylindrical whorl partly coverings protoconch and also lacking visible sculpture. Body whorl having fine spiral sculpture, latter consisting of 35 rows of irregularly shaped micropits; micropits being larger

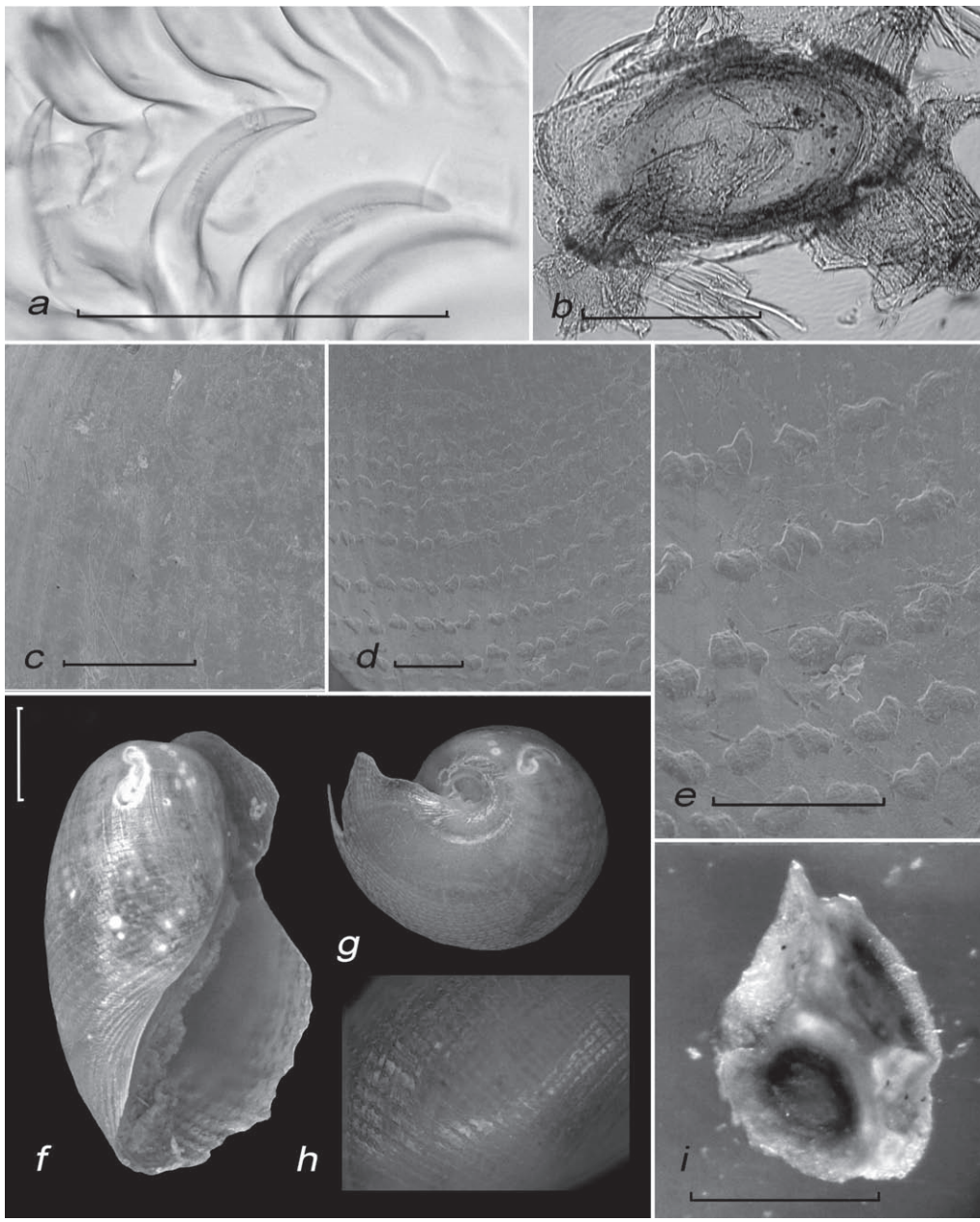

Fig. 1. *Scaphander punctostriatus*, juvenile specimen: radula, light microscope **(a),** unpaired gizzard plate, light microscope **(b),** shell sculpture, SEM (first definitive whorl – **c,** body whorl – **d, e**), shell, ventral view **(f)** apex **(g)**, spiral sculpture, light microscope **(h)**; gizzard with gizzard plates, light microscope **(i)**. Scale bar: 0.1 mm **(a, c–e)**, 0.25 mm **(b)**, 0.5 mm **(f, g–i)**.

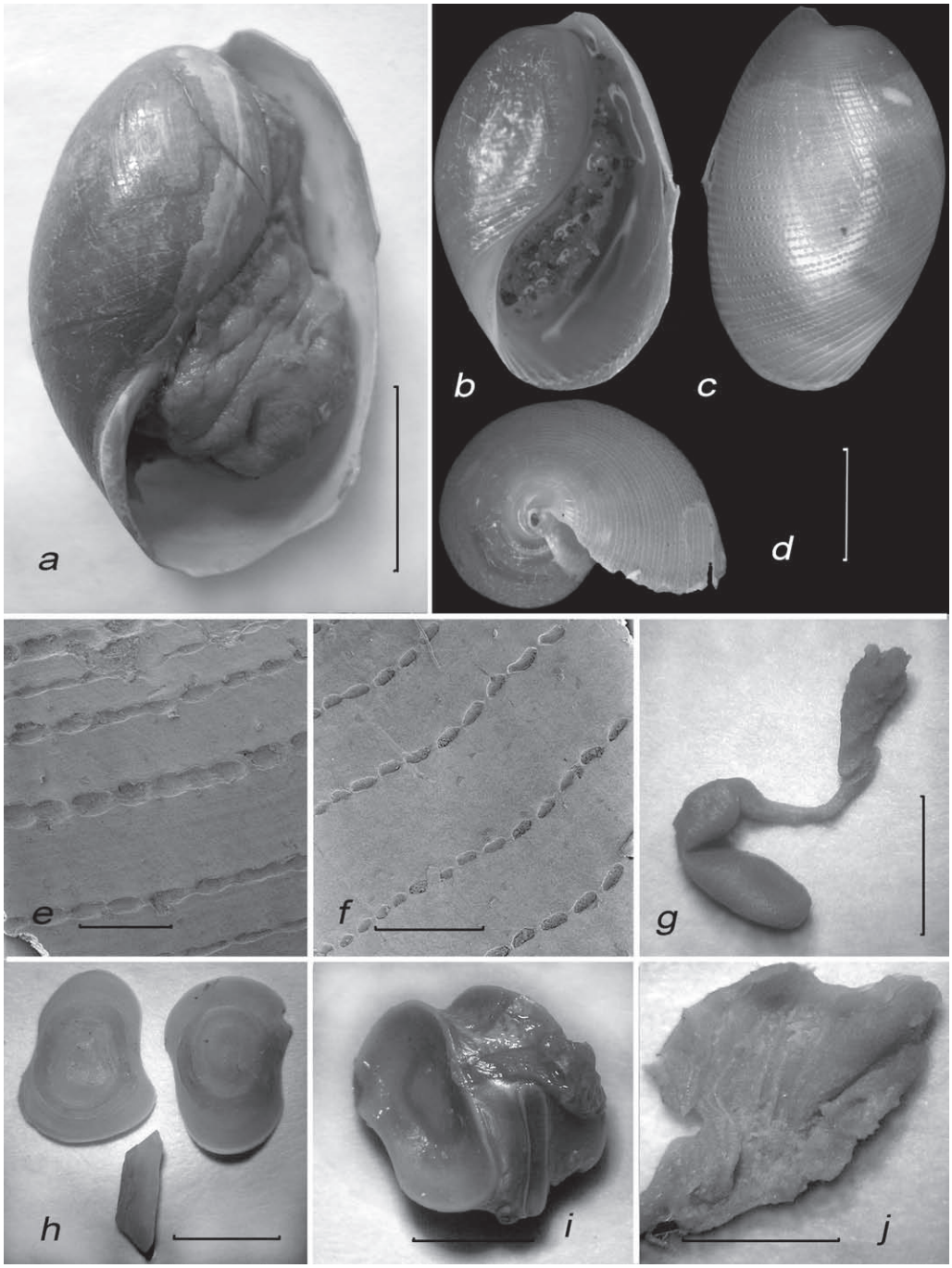

Fig. 2. *Scaphander punctostriatus*: **a, g–j,** adult specimen 32 mm high; **b–d,** subadult specimen 3.5 mm heigh; **e, f,** adult specimen 18 mm high. Shell, ventral view (a, b), dorsal view (c), apex (d), male copulatory system (g) with dissected penial sac (j), gizzard plates (h), gizzard (i). Scale bars: 10 mm (a), 1 mm (b–d), 0.3 mm (e, f), 5 mm (g–i), 2 mm (j).

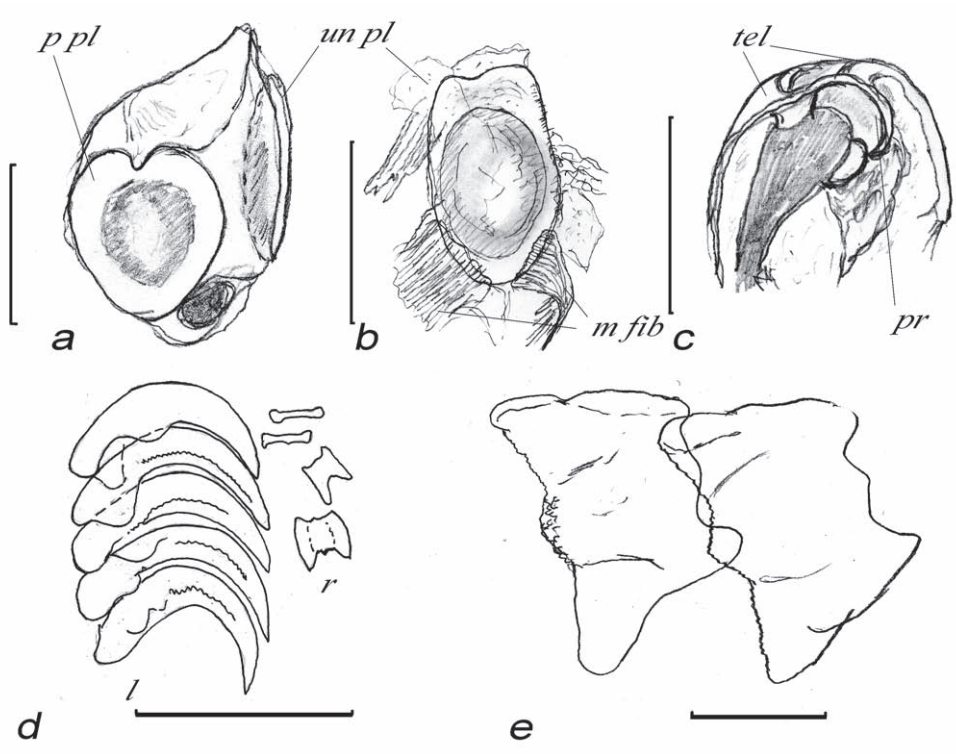

Fig. 3. *Scaphander punctostriatus*. Juvenile specimen: gizzard **(a)**, unpaired gizzard plate **(b)**, dissected posterior part of shell **(c)**, radula **(d);** adult specimen **(e)**; *l* – lateral teeth, *m fib* – muscular fiber, *p pl* – paired plate, *pr* – protoconch, *r* – rachidian teeth, *tel* – teleoconch, *un pl* – unpaired plate. Scale bars: 0.5 mm (a–c), 0.1 mm (d, e).

and more rounded on shell base and absent on apex.

Gizzard plates soft, corneous, internally concave. Plates brownish with darker central part. Unpaired plate narrow, scaphoid, length of 0.4 mm and 0.3 mm wide. Paired plates narrow heart-shaped, rounded, located slightly below unpaired one, length of 0.5 mm and 0.4 mm wide.

Radula 12 × 1.1(0).1, colourless, lateral teeth with 25–30 sharp regular denticles; rachidian teeth equally tetragonal with tapered edges, 6 teeth found.

DISCUSSION

Young specimens of *Scaphander punctostriatus* were described as *S. zonatus* Jeffreys, 1859 and *Cryptaxis crebripunctatus* Jeffreys, 1883 (Friele & Grieg, 1901; Lemche, 1948). Like the juvenile specimen described above, they also have a perforated apex and shell sculpture consisting of unconnected micropits (Jeffreys, 1859, 1883), but they are subadult form because the shell of *Cryptaxis crebripunctatus* was significantly larger (height of 5 mm) and the shells of both *Cryptaxis crebripunctatus* and *Scaphander zonatus* were oval as well as studied subadult and adult specimens of *Scaphander punctostriatus*. A small cylindrical shell identified as *Cryptaxis crebripunctatus* was observed by Norman (1890), but its internal morphology was not studied, and Norman considered it to be close to *Cylichna insculpta* (Totten, 1835). The difficulties with identification of juvenile specimens were caused by relatively

abrupt changes in the shell shape: the shell of *Scaphander punctostriatus* 2.3 mm high is cylindrical, whereas subadult specimens with shell height of 3.5 mm (Fig. 2b–d) and above have an oval shell with a narrow apex like that of the adult specimens. The sculpture changes significantly during ontogeny: the first definitive whorl lacks any sculpture (Fig. 1c), whereas the next whorl which covers the previous one (Figs 1d–e) has distinct spiral rows of micropits. The specimens depicted and described by Ohnheiser and Malaquias (2013: 319, figs 32a–c) as *Philine* sp. 3 with shell height 3.3 mm resemble the smallest specimen examined by us and most probably also belong to *Scaphander*.

Scaphander punctostriatus is the only species of this genus in the Russian Arctic seas. It was collected from Franz Joseph Land (Nekhaev, unpubl.), recorded from the Barents (Herzenstein, 1885; Derjugin, 1915; Golikov, 1995; Chaban, 2001; this study), White (Golikov, 1987; Chaban, 2001) and Kara (Lubin, 2003) seas. The shallowest known habitat of *S. punctostriatus* is at 16.5 m deep in Voronka of the White Sea (Golikov, 1987), and at 20 m in Kola Gulf off the Murman coast in the Barents Sea (Nekhaev, unpubl.), whereas in the west and south of its range this species occurs below 260 m (Eilertsen & Malaquias, 2013a). *Scaphander lignarius* (Linnaeus, 1758) was also reported for the Russian waters at least twice (Filatova & Zatsepin, 1948; Denisenko et al., 1993). Shell drawings of both *Scaphander punctostriatus* and *S. lignarius* were published by Filatova and Zatsepin (1948: Table CIII, figs 4, 5); both shells look like *S. lignarius*, but the description of the shell sculpture of both species correspond to *S. punctostriatus* (Filatova & Zatsepin, 1948: 393). Denisenko et al. (1993) included *S. lignarius* in a check-list for the Kara Sea. We could not locate any specimens of *S. lignarius* from Russian waters in museum collections and suggest that the presence of this species in the Russian fauna is doubtful.

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