A new subspecies of the bathyal sepiolid cephalopod *Neorossia caroli* (Joubin, 1902) from the southwestern Atlantic off the Falkland Islands

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ABSTRACT. A new subspecies of the bathyal cephalopod *Neorossia caroli jeannae* Nesis, Arkhipkin, Nikitina, Middleton et Brickle, ssp. nov. (Sepiolidae, Rossiinae) is described by six specimens, all mature females, with mantle length 50-60 mm, caught by bottom trawls in the southwestern Atlantic on the Patagonian slope north of Falkland Islands at depths of 474-670 m. It differs from the nominal subspecies by shorter fins and smaller nuchal cartilage. A review is given of the data on distribution and biology of sepiolid cuttlefish genus *Neorossia*.

The bathyal cephalopod genus *Neorossia* Boletzky, 1971 (Sepiolidae, Rossiinae) is the deepest-living sepiolid, characterized by total absence of an ink-sac and anal papillae — a unique feature among cuttlefishes (Sepiida) and clearly an adaptation to a deep benthic habitat. It consists of two species with very similar morphology: *N. caroli* (Joubin, 1902) and *N. leptodons* Reid, 1992.

In July 2000 seven specimens of *Neorossia* were caught with a bottom trawl on the Patagonian slope north of the Falkland Islands. One more specimen was found in the collections of Falkland Islands Fisheries Department, sampled in 1994. Investigation of these specimens has shown that they are very close to *N. caroli* but subspecifically different and should be described as a new subspecies.

Material and methods

Seven specimens (5 measured, dorsal mantle length (ML) 50-60 mm, Nos. 1-5 in the Table 1) were caught by the R/V *Dorada* at sta. 408, 28.07. 2000, time 10.26, 48°43.5' — 48°44.2'S, 59°49.5' — 59°42.5'W, depth 474-488 m, and brought ashore frozen. After preliminary examination they were fixed in formalin for 2 days, and then transferred to ethyl alcohol. One female, ML 50 mm was caught by EDKN *Heroya Primero*, at sta. 15, 05.11.1994, 50°47'S, 56°07'W, depth 670 m (No. 6 in the Table 1). The measurements and indexes,

as percentage of dorsal mantle length, were made according the diagram of Reid [1992, fig. 1]. Maturity was determined according the scheme of Arkhipkin [1992]. Data are compared with those for *N. caroli* and *N. leptodons* in Reid [1992] and presented in the Table 1.

Neorossia caroli **jeannae** Nesis, Arkhipkin, Nikitina, Middleton et Brickle, ssp.nov.

(Fig. 1 A-D)

Type specimens. Holotype: female, V maturity stage, ML 55 mm, R/V *Dorada*, sta. 408, 28.07.2000, time 10.26, 48°43.5′ — 48°44.2′S, 59°49.5′ — 59°42.5′W, depth 474-488 m: Zoological Museum, Moscow State University, No. Y-381. Paratypes: two females, V maturity stage, ML 60 and 50 mm, the same station, the same Museum, No. Y-382; three females, V maturity stage: ML 60 and 53 mm, the same station, ML 50 mm, EDKN *Heroya Primero*, St. 15, 05.11.1994, 50°47′S, 56°07′W, depth 670 m, Fisheries Department, Falkland Islands Government, Stanley, Falkland Islands, uncataloged.

Diagnosis. As *Neorossia caroli* but fin short {fin length index 43.0-48.6-54.0 (% of ML), fin length/width 1.1-1.3-1.5 against 57.0-72.1-89.1 and 1.4-1.8-2.6 in female *N. caroli caroli*, according to Reid [1992]}, and nuchal cartilage small (nuchal cartilage length index 12.0-14.3-17.0, width index 6.0-7.0-8.3 against 17.3-19.4-22.2 and 4.7-9.5-12.4 in female *N. caroli caroli*); the form of nuchal cartilage (approximately rectangular), its length-to-width relation (1.9-2.1-2.6), and radula as in *N. caroli caroli*.

[Диагноз. Как Neorossia caroli, но плавник короткий {индекс длины плавника 43,0-48,6-54,0 (% длины мантии), длина/ширина плавника 1,1-1,3-1,5 против 57,0-72,1-89,1 и 1,4-1,8-2,6 у самок N. caroli caroli по [Reid, 1992]} а затылочный хрящ маленький (индекс длины затылочного хряща 12,0-14,3-17,0, индекс ширины 6,0-7,0-8,3 против 17,3-19,4-22,2 и 4,7-9,5-12,4

Table 1. Measurements and indexes (% of dorsal mantle length) of Neorossia caroli jeannae from off the Falkland Islands and comparison with Neorossia caroli and N. leptodons.

Measurements and indexes	Neorossia caroli jeannae from off the Falkland Islands							Neorossia caroli	Neorossia leptodons
No., sex, stage	No. 1 Female V	No. 2 Female V	No. 3 Female V	No. 4 Female V	No. 5 Female V	No. 6 Female V	Females 50-60 mm, average	females, average ±SD [Reid, 1992]	females, average ±SD [Reid, 1992]
Mantle length, mm	60	55	50	60	53	50	54.7	46	44.4
Mantle width index	85.0	79.1	84.0	83.3	92.5	84.0	84.6±4.4	70.1±8.2	81.8±7.2
Head length index	81.7	78.2	72.0	83.3	83.0	70.0	78.0±5.8	67.0±7.5	72.0±7.5
Head width index	80.0	65.5	60.0	50.0	71.7	72.0	66.5±10.5	84.1±17.3	87.2±9.0
Eye diameter index	36.7	40.0	40.0	38.3	39.6	42.0	32.4±1.8	51.4±10.2	50.0±6.1
Nuchal cartilage length index	13.3	14.5	12.0	15.0	17.0	14.0	14.3±1.7	19.4±1.6	20.1±2.2
Nuchal cartilage width index	7.0	7.1	6.0	8.3	6.6	7.0	7.0±0.8	9.5±2.3	12.4±1.5
Nuchal cartilage length /width	1.90	2.05	2.0	1.81	2.57	2.00	2.06±0.3	2.2±0.7	1.6 ± 0.2
Funnel length index	47.5	52.7	43.0	48.3	52.8	48.0	48.7±3.7	49.3±5.1	48.2±12.5
Arm I length index	86.7	78.2	84.0	81.7	79.2	70.0	80.0±5.8	81.1±8.1	87.8±12.4
Arm II length index	93.3	89.1	92.0	95.0	98.1	78.0	90.9±7.0	97.1±10.7	94.9±8.9
Arm III length index	105.0	89.1	88.0	111.7	103.6	78.0	95.9±12.8	109.8±9.8	106.7±10.4
Arm IV length index	106.7	98.2	80.0	108.3	98.1	88.0	96.6±10.9	99.8±10.3	97.4±12.1
Tentacle length index	316.7	360.0	230.0	291.7	335.8	228.0	293.7±54.9	233.2±84.2	244.5±95.0
Club length index	46.7	54.5	42.0	43.3	52.8	38.0	46.2±6.4	61.4±13.9	65.2±13.2
Arm I sucker diameter index	3.5	3.1	3.2	3.2	3.6	4.0	3.4 ± 0.3	3.5±0.8	3.9±0.6
Arm II sucker diameter index	3.7	3.1	3.6	3.5	3.8	3.8	3.6 ± 0.3	3.9±0.9	4.5±0.7
Arm III sucker diameter index	3.7	3.3	3.6	3.7	3.6	3.4	3.6 ± 0.2	4.2±1.0	4.7±0.8
Arm IV sucker diameter index	3.5	2.9	3.2	3.2	3.2	4.0	3.3 ± 0.4	3.6±1.0	3.9 ± 0.6
Club sucker diameter index	1.0	1.3	1.2	1.2	1.1	1.2	1.17±0.1	0.84 ± 0.3	1.04±0.2
Fin position index	20.0	21.8	24.0	20.0	20.8	24.0	21.8±1.8	. 17.2±3.4	17.7±4.4
Fin insertion length index	45.0	43.6	40.0				42.9±2.6	59.4±7.0	62.2±7.8
Fin length index	48.3	49.1	43.0	48.3	49.1	54.0	48.6±3.5	72.1±10.7	$73.2{\pm}10.8$
Single fin width index	38.3	40.0	40.0	40.0	32.1	36.0	37.7±3.2	39.7±67.7	42.7±8.3
Single fin length/width	1.26	1.23	1.08	1.21	1.53	1.50	1.3±0.2	1.8±0.4	1.8±0.4
Both fin width with mantle index	146.7	150.9	130.0	163.3	152.8	138.0	147.0±11.7	138.2±14.5	154.1±25.0
Egg length, mm	8	8	10	9		9	8.8		
Nidamental gland length index	43.3	49.1	44.0			40.0	44.1±3.8	28.4±12.4	35.7±8.2

Characters differentiating Neorossia caroli jeannae from Neorossia caroli and N. leptodons are shown in bold.

у самок *N. caroli caroli)*; форма затылочного хряща (почти прямоугольная), отношение его длины к ширине (1,9-2, *I*-2,6) и строение радулы как у *N. caroli caroli*.]

Description of specimens. Mantle short, broad, rounded posteriorly, median antero-dorsal edge of mantle with low V-shaped projection, antero-ventral one with shallow crescentic emargination (Fig. 1 A-B). Dorsal edge of the mantle margin projects beyond the ventral edge. Skin is smooth. Fins rather small, round, fin length somewhat less than half ML, fin width approx. 40% ML, fin length/width approximately 1.25 or less. Fins are located between first and fourth quarters of mantle and anterior fin margin does not extent to the level of anterior mantle margin. Funnel long, conical, projecting anteriorly beyond the level of mid-eye. Funnel valve small, rounded. Dorsal funnel organ large, λ-shaped. Funnel locking cartilage a deep straight grove, mantle locking cartilage a straight narrow

ridge. Head longer than broad and narrower than mantle width. Eyes very large, bulbous. Nuchal locking cartilage (Fig. 1 C) approximately rectangular or rectangular-ovoid, not narrowed posteriorly, its width about half of its length. Buccal membrane with six lappets, without suckers. Arms short, robust, the first is shortest, others subequal. Arm suckers in two rows, those on II and III arms a bit larger than those on I and IV arms, their ring almost smooth. Tentacles very long, on average three times longer than mantle, narrow. Club (Fig. 1 D) approximately half ML with low swimming keel in proximal part. Club suckers small, about a third of the suckers on II-III arms, disposed in approximately 8-10 oblique rows, inner rings with blunt projections.

Ovary filled with large round or oval ambercolored eggs 8-10 mm in size. Nidamental glands long and wide. Accessory nidamental glands small,

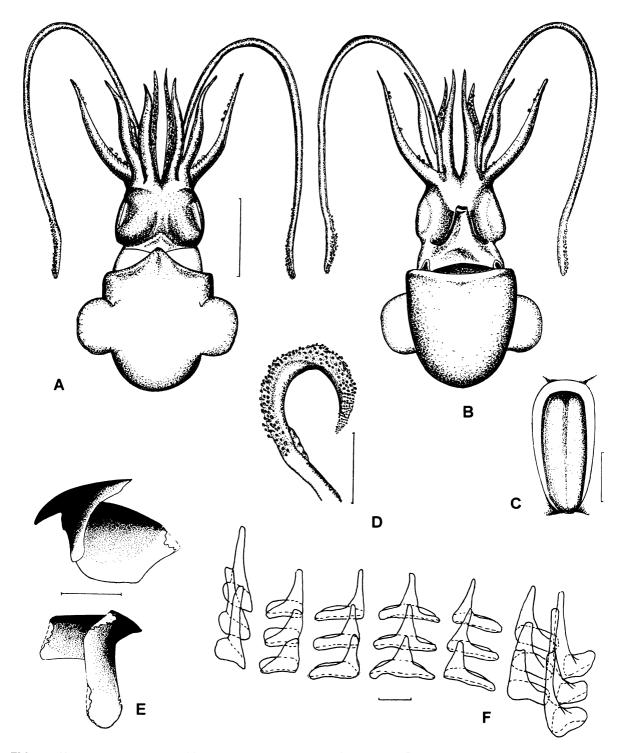


FIG. 1. Neorossia caroli jeannae Nesis, Arkhipkin, Nikitina, Middleton et Brickle, ssp.nov.

A-D — holotype, E-F — paratype, ML 60 mm. A — dorsal view; B — ventral view; C — nuchal cartilage;

D — tentacular club; E — upper and lower mandible; F — radula. Scale bar: A-B — 30 mm, C — 3 mm,

D — 10 mm, E — 5 mm, F — 0.2 mm.

РИС. 1. Neorossia caroli jeannae Nesis, Arkhipkin, Nikitina, Middleton et Brickle, ssp.nov. A-D — голотип, E-F — паратип, ML 60 мм. A — вид с дорсальной стороны; В — вид с вентральной стороны; С — затылочный хрящ; D — булава щупальца; Е — верхняя и нижняя мандибула; F — радула. Масштаб: A-B — 30 мм, C — 3 мм, D — 10 мм, E — 5 мм, F — 0,2 мм.

creamy. The females are mated and spermatophore ends projects from oviduct opening.

Beaks (Fig. 1 E). Both beaks with black rostrum, wide crest and smooth lateral walls. Upper beak with slightly curved rostral edge, jaw angle acute, shoulder with small obtuse protrusion, lateral wall edge with shallow indentation. Lower beak with almost straight rostral edge, rostrum slightly protruded, jaw angle obtuse, lateral wall edge without indentation, hood notch absent, wings almost straight, widely spread. In general beak is as in N. caroli [Reid, 1992]. Radula (Fig. 1 F) with seven transverse rows of teeth. Rachidian tooth very broad, stout, arrowhead-shaped, without cusps, base almost flat; first lateral tooth subtriangular, displaced toward midline, base wide and almost flat. The height of rachidian and first lateral teeth does not exceed their width. Second and third lateral teeth each with a long scythe-shaped blade, longer and more robust in third than in second lateral tooth. Base of second lateral tooth almost flat, of the third — rounded. Marginal plates absent.

Etymology. Named after Jeanna Scherbich, who created a good working atmosphere to the authors.

Discussion. Neorossia caroli and N. leptodons are very similar, they differ in fact only in the form of the radular teeth and nuchal cartilage. Reid [1992] also noted small differences in the height of the club keel and spermatophores but mentioned that "these differences are within the variation found within the two species" [p. 806]. Our specimens are more like Neorossia caroli than Neorossia leptodons in all differencial characters including the form of nuchal cartilage, not widened anteriorly, low club keel, and wide rhachidian and first lateral teeth.. They differ from Reid's description of N. caroli primarily in the smaller arm suckers (particularly on arm III), smaller eye, smaller nuchal cartilage, and shorter fins. The difference in arm suckers diameter is small and may be caused by the fact that most arm suckers of our specimens were lost and those measured (those that remained) may not be the largest. Smaller eye diameter may be the consequence of individual differences in the method of eye measurement.

The difference in the length of nuchal cartilage is important, while differences in its width is less important. Its form is much nearer to that in *N. caroli* than *N. leptodons*.

The difference in fin length is also important: fin length index in our specimens is on average 48.6 versus 72.1 in *N. caroli* according to Reid [1992], while fin width index is almost the same (37.7 and 39.7). As a result the fin length/width in our specimens is on average 1.17 versus 1.80 in *N. caroli* and *N. leptodons* and fin position index (distance between mantle margin and fin insertion) is 21.8 against 17.2 in *N. caroli* and 17.7 in *N. leptodons*, according to Reid. This character itself may be sufficient to describe a new subspecies (at least) but it should be noted that the form of fin is very variable. For example, the width of a single

fin in *N. caroli*, according to Reid [1992, table 23], is 39.7±67.7! Fin measurements of two specimens of N. caroli, published by Mangold-Wirz [1963 b, Tab. I], and measurement of fins on illustrations [Joubin, 1902 a, figs. 1, 2; 1920, pl. VIII, figs. 1, 2; Fischer, Joubin, 1906, pl. XXIV, figs. 3, 4; Roper et al., 1984: 76] indicated that in all these specimens the fins are intermediate in length between the figures given by Reid [1992] and ours: fin length index 47-59, average 54.3, fin length/width 1.13-1.63, average 1.38. The form of fin in the holotype (from the Azores Islands) and of the specimen from off Nova Scotia are particularly close to ours: measurement of the fin of the holotype on a rather bad photo in Joubin [1902 a, b], and on much clearer one in Joubin [1920], gave fin length/width ratios of 1.13 and 1.35 respectively. In the Nova Scotian specimen [Fischer, Joubin, 1906] the ratio is 1.21. Reid [1992] specifically mentioned small fin length in the holotype she re-investigated.

The radula of our paratype ML 60 mm differs from the radula of *N. caroli* in a wider rhachidian and first lateral teeth but these characters are variable.

In general the differences in both the nuchal cartilage size and fin length are sufficiently large that we are inclined to interpret the differences in meristic characters between our specimens and *N. caroli* as less than specific but more significant than individual variations. Thus we decide to nominate our specimens as belonging to a separate subspecies of *N. caroli*.

The genus Neorossia, its distribution and way of life. Neorossia caroli occurs in the North and East Atlantic: along Reykjanes Ridge southwest of Iceland ("Akademik Mstislav Keldysh", cruise 4, Sept. 8th, 1982, 58°21.7' - 58°22.0'N, 31°39.8' -31°41.0'W, Sigsbee trawl, depth 1550-1560 m, mature male ML 33 mm), the southern slope of the Great Newfoundland Bank and the slope off Nova Scotia [Chun, 1913; Joubin, 1924] and in a supposedly uninterrupted belt along eastern Atlantic coasts from southwestern Ireland (Porcupine Seabight) to South Africa, including the Azores Islands and the Mediterranean Sea, at depths from 40 to 1560 m (commonly deeper than 300-400 m), and in bottom temperatures of 5-14°C [Collins et al., 2001; Fischer, Joubin, 1906; Guerra, 1992; Joubin,1902 a, b, 1920; Massy, 1909; Nesis, 1987; Reid, 1992; Roeleveld, 1999; Roper et al., 1984]. In the Mediterranean Sea it is distributed from Spain to western Turkey from 119-200 to 1744 m, but usually deeper than 400 m, at bottom temperature 12.5-13°C [Bello, 1990; Boletzky, 1971; D'Onghia et al., 1993; Guerra, 1992; Joubin, 1920; Lumare, 1972; Mangold-Wirz, 1963 a, b; Salman et al., 1997; Sartor, Belcari, 1995; Villanueva, 1992, 1995]. Unfortunately, Aldrich et al. [1971] did not indicate where the specimen of N. caroli they studied was collected.

Dorsal mantle length (ML) in males is up to

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Новый подвид батиальной сепиолиды Neorossia caroli (Joubin, 1902) из юго-западной Атлантики у Фолклендских островов

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РЕЗЮМЕ. Новый подвид батиальной сепиолиды *Neorossia caroli jeannae* Nesis, Arkhipkin, Nikitina, Middleton et Brickle, ssp. nov. (Sepiolidae, Rossiinae) описан по 6 половозрелым самкам с длиной мантии 50-60 мм, добытым донными тралами на Патагонском склоне севернее Фолклендских о-вов, глубины 474-670 м. От номинотипического подвида отличается более короткими плавниками и меньшими размерами затылочного хряща. Дан обзор имеющихся в литературе сведений о распространении и образе жизни каракатиц-сепиолид рода *Neorossia*.