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The subgenus *Septenaria* Regenhardt, 1961 (Polychaeta: Serpulidae) from Lower Turonian (Upper Cretaceous) nearshore facies of the Bohemian Cretaceous Basin, Czech Republic

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Abstract. Six species of the subgenus *Septenaria* Regenhardt, 1961 from the genus *Pyrgopolon* de Montfort, 1808 (Polychaeta, Canalipalpata, Serpulidae) were recorded in the nearshore facies of the Bohemian Cretaceous Basin in the Kolín area. They include *Pyrgopolon* (*Septenaria*) *ziegleri* sp. nov.
Key words. *Pyrgopolon*, *Septenaria*, Serpulidae, nearshore facies, Bohemian Cretaceous Basin, Turonian.

INTRODUCTION

Fossil tubes of serpulid worms are frequent in nearshore facies deposits of the Bohemian Cretaceous Basin (hereafter 'BCB'). They were reviewed by Ziegler (1984). With more material at hand I present below a revision of BCB serpulid worms belonging to the subgenus *Septenaria* Regenhardt, 1961 of the genus *Pyrgopolon* de Montfort, 1808. Taxonomic identity of species incorrectly assigned by Ziegler (1984) to *Pyrgopolon* worms will be discussed elsewhere (Jäger & Kočí in prep.).

MATERIAL AND METHODS

I collected ca. 70 specimens of *Septenaria* worms during 2001-2009 at the Lower Turonian nearshore facies localities Velim, Kaňk, Vítězov, Chrtníky and Markovice, all lying in east-central Bohemia. These specimens are deposited in the private Kočí Collection and in NPM. In addition I studied *Septenaria* specimens in the National Museum in Prague (NMP; including those from the Václav Ziegler Collection), in the Polabské museum at Poděbrady (PMP), and in the private Vodrážka Collection. For preliminary reports on specimens from Velim and Kaňk see Kočí (2007, 2008, 2009).

Classification of serpulid worms follows Regenhardt (1961), Ziegler (1967, 1984), Jäger (1983, 2005) and Jäger & Breton (2002).

Class *Polychaeta* Grube, 1850

Order *Sabellida* Fauchald, 1977

Family *Serpulidae* Rafinesque, 1815

Genus *Pyrgopolon* de Montfort, 1808

Subgenus *Septenaria* Regenhardt, 1961

Type species: *Sclerostyla* (*Septenaria*) *septenaria* Regenhardt, 1961.

Description: The attached tube part is often well preserved and bears one longitudinal keel or a usually odd number of longitudinal edges or keels. The base of the tube lacks a cellular construction, but the tube wall usually shows the "*Favosites* structure", i.e. the interior of the lower half of the tube wall consists of many minute oblique-polygonal "tubes" with many transverse floors, closely resembling the Palaeozoic coral genus *Favosites*, but of much smaller size. At least in some species, tabulae occur occasionally (Jäger 1983). The erect tube part (if present) is more or less circular and usually bears 5, 7, 9 or more longitudinal ridges.

Occurrence: The subgenus *Septenaria* is most common in sediments with large hard substrates, such as belemnite guards, echinoid tests or oyster valves. It is less common, though not completely missing, if such substrates are rare or absent. It occurs predominantly in shallow marine environments, but also in moderately deep offshore areas of the chalk sea. In even deeper environments it is absent. It occurs in coarse-grained facies, chalk, limestones, marly limestones and calcareous marlstones. It is very rare or absent in claystones and clayey marlstones (Jäger, pers. comm.).

Remarks: The Late Cretaceous *Serpula triangularis* Münster in Goldfuss was referred to as *Pomatoceros triangularis* or *Propomatoceros triangularis* by Regenhardt (1961) and Ware (1975), but it belongs to the complex of *Neovermilia* ex gr. *ampullacea* (Sowerby) according to Jäger (2005). Specimens of this complex from the BCB were often incorrectly listed as *Serpula macropus* (Sowerby) (e.g. Geinitz 1875, Frič 1883). The latter species belongs to the subgenus *Septenaria.* The genus *Neovermilia* differs from the subgenus *Septenaria* in having more rounded and thinner-walled tube with an annular aperture, transversal ornament fine or absent and in lacking the "*Favosites* structure". Moreover, the cells at the tube's base are shorter in *Neovermilia ampullacea* than in the genera *Pyrgopolon* and *Pomatoceros*.

Hamulus hexagonus (Roemer) was reported by Ziegler (1984) from the BCB, but the specimen was not figured by Ziegler (1984) and I was not able to locate it in the NMP. Its taxonomic identity thus remains uncertain.

***Pyrgopolon* (*Septenaria*) *ares* (Ziegler, 1984)**

1984 *Pomatoceros ares* nov. spec. – Ziegler 1984: 230, pl. 4, figs. 7-8.

Material: Holotype only (NMP O 1734).

Occurrence: Velim.

Description: Tube triangular in cross-section, with a high, sharp and prominent longitudinal keel. The tube surface is smooth. Tube length 9.6 mm, height of tube with keel 4.8 mm, height of keel alone 2.2 mm, lumen diameter 2.7 mm, thickness of tube wall 0.7 mm. The anterior portion of the basis shows "*Favosites* structure" (see Jäger & Breton 2002).

Remarks: *Pyrgopolon* (*Septenaria*) *ares* (Ziegler) is characterized by its very high and sharp longitudinal keel which is more prominent than in most other specimens in that subgenus, although some specimens of *Pyrgopolon* (*Septenaria*) *macropus* (Sowerby) possess a high, sharp and prominent keel, too (see e.g. Jäger 2005; pl. 9, fig. 5a), but the erect free tube portion of *macropus* has a heptagonal cross-section (Jäger 1983; 2005; pl. 9, fig. 5b).

M. Jäger (pers. comm.) indicated that *Pyrgopolon* (*Septenaria*) *ares* (Ziegler) should be compared with *Pyrgopolon*? (*Septenaria*?) *iubata* (Regenhardt). I found that the two species differ in shape and cross-section of the tube and number and shape of longitudinal keel(s). Moreover, *Pyrgopolon*? (*Septenaria*?) *iubata* is smaller than *ares*.

***Pyrgopolon* (*Septenaria*) sp. A1**

(Figs. 1-2)

2007 *Pyrgopolon* sp. A1 – Kočí 2007: 110, fig. 2A.

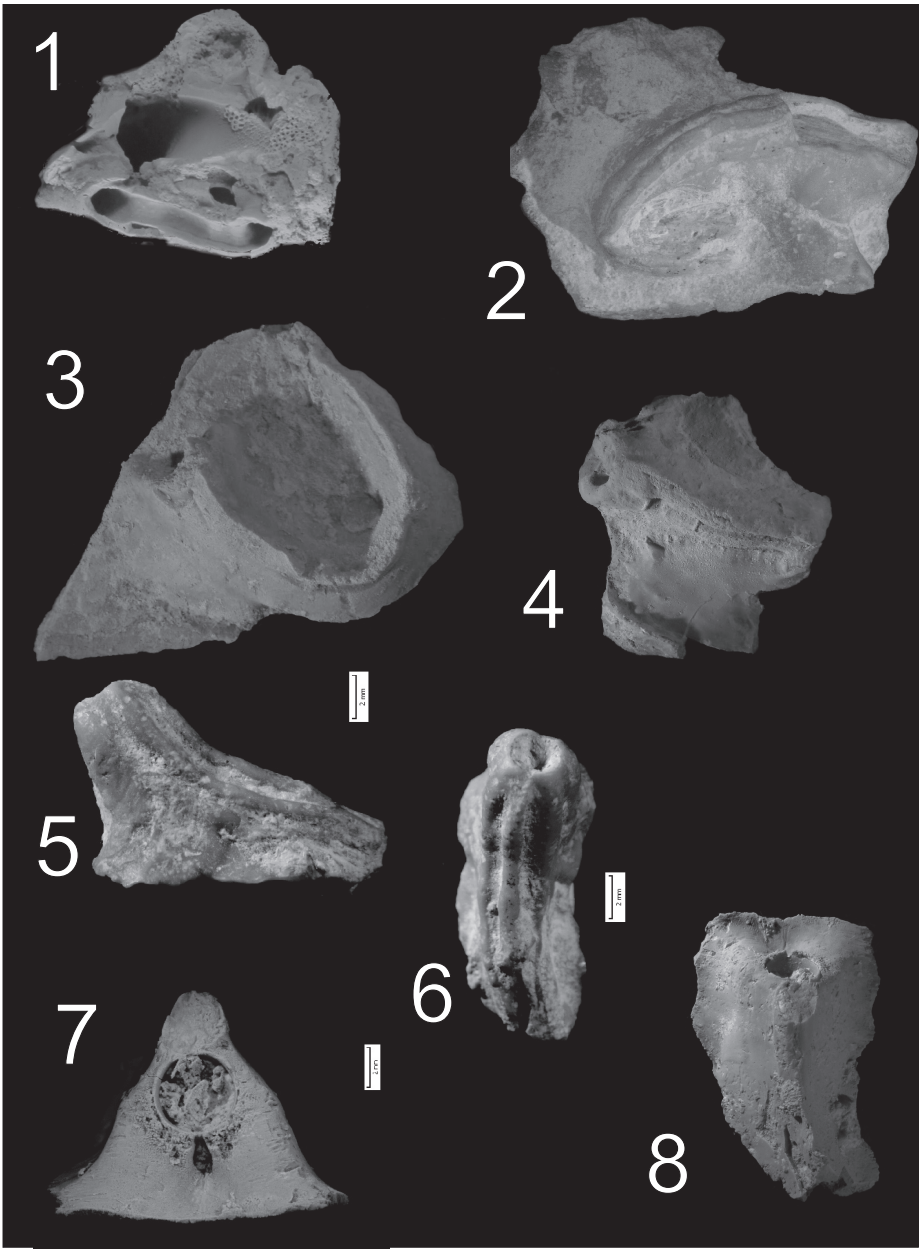
2008 *Pyrgopolon* sp. A1 – Kočí 2008: 227, fig. 8.

Material: One complete specimen attached to the rest of an oyster (*Ostrea* sp.). Another specimen consists of three tubes which are attached to their tubes. Deposited in the Kočí Collection.

Occurrence: Velim, western part of the quarry (pocket Veronika, Lower Turonian).

Description: First specimen: Tube triangular in cross-section, forming a loop, length 30 mm, width at base 10.6 mm. Lumen circular. The thickness of the tube wall is 1.1 mm. A strong, 1.4 mm wide longitudinal keel is well developed. On each side of this main keel there are smaller keels or fine but distinct longitudinal lines. The surface of the tube is smooth, without transversal ornament.

Second specimen: Tube triangular, height of the anterior tube part 6.9 mm, height of tube including longitudinal keel 11 mm. Width of lumen 4.4 mm and 4.8 mm, respectively. Width of longitudinal keel is 1.9 mm in the anterior tube part. Cellular layers are strongly developed. On each side of the main keel there are smaller keels or fine but distinct longitudinal lines all along the length of the tube. Note: The tubes are fixed to their tubes or small pebble, and the posterior parts of these tubes are in turn covered by the *Ostrea* valve. Tubes of a different serpulid, *Neovermilia* sp., are attached to this cluster. These *Neovermilia* tubes were either bored by undetermined borers or, more probably, infested by the symbiont *Protulophila gestroi* Rovereto. On the right side of one of the two tubes, near its anterior end, a third tube of *Pyrgopolon* (*Septenaria*) sp. A1 is attached. The anterior portion of this third specimen is attached to the posterior portion of the bigger one of the two tubes. The tube diameter of the third specimen is 4.4 mm in the anterior portion, and the thickness of the upper part is 2.4 mm.



Figs. 1–8. ***Pyrgopolon*** **(*Septenaria*) worms from the Upper Crertaceous of Bohemia.**
1 – sp. A1, anterior tube portion, with *Neovermilia* sp. attached to an oyster valve, Velim, western part of the quarry, × 2.9; 2 – sp. A1, dorsal view, Velim, western part of the quarry, × 3.1; 3 – sp. A2, dorsal view, Velim, eastern part of the quarry, × 1.9; 4 – sp. B, dorsal view, Velim, western part of the quarry, × 1.7; 5 – *P.* (*S.*) cf. *tricostata* (Goldfuss), lateral view, Kaňk – Na Vrších; 6 – *P.* (*S.*) cf. *tricostata* (Goldfuss), dorsal view, Kaňk – Na Vrších; 7 – *P.* (*S.*) *ziegleri* sp. nov., frontal view showing aperture, Kaňk – Na Vrších; 8 – *P.* (*S.*) *ziegleri* sp. nov., dorsal view, Kaňk – Na Vrších, × 4.5.

Remarks: *Pyrgopolon* (*Septenaria*) sp. A1 differs from *Pyrgopolon* (*Septenaria*) sp. A2 in having two additional small keels or longitudinal lines beside the round main keel. Moreover, the same remarks and relationships as given for *Pyrgopolon* (*Septenaria*) *ares* (see above) are valid also here.

***Pyrgopolon* (*Septenaria*) sp. A2**

(Fig. 3)

2007 *Pyrgopolon* sp. A2 – Kočí 2007: 111, fig. 2B.

2008 *Pyrgopolon* sp. A2 – Kočí 2008: 229, fig. 9.

Material: One complete specimen attached to the oyster "*Ostrea*" sp. Deposited in the Kočí Collection.

Occurrence: Velim, eastern part of the quarry.

Description: Tube triangular in cross-section, forming a loop. The posterior end is tapering, with a sharp apex. A fine narrow longitudinal keel is present. Width of the aperture at tube base is 8.8 mm. Lumen is circular, 2.8 mm in diameter. The cellular layers are strongly developed. The surface of the tube is smooth.

Remarks: This specimen differs from *Pyrgopolon* sp. A1 in having narrower keel and in the absence of additional smaller keels or longitudinal lines. Moreover, the same remarks and relationships as given for *Pyrgopolon* (*Septenaria*) *ares* (see above) are valid also here.

***Pyrgopolon* (*Septenaria*) sp. B**

(Fig. 4)

2007 *Pyrgopolon* sp. B – Kočí 2007: 111, figs. 1, 3, 4.

2008 *Pyrgopolon* sp. B – Kočí 2008: 230, fig. 10.

Material: One complete specimen attached to the oyster *Ostrea* sp. Deposited in Kočí Collection.

Occurrence: Velim, western part of quarry (pocket Václav, Lower Turonian).

Description: Tube tunnel-shaped in cross-section, less rounded, straight. A large longitudinal keel is present, which is 3.4 mm thick at the base and which is tapering to the end of the tube, where it is 2 mm thick. Beside the main keel there are developed two distinct lines or smaller keels, which are enlarging to anterior of the tube. The cellular layers are strongly developed. The "*Favosites* structure" is present (Jäger & Breton 2002) in the left side of the anterior part of the tube. Both sides of the tube and main keel were either bored by undetermined borers or infested by the symbiont *Protulophila gestroi* Rovereto. Two small oysters (*Ostrea* sp.) are attached to the right side of the anterior part. A third small oyster (*Ostrea* sp.) is attached to the left side of the posterior part.

Remarks: This specimen differs in the size and shape of the keel and the thickness of the tube wall from the three species described above and also from *Pyrgopolon*? (*Septenaria*?) *iubata* (Regenhardt, 1961) from France. Jäger (2005, personal communication) has no doubt that *Pyrgopolon* (*Septenaria*) sp. B belongs to the species group of *Pyrgopolon* (*Septenaria*) *ares/macropus.*

***Pyrgopolon* (*Septenaria*) cf. *tricostata* (Goldfuss)**

(Figs. 5-6)

pars 1910 *Burtinella* (?) *Reussi* m. – Weinzettl 1910: 23-24, pl. 3, figs. 48, 50; specimen NMP O 3536.

pars 1984 *Ditrupa subtorquata* (Münster). – Ziegler 1984: 238-239; specimen NMP O 5363. This specimen is not identical with the specimen figured on pl. 6, fig. 7.

1984 *Ditrupa tricostata* (Goldfuss). – Ziegler 1984: 239, pl. 6, figs. 8-9; specimens NMP O 5394-5395.

2008 *Pyrgopolon* cf. *tricostata* (Goldfuss) – Kočí 2008: 225, fig. 7.

2009 *Pyrgopolon* cf. *tricostata* (Goldfuss) – Kočí 2009: 98-100, figs. 5-6.

Material**:** One complete specimen, 30 anterior free tube portions, 4 incomplete anterior free tube portions and of the attached posterior tube portions, 26 tube rests. Deposited in Kočí Collection. Seven specimens from locality Kolín – Hvězdův lom (PMP 63118) and three specimens from locality Velim, which are deposited in the PMP. Two specimens described as *Ditrupa subtorquata* (Münster) from locality Hvězdův lom are deposited in the PMP.

Occurrence: Velim, Nová Ves u Kolína, Vítězov, Kolín – Hvězdův lom, Kaňk – Na Vrších, Markovice, Kamajka u Chotusic and Chrtníky.

Description: Posterior tube portion attached to the substrate; the cross-section of this part is triangular, and there is one median keel. Anterior tube portion erected freely with five rounded keels respectively four lobes and a very fine distinct median keel. Diameter of the anterior tube portion from 2.6 mm up to 6 mm (specimen from locality Velim). Lumen circular, 2.4 mm in diameter. A groove is present on the underside between the lower lateral lobes. A transversal ornament is not developed, the surface of the tube is smooth respectively.

Remarks: These specimens are very similar to *Pyrgopolon*? (*Septenaria*?) *iubata* (Regenhardt, 1961) from the Turonian of Troo, Loire-et-Cher, France, which has four rounded keels (lobes) and a very distinct keel. The cross-section is pentangular, there is no transversal ornament. The holotype differs from the Kaňk specimens in having larger median keel, and from Regenhardt's description it is clear that the anterior tube portion was still attached to the substrate, in contrast to the specimens from Kaňk, whose anterior tube portions are free and erect above the substrate. Moreover, the specimens from Kaňk do not belong to the typical species *tricostata* from the Cenomanian of Essen, Germany. Morphologically they belong in the subgenus *Septenaria* (see Jäger 1983, 2005, Jäger & Breton 2002). The specimen from Nová Ves near Kolín (NMP O 5391), which Ziegler (1984) described as *Ditrupa iubata* (Regenhardt), is not a serpulid at all. The specimen which according to its inventory number NMP O 5363 should be, but is not the specimen figured by Ziegler (1984) on his pl. 6, fig. 7 as *Ditrupa subtorquata* from Nová Ves, and also the specimens NMP O 5394 and O 5395 from Velim, determined by Ziegler (1984) as *Ditrupa tricostata*, are all very similar to the specimens from Kaňk and represent the same species, which is however neither *subtorquata* nor *tricostata*. Ziegler (1967, 1984) identified specimens from the BCB as *Ditrupa*, but this is a misinterpretation, because in contrast to *Ditrupa* the posterior tube portion is attached to the substrate, whereas the shape is similar to the genus *Pyrgopolon* and especially the subgenus *Septenaria.* The specimens labeled *Ditrupa*

subtorquata from the locality Kolín – Hvězdův lom belong to *Pyrgopolon* (*Septenaria*) *tricostata* (Goldfuss).

***Pyrgopolon* (*Septenaria*) *ziegleri* sp. nov.**

(Figs.7-8)

2008 *Pyrgopolon* sp. C – Kočí 2008: 232, fig. 11.

2009 *Pyrgopolon* sp. nov. – Kočí 2009: 100, figs 3-4.

Diagnosis: A relatively large species of the genus and subgenus. Fixed tube portion is straight and triangular in cross-section and bears a distinct wide median keel. Free erect tube portion is unknown. There is no longitudinal or transversal ornament.

Etymology: After Václav Ziegler, a famous expert on serpulid worms from the Bohemian Cretaceous Basin.

Holotype: Specimen NMP O 6832 (figs. 7-8).

Type locality: Kaňk – Na Vrších near Kutná Hora.

Type horizon: Lower Turonian, Bílá Hora Formation; the topmost portion of the eastern part of the type locality.

Material: One complete specimen. Two tube rests.

Description: The tube is large, smooth, triangular in cross-section. The tube width at the anterior end of the base is 13.2 mm, the tube height here is 12.6 mm. Towards the posterior, the tube is considerably narrower, and the height here is only 6.7 mm. Lumen circular, 3.96 mm in diameter. The lumen is situated in an eccentric position, near to the keel. Immediately below the aperture, there is a smaller high but narrow chamber measuring ca. 2 mm in diameter, and between that chamber and the tube's base there is a fine groove. Transversal ornament is not developed.

Remarks: This species includes the largest specimens of triangular cross-section in the BCB and is characterized by its shape and size. *Pyrgopolon* (*Septenaria*) *ares* (Ziegler) differs by the position of its lumen and by its narrower longitudinal keel. *Pyrgopolon* sp. A1, *Pyrgopolon* sp. A2 and *Pyrgopolon* sp. B from the nearshore locality Velim (Kočí 2007) differ by the position of the lumen and in part by their tube morphology. *Pyrgopolon* (*Septenaria*) *marechali* Jäger & Bréton from the Lower Cenomanian of Normandy, France, is even larger, and its tube is much more rounded. *Pyrgopolon* (*Septenaria*) *polyforata* (Jäger) differs by its special ornament. *Pyrgopolon* (*Septenaria*) *macropus* (Sowerby) has a pentagonal to heptagonal cross-section and a more prominent keel (Jäger 2005, pl. 9, fig. 5a). In *Pyrgopolon* (*Septenaria*) *macropus*, the posterior tube portion is attached to the substrate, and the anterior tube portion erects freely above the substrate. The same is seen in *Pyrgopolon* (*Septenaria*) *erecta* (Goldfuss), which is distinguished by its larger tube diameter which may reach 14 mm.

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