

A new Species of *Solenaiia* from Thailand (Bivalvia: Unionidae: Ambleminae)

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ABSTRACT.—*Solenaiia khwaenoiensis* n. sp. (Bivalvia: Unionidae) is described from The Khwae Noi River, Phitsanulok, Thailand. *Solenaiia khwaenoiensis* n. sp. has long razor-shell like shells similar to a former described *Solenaiia emarginatus* (Lea, 1860) from “Siam”. The new species possesses an elongate linguiform shell but the narrow anterior and wide posterior confers a unique razor shell shape. The umbo is located towards the anterior near the adductor muscle scar. *Solenaiia khwaenoiensis* exhibits distinct intrageneric differentiation in the diploid chromosome number ($2n=37$) but is uniform in haploid number ($n=19$), with 3 metacentric 15 submetacentric and 1 subtelocentric chromosomes.

KEY WORDS: *Solenaiia khwaenoiensis*; Unionidae; Khwae Noi River; Phitsanulok; Thailand.

INTRODUCTION

Classification at the species level for Southeast Asian unionid mussels is in urgent need of revision. On the basis of characters such as a semi-oval glochidial shell shape and marsupia in four demibranchs, Brandt (1974) included Thai unionids in the family Amblemidae Rafineque, 1820. However in the present classification, we have followed Graft's (2002) molecular analysis, which established that some Thai species come within the Unionidae.

Solenaiia khwaenoiensis was found in April 2003, in deep waters of the Khwae Noi River, Phitsanulok, Thailand (Fig. 1). Comparisons of shell and soft part morphology and karyotypes revealed that these specimens differ from all recognized 5 subfamilies of Thai Amblemidae i.e. Rectidentidae, Modellnaiinae, Pseudodontinae, Hyriopsinae and Parreysiinae. At subfamily level of *Solenaiia* is placed in the subfamily Ambleminae, we have followed the recent classification comments by Huang et al., (2002)'s molecular analysis.

GENUS *SOLENAIA* CONRAD, 1869

Solenaiia khwaenoiensis Panha and Deein n. sp.
(Fig. 2, 3)

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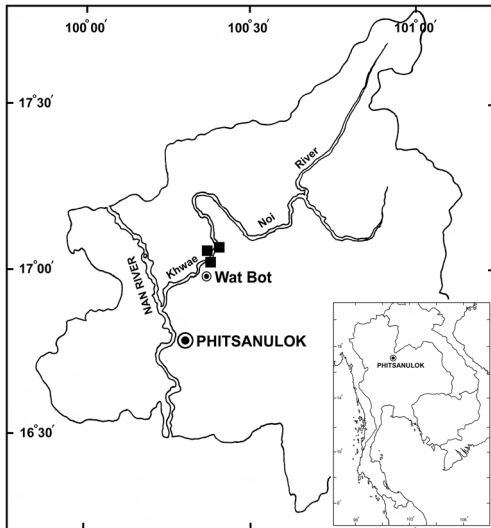


FIGURE 1. Map showing position of the Khwae Noi River area, Phitsanulok Province (dark squares).

Description of holotype.— Shell from anterior to posterior length 114.7 mm, 20.3 mm high (Table 1). Shell elongate, with razor-like

shape, thin, inflated, covered with greenish-brown periderm, which turns dark brown, or black in places but especially at posterior. The umbones (beaks) and many parts of shells are corroded. The muscle scars are large and for the thin shell they are comparatively deep.

Type locality.— Khwae Noi River at Ban Ta Ngam, Wat Bot District, Phitsanulok Province, 17° 00' 48.8'' N 100° 20' 09.8'' E (PRDC 10001), Thailand, 2003 (collected by Gridsada Deein and Mongkut Mensin).

Etymology.— The specific epithet, *khwaenoiensis*, is from the name of The Khwae Noi River, the locality of the new species.

Type material.— The holotype (PRDC 10001) is deposited in the Museum of Phitsanulok Inland Fisheries Research and Development Center, Inland Fisheries Research and Development Bureau, Department of Fisheries, Ministry of Agriculture and Cooperatives, Naraesuan Dam Area,

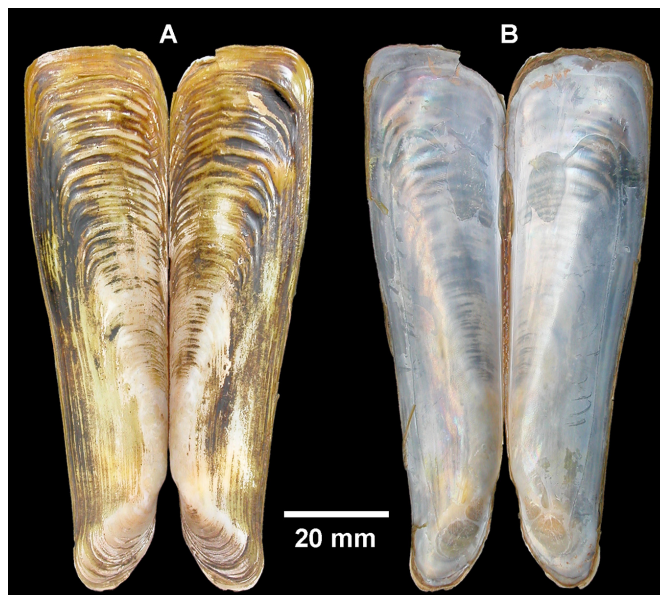


FIGURE 2. Shell of *Solenaiia khwaenoiensis* Panha and Deein, n. sp., holotype. A, outer shells; B, inner shell side.

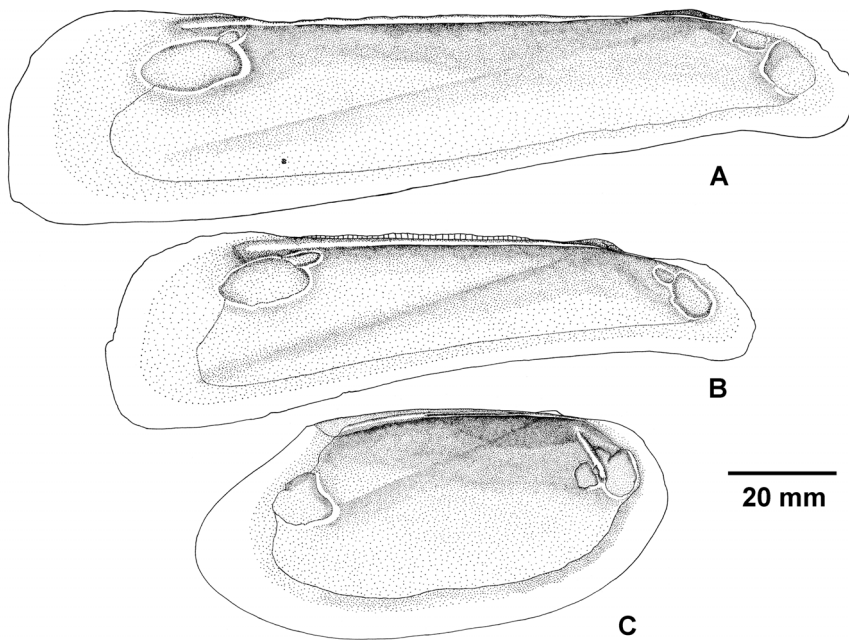


FIGURE 3. Left valves showing hinge characteristics of *Solenaia khwaenoiensis* Panha and Deecin, n. sp. (A), *Solenaia emarginatus* (Lea, 1860) (B) and *Pilsbryochoncha exilis exilis* (Lee, 1839) (C).

TABLE 1. Holotype and paratype shell dimensions of *Solenaia khwaenoiensis* n. sp.

Type	Dimension (in mm)		
	L	A	D
Holotype	114.7	20.3	14.8
Paratype			
1	139.0	21.7	18.8
2	145.5	22.1	21.2
3	143.5	23.0	19.9
4	133.4	20.1	18.4
5	132.6	20.3	16.4
6	140.3	21.7	19.1
7	129.6	21.3	13.6
8	134.5	21.1	18.0
9	121.0	19.4	18.4
10	133.4	20.8	19.4
11	140.5	20.7	18.6

Promptpiram District, Phitsanulok together with 30 other paratypes (PRDC 10002). An additional 40 paratype specimens (CUMZ 00744) are deposited in the Chulalongkorn University Zoological Museum in Bangkok.

Habitat and geographic distribution.—*Solenaia khwaenoiensis* occurs in deep-water on a mud latteritic substrate, or on fine to medium gravel interspersed with mud. It is currently known only from an approximately 4 kilometer range of the Khwae Noi River (Fig. 4) which exhibits moderate currents. This species often occurs in slow moving sloughs on mud gravel at depths from 10 to 12 meters in the rainy season (June to October). *Trapezoideus exolescens exolescens* (Gould, 1843), *Hyriopsis (Limnoscapha) myersiana* (Lea, 1856), *Chamberlainia hainesiana* (Lea, 1856), *Scabies crispata* (Gould, 1843), *Ensidents ingallsianus ingallsianus* (Lea, 1852) and *Pilsbryochoncha*

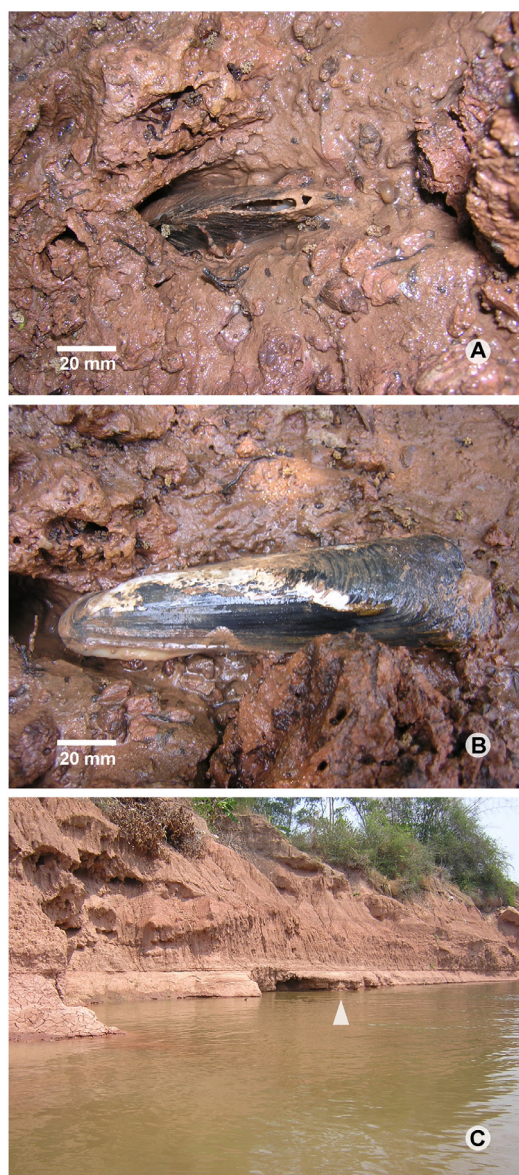


FIGURE 4. Pictures showing habitat and type locality at Ban Ta Ngam in March, 2004 of *Solenaia khwaenoiensis* Panha and Deenin, n. sp. A, B mussel in substrate; c, the locality, which the new species was collected (white arrow head).

exilis exilis (Lea, 1839) were also found in this habitat. Locally, it is consumed as food.

Karyotype.— The diploid chromosome number of the new species is 37; the haploid

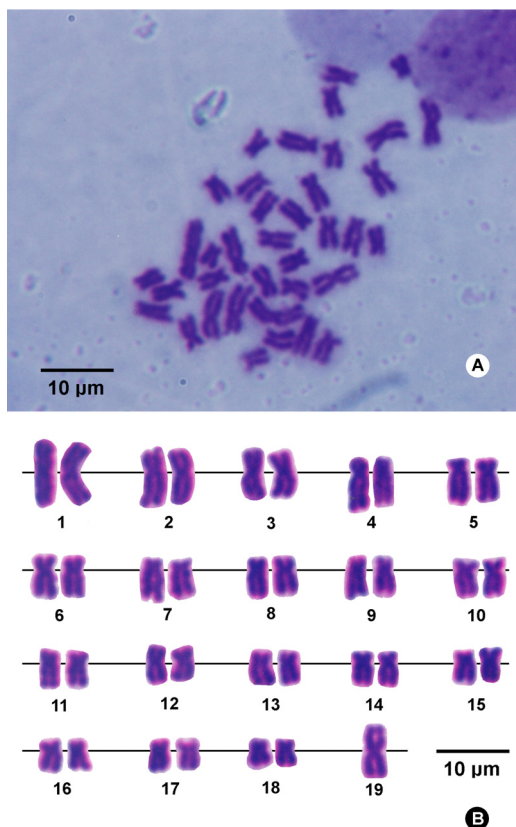


FIGURE 5. Gill metaphase chromosomes of *Solenaia khwaenoiensis* Panha and Deenin, n. sp. (A), and karyotype (B) from The Khwae Noi River (CUMZ 00744).

number is 19. The karyotypes are 3 pairs of metacentric (m), 15 pairs of submetacentric (sm) and 1 pair of subtelocentric (st) chromosomes (Fig. 5). The diploid chromosome numbers of unionid mussels as analyzed from many areas of the world are nearly always the same at 38 (Griethuysen et al., 1969; Nadamitsu and Kanai, 1975, 1978; Jenkinson, 1976; Vitturi et al., 1982; Park et al., 1988; Park and Kwon, 1991; Park and Burch, 1995; Meesukko, 1996). Apart from the new species, the one other exception is the diploid chromosome number of 32 in *Lasmigona complanata* (Barnes, 1823), reported in a study by Lillie (1901). The diploid chromosome number of our new species is different from that generally found in unionids.

Diagnosis.— Elongated razor clam-like shape is not equal throughout, the shell broadens gradually from a narrow anterior end to a wider posterior end. Anterior rounded; posterior truncated. The hinge is located close to the anterior end. Hinge ligament is long.

Remarks.— The shell of *Solenaiia khwaenoiensis* is superficially similar shell shape to *Solenaiia emarginatus* (Lea, 1860), but *S. emarginatus* has shorter shell, shell base incurved medially, a distinct oblique sulcus on the shell and a distinct lateral tooth-like character, while the new species possesses longer shell, shell base straight without oblique sulcus on the shell and indistinct lateral tooth character. Siam is the only recorded locality for *S. emarginatus*. In Chulalongkorn University Zoological Museum, some shell of *Solenaiia emarginatus* were recorded from The Noi River (Mae Nam Noi) in Karnchanaburi Province west of Thailand. The specimen described by Lea in 1860 as *Mycetopus emarginatus*, which later redescribed as *Solenaiia emarginatus* by Conrad in 1869, the type species of the genus *Solenaiia* (Preston, 1915). *S. emarginatus* should be collected from somewhere in the west while the new species was found in the north of Thailand. Shell shape of the new species is also superficially similar to that of the South American species *Mycetopoda soleniformis* (Orbigny, 1835), but the new Thai species exhibits other different features. For example *M. soleniformis* possesses a shell base incurved medially; nacre very dark and lasidium larvae. The new species possesses glochidium larvae, a straight shell base and the nacre are a combination of white yellow and pink. The new species lives in a very distinctive, deep water habitat characterised by a latteritic muddy substrate. On the basis of hinge teeth characteristics the genus *Pilsbryochoncha* looks closely related to *Solenaiia khwaenoiensis*, however the shell shape of the two species are very different, and molecular analyses placed the two genera in different subfamily. Interestingly, karyotypes of both species are identical i.e. 3 m, 15 sm and 1st. However,

while the new species shows a diploid chromosome number of 37. *P. exilis exilis* exhibits a diploid chromosome of 38, which is the usual diploid chromosome number of unionid mussels all over the world. This may be due to the unusual cytogenetic phenomena. Further studies are needed to critically investigate phylogenetic relationships in this group. Molecular phylogenetic analyses are particularly important in this respect, as they offer a way of overcoming the problems of homoplasy encountered when analysing morphological characters.

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LITERATURE CITED

- Brandt, R. A. M. 1974. The non marine aquatic Mollusca of Thailand. Archiv für Molluskenkunde 105: 1-423.
- Graft, D. 2002. Molecular phylogenetic analysis of two problematic freshwater genera (*Unio* and *Gonidea*) and a re-evaluation of the classification of Nearctic Unionidae (Bivalvia: Palaeoheterodonta: Unionoidea). Journal of Molluscan Studies 68: 65-71.

- Griethuysen, G. A. , B. van Kiauta and L. J. M. Butot. 1969. The chromosomes of *Anodonta anatina* (Linnaeus, 1758) and *Unio pictorum* (Linnaeus, 1758) (Mollusca: Bivalvia: Unionidae). *Basteria* 33: 51-56.
- Huang, Y., H. Liu, X. Wu and S. Ouyang. 2002. Testing the relationships of Chinese freshwater Unionidae (Bivalvia) based on analysis of partial mitochondrial 16S rRNA sequences. *Journal of Molluscan Studies* 68: 359-363.
- Jenkinson, J. J. 1976. Chromosome numbers of some north American naiads (Bivalvia: Unionacea). (Abstract). *Bulletin of the American Malacological Union, Inc.*, for 1976, pp. 16-17.
- Jenkinson, J.J. 1984. An analysis of naiad chromosome morphology (Bivalvia: Unionacea). (Abstract). *American Malacological Bulletin* 2: 86-87.
- Lillie, F.R. 1901. The organization of the egg of *Unio*, based of a study of its maturation, fertilization and cleavage. *Journal of Morphology* 17: 227-292.
- Meesukko, C. 1996. Karyotype of freshwater amblymid mussels in Yom and Nan watersheds. Thesis submitted for degree of Master of Science, Graduate School, Chulalongkorn University, Bangkok, Thailand (in Thai with English abstract).
- Nadamitsu, S. and T. Kanai. 1975. Chromosome of the freshwater pearl mussel *Margaritifera leavis* (Haas). *Bulletin of Hiroshima Women's University* 10: 1-3.
- Nadamitsu, S. and T. Kanai. 1978. On the chromosome of three species in two families of freshwater Bivalvia. *Bulletin of Hiroshima Women's University* 13: 1-5.
- Park, G. M., J. S. Lee, H. B. Song, J. C. Park and O. K. Kwon. 1988. Cytological studies of *Anodonta (Sianodonta) woodiana* (Paleoheterodonta: Unionidae) in Korea. *Korean Journal of Malacology* 7: 12-29.
- Park, G. M. and O. K. Kwon. 1991. Chromosome study of seven species of Unionidae (Bivalvia: Palaeoheterodonta) in Korea. *Korean Journal of Malacology* 7: 12-29.
- Park, G. M. and J. B. Burch. 1995. Karyotype analyses of six species of north American freshwater mussels (Bivalvia: Unionidae). *Malacological Review* 28: 43-61.
- Preston, H. B. 1915. Mollusca (Freshwater Gastropoda & Pelecypoda) In: *The Fauna of British India including Ceylon and Burma* (edited by A. E., Shipley and G. A. K., Marshall), Taylor and Francis, Calcutta.
- Vitturi, R., M. B. Rasotto and N. Farinella-Ferruzza, 1982. The chromosome of 16 molluscan species. *Bullitino di Zoologia* 49: 61-71.

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