

# First Record of Tri-spine Horseshoe Crab, *Tachypleus tridentatus* (Merostomata: Xiphosurida: Limulidae) from Korean Waters

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## ABSTRACT

A tri-spine horseshoe crab, *Tachypleus tridentatus* (Leach, 1819) was collected from a sandy beach of Udo Island of Jeju during the full moon tides in November 1997. Three spines on the posterior margin of the opisthosoma were characterized indicating that the specimen was *T. tridentatus*. This specimen was a female with the total length of 49.5 cm and prosoma width of 23.0 cm. *Tachypleus tridentatus* was the first record from Korean waters. A brief description and figures of the species were given. This finding indicates that Korea is included to the distribution range of the species.

**Keywords:** tri-spine horseshoe crab, *Tachypleus tridentatus*, Limulidae, Udo Island, Jeju, Korea

## INTRODUCTION

Horseshoe crabs have been known as “living fossils” because their fossil forms date as far back to 500 million years ago in the Paleozoic (Sekiguchi, 1988). There are four species (one American and three Asian species) in the world: *Limulus polyphemus* (Linnaeus, 1758) from North America to Mexico (Shuster, 1982), *Carcinoscorpius rotundicauda* (Latreille, 1802) from India to Philippines, *Tachypleus gigas* (Müller, 1785) from India to Malaysia, and *Tachypleus tridentatus* (Leach, 1819) from Malaysia to Japan (Sekiguchi and Nakamura, 1980). They have been collected for food in Hong Kong, Thailand, and Malaysia (Christianus and Saad, 2007; Shin et al., 2009) or for medical research (Nakamura et al., 1986). Tri-spine horseshoe crab, *T. tridentatus*, is currently classified as a red list of threatened species or data deficient (International Union for Conservation of Nature, 2014). Barnes (1974) showed in his book the range of this species along the Asian coasts from Japan and South Korea to the Philippines and East India. However, no references documenting the finding of this species from Korean waters have been found, nor were there any records of horseshoe crab

specimens from Korea available in the collections (The Korean Society of Systematic Zoology, 1997).

During a visit to the Folklore and Natural History Museum in Jeju Special Self-governing Province, a specimen of *T. tridentatus* was found from the arthropod collections of the museum in 1997, which was collected from the sandy beach of Udo Island of Jeju in Korea. The specimen was described here as the first record of the species from Korean waters. The classification follows that of World Register of Marine Species (WoRMS, 2014).

## SYSTEMATIC ACCOUNTS

Order Xiphosurida R. & E. Richter, 1924

Family Limulidae Leach, 1819

<sup>1</sup>\*Genus *Tachypleus* Leach, 1819

<sup>2</sup>\**Tachypleus tridentatus* (Leach, 1819) (Figs. 1, 2A, B)

*Limulus tridentatus* Leach, 1819: 537.

*Limulus longispina* Van der Hoeven, 1838: 32, pl. v.

*Tachypleus tridentatus*: Pocock, 1902: 263, pls. V, VI, fig.

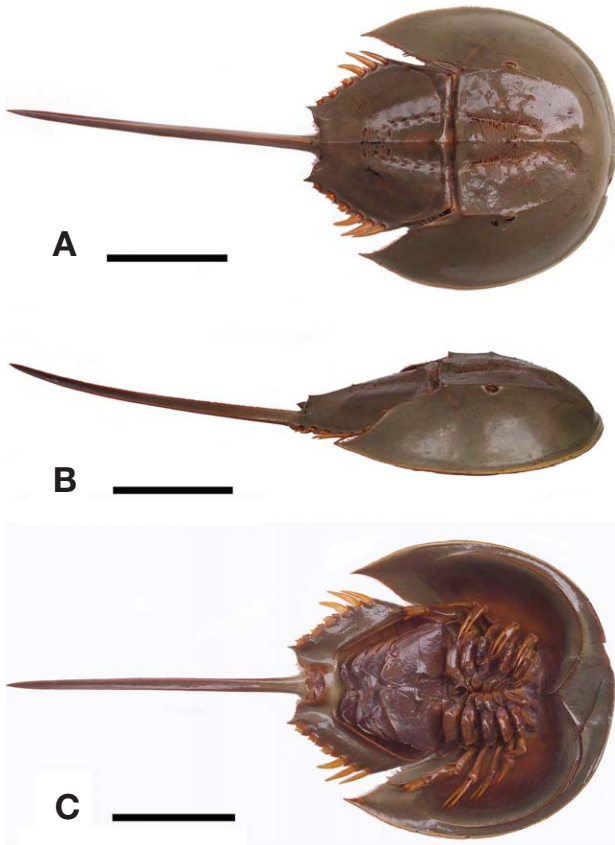
Korean name: <sup>1</sup>\*투구게속, <sup>2</sup>\*세가시투구게

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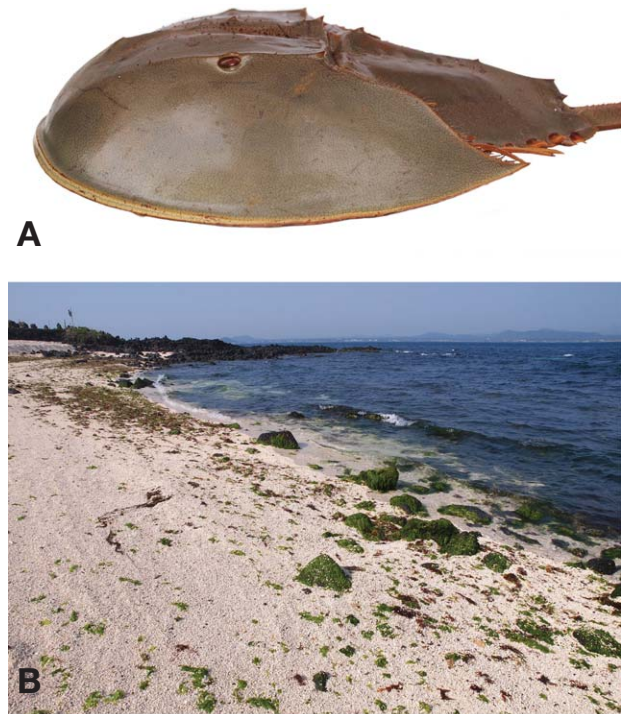


**Fig. 1.** *Tachypleus tridentatus* (Leach, 1819), female (total length 49.5 cm). A, Dorsal view; B, Lateral view; C, Ventral view. Scale bars: A–C=10 cm.

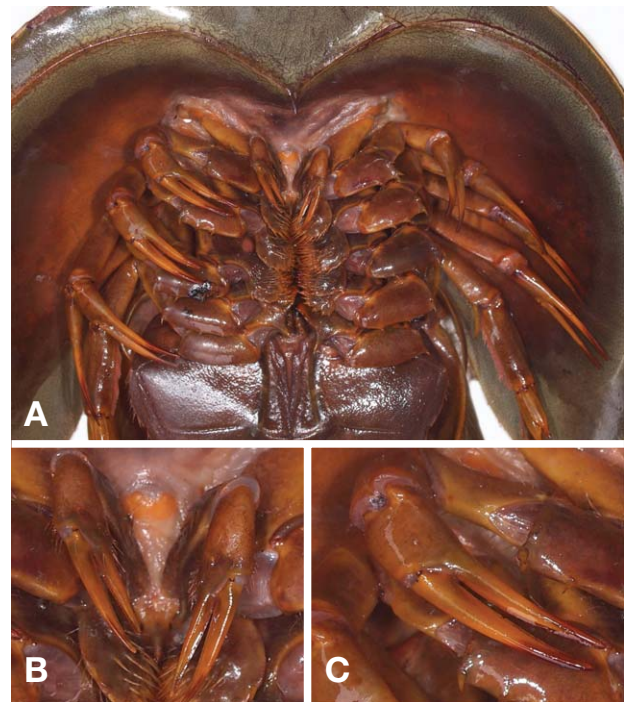
2E; Okada et al., 1981: 332; Nishimura, 1995: 8, pl. 73-1.

**Material examined.** 1 ♀ (total length 49.5 cm, prosoma length 14.3 cm and width 23.0 cm, telson length 25.1 cm, middle part of telson width 7.5 mm and height 8.0 mm), Udo Island (Jeju), 17 Nov 1997, Yang KC, on coarse sandy beach, 33° 30' 18.457''N, 126° 56' 29.808''E.

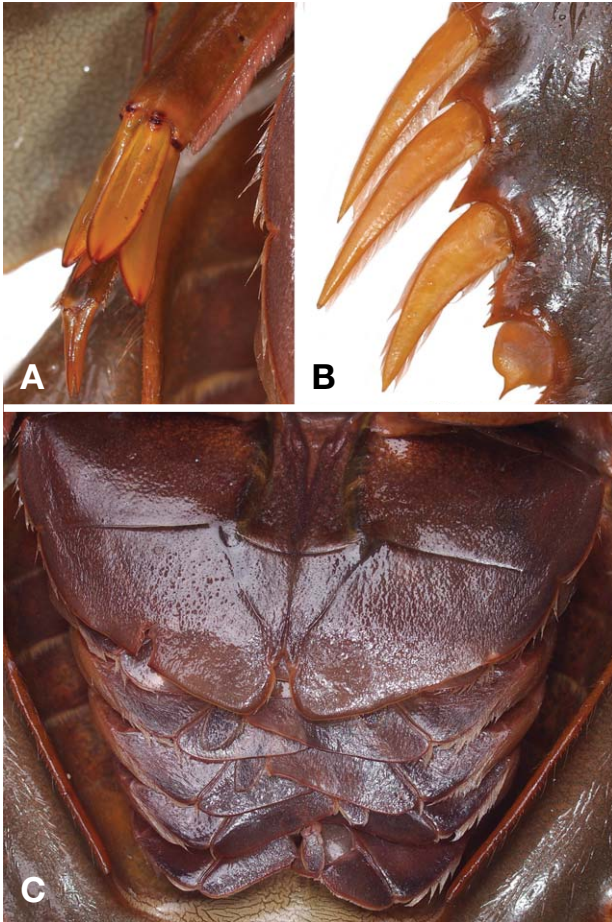
**Description.** Dorsal surface of prosoma smooth, convex, with posterior lateral angles prolonged backward approximately 1/2 length of opisthosoma; small median eye located anterior to each side of median ridge, compound eye located laterally to each lateral ridge (Figs. 1A, B, 2A). Prosoma concave ventrally; anterior dorsal surface reflected ventrally, forming triangular apex; 7 pairs of appendages present (Figs. 1C, 3A); first pair 3-segmented chelicerae (Figs. 1C, 3A, B); second pair pedipalps with chelate tips (Figs. 1C, 3A, C); third to sixth pairs 4 walking legs with chelate tips; last walking leg with movable spur distally on segment 4, with flat and strongly compressed segment 5, which longer than segment 6, with 4 leaf-like processes for pushing and sweeping



**Fig. 2.** A, Lateral view of prosoma of *Tachypleus tridentatus* (Leach, 1819), female (total length 49.5 cm); B, Collecting site of *T. tridentatus* in Udo Island.



**Fig. 3.** *Tachypleus tridentatus* (Leach, 1819), female (total length 49.5 cm). A, Ventral view of prosoma; B, Ventral view of chelicerae; C, Ventral view of pedipalp (right).



**Fig. 4.** *Tachypleus tridentatus* (Leach, 1819), female (total length 49.5 cm). A, Ventral view of last walking leg (right); B, Ventral view of spines on lateral margin of opisthosoma (right); C, Ventral view of opisthosoma.

away mud and silt during burrowing; seventh pair chilaria for food manipulation (Figs. 1C, 3A, 4A).

Opisthosoma unsegmented dorsally, hexagonal, with 6 small pits along 2 median furrows; lateral margin with 3 movable spines (Fig. 1A): first spine slender and straight, second spine longest, third spine shortest and curved slightly (Figs. 1A, C, 4B); 3 small spines present on posterior margin (Figs. 1A, 2A). Opisthosoma with 6 pairs of appendages ventrally; first pair biramous genital operculum covering gonophores, inner ramous not reaching to tip of distal segment of outer ramous; last 5 pairs of appendages modified as biramous flap-like appendage (book gills) (Figs. 1C, 4C).

Telson long, triangulate in cross section of middle part, crested above, slightly concave below (Fig. 1).

**Color.** Prosoma, opisthosoma, and telson glossy greenish brown. Lateral spines of opisthosoma pale brown. Eyes black.

**Habitat.** This species hibernates on sandy to muddy bottoms

in a depth of approximately 20 m in winter and migrates to the spawning beaches at night in the spring or summer (Sekiguchi, 1988; Nishimura, 1995).

**Distribution.** Malaysia, southwestern part of the Philippines, Taiwan, western part of Japan (Sekiguchi and Nakamura, 1980), and now Udo Island of Korea (Fig. 2B).

**Remarks.** Three Asian horseshoe crabs (*Carcinoscorpius rotundicauda*, *Tachypleus gigas*, and *T. tridentatus*) can be easily distinguished by the morphology of the cross section in the telson. It is triangular in two *Tachypleus* species (vs. circular in *Carcinoscorpius*) (Lazarus et al., 1990). In the triangular telson the width is subequal to the height in *T. tridentatus* (vs. shorter than the height in *Tachypleus gigas*) (Shuster, 2014). Also, based on the key of Pocock (1902), this present specimen can be identified as *T. tridentatus* by having the posterior margin of opisthosoma armed with three spines dorsally (Fig. 2A). It is female, with a pedipalp terminating with a chelate tip (Fig. 3C) and an opisthosoma bearing three movable spines on the lateral margin (Figs. 1, 4B), whereas in male, the former is not chelate and the latter has six spines instead of three. Although the specimen described here (prosoma width 23.0 cm) is slightly smaller than the females (mean prosoma width 27.6 cm) reported from Japan by Wada et al. (2010), it seems to be an adult.

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## REFERENCES

- Barnes RD, 1974. Invertebrate zoology. 3rd ed. Saunders, Philadelphia, PA, pp. 452-454.
- Christianus A, Saad CR, 2007. Horseshoe crabs in Malaysia and the world. Fishery Mail, 16:8-9.
- International Union for Conservation of Nature (IUCN), 2014. Red List of Threatened Species. *Tachypleus tridentatus* [Internet]. IUCN, Cambridge, Accessed 21 Oct 2014, <<http://www.iucnredlist.org/details/21309/0>>.
- Latreille PA, 1802. Histoire naturelle, générale et particulière des crustacés et des insectes: ouvrage faisant suite aux oeuvres de Leclerc de Buffon, et Partie du Cours Complet d'Histoire Naturelle Rédigé par C.S. Sonnini. F. Dufart, Paris, pp. 1-20.
- Lazarus S, Nammalwar P, Pillai VN, Devadoss P, Mohanraj G, 1990. Occurrence of king crab, *Tachypleus gigas* (Müller), off the northeast coast of India. In: Proceedings of the First Workshop on Scientific Results of FORV Sagar Sampada,

- 1989 Jun 5–7, Kochi, pp. 393-395.
- Leach WE, 1819. Entomostraca. Dictionnaire des Sciences Naturelles. Vol. 14. Levrault and Schoell, Paris, pp. 1-537.
- Linnaeus C, 1758. Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima, reformata. Laurentius Salvius, Holmiae, pp. 1-824.
- Müller OF, 1785. Entomostraca seu insecta testacea, quae in aquis Daniae et Norvegiae reperit, descripsit et iconibus illustravit Otho Fridericus Müller. F.W. Thiele, Lipsiae & Havniae, pp. 1-134.
- Nakamura T, Horiuchi T, Morita, T, Iwanaga S, 1986. Purification and properties of intracellular clotting factor, factor B, from horseshoe crab (*Tachypleus tridentatus*) hemocytes. Journal of Biochemistry, 99:847-857.
- Nishimura S, 1995. Guide to seashore animals of Japan with color. Pictures and keys. Vol. II. Hoikusha Publishing Company, Tokyo, pp. 1-663.
- Okada K, Uchida S, Uchida T, 1981. New illustrated encyclopedia of the fauna of Japan. Vol. 2. Hokuryu-kan Publishing Co., Ltd., Tokyo, pp. 1-469.
- Pocock RI, 1902. XLII. The taxonomy of recent species of *Limulus*. The Annals and Magazine of Natural History, 9: 256-266.
- Sekiguchi K, 1988. Biology of horseshoe crabs. Science House, Tokyo, pp. 1-428.
- Sekiguchi K, Nakamura T, 1980. Sympatric distribution pattern of three species of Asian horseshoe crabs. Proceedings of Japanese Society of Systematic Zoology, 18:1-4.
- Shin P, Li HY, Cheung SG, 2009. Horseshoe crabs in Hong Kong: current population status and human exploitation. In: Biology and conservation of horseshoe crabs (Eds., Tanacredi JT, Botton ML, Smith DR, Earle SA). Springer Science and Business Media, Heidelberg, pp. 347-360
- Shuster CN Jr, 1982. A pictorial review of the natural history and ecology of the horseshoe crab, *Limulus polyphemus*, with reference to other Limulidae. In: Physiology and biology of horseshoe crabs: studies on normal and environmentally stressed animals (Eds., Bonaventura J, Bonaventura C, Tesh S). Alan R. Liss, Inc., New York, pp. 1-52.
- Shuster CN Jr, 2014. The Amazing Horseshoe [Internet]. The Horseshoe Crab, Dover, DE, Accessed 21 Oct 2014, <<http://www.horseshoecrab.org/nh/species.html>>.
- The Korean Society of Systematic Zoology, 1997. List of animals in Korea (excluding insects). Academy Publishing Company, Seoul, pp. 1-489.
- Van der Hoeven, 1838. Recherches sur l'histoire naturelle et l'anatomie des *Limulus*. Nabu Press, Paris, pp. 1-48.
- Wada T, Itaya S, Shuuno M, 2010. Spawning sites and annual variability of the number of reproductive visiting pairs of the horseshoe crab *Tachypleus tridentatus* along the Tsuyazaki Coast in Fukuoka, Japan. Japanese Journal of Conservation Ecology, 15:163-171.
- World Register of Marine Species (WoRMS), 2014. *Tachypleus tridentatus* (Leach, 1819) [Internet]. WoRMS, Accessed 21 Oct 2014, <<http://www.marinespecies.org/aphia.php?p=taxdetails&id=238270>>.

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