

## *Lagocephalus wheeleri* Abe, Tabeta & Kitahama, 1984, a Junior Synonym of *Tetrodon spadiceus* Richardson, 1845 (Actinopterygii, Tetraodontiformes, Tetraodontidae)

**Keiichi Matsuura**

Collection Center, National Museum of Nature and Science,  
3–23–1 Hyakunin-cho, Shinjuku-ku, Tokyo 169–0073, Japan  
E-mail: matsuura@kahaku.go.jp

**Abstract.** Examinations of 43 specimens of the puffer genus *Lagocephalus* including the type specimens of *L. wheeleri* Abe, Tabeta & Kitahama, 1984 and *Tetrodon spadiceus* Richardson, 1845 (= *L. spadiceus*) revealed that these two nominal species are not separable, thereby *L. wheeleri* is a junior synonym of *T. spadiceus*. *Lagocephalus spadiceus* has been recorded from seas in Southeast Asia including the west coast of the Malay Peninsula northward to Japan and eastward to northern Australia. This species is distinguished from the other species of *Lagocephalus* by the following combination of the characters: a rhomboidal- or elliptical-shaped spinule patch that precedes, but does not reach, the dorsal-fin origin; caudal fin slightly concave; dorsal-fin rays 11–14 (usually 12 or 13), anal-fin rays 10–12 (usually 11), pectoral-fin rays 14–17 (usually 15 or 16); vertebrae 19 or 20; dorsal half of body light brown to light gray with greenish yellow tinge; no black spots; caudal fin yellowish brown or tan on dorsal three-fourths with ventral one-fourth white, and dorsal and ventral tips of the fin white.

**Key words:** Tetraodontidae, puffers, *Lagocephalus wheeleri*, *Tetrodon spadiceus*.

### Introduction

Puffers of the genus *Lagocephalus* are widely distributed in the warm waters of the world (Kyushin *et al.*, 1982; Dor, 1984; Sainsbury *et al.*, 1985; Smith & Heemstra, 1986; Mohsin & Ambako, 1996; Matsuura, 1997, 2001). They are easily distinguished from puffers of other tetraodontid genera by having the following combination of characters: a wide, silver-white band coursing longitudinally on the side ventral to the level of the eye from the snout to the caudal-fin base; a longitudinal skin fold extending on the ventro-lateral corner of the body from the chin to the ventral part of the caudal peduncle; the lateral lines divided into ventral and lateral elements, the ventral element coursing along the skin fold and the lateral element extending along the mid-lateral side of the body from the region dorsal to the gill opening to the caudal-fin base with the

anterior extension coursing from ventral to the eye to the snout region; and two openings in the nasal organ (Matsuura, 2001). Although the genus *Lagocephalus* has been well recognized by many authors (Ship, 1974; Smith & Heemstra, 1986; Randall, 1995; Matsuura, 1997, 2001; Yamada, 2002), classification at the species level in *Lagocephalus* has not yet been studied in depth, causing confusion in the status of several species including *L. spadiceus* (Richardson, 1845), *L. cheesemani* (Clarke, 1897), *L. guntheri* (Miranda Ribeiro, 1915) and *L. wheeleri* (Abe, Takita & Kitahama, 1983). Although my revisional study on *Lagocephalus* is still in an early stage, examination of many specimens of the genus collected from Japan and the seas in South East Asia enable me to conclude that *Lagocephalus wheeleri* (Abe, Takita & Kitahama, 1984) is a junior synonym of *Tetrodon spadiceus* Richardson, 1845.

### Materials and Methods

Specimens used in this study are deposited in the following museums and universities: Fish Section, Natural History Museum, London (BMNH); Kanagawa Prefectural Museum of Natural History, Odawara (KPM); Division of Fisheries Sciences, Faculty of Agriculture, Miyazaki University, Miyazaki (MUFS); Fish Division, National Museum of Nature and Science, Tokyo (NSMT); Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC); Department of Zoology, University Museum, University of Tokyo, Tokyo (ZUMT). Counts and measurements follow Dekkers (1975). Measurements were made with calipers to the nearest 0.1 mm. Data for the paratype of *Lagocephalus wheeleri* (SMF 19427, Senckenberg Forschungsinstitut und Naturmuseum, Abteilung Marine Zoologie, Sektion Ichthyologie, Frankfurt am Main, Hessen, Germany) was

taken from Abe *et al.* (1984).

### *Lagocephalus spadiceus* (Richardson, 1845)

[Japanese name: Shiro-sabafugu]

(Figs. 1–2)

*Tetrodon spadiceus* Richardson, 1845: 123, pl. 58 (figs. 4–5).

*Tetrodon lunaris* var. *spadiceus*: Günther, 1870: 275.

*Lagocephalus wheeleri* Abe, Tabeta & Kitahama: 4, pls. 2–3.

**Specimens examined.** 43 specimens, 55.0–262 mm SL. **China:** NSMT-P 71418 (1 specimen), 153 mm SL, Hainan Island, Sanya Bay, 22 Nov. 1997; BMNH 1970.3.3.1 (1), 124 mm SL, detailed collection locality and date unknown, holotype of *Tetrodon spadiceus*. **Japan:** KPM-NI 15864 (1), 157.6 mm SL, Sagami Bay, off Oiso, 13 May 2005; KPM-NI 16282 (1), 140 mm SL, Sagami Bay, off mouth of Oshikiri-gawa River, 26 Sep. 2005; KPM-NI 19598–19599 (2),



Fig. 1. Holotype of *Tetrodon spadiceus* Richardson, 1845. BMNH 1970.3.3.1, 124 mm SL, Chinese Sea. Top, lateral view; bottom, dorsal view.



Fig. 2. Holotype of *Lagocephalus wheeleri* Abe, Tabeta & Kitahama, 1984. ZUMT 54368, 179 mm SL, Japan, Honshu, Sagami Bay, off Manazuru. Top, lateral view; bottom, dorsal view.

133–149 mm SL, Sagami Bay, Enoshima, 25 Sep. 2007; KPM-NI 20093 (1), 184 mm SL, Sagami Bay, off Hayama, 3 Dec. 2007; KPM-NI 20101 (1), 158 mm SL, Sagami Bay, 2007 (day and month unknown); KPM-NI 21451 (1), 178 mm SL, southern part of Boso Peninsula, Sunosaki Point, 26 May 2008; MUFS 29292–29293 (2), 55.0–99.0 mm SL, Kyushu, Miyazaki Prefecture, Kadokawa-cho, Iorigawa, 19 July 2009; MUFS 29401 (1), 66.6 mm SL, same as MUFS 29292, 7 July 2009; MUFS 29513–29514 (2), 99.8–101 mm SL, same as MUFS 29292, 15 Aug. 2009; MUFS 29683–29684 (2), 59.1–72.9 mm SL, same as MUFS 29292, 27 July 2009; MUFS 29806–29807 (2), 83.0–86.5 mm, same as MUFS 29292, 8 Aug. 2009; MUFS 29873 (1), 65.4 mm SL, same as MUFS 29292, 1 Aug. 2009; MUFS 30312 (1), 144 mm SL, same as MUFS 29292, 24 Sep. 2009; MUFS 30314 (1), 130 mm SL, same as MUFS 29292, 11 Sep.

2009; MUFS 30255 (1), 158 mm SL, same as MUFS 29292, 27 Sep. 2009; NSMT-P 1872 (1), 176.9 mm SL, Kyushu, Amakusa, collecting date unknown; NSMT-P 63130 (1), Honshu, Yamaguchi Prefecture, Shimonoseki, 30 Aug. 2001; NSMT-P 65392 (1), 189 mm SL, Honshu, obtained at Odawara fish market, collecting date unknown; NSMT-P 75304–75307 (4), 153–262 mm SL, Mie Prefecture, Aug. 2009; YCM-P 12959 (1), 124 mm SL, Sagami Bay, off Yokosuka City, Kurosaki, 1983 (day and month unknown), ZUMT 54368 (1), 179 mm SL, holotype of *Lagocephalus wheeleri*, Honshu, Sagami Bay, off Manazuru, 29 July 1983; ZUMT 54369 (1), 149.0 mm SL, paratype of *L. wheeleri*, collection data same as that of holotype. **Philippines:** NSMT-P 76078–76079 (2), 67.4–84.6 mm SL, Panay Island, Iloilo, Santa Cruz, 7 Dec. 2006; NSMT-P 96208 (1), 65.4 mm SL, Luzon, Subic Bay, 2 Aug. 2008. **South China Sea:** ZRC 980

(3), 265.0–295 mm SL, 06°21.5'N, 108°11'–06°09'N, 108°11.5'E, 12 Jun. 1956. **Thailand:** NSMT-P 95880–95882 (3), 126.5–134.9 mm SL, NSMT-P 95885 (1), 140.0 mm SL, Gulf of Thailand, Songkhla, 28 July 2009. **Vietnam:** NSMT-P 66247 (1), 122 mm SL, Lang Chau Bay, 22 Sep. 2002; NSMT-P 97047–97049 (3), NSMT-P 97050(4), 128–170.0 mm SL, Nghe An Province, Lach Van, 17 Nov. 2004.

**Remarks.** Richardson (1845) described *Tetrodon spadiceus* based on a single specimen collected from a Chinese sea. He did not provide any detailed collection locality, making it impossible to know from which sea around China the holotype came. The holotype of *Tetrodon spadiceus* is characterized by having the following characters: a narrow posterior extension of spinules, forming a rhomboidal-shaped spinule



Fig. 3. Spinule distributions on the back in *Lagocephalus spadiceus*. Note differences in posterior extension of spinules. Top, YCM-P 12959, 1240 mm SL, Japan, Honshu, Sagami Bay, off Yokosuka City, Kurosaki; middle, NSMT-P 75307, 161 mm SL, Japan, Honshu, Mie Prefecture; bottom, NSMT-P 95885, 140 mm SL, Thailand, Gulf of Thailand, Songkhla (a piece of muscle in front of the dorsal fin was taken for DNA analysis).

patch on the dorsum anterior to the dorsal fin, but not reaching the dorsal-fin origin (Fig. 1); the posterior margin of the caudal fin slightly concave, but not making a lunate shape; and no dark spots on the dorsum. In Richardson's (1845) original description, the number of vertebrae was not given. An X-ray photograph of the holotype revealed that the number of vertebrae is 19 and no hyperostosis is found in the vertebrae and associated haemal and neural spines.

Günther (1870) recognized this species as a subspecies, *Tetrodon lunaris* var. *γ spadiceus*.

However, *Tetrodon lunaris* Bloch & Schneider, 1801 (now classified in the genus *Lagocephalus*) is clearly distinguished from the other species of *Lagocephalus* by having: the well-developed spinule patch on the back extending posteriorly from the region between the nares with the widest expansion dorsal to the gill opening, gradually tapering posteriorly and reaching the dorsal-fin origin; the caudal fin lunate; and the dorsum without black spots. Thus, *Lagocephalus lunaris* has been recognized as a valid species by many authors (Beaufort & Briggs, 1962; Dor,

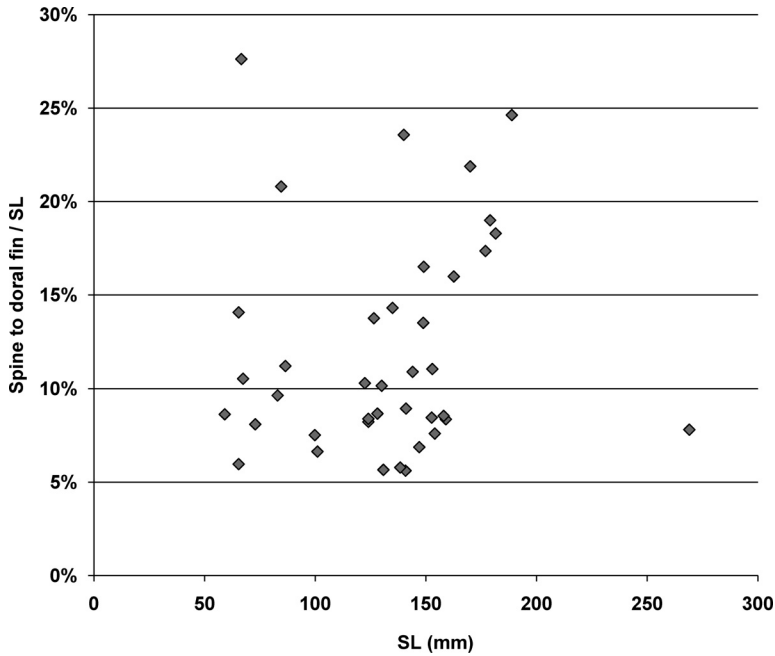


Fig. 4. Relationship of standard length and proportional measurement of distance between dorsal-fin origin and posteriormost spinule in *Lagocephalus spadiceus*.

Table 1. Frequency distributions of fin-ray counts in *Lagocephalus spadiceus*.

Fin-ray counts	10	11	12	13	14	15	16	17
Dorsal-fin rays				18 <sup>1,2,3</sup>	1			
Anal-fin rays		5	19					
Pectoral-fin rays	5	30 <sup>3</sup>	8 <sup>1,2,3</sup>					
				2	25 <sup>2</sup>	13 <sup>3</sup>	3 <sup>1</sup>	

<sup>1</sup> Holotype of *Tetrodon spadiceus*.

<sup>2</sup> Holotype of *Lagocephalus wheeleri*.

<sup>3</sup> Paratypes of *Lagocephalus wheeleri* (data of paratype SMF 19427 taken from Abe *et al.*, 1984).

1984; Smith & Heemstra, 1986; Matsuura, 1997, 2001; Yamada, 2002; Kim *et al.*, 2005; Yamada *et al.*, 2007)

Abe *et al.* (1984) described *Lagocephalus wheeleri* based on three specimens collected from Japan. They stated in the “Diagnosis” for this species as follows.

*The number of vertebrae is mostly 19 or 20; no Tilly bones [hyperostotic vertebrae and haemal spines]. The length of the head is less than its distance from the dorsal fin. The length of the pectoral fin is less than the distance between its posterior end and the dorsal fin. The abdomen and the anterior part of the back are spinulose; the dorsal spinulose area narrows posteriorly and its rearward extension varies from individual to individual, sometimes being interrupted, but never reaching to the dorsal-fin origin. In fresh specimens the back is yellow or olive green with irregular dark cross-bands; the ventral side of the body and the anal fin are white; the pectoral fins are nearly transparent; no melanophores on the distal part of the fin membrane. The caudal fin is never protruded posteriorly medially; the posterior margin [of the caudal fin] is nearly straight, the upper and lower corners being a little produced.*

Although Abe *et al.* (1984) provided many diagnostic characters for *Lagocephalus wheeleri*, examination of the type specimens of *T. spadiceus* and *L. wheeleri* revealed that these characters cannot separate *L. wheeleri* from *T. spadiceus*. The number of vertebrae (19) and the absence of hyperostosis in the vertebrae and haemal spines are shared by *T. spadiceus* and *L. wheeleri*. The color of *L. wheeleri* also appears in fresh specimens of *T. spadiceus* (= *L. spadiceus*) collected from the seas in Southeast Asia and Japan. The caudal fin is slightly concave both in *L. spadiceus* and *L. wheeleri*.

Abe *et al.* (1984) included some measurements in the “Diagnosis” for *L. wheeleri*, including the distance between the dorsal fin and the posterior end of the pectoral fin. However, this distance cannot be measured objectively because the shape of the pectoral fin varies according to

degree of expansion of the pectoral fin after specimens are preserved. When the pectoral fin is fully expanded, the distance becomes shorter, and when the pectoral fin is relatively folded, the distance becomes longer. Abe *et al.* (1984) also stated in the “Diagnosis” that the length of the head is less than its distance from the dorsal fin. This character is found not only in *L. wheeleri*, but also in *L. spadiceus*, *L. gloveri*, and *L. lunaris*.

The spinule distribution on the back seems to separate the typical forms of *L. spadiceus* and *L. wheeleri*. Typical *spadiceus* specimens have the rhomboidal-shaped spinule patch on the back, which is distinguished from typical *wheeleri* specimens that have an elliptical-shaped spinule patch on the back (Figs. 1–3), however, there is great variation in the shape of the spinule patch. In some specimens, the spinule patch has a long posterior extension such that there is a short distance between the posteriormost spinule and the dorsal-fin origin, whereas in other specimens, the spinule patch has a short posterior extension that terminates dorsal to the middle part of the pectoral fin (Figs. 3–4). This demonstrates that the two forms cannot be separated by the shape of the spinule patch distribution on the back. Thus, it is clear that *L. spadiceus* and *L. wheeleri* cannot be distinguished from each other by morphological characters (Table 1).

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## References

- Abe, T. & O. Tabeta, 1983. Description of a new swellfish of the genus *Lagocephalus* (Tetraodontidae, Teleostei) from Japanese waters and the East China Sea. *UO*, (32): 1–8, pls. 1–3.
- Abe, T., O. Tabeta & K. Kitahama, 1984. Notes on some swellfishes of the genus *Lagocephalus* (Tetraodontidae, Teleostei) with description of a new species from Japan. *UO*, (34): 1–10, pls. 1–3.
- Beaufort, L. F. de & J. C. Briggs, 1962. The Fishes of the Indo-Australian Archipelago. Vol. 11. 481 pp. E. J. Brill, Leiden.
- Bloch, M. E. & J. G. Schneider, 1801. M. E. Blochii, Systema Ichthyologiae iconibus cx illustratum. Post obitum auctoris opus inchoatum absolvit, correxit, interpolavit Jo. Gottlob Schneider, Saxo. Berolini. Sumtibus Auctoris Impressum et Bibliopolio Sanderiano Commisum. M. E. Blochii, Systema Ichthyologiae, lx+584 pp, 110 pls.
- Clarke, F. E., 1897. On two new globe-fish. *Transactions New Zealand Institute*, 29: 243–250, pls. 14–15.
- Dekkers, W. J., 1975. Review of the Asiatic freshwater puffers of the genus *Tetraodon* Linnaeus, 1758 (Pisces, Tetraodontiformes, Tetraodontidae). *Bijdragen tot de Dierkunde*, 45: 87–142.
- Dor, M., 1984. Checklist of the Fishes of the Red Sea. CLOFRES. xxii+437 pp. Israel Academy of Sciences and Humanities.
- Günther, A., 1870. Catalogue of the Fishes in the British Museum. Catalogue of the Physostomi, Containing the families Gymnotidae, Symbranchidae, Muraenidae, Pegasidae, and of the Lophobranchii, Plectognathi, Dipnoi, Ganoidi, Chondropterygii, Cyclostomata, Leptocardii, in the British Museum. Volume 8. xxv+549 pp. British Museum, London.
- Kim, I. S., Y. Choi, C. L. Lee, Y. J. Lee, B. J. Kim & J. H. Kim, 2005. Illustrated Book of Korean Fishes. 615 pp. Kyo-Hak Publishing Co., Ltd. (In Korean.)
- Kyushin, K., K. Amaoka, K. Nakaya, H. Ida, Y. Tanino & T. Senta (eds.), 1982. Fishes of the South China Sea. 333 pp., 291 pls. Japan Marine Fishery Resource Research Center, Tokyo. (In Japanese and English.)
- Matsuura, K., 1997. Tetraodontidae. In: O. Okamura and K. Amaoka (eds.), Sea Fishes of Japan. Pages 706–716. Yama-kei Publishers Co., Ltd., Tokyo. (In Japanese.)
- Matsuura, K., 2001. Families Ostraciidae, Aracaniidae, Triodontidae, Tetraodontidae. In: K. E. Carpenter and V. Niem (eds.), Species identification guide for fishery purposes. Bony fishes Part 4, Vol. 6. Pages 3948–3957. FAO, Rome.
- Miranda Ribeiro, A. de, 1913–1915. Fauna brasiliense. Peixes. Tomo V. Physoclisti. Arquivos do Museu Nacional do Rio de Janeiro, 17, 679 pp., 30 pls. [Issued in parts by families. Not continuously paginated, plates unnumbered.]
- Mohsin, A. K. M. & M. A. Ambako, 1996. Marine Fishes and Fisheries of Malaysia and Neighbouring Countries. xxxvi+744 pp. Universiti Pertanian Malaysia Press, Serdang.
- Randall, J. E., 1995. Coastal fishes of Oman. 439 pp. Crawford House Publishing Pty Ltd, Bathurst, Australia.
- Richardson, J., 1845. Ichthyology—Part 1. In: R. B. Hinds (ed.), The zoology of the voyage of H. M. S. Sulphur, under the command of Captain Sir Edward Belcher, R. N., C. B., F. R. G. S., etc., during the years 1836–42. No. 10, pp. 99–150, pls. 55–64.
- Sainsbury, K. J., Kailola, P. J. & G. G. Leyland, 1985. Continental Shelf Fishes of Northern and North-western Australia. 375 pp. Clouston & Hall and Peter Pownall Fisheries Information Service, Canberra, Australia.
- Shipp, R. L., 1974. The pufferfishes (Tetraodontidae) of the Atlantic Ocean. *Publications of the Gulf Coast Research Laboratory Museum*, (41): 1–162.
- Smith, M. M. & P. C. Heemstra, 1986. Smiths’ Sea Fishes. xx+1047 pp., 144 pls. Macmillan South Africa, Johannesburg.
- Yamada, U., 2002. Tetraodontidae. In: T. Nakabo (ed.).

Fishes of Japan with Pictorial Keys to the Species, Volume 2, English edition. Pages 1418–1431, 1632. Tokai University Press, Hadano-shi.

Yamada, U., M. Tokimune, H. Horikawa & T. Nakabo,

2007. Fishes and fisheries of the East China Sea and Yellow Seas. lxxiii+1262 pp., 54 pls. Tokai University Press, Hadano-shi. (In Japanese.)

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サバフグ属魚類の *Lagocephalus wheeleri* Abe, Tabeta & Kitahama, 1984 は *Tetrodon spadiceus* Richardson, 1845 (条鰭類, フグ目, フグ科) の主観新参異名

松浦啓一

東南アジア及び日本周辺から採集された多くのサバフグ属魚類標本と *Lagocephalus wheeleri* 及び *Tetrodon spadiceus* のタイプ標本を調べた結果、両者の相違とされていた計測形質や背鰭前方の小棘の分布状態には差が見られないことが明らかになった。したがって、前者は後者の主観新参異名となる。これら二つの名義種は従来サバフグ属に分類され、前者にはシロサバフグ、後者にはモトサバフグという和名が用いられてきた。学名の変更に連動すると、本種にはモトサバフグを適用することになる。しかし、本種が水産重要種であること、国内ではモトサバフグという和名が用いられる頻度が少なかったことを考慮すると、シロサバフグという広く普及した和名を保持することが妥当である。本種は東部インド洋を含む東南アジア海域から日本及び北部オーストラリアに分布する。