

First record of the freshwater puffer *Tetraodon fluviatilis fluviatilis* from the coastal waters of Goa, west coast of India

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Received 12 October 2011; revised 30 January 2012

Present study describes a new record of the freshwater green spotted puffer *Tetraodon fluviatilis fluviatilis* based on detailed examination of four specimens collected from the bay-estuarine regions of Goa. Differences between the present specimens and original description with respect to color pattern (on the back, flanks and caudal fin) are elucidated.

[**Keywords:** Puffer, new record, Goa, morphology, color pattern]

Introduction

Genus *Tetraodon* Linnaeus, 1758

Tetraodon Linnaeus, 1758 (type species: *Tetraodon lineatus* Linnaeus, 1758). Dekkers¹ defined the genus *Tetraodon* based on several phenotypic and osteological characters of the Asian freshwater puffers as follows. “Sphenotic expanded laterally beyond frontal to form a broad flattened lobe; orbital roof scarcely arched, the lateral ethmoid not bent down before the eye, not forming an olfactory foramen; mesethmoid broad; upper lateral line not reaching end of tail, curved down above anal fin to meet lower line, which extend forward beyond the point of union; 19 vertebrae; dermal ossifications of back bearing simple prickles, evenly scattered; spines on sides small, closely set; dorsal fin maximally counting 16 rays; nasal organ an elevated tube, terminally often divided into two lips or lobes which may nearly reach the basis”. He successfully demonstrated the use of morphological characters such as the nasal organ structure, relative snout length, relative head length, form of the inter-orbital region, position of the mouth, color pattern, and fin ray counts in differentiating between and within the highly polymorphic species of the genus *Tetraodon*.

Present study describes the new record of occurrence of the freshwater puffer, *Tetraodon fluviatilis fluviatilis* from the coastal waters of Goa, west coast of India. An attempt is made to elucidate the variations in color pattern on the back, sides and caudal fin.

Materials and Methods

Eighty three trawling stations were undertaken in the estuarine and offshore waters (up to 20 m depth) of Goa, Central West coast of India (Fig. 1) to assess the diversity and total community structure of demersal fish fauna. Trawl nets with mesh sizes of 15 mm (mouth end) and 9 mm (cod end) were towed at a speed of 2.16 knots (4 km.h⁻¹). Trawl catch obtained was immediately examined for species composition and uncommon (or rare) specimens were separately sorted and preserved in ice. In addition, beach seines (N = 03) and gill nets (N = 01) were operated in the estuarine embayment where the bottom trawl could not be operated. Subsequently, a thorough morphological study of the biological specimens was carried out in the laboratory.

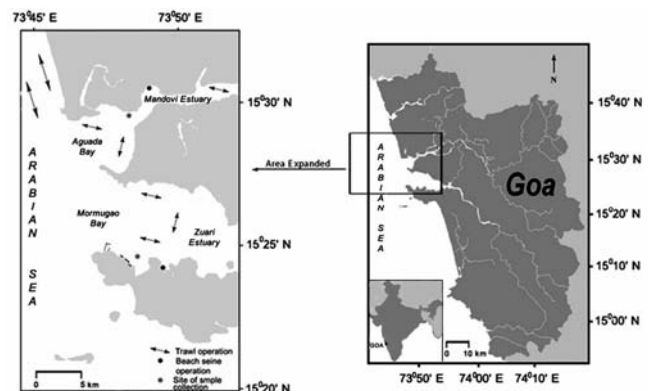


Fig. 1—Map indicating site of collection of *Tetraodon fluviatilis fluviatilis* specimens

One gill net operation at Betim (15°30'N, 73°50'E) in December 2005, and two trawl operations, including one off Mormugao Port Trust (between 15°25'N, 73°49'E and 15°25'N, 73°51'E) in September 2006 and another along the upper Mandovi Estuary yielded altogether four specimens of the freshwater "green-spotted puffer". Specimens were photographed and identified up to the species level by employing traditional taxonomic studies based on morphometric and meristic characters¹. Morphometric parameters were measured up to the nearest 0.01 cm using vernier calipers and details of morphometric measurements of specimens along with their means and standard deviation are provided in Table 1. Vertebral count was taken from X-ray photograph of specimen. The specimens stored in 5% formalin are deposited at the Marine Biology laboratory, Department of Marine Sciences, Goa University.

The following abbreviations are used. TL- Total length; FL-Fork length; SL-Standard length; PDL- Pre-dorsal length; PAL- Pre-anal length; PPL- Pre-pectoral length; BD- Body depth; HL- Head length; OD- Orbital diameter; SnL- Snout length; POL- Pre-orbital length; PHL- Post-orbital head length; CH- Caudal fin height; CL- Caudal fin length; CA- Surface area of caudal fin; AR- Aspect ratio; D- Dorsal fin; A- Anal fin; P- Pectoral fin; C- Caudal fin. Terminology used in the

morphological description of pufferfish follows Dekkers¹, Froese and Pauly².

Results

Comparison of morphological parameters (form of the olfactory rosette, form of inter-orbital space, morphometric measurements, color pattern and fin ray counts) using published literature¹ revealed that the specimens resembled *T. fluviatilis fluviatilis*.

Dekkers¹ described *T. fluviatilis fluviatilis* as "Body oblong, compressed laterally except in fleshy specimens; dorsal profile arched, highest at midst of back; inter – orbital convex, without a groove; lateral line system distinct; body spines small, sometimes very distinctly two based, sometimes partially or wholly indistinct, covering back, sides and belly between eyes and origin of dorsal fin; origin of anal fin situated beneath anterior half of dorsal fin base; mouth terminal, directed forwards; lower border of eye slightly above or below level of mouth corner, upper border not interfering with dorsal profile (Fig. 2); nasal organ a tentacle, more than distal half of which is divided in two flattened and broadened lobes; apposed surface of lobes generally with spongy tissue (in 90% of specimens ≥ 60 mm sl, N = 20; in 80% of specimens < 60 mm sl, N = 5; Fig. 3a). Color in alcohol: Ground color of upper parts tan, of belly yellowish white; three large yellowish – encircled

Table 1—Morphometric measurements of *Tetraodon fluviatilis fluviatilis* obtained from Goa coast (N = 4) along with their mean and standard deviation

Sr. No.	Morphometric parameter (cm)	Specimens examined				Mean \pm S.D.
		ZMPT-1	MBT-1	MBT-2	MTP	
1.	TL (=FL)	12.55	12.38	13.51	14.40	13.21 \pm 0.94
2.	SL	9.70	9.28	10.53	10.95	10.12 \pm 0.76
3.	PDL	7.34	7.38	7.52	8.23	7.62 \pm 0.42
4.	PAL	7.19	6.93	7.75	8.14	7.50 \pm 0.55
5.	PPL	3.65	3.81	4.12	4.47	4.01 \pm 0.36
6.	BD	5.12	4.63	4.18	4.58	4.63 \pm 0.39
7.	HL	3.11	3.46	3.51	3.91	3.50 \pm 0.33
8.	OD	0.74	0.74	0.99	0.86	0.83 \pm 0.12
9.	SnL	1.24	1.24	1.54	1.87	1.47 \pm 0.30
10.	POL	0.91	0.83	0.84	–	0.86 \pm 0.04§
11.	PHL	1.45	1.39	1.47	–	1.44 \pm 0.04§
12.	CH	4.55	4.52	4.69	–	4.59 \pm 0.09§
13.	CL	2.81	2.64	2.78	–	2.74 \pm 0.09§
14.	CA [#]	11.27	10.67	9.64	–	10.53 \pm 0.82§
15.	AR*	1.84	1.91	2.81	–	2.19 \pm 0.54§

[#]Surface area expressed in cm²

*not expressed in units

§n=3

dark patches on back between eyes and dorsal fin; anterior patch on posterior half of head (length along midline of back 6.2–14.0 in sl, and 1.3–2.9 in transverse length), middle patch between pectoral fins (length along midline of back 5.5–13.8 in sl, and 0.8–1.8 in transverse length), posterior patch in front of dorsal fin (length along midline of back 8.3–14.4 in sl, and 0.6–1.3 in transverse length); middle dorsal patch occasionally broken up into two smaller patches; anterior half of head variably colored, often irregularly dark; sides with 5–28 rounded, mostly ocellated, dark spots (horizontal diameter 8–80 in sl) of which always one at base of dorsal fin (usually the largest), one at base of caudal fin (usually the smallest), and one below or against posterior dorsal patch; belly uniform yellowish white or with same or confluent spots as on sides; 0–9 (m 3.8) crossbars on caudal fin; sometimes a small dark spot on interior side of pectoral fin base; other fins plain (Fig. 2)".

The present specimens bore greatest resemblance to the above description based on:

- 1 Olfactory rosette (nasal organ) a tentacle, more than distal half of which is divided into two flattened and broadened lobes; apposed surfaces of lobes (of the rosette) generally with spongy tissue (Fig. 3b).
- 2 Snout length almost 2.3 – 2.9 times in HL.

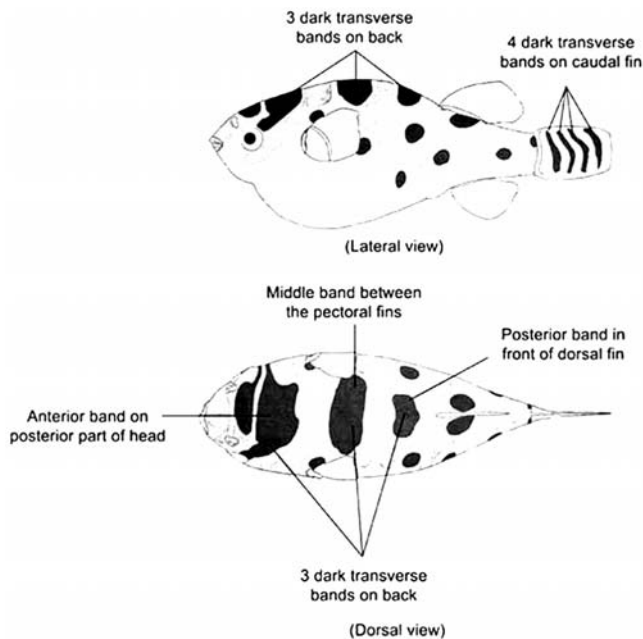


Fig. 2—Diagrammatic representation of color pattern on back and sides of *Tetraodon fluviatilis fluviatilis* (redrawn and modified from Dekkers, 1975)

- 3 HL > 2.4 times in SL.
- 4 Inter-orbital convex, without a groove.
- 5 Mouth terminal, directed forwards.
- 6 Three large dark transverse bands on back encircled by yellow coloration (fades in preserved specimens); middle band between pectoral fins, posterior band in front of dorsal fin (Figs. 4, 5).
- 7 Fin count D 13, A 11, P 21–22 (i.e. within the range described by Dekkers¹).

However, the present specimens differed from *T. fluviatilis fluviatilis* in possessing:

- 1 Anterior dorsal band between the eyes (Figs. 4, 5), as compared to “posterior portion of head” (behind the eyes) in *T. fluviatilis fluviatilis* (Fig. 2),
- 2 More than 30 dark ocellated patches on sides (Fig. 4), as compared to “5 – 28” ocellated patches in *T. fluviatilis fluviatilis* (Fig. 2),

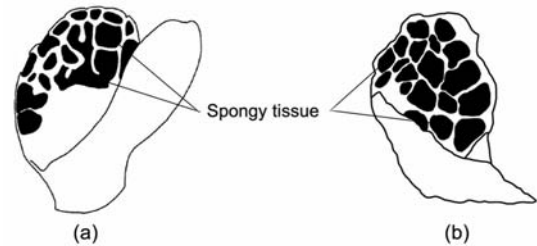


Fig. 3—Diagrammatic representation of the olfactory rosette of *Tetraodon fluviatilis fluviatilis* – (A) specimen redrawn from Dekkers (1975) and (B) present specimen

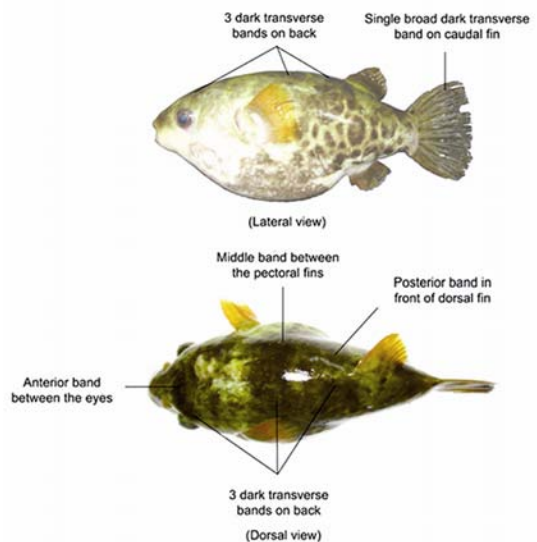


Fig. 4—Photograph of color pattern on back and sides of *Tetraodon fluviatilis fluviatilis* specimens collected from Goa, Central West coast of India

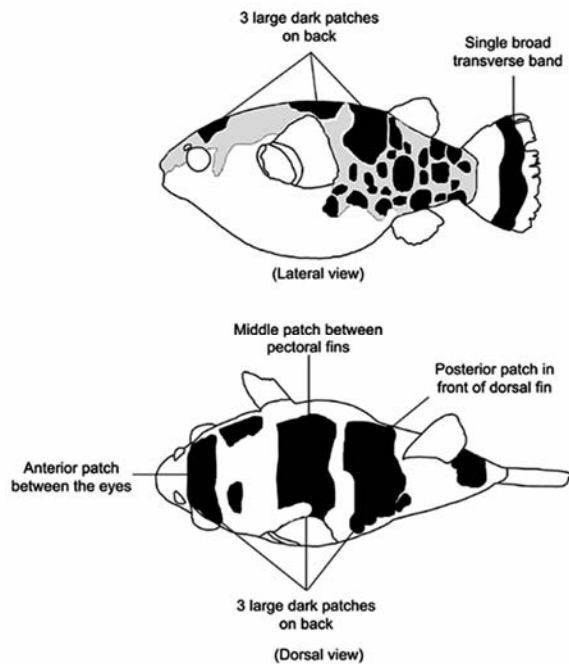


Fig. 5—Diagrammatic representation of color pattern on back and sides of *Tetraodon fluviatilis fluviatilis* specimens collected from Goa, Central West coast of India

3 Single dark broad transverse band on caudal fin (Fig. 4, 5) as compared to four bands in *T. fluviatilis fluviatilis* (Fig. 2).

It is apparent from the above comparison that the present specimens unambiguously resemble *T. fluviatilis fluviatilis*, and the color differences are suggestive of regional morphological variation.

Acknowledgements

Authors are grateful to the Ballast Water Management Programme, India executed by the National Institute of Oceanography, Dona Paula, Goa for Directorate General of Shipping, Government of India and is a joint contribution of the Goa University and the National Institute of Oceanography.

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