

***Toxotes kimberleyensis*, a New Species of Archerfish (Pisces: Toxotidae) from Fresh Waters of Western Australia**

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ABSTRACT. *Toxotes kimberleyensis* n.sp. is described from 22 specimens, 52.5–126.3 mm SL, collected from freshwater streams in the Kimberley region of northwestern Australia. It was previously identified as *Toxotes oligolepis* Bleeker, a poorly known species from Indonesia. However, re-examination of Bleeker's type specimen indicates significant differences between the two species relating to the length of the dorsal spines, and lateral-line scale count. A key to the seven species of *Toxotes* is provided.

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The perciform family Toxotidae is well known for its ability to shoot down insects from overhanging vegetation with a jet of water squirted from the mouth. The family contains a single genus, *Toxotes*, which ranges from India to Vanuatu, and northern Australia to the Philippines. These fishes are common inhabitants of mangrove-lined estuaries and freshwater streams. Allen (1978, 2001) recognized six species: *T. blythi* Boulenger, *T. chatareus* (Hamilton), *T. jaculatrix* (Pallas), *T. lorentzi* Weber, *T. microlepis* Günther, and *T. oligolepis* Bleeker. The last mentioned species was described from a single specimen from Indonesia with questionable collecting data, but most likely originated from the island of Buru. Although the population from the Kimberley district of Western Australia was previously identified as *T. oligolepis*, I stated in the 1978 review that “there is a possibility that it may represent a distinct species” due to its greater number of lateral-line scales and deeper body. An opportunity to re-examine Bleeker's holotype of *T. oligolepis* and directly compare it with specimens from

the Western Australia in 2001 revealed additional significant differences. Therefore, it is concluded that the population from Western Australia is a distinct new species, which is described herein.

Materials and methods

Proportional measurements were taken with dial calipers to the nearest 0.1 mm. The methods for counts and measurements are as follows: the last dorsal and anal soft rays are split at the base and are counted as a single element; principal caudal rays include all rays extending to the posterior margin of the caudal fin; lateral-line scale counts include all tubed scales between the upper edge of the gill opening to the caudal-fin base; horizontal scale rows above and below the lateral line are counted below the dorsal-fin origin and above the anal-fin origin respectively; circumpeduncular scales include the total number of transverse scale rows on both sides of the narrowest portion



Fig. 1. *Toxotes kimberleyensis*, holotype, 126.3 mm SL, Plain Creek, Western Australia.

of the caudal peduncle; gill-raker counts pertain to the first gill arch and are presented as separate upper and lower arch elements. Standard length (SL) is measured from the tip of the upper jaw to the tail base, also indicated by the line of flexure at the hypural base; head length is taken from the front of the upper lip to the posterior end of the opercular membrane; body depth is the maximum depth measured from the base of the dorsal spines, and body width the greatest width just posterior to the gill opening; eye diameter is the greatest bony diameter of the orbit, and interorbital width is the least bony width; snout length is measured from the front of the upper lip to the fleshy anterior edge of the orbit; upper jaw length is the straight line measurement between the snout tip and posterior edge of the maxilla; predorsal, prepelvic, and preanal distances are also taken from the front of the upper lip to the origin of the respective fins; caudal peduncle depth is the least depth of the tail base and its length is measured between two verticals, one from the base of the last anal ray and the other at the line of flexure on the hypural (caudal-fin base); lengths of fin spines and soft rays of fins are measured in a straight line from the level of their basal articulation.

Counts and proportions appearing in parentheses apply to the paratypes. Type specimens are deposited at the Australian Museum, Sydney (AMS), Northern Territory Museum, Darwin (NTM), and Western Australian Museum, Perth (WAM). The type specimen of *Toxotes oligolepis* was examined at the National Museum of Natural History (RMNH), Leiden, The Netherlands.

***Toxotes kimberleyensis* n.sp.**

Figs. 1, 2; Tables 1–3

Type material. HOLOTYPE: WAM P.25039-002, 126.3 mm SL, Plain Creek Gorge, Beverley Springs Station, West Kimberley District, Western Australia (16°35'S 125°30'E), hook and line near surface, G. Allen and W. Bailey, 1 September 1974. PARATYPES: AMS I.42570-001, 107.5 mm SL, collected with holotype; NTM S.15530-001, 102.4 mm SL; WAM P.25039-001, 3 specimens, 98.2–109.2 mm SL, collected with holotype; WAM P.25437-001, 65.5 mm SL, May River, Western Australia (17°21'S 124°00'E), rotenone, B. Hutchins and A. Chapman, 26 July 1975; WAM P.25440-006, 15 specimens, 52.5–92.8 mm SL, Lennard River, Western Australia (17°20'S 124°40'E), rotenone, B. Hutchins and A. Chapman, 27 July 1975.

Diagnosis. A species of *Toxotes* with the following combination of characters: dorsal rays V, 11–13 (usually 11–12); longest (fourth and fifth) dorsal-fin spines about equal in length and shorter than longest soft dorsal ray in adults; anal rays III, 14–16 (usually 15); pectoral rays 12–13; tubed lateral-line scales 28–33 (usually 30–31); diagnostic colour markings consisting of 4–5 wedge-shaped black bars or saddles without intervening small spots.

Description. Dorsal rays V, 12 (11–13), anal rays III, 15 (14–16); pectoral rays 12 (12–13); principal caudal rays 17; gill-rakers on lower limb of first branchial arch 7 (6 or 7), usually a single raker on upper limb; tubed lateral-line scales 31 (28–33); horizontal scale rows above lateral-line to dorsal fin origin 3; horizontal scale rows below lateral line to anal fin origin 9 (8–10); circumpeduncular scale rows 16 (17–16).

Body depth 2.2 (2.1–2.3) in standard length; maximum body width 2.4 (2.2–2.6) in depth; head length contained



Fig. 2. *Toxotes kimberleyensis*, about 150 mm total length (G. Schmida photo).

3.0 (2.6–2.9) in standard length; snout 4.0 (3.5–4.3), eye 3.5 (3.3–3.9), interorbital width 3.0 (2.9–3.3), upper jaw length 1.9 (2.0–2.3); least depth of caudal peduncle 2.5 (2.5–3.1), length of caudal peduncle 3.0 (2.7–3.7), all in head length.

Mouth large, the lower jaw protruding; mouth opening oblique, angle of jaw about 42 degrees from horizontal axis of body; maxilla slender and scaly, without supplemental bone, reaching a vertical level with middle of eye; fine villiform teeth on jaws, vomer, and palatines; pair of prominent nasal opening on each side of snout just anterior to eye; anterior nostrils in short fleshy tube; scattered sensory pores evident on interorbital region, tip of snout, margin of

preopercle, sub-preorbital series, and ventral surface of lower jaw; free edges of preopercle and opercular series smooth except lower margin of preopercle very finely crenate.

Scales of head and body very finely ctenoid, but smooth to touch; head fully scaled except for small naked patch on central rear margin of preopercle; dorsal and anal fins with well-developed basal scaly sheath and small scales extend nearly to margin of fins; outer base of pectoral fin scaled, but axil naked; pelvic axillary scale about half length of pelvic fin; innermost pelvic-fin ray attached to abdomen by membrane.

Lateral line nearly complete (except usually interrupted

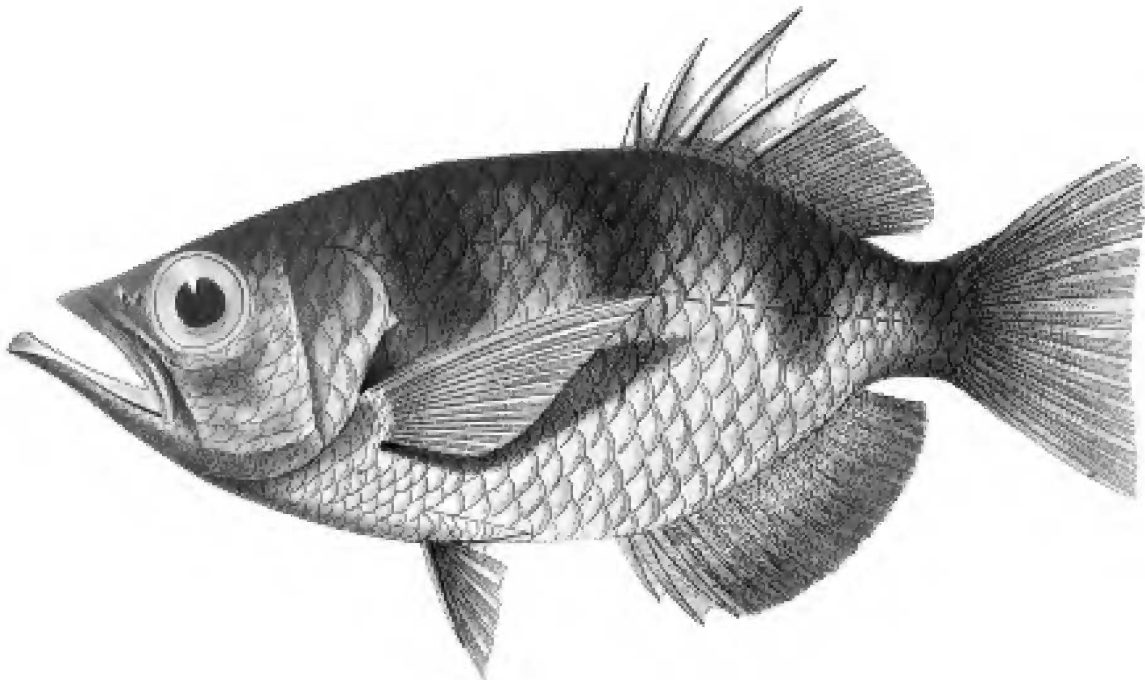


Fig. 3. *Toxotes oligolepis*, 102 mm SL, L. Speigler drawing from Bleeker (1875–1878).

Table 1. Proportional measurements of selected type specimens of *Toxotes kimberleyensis* as percentage of the standard length.

character	holotype			paratypes			
	WAM P.25039-002	WAM P.25039-001	AMS I.42570-001	WAM P.25039-001	NTM S.15530-001	WAM P.25039-001	WAM P.25440-006
standard length (mm)	126.3	109.2	107.5	106.2	102.4	98.2	76.7
body depth	45.3	42.6	47.4	45.7	43.2	43.3	47.3
body width	18.7	19.0	21.0	18.8	18.6	18.3	19.4
head length	33.4	34.6	38.3	35.2	37.2	34.9	37.2
snout length	8.3	8.0	11.1	9.2	8.7	9.7	9.6
eye diameter	9.7	9.2	10.0	10.8	9.9	9.3	9.5
interorbital width	11.2	11.3	10.9	12.0	11.4	11.9	12.0
upper jaw length	17.6	16.7	17.8	16.9	18.2	17.6	17.1
depth of caudal peduncle	13.5	13.1	14.3	11.3	13.5	13.4	14.5
length of caudal peduncle	11.1	12.8	12.5	10.9	12.7	11.7	10.2
predorsal distance	55.9	57.2	62.3	55.1	57.1	58.0	57.8
preanal distance	67.5	67.2	75.1	68.1	68.2	67.6	70.3
prepelvic distance	44.3	44.9	49.3	45.0	46.2	44.5	46.7
length of dorsal-fin base	36.3	35.1	38.6	34.8	32.7	33.6	34.3
length of anal-fin base	31.8	31.5	34.9	32.1	31.1	31.4	31.0
pectoral-fin length	28.8	29.3	34.0	29.0	30.6	29.5	28.2
pelvic-fin length	15.0	17.7	19.1	14.2	17.6	16.6	17.7
pelvic-fin spine length	12.9	12.2	12.5	12.8	12.7	12.1	13.7
1st dorsal spine	7.0	7.3	7.7	7.6	7.2	6.6	8.1
2nd dorsal spine	12.7	13.9	12.2	11.9	12.6	12.9	15.8
3rd dorsal spine	17.2	16.9	16.7	15.5	18.5	19.5	16.6
4th dorsal spine	17.8	17.5	18.0	17.9	19.8	20.8	18.9
5th dorsal spine	17.8	17.7	17.7	19.6	20.2	21.7	18.0
longest soft dorsal ray	19.7	19.0	19.1	20.2	20.8	23.1	17.6
1st anal spine	7.0	7.1	7.1	7.3	7.9	7.3	7.2
2nd anal spine	12.0	11.0	11.6	10.9	13.0	12.7	11.6
3rd anal spine	17.2	16.9	17.1	17.7	19.5	18.2	15.5
longest soft anal ray	22.4	22.9	23.9	21.7	24.5	24.5	20.6
caudal-fin length	28.7	26.4	28.2	26.8	30.8	27.5	27.4

by 1–2 tubeless scales above pectoral fin), consisting of simple unbranched tubes, extending from upper rear corner of operculum to hypural base, usually with a pronounced dorsal inflection above pectoral region.

Origin of dorsal fin about level with origin of anal fin, on rear half of body; first dorsal spine 4.8 (4.4–5.0) in head length; spines of dorsal fin gradually increasing in length and thickness to fourth spine, fourth and fifth dorsal spines about equal in length; fifth dorsal spine 1.9 (1.6–2.1) in head length; longest (first two) soft dorsal rays about equal or slightly shorter than tallest dorsal spines, 1.7 (1.5–2.1) in head length; anal spines progressively increasing in

length; first anal spine 4.8 (4.7–5.4), and third anal spine 1.9 (1.9–2.4), both in head length; length of dorsal-fin base 0.9 (1.0–1.1), of anal-fin base 1.0 (1.1–1.2), both in head length; caudal fin truncate to very slightly emarginate, its length 1.2 (1.2–1.4) in head length; pectoral reaching a vertical through origin of dorsal and anal fins, the longest ray 1.2 (1.1–1.3) in head length; pelvic fins short, longest ray falling well short of anal fin origin when depressed, 2.2 (2.0–2.5) in head length.

Preserved coloration (in alcohol). Ground colour yellowish white with slight silvery sheen, grading to brown on dorsal

Table 2. Dorsal and anal fin-ray counts for type specimens of *Toxotes kimberleyensis* (frequency of each count is indicated in bottom row).

	dorsal rays			anal rays		
counts	11	12	13	14	15	16
frequency	7	13	2	6	15	1

Table 3. Pectoral fin-ray and lateral-line scale counts for type specimens of *Toxotes kimberleyensis* (frequency of each count is indicated in bottom row).

	pectoral rays		lateral-line scales				
counts	12	13	28	29	30	31	33
frequency	6	16	1	1	4	15	1

surface; a series of five diffuse blackish bars, primarily on upper side, the last (on caudal peduncle) very faint; dorsal and anal fins dusky blackish, with pale central band; caudal-fin membranes dusky blackish; pelvic fins pale tan; pectoral fins translucent with uppermost rays dusky blackish. The paratypes are similar except the dark bars are more vivid and strongly contrasted. In addition, the last bar (on caudal peduncle) is frequently reduced to a small rounded spot, especially in the smallest specimens.

Live coloration (from 35 mm transparency): overall silvery white with five black bars or vertically ovoid spots between eye and caudal fin base; fins generally transparent to whitish in young to dusky blackish (especially dorsal and anal) in adults.

Etymology. The species is named *kimberleyensis* with reference to the type locality. Major surveys of northern Australian freshwater fishes by the author and co-workers over the past 3 decades indicate that it is restricted to the Kimberley region.

Remarks. Bleeker (1876) described *Toxotes oligolepis* from a single specimen, 111.7 mm SL. The precise collection locality is uncertain, but according to Bleeker and Weber & de Beaufort (1936), was probably the island of Buru in the Molucca Islands, Indonesia. Specimens from the Kimberley district of Western Australia were previously identified (Allen, 1978) as *T. oligolepis* based largely on colour pattern similarity. However, I recently had an opportunity to re-examine Bleeker's holotype at RMNH and compare it with specimens from Western

Australia. Several significant differences were noted. The dorsal spines of *T. oligolepis* are notably taller and stronger than those of Australian fish. The third dorsal spine is the tallest and strongest, and is significantly higher than the soft portion of the dorsal fin. In contrast the fourth and fifth spines are the tallest and strongest in the Australian fish and are about equal in height or lower than the soft part of the dorsal fin. In addition, the Australian specimens have a higher lateral-line scale count (30–31) in comparison to *T. oligolepis*. Although the holotype of *T. oligolepis* has damaged and missing scales, close inspection of scale pockets reveals a count of about 25. This count is further corroborated by the illustration of *T. oligolepis* in Bleeker's Atlas Ichthyologique (1875–1878, pl. 363, Fig. 1), which is reproduced here as Fig. 3.

Toxotes kimberleyensis is known only from a relatively small area of the western Kimberley district of Western Australia, including the Fitzroy, Meda, May, and Isdell Rivers (Allen *et al.*, 2002). It is especially common in the Fitzroy system, but appears relatively scarce elsewhere. Unlike *T. chatareus* and *T. jaculatrix* that are found in coastal areas of the Kimberley, frequently in brackish water (or marine conditions in the case of *T. jaculatrix*), *T. kimberleyensis* is strictly confined to freshwater. It penetrates well inland, at least as far as Geike Gorge National Park in the Fitzroy system, or approximately 300 km upstream from the sea. The species has an affinity for deeper pools where it swims near the surface, patrolling the shoreline for insects.

The following key provides characters for differentiating the seven known species of *Toxotes* (modified from Allen, 1978).

Key to the species of *Toxotes*

- | | | |
|---|---|--------------------------|
| 1 | Dorsal spines 4: series of 4–5 black bars on upper sides (widespread, India to Vanuatu) | <i>T. jaculatrix</i> |
| — | Dorsal spines normally 5; colour variable with either bars, spots, or irregular stripes on sides, or colour uniform without dark markings | 2 |
| 2 | Lateral-line scales usually 25–38 | 3 |
| — | Lateral-line scales usually 39–50 | 5 |
| 3 | Colour pattern consisting of a series of 6–7 alternating, large and small black spots (widespread, India to Papua New Guinea and northern Australia) | <i>T. chatareus</i> |
| — | Colour pattern consisting of a series of 4–5 wedge-shaped, black bars or saddles without intervening small spots | 4 |
| 4 | Third dorsal spine notably taller and thicker than fourth and fifth spines; spinous portion of dorsal fin much higher than soft portion of fin (Buru Island, Indonesia) | <i>T. oligolepis</i> |
| — | Third dorsal spine shorter and thinner than fourth and fifth spines; spinous portion of dorsal fin shorter or about equal in height compared to soft portion of fin (Kimberley region of Western Australia) | <i>T. kimberleyensis</i> |

- 5 General coloration in preservative uniform tan or brown without markings (may have about 10 faint, narrow bars on upper side in life); lateral line more or less straight; gill-rakers on lower limb of first arch 2–4, usually 3 (northern Australia and New Guinea) *T. lorentzi*
- General coloration not uniform tan or brown without markings, consisting of ovate spots or 4–5 elongate black bars or triangular saddles interspersed with smaller black spots on upper back; lateral line arched over pectoral region; gill-rakers on lower limb of first arch usually 5–8 6
- 6 Colour pattern consisting of irregular horizontally ovate spots on a light background; irregular dark stripes on soft portion of dorsal fin (Burma) *T. blythi*
- Colour pattern consisting of 4–5 vertically elongate, black bars or triangular saddles interspersed with smaller black spots on upper back; soft portion of dorsal fin with pair of large black spots (Thailand, Sumatra, and Borneo) *T. microlepis*

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