



BALITORA JALPALLI, A NEW SPECIES OF STONE LOACH (TELEOSTEI: CYPRINIFORMES: BALITORIDAE) FROM SILENT VALLEY, SOUTHERN WESTERN GHATS, INDIA

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Abstract: A new species of stone loach (Cypriniformes: Balitoridae), *Balitora jalpalli*, is described from Kunthi tributary of Bharatapuzha River located inside Silent Valley National Park in the southern Western Ghats of Kerala, India. It can be distinguished from known Indian species of *Balitora* by five major characters: head length, caudal peduncle depth, maximum head width and difference in number and pattern of bands on the dorsal side. The new species is distinct in having two unbranched and 8–9 branched ventral fin rays, nine unbranched and 10–11 branched pectoral fin rays and 66 lateral line scales, a caudal peduncle length to depth ratio of 2.3–2.7, anal fin to anus distance 3.3–4.7 % SL, least depth of caudal peduncle 6.3–6.7 % SL, length of caudal peduncle 15.4–17.2 % SL, length of upper caudal lobe 22.1–22.8 % SL, maximum head width 67.9–74.1 % HL, eye diameter 12.1–14.2 % HL, and gape 31.3–31.5 % HL.

Keywords: Bharatapuzha, freshwater fish, Kerala, new species.

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INTRODUCTION

Stone loaches of the genus *Balitora* Gray, 1830 are characterized by a strongly depressed body; ventrally flattened head and abdomen; inferior mouth, arched, jaws covered with horny sheath; papillated lips; gill-opening extending on the ventral surface of head; two to three simple pelvic rays, 8–10 simple pectoral rays; and paired fins ventrally placed (Kottelat 1988). They are distributed in the fast flowing mountain streams of South Asia and Indochina from Pakistan in the West to Hainan Islands in the East (Kottelat 1988; Kottelat & Chu 1988; Conway & Mayden 2010). They comprise 11 or 12 valid species (Kottelat 2012) of which four species, *Balitora burmanica*, *B. brucei*, *B. laticauda* and *B. mysorensis* are known to occur in India (Vishwanath et al. 2007; Bhoite et al. 2012; Kottelat 2012). While *B. brucei* is known from the Ganga-Brahmaputra basin, *B. burmanica* occurs in the Salween drainage in Myanmar (Kottelat 2012) and Chindwin basin in Manipur, India (Vishwanath et al. 2007), *B. laticauda* in the Krishna drainage of northern Western Ghats and *B. mysorensis* in the Cauvery drainage and some west flowing rivers of southern Western Ghats (Ali & Raghavan 2011; Bhoite et al. 2012).

Fieldwork in the Kunthi tributary of Bharatapuzha River inside the Silent Valley National Park, Kerala (part of the Western Ghats Hotspot) led to the collection of specimens of a *Balitora* which differed from its congeners. This species is described herein as *Balitora jalpalli* sp. nov.

MATERIALS AND METHODS

Counts and measurements generally follow Kottelat (1988) and Conway & Mayden (2010). Measurements were taken point to point using dial calipers to the nearest 0.1mm. Subunits of the body are presented as percent of standard length (SL), and those of the head, as percent of head length (HL). Values for the holotype are marked with an asterisk (*) and values in parentheses are ranges. If there is no variation in a character the values are not marked with an asterisk. All pored lateral line scales were counted. Holotype of *Balitora jalpalli* is deposited in the Zoological Survey of India, Western Regional Center (ZSI-WRC), Pune, one paratype each in the museum of the Conservation Research Group, St. Albert's College (CRG-SAC), Kochi, Kerala, and museum collection of Wildlife Information Liaison Development (WILD), Coimbatore, India.

Government (Kerala State Department of Forest and Wildlife) regulations on scientific collections inside protected areas restricted the number of individuals that could be collected to only three specimens of the new species.

Data from Kottelat (1998) for *Balitora annamitica* and *B. meridionalis*, from Conway & Mayden (2010) for *B. eddsi*, Chen et al. (2005) for *B. nantingensis*, Liu et al. (2012) for *Balitora ludongensis* and *B. longibarbata*, and Zheng (1980) for *B. lancangjiangensis* were used for comparison. Since the holotype of *B. mysorensis* (ZSI Kolkata F13512/1) is not in good condition, information on the morphometry of the holotype was taken from the type description by Hora (1941). Additional data on *B. mysorensis* were obtained from two museum specimens collected near Shivasamudra, the type locality and one comparative material collected from an upper tributary of the Cauvery (please see section on comparative materials).

We performed MANOVA/CVA to differentiate the various *Balitora* species of the Indian subcontinent (Huberty & Olejnik 2006). Multivariate normality of the data was checked using Doornik & Hansen (2008) omnibus and Pillay's trace statistics was performed to find the significant difference between the clusters (Harris 2001). To predict the species using morphometric characters, we constructed decision tree (regression tree) using exhaustive CHAID (Chi-squared Automatic Interaction Detection) algorithm. At each step, CHAID chooses the independent (predictor) variable that has the strongest interaction with the dependent variable. Categories of each predictor are merged if they are not significantly different with respect to the dependent variable (Kass 1980). Statistical analysis was performed in PAST (Hammer et al. 2001) and Tanagra (Rakotomalala 2005).

RESULTS

Balitora jalpalli sp. nov.

(Images 1, 2, 3)

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Material examined

Holotype: ZSI-WRC P/3156, 29.v.2010, 54.2mm SL, Valleparrathodu, near Poochipara, Silent Valley National Park (76°26'11"E & 11°06'47"N; 924m), Palakkad District, Kerala, India, coll. Josin Tharian.

Paratypes: 29.v.2010, 1 ex, 61.7mm SL, same data as holotype, CRG-SAC 2012.6.1; 29.5.2010, 1 ex, 58.1mm SL, same data as holotype, WILD-12-PIS-025.



Image 1. Holotype of *Balitora jalpalli* sp. nov. holotype (ZSI-WRC P/3156) in (a) lateral view, (b) dorsal view and (c) ventral view. Scale bar = 10mm.

Diagnosis

Balitora jalpalli sp. nov. can be distinguished from all known species in the genus *Balitora* based on a combination of characters including ii8-9 ventral fin rays, ix10-11 pectoral fin rays, 66 lateral line scales, nine dark blotches on the dorsal side, caudal peduncle length to caudal peduncle depth ratio (2.3–2.7), anal fin to anus distance (3.3–4.7% SL), least depth of caudal peduncle (6.3–6.7% SL), length of caudal peduncle (15.4–17.2% SL), length of upper caudal lobe (22.1–22.8% SL), maximum head width (67.9–74.1% HL), eye diameter (12.1–14.2% HL), and gape (31.3–31.5% HL).

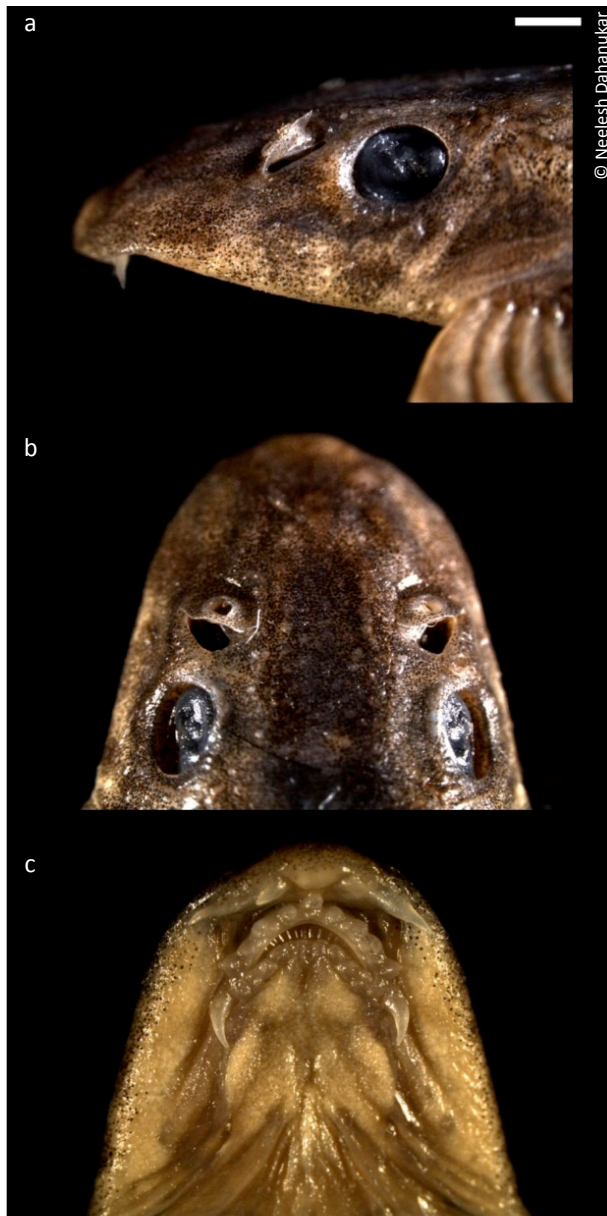
Balitora jalpalli sp. nov. differs from its most closely related species *B. mysorensis* in having a shorter anal fin to anus distance (3.3–4.7% SL vs. 6.9–8.5% SL), deeper caudal peduncle (6.3–6.7% SL vs. 5.1–5.4% SL), longer anal fin base (7.2–7.9% SL vs. 6.2–6.4% SL), wider gape of mouth (31.3–31.5% HL vs. 18.9–20.6% HL), lower

caudal peduncle length to depth ratio (2.3–2.7 vs. 3.0–3.3), more number of dark blotches (9 vs. 7) on the dorsal side where the posterior dorsal blotches in *B. jalpalli* sp. nov. are much wider than the anterior ones as opposed to more or less equally broad dorsal blotches in *B. mysorensis*, and rounded head in *B. jalpalli* sp. nov. as compared to triangular head in *B. mysorensis* (see discussion for more details).

Description

Biometric data are provided in Table 1. General body shape as in Image 1 and details of head as in Image 2. Appendix A provides detailed raw morphometry of the type series.

Head depressed, longer than broad, with tubercles, more prominent on lateral side. Tubercles prominent on cheeks, snout, lateral and ventral surface of head up to base of pectoral fin, a distinct row on dorsal margin of



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Image 2. Holotype of *Balitora jalpalli* sp. nov. holotype (ZSI-WRC P/3156). Lateral (a), dorsal (b) and ventral (c) view of head. Scale bar = 1mm.

orbit. Eyes small, dorso–laterally positioned, not visible from underside of head, closer to operculum than to snout. Snout oblique, rounded. A skin flap divides nares. Mouth inferior, a deep groove between rostral fold and upper lip. Gape of mouth about half of head width at nares. Barbels three pairs, two rostral; outer rostral barbels slightly longer than inner ones; one pair of maxillary barbels, one each at both angle of mouth. Upper lip encircled by two rows of uneven papillae; first row having 8* small papillae positioned continuously end to end, second row having 9* large papillae positioned discontinuously with wide interspaces. Lower lip with 9*

large papillae, two in the middle elongated. Gill opening extending from level of posterior border of eye to mid-point of pectoral-fin base.

Body depressed before dorsal fin origin, compressed posterior to dorsal fin; dorsal profile of body convex, shows rapid increase from snout to nostril, becomes flattened till nape, increases gradually till origin of dorsal fin, decreases gradually till end of caudal peduncle. Lateral line complete, slightly curved towards dorsal surface at the posterior border of pectoral fin. Lateral line scales 64–66*. Ventral profile flat up to anal fin origin, and gradually descends till the end of the caudal peduncle. Chest without scales. Body deepest at dorsal fin origin. Body wider than its depth at both dorsal fin origin and anus.

Dorsal fin origin exactly above pelvic fin origin, closer to tip of snout than to caudal fin base; its outer margin straight. Paired fins horizontally placed. Pectoral fin elongated, longer than head, its origin slightly behind posterior border of eye, its anterior margin thickened and curved, posterior profile straight with large gap between posterior border and pelvic fin origin; with ix* (viii–ix) simple rays and 10* (10–11) branched rays. Eight anterior simple rays of pectoral fin with thick cushion-like longitudinal pads of muscle on the ventral surface. Pelvic fin equal to or slightly shorter than head; fin origin closer to snout tip than caudal peduncle end; with three simple and eight branched rays, last branched ray bifurcated at base and first three anterior rays plaited. Anal fin with three simple and five branched rays with last branched ray bifurcating at base. Caudal fin emarginate, lower lobe longer than upper, lowermost four principal caudal rays tightly associated. Caudal peduncle slender, length 2.3–2.7 times its depth.

Maximum size of *Balitora jalpalli* sp. nov. is 61.7mm SL.

Coloration

In life (Image 3): Yellowish-brown on back with nine saddle shaped dark brown blotches surrounded by yellowish-brown area, behind occiput to base of caudal fin (3 predorsal, 2 sub-dorsal and 4 post-dorsal). Sub-dorsal and post-dorsal blotches spread sideways beyond lateral line. Flanks yellowish-brown, with two rows of black blotches below lateral line, commencing just beneath posterior margin of orbit. Both paired and unpaired fins yellowish-brown with orange reddish tinge along the distal borders. Ventral surface pale yellow to white. Mid lateral row of very irregular dark brown spots between opercle and middle of caudal fin base. Small irregular dark brown blotches scattered randomly

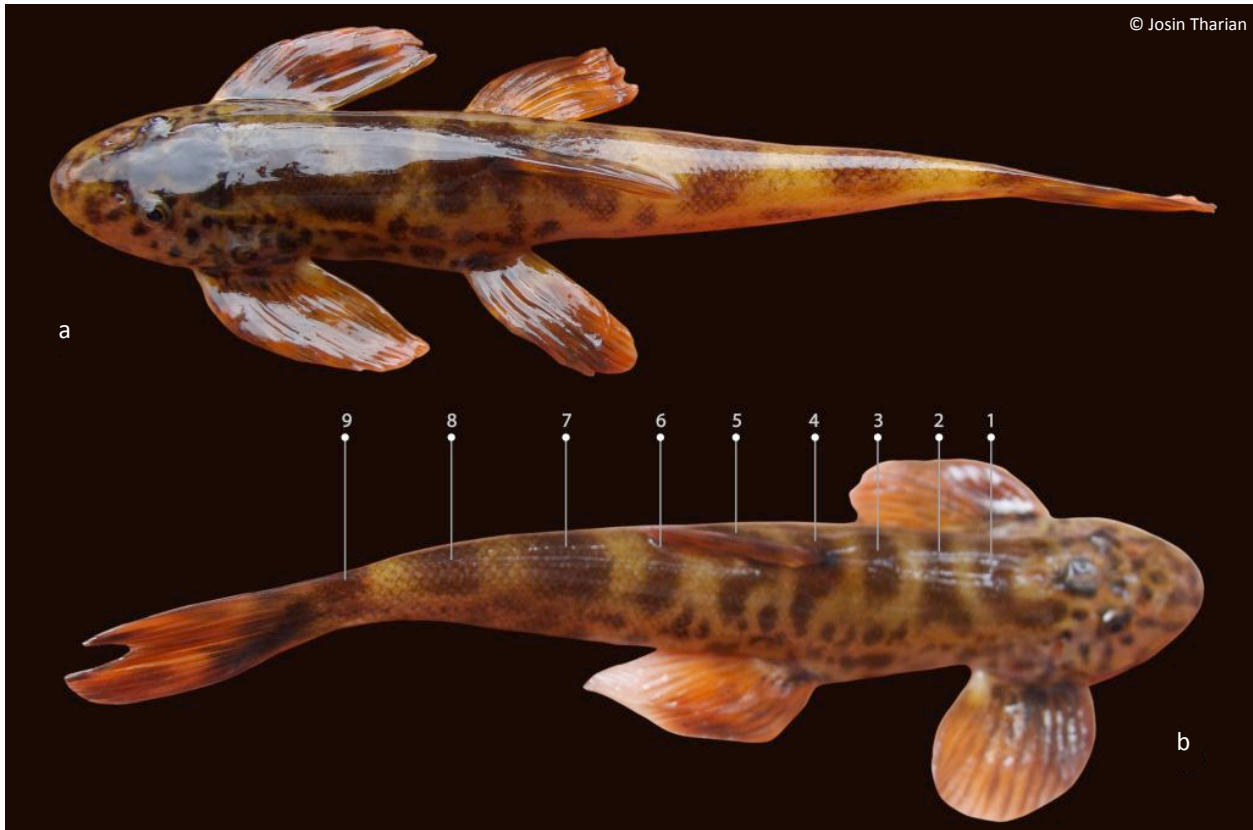


Image 3. (a) Live coloration of *Balitora jalpalli* sp. nov. Holotype ZSI-WRC P/3156 (photographed immediately after collection), and (b) showing the dorsal banding pattern of nine blotches with posterior bands much broader than the anterior ones.

on lateral surface of body below lateral line. Parts of head grayish-brown above, pale yellow below; with irregular brown patches on dorsal surface. Dorsal side of pectoral fin base with 3–4 dark brown spots. Dorsal and anal fins with light brown markings on centre of fin rays which appear as oblique band. Pectoral and pelvic fins with dark brown markings extending from its base to middle of fin rays, hyaline distally. Caudal fin with two wavy dark vertical markings which extends to lower lobe of caudal fin.

In preservative (Image 1) dorsal and lateral sides of the body become dark brown and ventral side turns to creamy white; other parts of the body similar to coloration in life.

Etymology

Specific name “*jalpalli*” is derived from the Sanskrit words “*jal*” meaning ‘water’ and “*palli*” meaning ‘small lizard’. “*Jalpalli*” (literally ‘water lizard’) refers to the lizard like appearance of the fish, and its habit of clinging to the rocks in fast flowing streams. The specific name is a noun in apposition.

Distribution

Balitora jalpalli sp. nov. is currently known only from the type locality in Valleparrathodu, near Poochippara, in the Kunthipuzha, tributary of Bharatapuzha River inside Silent Valley National Park, Kerala, India (Image 4).

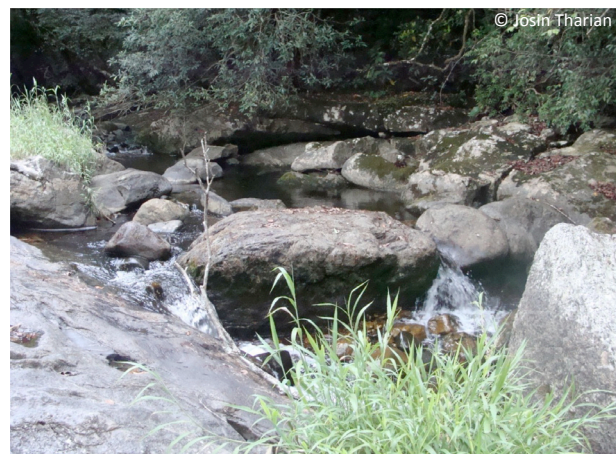


Image 5. Habitat of *Balitora jalpalli* sp. nov. at the type locality.

Table 1. Morphometrics and meristics of *Balitora jalpalli* sp. nov. (holotype and two paratypes), *B. laticauda* (type material), *B. mysorensis* (holotype, two topotypes and one comparative material), *B. brucei* (comparative material) and *B. burmanicus* (syntypes). For detailed data of *B. jalpalli* sp. nov. refer to Appendix A and for photographs of some of the comparative material refer to Appendix B.

Character	<i>Balitora jalpalli</i> sp. nov. (n = 3)		<i>Balitora laticauda</i> (n = 9)		<i>Balitora mysorensis</i> (n = 4)		<i>Balitora brucei</i> (n = 2)		<i>Balitora burmanica</i> (n = 2)	
	Mean (sd)	Range	Mean (sd)	Range	Mean (sd)	Range	ZSI-WRC P/2669	F11092/1	Syntype (F11034/1)	
Morphometric										
Standard length, mm	58.0 (3.8)	54.2–61.7	64.9 (11.4)	48.7–84.4	53.6 (16.3)	38.8–68.3	59.7	84.3	71.9	53.0
Total length, mm	73.3 (5.4)	67.9–78.6	78.3 (12.9)	59.2–98.3	72.7 (19.7)	50–84.7	69.3	Caudal fin damaged	Caudal fin damaged	Caudal fin damaged
%SL										
Head length	21.8 (0.1)	21.6–21.9	20.9 (0.7)	20.1–21.9	21.1 (1.6)	19.6–22.9	19.0	19.0	17.8	19.2
Predorsal length	47.1 (0.6)	46.5–47.7	46.0 (1.2)	43.7–47.4	46.0 (2.6)	44.2–49	43.3	43.2	44.0	44.0
Dorsal to caudal distance	54.4 (1.1)	53.7–55.7	55.6 (1.2)	53.6–57.2	57.0 (1.5)	55.8–58.7	59.3	60.3	58.4	56.8
Prepectoral fin length	14.8 (1.0)	13.7–15.5	14.9 (1.1)	13.0–16.2	16.0 (1.1)	15.1–17.2	12.9	13.0	12.7	13.6
Prepelvic length	46.2 (1.6)	45.2–48.1	46.4 (1.3)	44.4–48.3	46.2 (0.2)	46–46.4	42.9	41.6	44.1	44.7
Preanus length	70.5 (3.7)	66.2–72.8	69.9 (1.5)	68.1–73.1	69.9 (1.7)	68–71.4	70.5	67.5	71.7	69.5
Preanal length	76.8 (2.3)	74.1–78.2	77.3 (1.5)	74.3–79.3	78.2 (1.0)	77.1–79.1	74.8	74.0	78.6	75.3
Ventral to anus distance	27.3 (0.7)	26.7–28	25.1 (1.4)	22.6–27.5	24.2 (1.4)	22.7–25.5	28.2	25.7	27.9	22.5
Anal to anus distance	3.8 (0.8)	3.3–4.7	6.8 (0.6)	5.7–7.8	8.3 (1.3)	6.9–9.5	4.4	6.9	6.3	6.3
Body depth (D)	11.3 (1.3)	9.8–12.1	12.4 (0.7)	11.5–13.4	55.6 (1.6)	53.6–57.3	11.8	11.8	7.1	9.3
Body depth (A)	8.3 (0.3)	7.9–8.5	10.2 (0.8)	9.1–11.4	42.9 (2.5)	40.6–45.6	7.2	9.8	6.4	7.1
Depth of caudal peduncle	6.5 (0.2)	6.3–6.7	7.0 (0.4)	6.3–7.4	5.4 (0.3)	5.1–5.8	5.2	5.3	4.8	5.0
Length of caudal peduncle	16.3 (0.9)	15.4–17.2	17.7 (1.7)	15.0–20.0	17 (1.8)	15.2–19.3	20.7	25.4	18.0	19.4
Body width (D)	17.1 (1.1)	15.8–17.8	18.1 (1.2)	16.3–19.7	16.2 (1.1)	14.8–17.4	15.7	18.9	16.2	15.3
Body width (A)	8.0 (0.4)	7.6–8.4	9.9 (1.2)	8.7–12	8.1 (0.6)	7.6–8.8	7.4	9.8	6.4	6.2
Height of dorsal fin	19.4 (0.4)	19.1–19.9	18.8 (1.2)	16.3–20.5	16.9 (2.8)	13.9–20.6	19.2	Damaged	19.6	19.8
Dorsal fin base	16.1 (0.4)	15.7–16.5	15.1 (0.7)	13.9–16.1	15 (1.8)	13–16.6	13.4	14.4	14.4	15.5
Length of upper caudal lobe	22.5 (0.4)	22.1–22.8	19.1 (1.7)	15.7–21	19.2 (1.8)	17.2–20.7	15.7	Damaged	Damaged	Damaged
Length of lower caudal lobe	25.8 (1.0)	24.7–26.6	21.8 (2.7)	16.1–24.3	25.4 (1)	24.7–26.5	17.1	Damaged	Damaged	Damaged
length of median caudal rays	12.6 (2.3)	10.3–14.8	14.1 (1.4)	12.3–16.5	12.2 (1.8)	11–14.3	13.9	Damaged	Damaged	Damaged
Height of anal fin	14.3 (0.8)	13.6–15.1	12.6 (1.1)	11.3–13.9	13.6 (3.1)	11.3–18	11.3	Damaged	13.6	17.9
Anal fin base	7.4 (0.4)	7.2–7.9	6.2 (0.6)	5.2–7.3	6.2 (0.3)	5.9–6.4	4.3	3.4	6.6	6.7
Length of pelvic fin	23.5 (4.0)	21.2–28.1	21.5 (1.2)	19.3–23.7	21.5 (1)	20.6–22.9	20.4	21.0	22.4	21.8
Length of pectoral fin	26.3 (2.0)	24.2–28.1	26.2 (1.6)	24.1–28.9	25 (1)	23.9–26.3	26.0	26.2	26.7	25.9
%HL										
Dorsal head length	96.9 (2.0)	95.4–99.2	99.0 (5.5)	91.3–109.4	98.4 (5.3)	92.4–102.3	102.5	-	-	-
Gape of mouth	31.4 (0.1)	31.3–31.5	23.1 (3.0)	16.9–27.1	21.4 (2.9)	18.9–24.6	30.5	30.1	27.3	27.5

Table 1. Continued from previous page

Character	<i>Balitora jalpalli</i> sp. nov. (n = 3)		<i>Balitora laticauda</i> (n = 9)		<i>Balitora mysorensis</i> (n = 4)		<i>Balitora brucei</i> (n = 2)		<i>Balitora burmanica</i> (n = 2)	
	Mean (sd)	Range	Mean (sd)	Range	Mean (sd)	Range	ZSI-WRC P/2669	F11092/1	Syntype (F11034/1)	
Head depth at eye	34.6 (1.7)	32.6-35.7	37.5 (1.8)	34.5-39.6	38.8 (1.9)	36.8-40.5	31.8	-	-	-
Maximum head depth	41.1 (2.5)	38.6-43.6	44.4 (2.4)	40.9-47.3	44.2 (1.4)	42.3-45.5	43.5	36.8	38.4	33.3
Snout length	58.7 (2.3)	56.1-60.3	56.5 (3.0)	52.7-61.8	60.9 (1.2)	59.8-62.1	60.8	59.6	57.0	55.5
Head width (at nares)	63.1 (4.6)	57.9-66.6	69.1 (4.0)	63.6-75.2	62.3 (1.9)	60.3-64	70.9	-	-	-
Maximum head width	70.9 (3.1)	67.9-74.1	86.5 (6.0)	77.7-93.3	75.2 (3.9)	70.8-79.4	88.8	92.7	82.2	83.5
Eye diameter	13.1 (1.1)	12.1-14.2	15.3 (2.7)	10.8-20.7	14.8 (2.2)	13.3-18	15.2	13.5	14.1	10.8
Interorbital width	37.2 (0.6)	36.6-37.7	39.8 (3.7)	33.7-45.4	35.1 (1.7)	32.6-36.2	41.9	46.6	44.0	42.3
Meristic										
D	iii 8		iii7-8		iii8-9		iii8	Damaged	iii8	iii8
A	ii 5		iii5		ii5		i5	Damaged	i5	i5
P	ix 10-11		viii-ix 10-11		viii-ix 10-12		ix 11	ix 11	ix 11	ix 11
V	ii 8-9		ii8-9		ii8-9		ii 9	ii 9	ii8	ii8
L.l.	66		66-68		68-69		69	65	70	72
LL to ventral	6-8		6-9		6		8	6	5	5
LL to dorsal	9-11		8-9		9		8	9	6	6
Predorsal scales	20-21		19-25		21		24	23	18	17

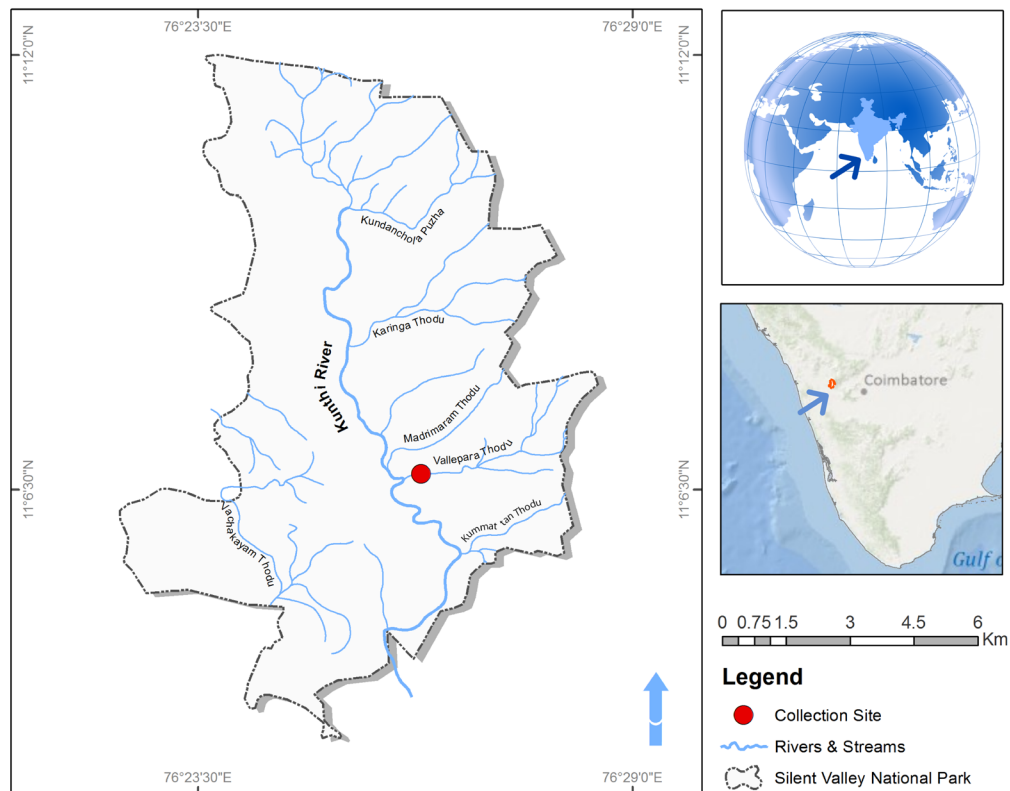


Image 4. Distribution of *Balitora jalpalli* sp. nov. in the Silent Valley National Park



Image 6. Comparison between (a–c) *Balitora jalpalli* sp. nov. (Paratype, CRG-SAC 2012.6.1) and (d–f) *B. mysorensis* (comparative material, CRG-SAC 2012.51.01). Note the more rounded head in *B. jalpalli* sp. nov. as compared to more triangular head in *B. mysorensis*, which is more prominent in the ventral profiles. Scale bar = 10mm.

Habitat

The type locality in Valleparathodu, is a high altitude stream (3–4 m width and 30–50 cm depth) with riffle-pool habitat (Image 5), where the co-occurring species were *Bhavana australis*, *Homaloptera pillai*, *Mesonoemacheilus remadevii* and *Garra menoni*.

Common name

We suggest ‘Silent Valley Stone Loach’ as common

name for this species.

Statistical analysis

Five species, *Balitora jalpalli* sp. nov., *B. laticauda*, *B. mysorensis*, *B. brucei* and *B. burmanica*, for which the morphometric data were collected by the authors, were used for statistical analysis. Only a subset of size-adjusted characters, viz., head length, body depth at dorsal fin origin, depth of caudal peduncle, length

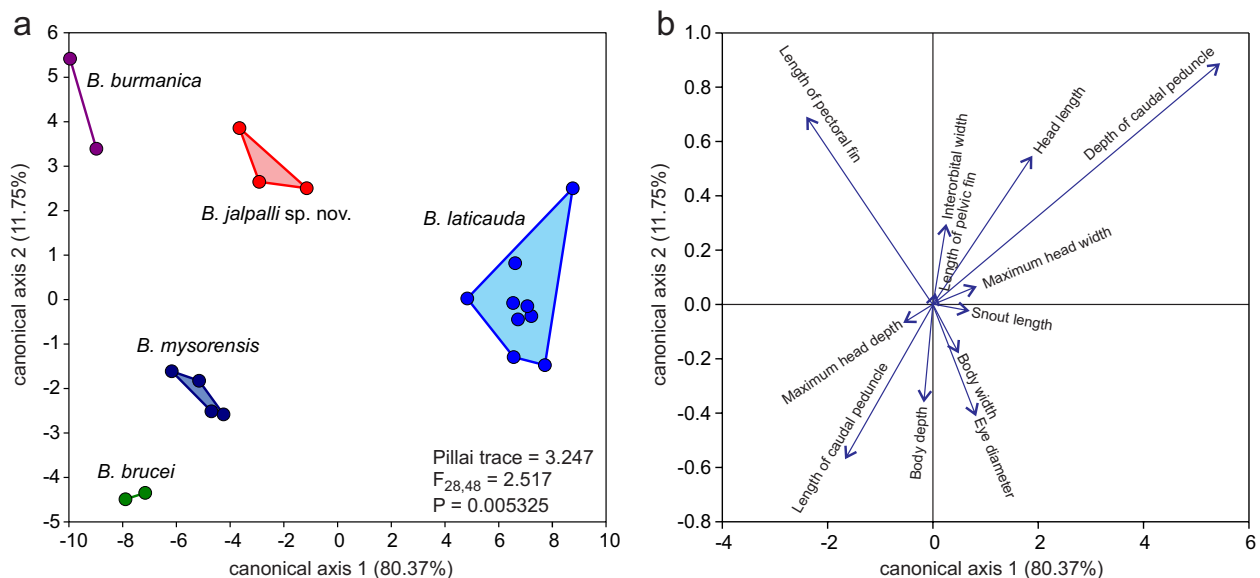


Figure 1. MANOVA/CVA analysis of the five species of *Balitora* from Indian subcontinent. (a) CVA scatter plot and (b) CVA factor loadings.

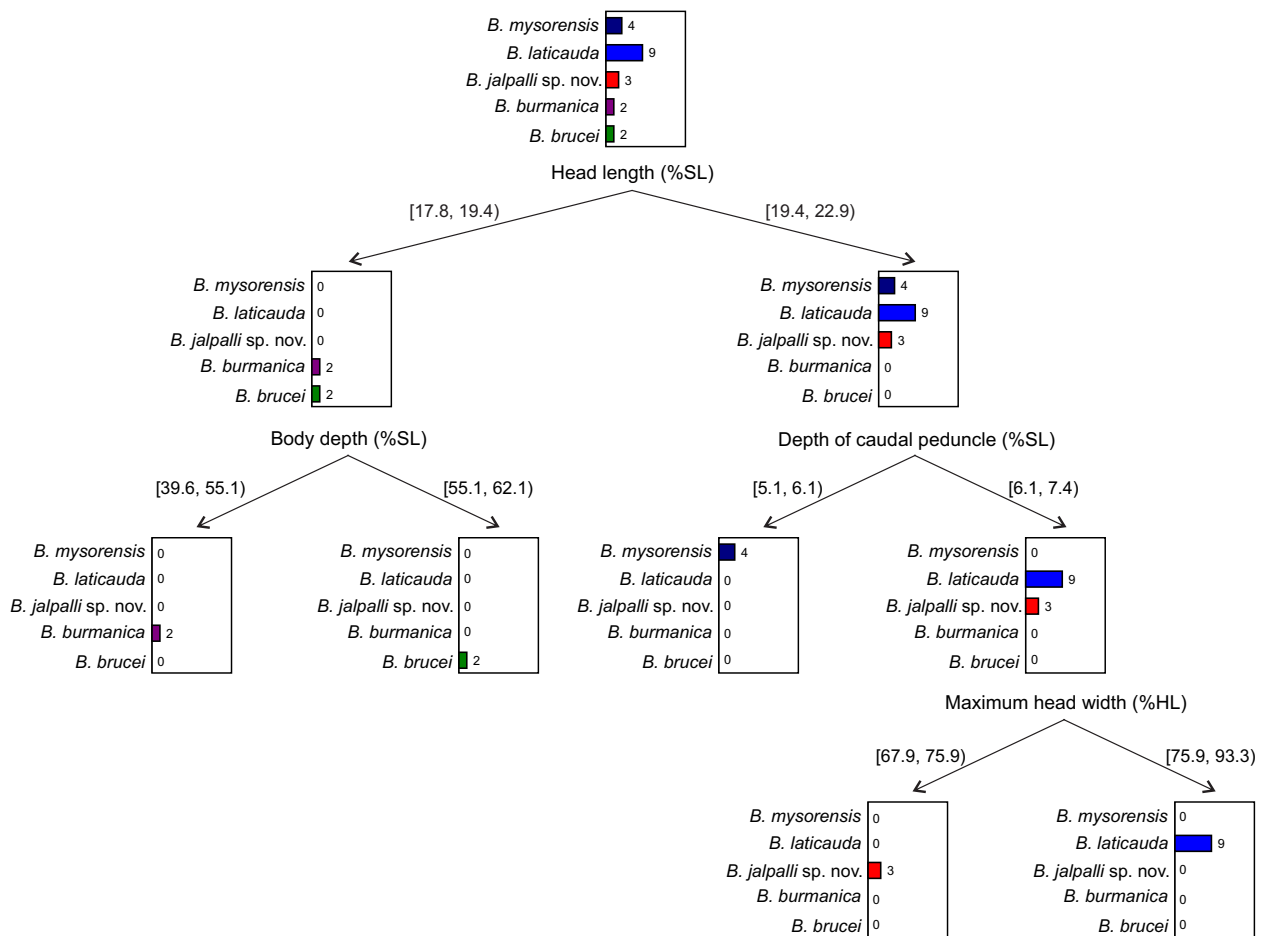


Figure 2. Decision tree using exhaustive CHAID (Chi-squared Automatic Interaction Detection) algorithm for differentiating five species of *Balitora* from Indian subcontinent. Frequency refers to number of individuals studied. Head length, body depth and depth of caudal peduncle are expressed as %SL and maximum head width as %HL.

of caudal peduncle, body width at dorsal fin origin, length of pelvic fin, length of pectoral fin, maximum head depth, snout length, maximum head width, eye diameter and interorbital width, could be used as data for only these characters were available for all comparative material. The null hypothesis that the data are normally distributed was not rejected (Doornik and Hansen omnibus, $E_p=32.63$, $P=0.1121$) indicating that the data showed multivariate normality. MANOVA/CVA of the data (Fig. 1) showed that the five species formed separate clusters (Pillai trace = 3.502, $F_{28,48} = 3.247$, $P = 0.005325$). CHAID analysis revealed that these five species can be separated from each other based on head length, caudal peduncle depth, maximum head width and body depth at dorsal fin origin (Fig. 2).

DISCUSSION

Balitora is currently represented by 11 or 12 species (see Kottelat 2012). Among the Indian species, *Balitora brucei* Gray, 1830 is distributed in the north and north-east, *B. mysorensis* Hora, 1941 in the Cauvery River system and *B. laticauda* Bhoite et al., 2012 in the Krishna River system. Other species in this genus *B. eddsi* Conway & Mayden, 2010 is known from Nepal, *B. burmanica* Hora, 1932 from Myanmar, *B. annamitica* Kottelat, 1988 from Cambodia, *B. meridionalis* Kottelat, 1988 from Thailand. *Balitora lancangjiangensis* (Zheng, 1980), *B. ludongensis* Liu & Chen, 2012, *B. nantingensis* Chen et al., 2005 from China. Substantial differences between all the species and *Balitora jalpalli* sp. nov. justify the erection of the new taxa.

Balitora jalpalli sp. nov. differs from its geographically most closely related species *B. mysorensis* in having a longer pre-dorsal length (46.5–47.7 % SL vs. 44.2–44.7

% SL), longer ventral to anus distance (26.7–28 % SL vs. 24.4–25.5 % SL), shorter anal fin to anus distance (3.3–4.7 % SL vs. 6.9–9.5 % SL), deeper caudal peduncle (6.3–6.7 % SL vs. 5.1–5.4 % SL), longer upper caudal lobe (22.1–22.8 % SL vs. 17.2–19.6 % SL), longer anal fin base (7.2–7.9 % SL vs. 6.2–6.4 % SL), wider gape of mouth (31.3–31.5 % HL vs. 18.9–20.6 % HL), lower head depth at eye (32.6–35.7 % HL vs. 39–40.5 % HL) and lower caudal peduncle length to depth ratio (2.3–2.7 vs. 3.0–3.3). It also possesses more number of dark blotches (9 vs. 7) on the dorsal side. The posterior dorsal blotches in *B. jalpalli* sp. nov. are much wider than the anterior ones (Image 3b) as opposed to more or less equally broad dorsal blotches in *B. mysorensis*. Further, both *B. jalpalli* sp. nov. and *B. mysorensis* form distinct clusters in MANOVA/CVA (Fig. 1). The most prominent morphometric character that separates *B. jalpalli* sp. nov. from *B. mysorensis* is the depth of caudal peduncle (Fig. 2) and the meristics is the lesser number of lateral line scales (Table 1). Another prominent character that separates *B. jalpalli* sp. nov. from *B. mysorensis* is more rounded head in *B. jalpalli* as compared to more triangular head in *B. mysorensis* (Image 6). Apart from these morphological differences, it is essential to note that *B. jalpalli* sp. nov. is recorded from west flowing river system while *B. mysorensis* is known from east flowing river system of the Western Ghats. The records of *B. mysorensis* from the West flowing rivers of the Western Ghats are not backed by voucher specimens. We strongly believe that these records are erroneous and may represent additional undescribed species within this genus.

Balitora jalpalli sp. nov. differs from the other peninsular Indian species *B. laticauda* based on a combination of characters including a shorter anal fin to anus distance (3.3–4.7 % SL vs. 5.7–7.8 % SL), lesser body depth at anal fin (7.9–8.5 % SL vs. 9.1–11.4 % SL), lesser body width at anal fin (7.6–8.4 % SL vs. 8.7–12.0 % SL), longer upper caudal lobe (22.1–22.8 % SL vs. 15.7–21.0 % SL), longer lower caudal lobe (24.7–26.6 % SL vs. 16.1–24.3 % SL) wider gape of mouth (31.3–31.5 % HL vs. 16.9–27.1 % HL) and lesser head width (67.9–74.1 % HL vs. 77.7–93.3 % HL). *Balitora jalpalli* sp. nov. possesses lesser number of dorsal blotches (9 vs. 10) compared to *B. laticauda*. The posterior dorsal blotches in *B. jalpalli* sp. nov. are much wider than the posterior ones as opposed to more or less equally broad dorsal blotches in *B. laticauda*. *Balitora jalpalli* sp. nov. and *B. laticauda* form distinct clusters in MANOVA/CVA (Fig. 1). The most prominent character that separates *B. jalpalli* sp. nov. from *B. laticauda* is the maximum head width (Fig. 2).

Balitora jalpalli sp. nov. can be further differentiated

from the north and northeastern Indian species *B. brucei*, with the most prominent character of longer head (Fig. 2) and other combination of characters including higher maximum head depth (8.35–9.56 % SL vs. 6.6–8.0 % SL), higher depth of caudal peduncle (6.3–6.7 % SL vs. 5.1–5.8 % SL), narrower maximum head width (14.8–16.2 % SL vs. 17.2–20.5 % SL), longer upper caudal lobe (22.1–22.8 % SL vs. 16.1–19.3 % SL), shorter median caudal rays (10.3–14.8 % SL vs. 15.6–21.1 % SL), longer height of anal fin (13.6–15.1 % SL vs. 9.7–12.7 % SL) and lesser caudal peduncle length to depth ratio (2.3–2.7 vs. 3.2–4.0).

Balitora jalpalli sp. nov. differs from *B. burmanica* found in the Irrawady, Tennasserim and Salween basins in Myanmar and the Chindwin basin in Manipur, based on longer upper caudal lobe (22.1–22.8 % SL vs. 17.7–20.2 % SL), lower caudal peduncle length to depth ratio (2.3–2.7 vs. 3.0–4.0) and more lateral line scales (66 vs 62–65). Further, both *B. jalpalli* sp. nov. and *B. burmanica* form distinct clusters in MANOVA/CVA (Fig. 1), and can be distinguished from each other based on the head length (Fig. 2).

Balitora jalpalli sp. nov. differs from *B. eddsi* found in the Karnali river drainage in south-western Nepal, based on characters including higher preanal length (74.1–78.2 % SL vs. 68.5–70.1 % SL), higher depth of caudal peduncle (6.3–6.7 % SL vs. 5.4–5.7 % SL), smaller length of caudal peduncle (15.4–17.2 % SL vs. 22.0–23.2 % SL), higher body width at dorsal (15.8–17.8 % SL vs. 11.4–12.0 % SL), higher height of dorsal fin (19.1–19.9 % SL vs. 16.8–17.9 % SL), higher length of pelvic fin (21.2–28.1 % SL vs. 12.8–14 % SL), higher length of pectoral fin (24.2–28.1 % SL vs. 19.6–21.7 % SL) and lower caudal peduncle length to depth ratio (2.3–2.7 vs. 4.1–4.2).

Balitora jalpalli sp. nov. differs from *B. annamitica* found in the Mekong basin, based on characters including lesser body depth at dorsal (9.8–12.1 % SL vs. 13.0–13.6 % SL), lesser head width (14.8–16.2 % SL vs. 17.1–18.5 % SL), higher caudal peduncle length to depth ratio (2.3–2.7 vs. 1.9–2.2) and more number of lateral line scales (66 vs. 61–62). *Balitora jalpalli* sp. nov. differs from *B. meridionalis*, a species found in the Chan River basin of northern Thailand, based on lesser pre anus length (66.2–72.8 % SL vs. 73.2–75.2 % SL), lesser head width (14.8–16.2 % SL vs. 17.4–18.2 % SL), lesser length of median caudal rays (10.3–14.8 % SL vs. 15.5–16.4 % SL) and more number of lateral line scales (66 vs. 62–64).

Balitora jalpalli sp. nov. has a number of morphological characters that differentiates it from the Chinese species of *Balitora*. *Balitora jalpalli* sp. nov. from *B. kwangsiensis* in having smaller eye (12.1–14.2 % HL vs. 19.7–21.4 % HL), lower head depth to head width ratio in proportion

to HL (43.4–51.4 % vs. 57.5–64.9 %), lower head width to body width ratio in proportion to HL (68.3–79.1 % vs. 88.9–117.8 %) and lower body depth to body width ratio in proportion to HL (50.6–54.1 % vs. 82.3–89.0 %). *Balitora jalpalli* sp. nov. from *B. lancangjiangensis* with higher body length to body depth ratio (8.3–10.2 vs. 5.9–6.7), higher head length to head depth ratio (2.3–2.6 vs. 1.7–2.0) and higher head length to eye diameter ratio (12.0–14.2 % HL vs. 17.5–20.0 % HL). *Balitora jalpalli* sp. nov. differs from *B. longibarbata* with less number of lateral line scales (66 vs. 74–76), lesser head width (67.9–74.1 % HL vs. 89.2–101.9 % HL), lower head width to body width ratio (68.3–79.1 % HL vs. 86.4–97.4 % HL) and lower body depth to body width ratio (50.6–54.1 % HL vs. 71.8–90.3 % HL). *Balitora jalpalli* sp. nov. can be distinguished from *B. ludongensis* based on lower body depth at dorsal (9.8–12.1 % SL vs. 15.0–19.5 % SL), lower maximum head depth (38.6–43.6 % HL vs. 51.2–67.2 % HL), lower head depth to head width ratio (43.4–51.4 % HL vs. 64.3–78 % HL) and lower body depth to body width ratio (50.6–54.1 % HL vs. 80.7–96.4 % HL). *Balitora jalpalli* sp. nov. differs from *B. nantingensis* in characters including smaller eye (12.1–14.2 % HL vs. 15.6–25.0 % HL), shorter anal fin length (32.7–36.2 % HL vs. 52.6–71.4 % HL) and more number of lateral line scales (66 vs. 59–64). *Balitora jalpalli* sp. nov. differs from *B. nujiangensis* in a most prominent character that the pectoral fins does not surpass pelvic fin base.

Other than *B. jalpalli* sp. nov., two other species of *Balitora* have been recorded from the rivers of Kerala. While *B. mysorensis* has been recorded from the rivers Kabini (Gopi 2000; Easa & Shaji 2003), Bhavani (Easa & Basha 1995; Easa & Shaji 2003; Kurup et al. 2004), Bharathapuzha (Kurup et al. 2004), Periyar (Menon 1987) and Achankovil (Kurup & Radhakrishnan 2006), there is also a record of *B. brucei* from the Achankovil River (Kurup et al. 2004). We however believe that this record of *B. brucei* by Kurup et al. (2004) is erroneous, as the same authors have listed *B. mysorensis* from Achankovil but not *B. brucei*, in various papers published two years later (Euphrasia et al. 2006; Kurup & Radhakrishnan 2006). There are also no voucher specimens available to validate and verify this record. As mentioned earlier, we believe that *B. mysorensis* is restricted in distribution to the east flowing Cauvery drainage and records from the west flowing rivers may comprise of yet to be described species.

The Silent Valley National Park from where *B. jalpalli* sp. nov. was collected is drained by two river systems, the west flowing Bharatapuzha and the east flowing Bhavani. There is no record till date of any species of *Balitora*

collected from the west flowing streams inside Silent Valley. While Kurup et al. (2004) has listed *B. mysorensis* as occurring in river Bharatapuzha, the collection site was mentioned as Mannarkad, which is located well outside the National Park limits. Easa & Basha (1995), Easa & Shaji (2003) and Kurup et al. (2004) mention collecting *B. mysorensis* from the east flowing Bhavani River. Easa & Basha (1995) recorded *B. mysorensis* from two sites in Bhavani River, Sinkaparathodu and Keralamedu. In their field guide to the fishes of Kerala, Easa & Shaji (2003; p. 59–60) mention that the *B. mysorensis* they collected from Bhavani and Kabini rivers has 64–65 scales on the lateral line. Measurements of the holotype and topotypic material of *B. mysorensis* (see Table 1) indicates that the species has a lateral line scale count of 68–69. In addition, Easa & Shaji (2003) mention that the specimens of *B. mysorensis* they collected have six blotches along the dorsum and the lateral line (vs. seven in the holotype and topotypes of *B. mysorensis*). As there is no information stating whether voucher specimens pertaining to the above studies (Easa & Basha 1995; Easa & Shaji 2003; Kurup et al. 2004) are available in registered collections, it is difficult to validate these records. Also, in spite of detailed field surveys both in the Bharatapuzha and Bhavani rivers including the locations surveyed by previous workers, we did not encounter any species of *Balitora* other than those observed in Valleparathodu, the type locality of *B. jalpalli* sp. nov.

Linnean shortfall (most species are still not formally described), especially in biodiversity hotspots, hinder the progress in conservation planning (Bini et al. 2006). This is especially true regarding the Western Ghats of India, which harbor a rich diversity of freshwater fishes, many of which are endemic to this zoogeographical region (Dahanukar et al. 2004, 2011). On the one hand while new species are still being described from the Western Ghats (Krishnakumar et al. 2011; Bhoite et al. 2012; Britz et al. 2012a,b,c), on the other, the rich diversity of freshwater fishes in this region is under threat due to several anthropogenic stressors (Dahanukar et al. 2011). The description of one more species of freshwater fish from the Western Ghats reiterate our views that the ichthyofauna of the region continues to be poorly known and is in need of increased exploratory surveys and associated taxonomic research (Dahanukar et al. 2011; Raghavan et al. 2012).

Comparative material

Balitora mysorensis: Holotype: ZSI Kolkata F13512/1, Sivasamudram (approx. 12.294°N & 77.168°E, 530m), Mysore, India, B.S. Bhimachar; CRG-SAC 2012.51.01, 1

ex., Siruvani, Palakkad (10.967°N & 76.641°E, 911m), Kerala, India, Anvar Ali et al.; ZSI-WRC P/3056, 2 ex, Shivasamudra falls near Tirumakudalu Narasipura (12.219°N & 76.953°E), Mysore District, Karnataka, India, R. Kumar.

Balitora laticauda: Holotype: ZSI-WRC P/2848, Venegaon Village near Krishna River bridge (17.499°N & 74.118°E, 590m), Satara District, Maharashtra, India, Sunil Bhoite; Paratypes: ZSI Pune P/2849–2850, 2 ex, Venegaon Village near Krishna River bridge (17.499°N & 74.118°E, 590m), Satara District, Maharashtra, India, Sunil Bhoite; ZSI Pune P/2851, 2 exs, Nagthane village on Urmodi River (17.568°N & 74.053°E, 606m), Satara District, Maharashtra State, India, Sunil Bhoite; WILD-12-PIS-019, 1 ex, Venegaon village near Krishna River bridge (17.499°N & 74.118°E, 590m), Satara District, Maharashtra, India, Sunil Bhoite. ZSI Pune P/3058, 1 ex, Nagthane village on Urmodi River (17.568°N & 74.053°E, 606m), Satara District, Maharashtra State, India, Sunil Bhoite; ZSI Pune P/3057, 2 ex, Khodashi Village below Khodshi Dam (17.308°N & 74.167°E, 562m), Krishna River, in Satara District, Maharashtra State, India, Madhavi Chavan.

Balitora brucei: ZSI Kolkata F11092/1, 1 ex, Nongpiomg stream below Cherrapunji (approx. 25.298°N & 91.699°E, 1436m), Khasi Hills, Assam, S.L. Hora; ZSI-WRC P/2669, 1 ex, Jim Corbet National Park (approx. 29.576°N & 78.819°E, 560m), Uttarakhand, S. Chikane; Additional information from Kottelat (1988).

Balitora burmanica: Syntypes, ZSI Kolkata F11034/1, 2 exs, Meekalan (approx. 16.117°N & 98.418°E, 136m), Myanmar, specimens donated by Genoa Museum; Additional information from Kottelat (1988).

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Appendix A. Morphometrics and meristics of *Balitora jalpalli* sp. nov. holotype and two paratypes.

Characters	Holotype (ZSI-WRC P/3156)	Paratype (CRG-SAC 2012.6.1)	Paratype (WILD-12- PIS-025)
Morphometric data (mm)			
Standard length	54.2	61.7	58.1
Total length	67.9	78.6	73.4
Head length	11.8	13.5	12.6
Pre-dorsal length	25.2	29.1	27.7
Dorsal fin origin to caudal fin origin distance	29.1	33.3	32.4
Pre-pectoral fin length	8.3	9.6	8.0
Pre-ventral fin length	24.5	29.7	26.4
Pre-anus length	35.9	44.8	42.3
Pre-anal fin length	40.1	48.1	45.4
Ventral fin origin to anus distance	14.7	16.5	16.3
Anal fin origin to anus distance	1.8	2.9	1.9
Body depth dorsal fin origin	5.3	7.4	7.0
Body depth anus	4.3	5.3	4.9
Depth of caudal peduncle	3.4	4.1	3.9
Length of caudal peduncle	9.3	10.0	8.9
Body width at dorsal fin origin	8.6	10.8	10.3
Body width at anus	4.1	5.2	4.6
Height of dorsal fin	10.8	11.8	11.2
Dorsal fin base	8.5	9.9	9.6
Length of upper caudal lobe	12.4	14.0	12.9
Length of lower caudal lobe	14.4	16.1	14.4
Length of median caudal rays	8.0	6.4	7.3

Characters	Holotype (ZSI-WRC P/3156)	Paratype (CRG-SAC 2012.6.1)	Paratype (WILD-12- PIS-025)
Height of anal fin	8.2	8.4	8.3
Length of anal fin base	4.3	4.4	4.2
Length of pelvic fin	11.5	13.1	16.3
Length of pectoral fin	13.1	16.5	16.3
Dorsal head length	11.4	13.4	12.0
Gape of mouth	3.7	4.3	4.0
Head depth at eye	4.2	4.8	4.1
Maximum head depth	4.9	5.9	4.9
Snout length	6.6	8.1	7.6
Head width (at nares)	6.8	9.0	8.2
Maximum head width	8.0	10.0	8.9
Eye diameter	1.7	1.8	1.5
Interorbital width	4.3	5.1	4.7
Meristics			
Dorsal fin rays	iii8	iii8	iii8
Anal fin rays	ii5	ii5	ii5
Pectoral fin rays	ix10	ix11	ix10
Ventral fin rays	ii9	ii8	ii9
Lateral line scales	66	66	66
Scales between lateral line and ventral fin origin	6	8	7
Scales between lateral line and dorsal fin origin	9	11	10
Pre-dorsal scales	21	20	21

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Appendix B. Photographs of some comparative material used in the study. (a) *Balitora laticauda* holotype (ZSI-WRC P/2848), (b) *B. mysorensis* (ZSI-WRC P/3056), (c) *Balitora brucei* (ZSI Kolkata F11092/1) and (d) *B. burmanicus* syntype (ZSI Kolkata F11032/1). Scale bar = 10mm.

