Osteobrama bhimensis (Cypriniformes: Cyprinidae): a junior synonym of *O. vigorsii*

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Author Contribution: SSJ and ND put forth the concept. SSJ, MP and ND collected the data, analyzed the data and wrote the paper.

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Abstract: *Osteobrama bhimensis* (Singh & Yazdani) was described from the Ujani wetland on Bhima River in Maharashtra, India, about 100 km downstream of the type locality of *O. vigorsii* (Sykes). Based on examination of the type material of *O. bhimensis* and comparison with *O. vigorsii* collected from different localities in the Krishna and Godavari River systems, we show that *O. bhimensis* is conspecific with *O. vigorsii*.

Keywords: Conspecific, junior synonym, *Osteobrama bhimensis*, *Rohtee vigorsii*.

INTRODUCTION

Sykes (1839) described *Rohtee vigorsii* (now *Osteobrama*) from the Bhima River at Pairgaon (approx. 18.506^{0}N & 74.704^{0}E). Although the types of this species are missing (Eschmeyer & Fricke 2011), Sykes (1841) provided a clear illustration of the species and gave an adequate description for purposes of identification. The species is widely distributed in the Krishna, Godavari and Mahanadi river systems of peninsular India and is common throughout its range (Dahanukar 2011). Singh & Yazdani (1992) described *Osteobrama bhimensis* from the Ujani Wetland on Bhima River, about 100km downstream of the type locality of *O. vigorsii*. *Osteobrama bhimensis* has since been considered a valid species by most authors (e.g., Menon 1999; Jayaram 2010). Even though Singh & Yazdani (1992) considered *O. bhimensis* to be closely related to *O. cotio*, owing to the lack of barbels, their figure of *O. bhimensis* resembles *O. vigorsii* more than it does *O. cotio*. Singh & Yazdani (1992) did, however, mention the similarity between *O. bhimensis* and *O. vigorsii* and sought to distinguish the two species through a number of characters (discussed below).

Recently we had an opportunity to study all the type material, comprising the holotype and five paratypes, of *O. bhimensis* currently in the collection of the Zoological Survey of India, Western Regional Centre, Pune. We compared the type material of *O. bhimensis* with specimens of *O. vigorsii* from the Krishna and Godavari river systems. Our study suggests that *O. bhimensis* and *O. vigorsii* are conspecific.

METHODS

Data collection

The type material of *Osteobrama bhimensis*, comprising of the holotype and five paratypes, was available in the fish collection of the

Zoological Survey of India, Western Regional Centre, Pune (ZSI Pune). Specimens of *O. vigorsii* and *O. cotio peninsularis* were available in the Wildlife Information Liaison Development, Coimbatore (WILD) and ZSI Pune. Morphometric and meristic data were recorded following Jayaram (2010). Measurements were taken point to point using dial calipers to the nearest hundredth of an inch and then converted to millimetres. Subunits of the body are presented as a percent of standard length (SL) and subunits of the head are presented as a percent of head length (HL). All pored scales were counted for reporting the lateral lines scales. We dissected three specimens of *O. vigorsii* (P/2671, 110mm SL; P/2672, 105mm SL and P/2673, 128mm SL) to resolve the structure of the urohyal bone.

Material examined

Osteobrama bhimensis: Holotype, 06.ix.1989, Bhima River, Saha Village (approx. 18.133^{0}N & 75.093^{0}E), Indapur Taluka, Pune District, Maharashtra, coll. D.F. Singh (ZSI Pune P/1235). Paratypes, 5 ex., collection data same as holotype (ZSI Pune P/1236).

Osteobrama vigorsii: 1 ex., WILD-11-PIS-017, Mula-Mutha River at Yerawada (18.542^{0}N & 73.877^{0}E), collected on 14.i.2011 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2670, Bhima River at Koregaon-Bhima (18.647^{0}N & 74.054^{0}E), collected on 25.v.2011 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2672, Mula-Mutha River at Yerawada (18.542^{0}N & 73.877^{0}E), collected on 07.i.2011 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2673, Krishna River at Wai (17.956^{0}N & 73.879^{0}E), collected in March 2011 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2671, Nira River at Bhor (18.153^{0}N, 73.843^{0}E), collected in December 2009 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2674, Wasumbre tank (approx. 17.298^{0}N, 74.579^{0}E) in Sangli District, collected on 16.vi.1979 by A.S. Mahabal; 1 ex., ZSI Pune P/2676, Mutha River at Warje (18.481^{0}N, 73.816^{0}E), collected on 24 February 1999 by N. Dahanukar; 1 ex., ZSI Pune P/2675, Mula River at Aundh (18.568^{0}N & 73.811^{0}E), collected on 02.vi.1999 by N. Dahanukar; 2 ex., unregistered, Bhima River at Kollakur (17.086^{0}N & 76.764^{0}E), collected on 10.v.2011 by Varsha Mysker; 3 ex., ZSI Pune P/2105, Godavari River at Kaigaon (approx. 19.624^{0}N, 75.026^{0}E) in Gangapur Taluka, Aurangabad, collected on 13.x.1999 by P.P. Kulkarni.

Osteobrama cotio peninsularis: 1 ex., WILD-11-PIS-015, Mula-Mutha River at Yerawada (18.542^{0}N & 73.877^{0}E), collected on 07.i.2011 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2595, Indrayani River at Markal (18.673^{0}N & 73.984^{0}E), collected during 2009–2010 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2443, Nira River at Bhor (18.153^{0}N & 73.843^{0}E), collected on 01.i.2011 by N. Dahanukar & M. Paingankar; 1 ex., ZSI Pune P/2684, Mula River at Paud (18.529^{0}N & 73.611^{0}E), collected on 08.vi.2011 by N. Dahanukar & M. Paingankar; 3 ex., ZSI Pune P/2685, Mula-Mutha River at Yerawada (18.543^{0}N & 73.879^{0}E), collected on 16.vi.2011 by N. Dahanukar & M. Paingankar.

RESULTS AND DISCUSSION

One of the most important characters that Singh & Yazdani (1992) used for diagnosing *Osteobrama bhimensis* was the absence of barbels. Our study of the type material of *O. bhimensis* revealed that the holotype and all the paratypes of *O. bhimensis* do in fact possess a pair of rudimentary maxillary barbels (Image 1), a character state also present in *O. vigorsii*.

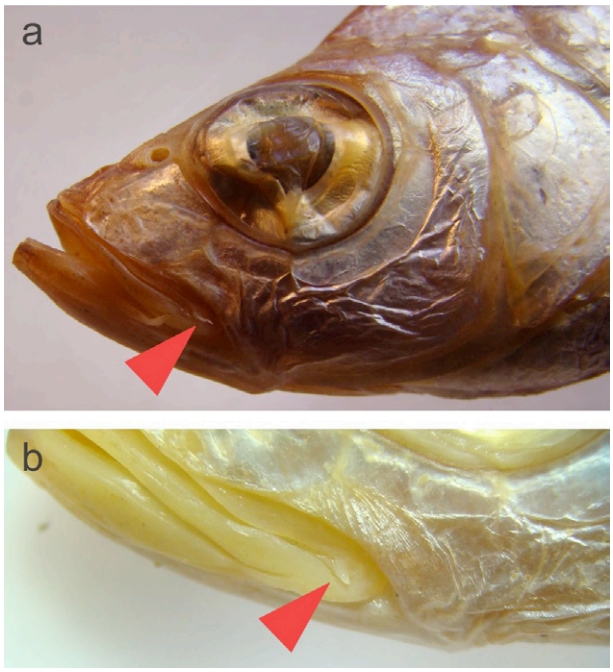


Image 1. Rudimentary maxillary barbels in *Osteobrama bhimensis* (a) holotype (ZSI Pune P/1235) and (b) one of the paratypes (ZSI Pune P/1236).

Indeed, if the character state 'barbels present' were applied to specimens of *O. bhimensis* using Singh & Yazdani's (1992) own key, the species keys out as *O. vigorsii*.

Singh & Yazdani (1992) suggested that *O. bhimensis* is related to *O. cotio* and compared it with two subspecies of *O. cotio*, namely *O. cotio cotio* and *O. cotio cunma*. Even though these authors did not explicitly mention why they consider *O. bhimensis* to be affined to *O. cotio*, it appears they considered the absence of barbels in *O. bhimensis* to be synapomorphic in the *O. bhimensis*-*O. cotio* group. Our data, however, does not suggest a closer relationship between *O. bhimensis* and *O. cotio* than that between the former species and *O. vigorsii*, for two reasons. First, the holotype and all the paratypes of *O. bhimensis* do possess rudimentary barbels (Image 1). Second, the morphometric and meristic data of *O. bhimensis* do not coincide substantially with *O. cotio*, an observation that was also made by Singh & Yazdani (1992). Interestingly, Singh & Yazdani (1992) did not compare *O. bhimensis* with *O. cotio peninsularis* described by Silas (1952) from Poona [= Pune], which is close to the type locality of *O. bhimensis*. Our comparison suggests that *O. bhimensis* differs from *O. cotio peninsularis* in a number of characters including ii22–ii24 (vs. ii27–ii32 in *O. c. peninsularis*) anal fin rays, 26-30 (vs. 17–18) predorsal scales, 72–79 (vs. 55–56) lateral-line scales and head length 26.0–28.3 % SL (vs. 22.3–24.0 % SL).

The type material of *O. bhimensis* and the figure given in Singh & Yazdani (1992, fig. 1), however, is consistent with Sykes' (1842) description and figure of *O. vigorsii*, a species very widely distributed across the Krishna and Godavari river systems of the north-central part of the peninsular India. A comparison of the morphometric data of the type series of *O. bhimensis* with the material of *O. vigorsii* referred to herein, from a number of locations across the Krishna River and Godavari basins (Fig. 1), suggests that

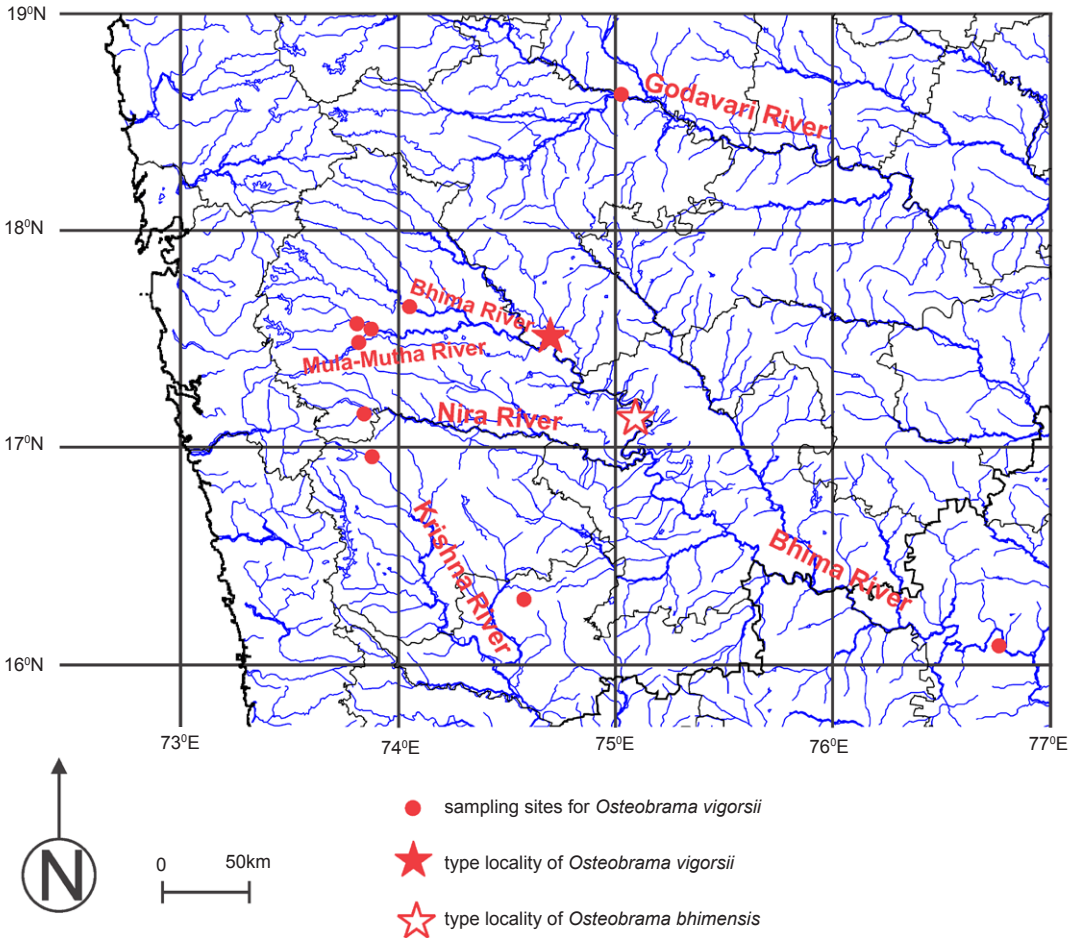


Figure 1. Study area showing sampling sites and type localities of *Osteobrama vigorsii* and *O. bhimensis*.

Table 1. Comparison of ranges of morphometric and meristic data of the type series of *Osteobrama bhimensis* (ZSI Pune P/1235 and ZSI Pune P/1236, total 6 specimens) and the 13 specimens of *O. vigorsii* listed in Material Examined.

Character	*Osteobrama bhimensis* (N=6)	*Osteobrama vigorsii* (N=13)
Morphometrics		
Total length (mm)	168–270	123–190
Standard length (mm)	135–212	96.4–147
As a percentage of SL		
Body depth	30.0–33.1	30.6–35.6
Head length	26.0–28.3	24.4–28.7
Predorsal length	52.0–54.6	50.2–54.8
Dorsal to caudal length	50.9–53.5	50.1–57.5
Distance between pectoral and ventral	15.7–17.9	15.8–18.4
Distance between ventral to anal fin	19.1–22.1	17.4–38.9
Pectoral to anal distance	34.3–39.5	33.9–40.8
Preanal length	60.4–63.1	56.7–63.2
Caudal peduncle length	16.4–19.2	15.0–19.7
Caudal peduncle depth	10.4–11.2	10.3–11.7
As a percentage of HL		
Snout length	23.0–26.8	25.3–30.6
Eye diameter	26.9–30.2	23.9–30.7
Interorbital width	21.7–23.6	19.7–26.4
Meristics		
Predorsal scales	26–30	26–28
Lateral line scales	72–79	75–78
Scale rows between lateral line and base of pelvic fin	11–11½	11–11½
Scale rows between lateral line and origin of dorsal fin	13–15	13–14
Dorsal fin rays	I,8	I,8
Pectoral fin rays	i,13–i,14	i,13–i,14
Ventral fin rays	i,8–i,9	i,8–i,9
Anal fin rays	ii,22–ii,24	ii,22–ii,23

the morphometric and meristic data of *O. bhimensis* substantially overlap with those of *O. vigorsii* (Table 1, Appendix A, B). Further, comparison of images of the types of *O. bhimensis* with those of *O. vigorsii* from a variety of sources, and the illustration of Sykes (1841) iteself, shows a remarkable resemblance (Image 2).

Although Singh & Yazdani (1992) were aware of the resemblance between *O. bhimensis* and *O. vigorsii*, they separated the former from the latter based on the absence of barbels (vs. presence), 13–17 transverse scale rows between lateral line and pelvic fin base (vs. 11–11½), the possession of 24–32 predorsal scales (vs. 33–37), and the structure of urohyal. As already mentioned, the entire type series of *O. bhimensis* possesses rudimentary maxillary barbels, a character state shared with *O. vigorsii*. Although Singh & Yazdani (1992, Table 2) mention the number of transverse scale rows between lateral line and pelvic fin base as 13-15, we count 11 or 11½ (Table 1), which is the same range also for *O. vigorsii* (Hora & Misra 1940; Singh & Yazdani 1992; see also Table 1). The predorsal scales of *O. bhimensis* and *O. vigorsii* also have overlapping ranges (Table 1).

An additional difference that Singh & Yazdani (1992) used to differentiate *O. bhimensis* from *O. vigorsii* was the shape of the urohyal. This is a single median triradiate bone with the anterior tip connected to the ventral hypohyals, the antero-dorsal part of which is connected to the first basibranchial and the posterior part of which is connected to the pectoral girdle by means of muscles (Johal et al. 2000). The shape of the urohyal of *O. vigorsii* (Image 3) matches

Image 2. *Osteobrama bhimensis* and *O. vigorsii*. (a) *Osteobrama bhimensis* holotype (ZSI Pune P/1235, 138mm SL), (b) *O. bhimensis* paratype (ZSI Pune P/1236, 143mm SL), (c) *O. vigorsii* from Bhima River at Koregaon-Bhima (ZSI Pune P/2670, 110mm SL), (d) *O. vigorsii* from Nira River at Bhor (ZSI Pune P/2671, 110mm SL), (e) *O. vigorsii* from Bhima River at Kollakur (unregistered, 126mm SL) and (f) original drawing of *O. vigorsii*, reproduced laterally inverted, from Sykes (1841).

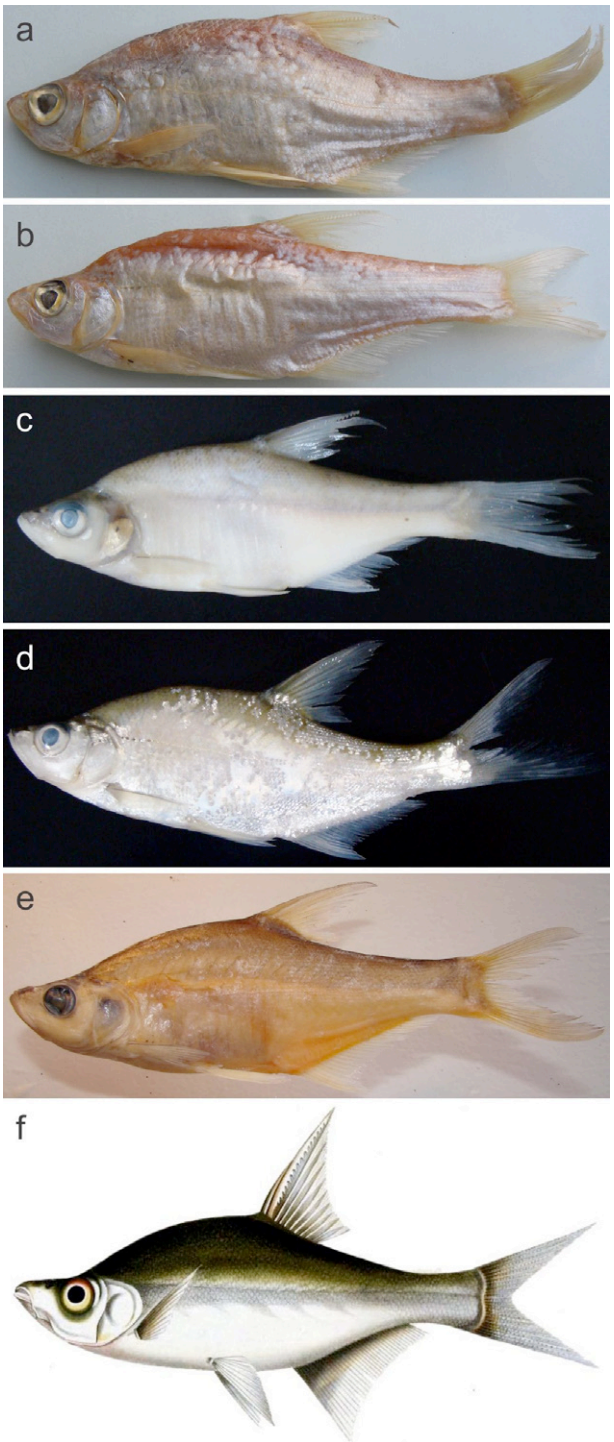
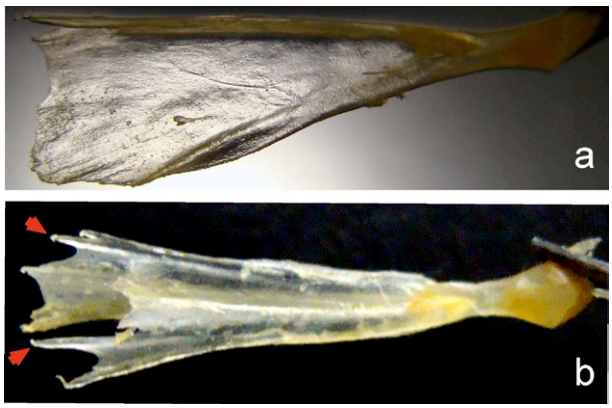


Image 3. Urohyal bone (ZSI Pune P/2683) of *Osteobrama vigorsii* (P/2673, 128mm SL). (a) Lateral view and (b) dorsal view.



that of *O. bhimensis* as illustrated in fig. 2 of Singh & Yazdani (1992). Singh & Yazdani (1992) suggested that the urohyal of *O. vigorsii* exhibits a radial process on the vertical plate, which is absent in *O. bhimensis*. However, in the three specimens of *O. vigorsii* we dissected, there is no such radial process (note that in Image 3a the thickened area on the lower surface is merely an undulation, not a process). Further, Singh & Yazdani (1992) mention that the dorsal spread ends in equal wings in *O. bhimensis*, while it ends in unequal wings in *O. vigorsii*. Our specimens of *O. vigorsii* show the dorsal spread to end in two equal wings (Image 3b). Therefore, the difference between the urohyals of *O. bhimensis* and *O. vigorsii* mentioned by Singh & Yazdani (1992) do not, in fact, exist. We did not dissect any of the type specimens of *O. bhimensis*. However, it is important to note that even though Singh & Yazdani (1992) mentioned that they studied the urohyal bone of *O. bhimensis* and *O. vigorsii*, they omitted to mention which specimens were used for their study. It is clear that none of the types of *O. bhimensis* have been dissected or cleared and stained.

The present study shows, therefore, that all the differences stated by Singh & Yazdani (1992) as distinguishing *O. bhimensis* from *O. vigorsii* do not in fact exist: the two nominal species are in fact conspecific and, *O. vigorsii* being the senior one, is valid, while *O. bhimensis* must now be placed in its synonymy.

Dahanukar (2010) assessed the IUCN conservation status of *Osteobrama bhimensis* as Endangered under criteria B1ab(iii)+2ab(iii) (IUCN 2001) owing to the

Appendix A. Morphometric and meristic data of type material of *Osteobrama bhimensis*.

Character	Holotype (ZSI Pune P/1235)	Paratypes (ZSI Pune P/1236)				
		#1	#2	#3	#4	#5
Morphometric						
Total length (mm)	173	270	178	182	171	168
Standard length (mm)	138	212	146	143	137	135
As a percentage of SL						
Body depth	30.1	31.7	31.5	33.1	31.3	30.0
Head length	26.4	26.0	28.0	28.3	27.3	26.6
Predorsal length	52.0	53.4	52.9	54.6	54.6	54.4
Dorsal to caudal length	53.3	52.4	50.8	53.5	51.2	51.3
Distance between pectoral and ventral	17.9	16.9	15.7	17.2	16.8	17.2
Distance between ventral to anal fin	20.5	19.7	19.0	20.8	22.1	21.3
Pectoral to anal distance	39.5	36.5	34.3	37.3	35.9	38.8
Preanal length	61.5	60.8	60.4	62.3	63.1	62.9
Caudal peduncle length	18.2	18.3	17.5	18.0	16.4	19.2
Caudal peduncle depth	11.0	11.0	10.3	11.1	11.2	11.0
As a percentage of HL						
Snout length	24.7	24.3	26.4	26.9	23.3	22.8
Eye diameter	30.1	27.0	26.9	29.6	27.5	28.1
Interorbital width	22.5	21.9	21.8	23.0	23.5	22.0
Meristic						
Predorsal scales	27	28	30	27	27	26
Lateral line scales	74	79	75	72	74	75
Scales between lateral line and pelvic fin	11.5	11.5	11.5	11.5	11.5	11
Scales between lateral line and dorsal fin	13	14	14	14	15	14
Dorsal fin rays	I,8	I,8	I,8	I,8	I,8	I,8
Pectoral fin rays	i,14	i,14	i,14	i,14	i,13	i,14
Ventral fin rays	i,8	i,9	i,9	i,8	i,9	i,9
Anal fin rays	ii,22	ii,22	ii,23	ii,22	ii,24	ii,23

fact that the species is known only from its type locality in the Ujani wetland, with an Extent of Occurrence of 260km^2 and threats to the habitat and the species due to increasing urbanization, agricultural pollution and invasive exotic fishes. Dahanukar (2010) also noted the need to validate the taxonomy of this nominal species because of its remarkable similarity to *O. vigorsii*. In the current study we have established that *O. bhimensis* is not a valid species but a junior subjective synonym of *O. vigorsii*.

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Appendix B. Morphometric and meristic data of *Osteobrama vigorsii* from Krishna and Godavari river systems. Krishna river system: Ml - Mula River (ZSI Pune P/2675); Mt - Mutha River (ZSI Pune P/2676); MM1 - Mula-Mutha River (WILD-11-PIS-017); MM2 - Mula Mutha River (ZSI Pune P/2672); BK - Bhima River at Koregaon (ZSI Pune P/2670); N - Nira River at Bhor (ZSI Pune P/2671); BKo1 - Bhima River at Kollakur (unregistered); BKo2 - Bhima River at Kollakur (unregistered); Kr - Krishna River at Wai (ZSI Pune P/2673), S - Wasumbre tank in Sangli District (ZSI Pune P/2674). Godavari river system: 3 examples, Godavari River at Kaigaon (ZSI Pune P/2105).

Character	Krishna river system										Godavari river system		
	Ml	Mt	MM 1	MM 2	BK	N	BKo 1	BKo 2	Kr	S	#1	#2	#3
Morphometric													
Total length (mm)	136	161	156	133	141	146	159	190	164	139	123	125	139
Standard length (mm)	113	123	122	105	110	110	126	147	128	110	96.4	98.2	110
As a percentage of SL													
Body depth	32.1	30.6	34.3	35.0	34.6	33.5	34.0	34.4	34.5	34.3	33.7	34.0	35.6
Head length	27.3	27.4	26.2	25.6	26.7	27.6	27.0	28.7	27.3	26.1	25.2	25.1	24.4
Predorsal length	53.4	51.1	53.4	52.0	54.8	53.7	51.7	54.0	54.6	53.2	50.5	50.2	52.9
Dorsal to caudal length	53.6	50.8	51.9	53.0	52.6	55.7	52.4	53.9	55.2	50.1	56.7	54.7	57.5
Distance between pectoral and ventral	16.7	17.7	17.5	18.4	16.7	18.4	16.3	16.5	16.3	16.7	16.9	15.8	17.0
Distance between ventral to anal fin	20.8	38.9	21.2	19.9	22.6	19.2	20.0	20.7	20.9	20.4	17.8	17.4	18.4
Pectoral to anal distance	35.7	36.6	37.5	36.3	38.0	34.5	40.8	36.4	37.0	38.4	35.7	35.6	33.9
Preanal length	61.1	62.5	60.1	61.2	62.0	61.3	63.2	61.8	61.8	61.2	59.4	56.7	57.5
Caudal peduncle length	16.4	18.1	16.7	16.7	19.7	18.4	16.6	15.9	19.0	15.0	18.1	15.7	15.6
Caudal peduncle depth	10.9	10.8	11.3	11.2	11.1	10.3	11.0	11.6	11.6	11.1	11.1	10.5	11.0
As a percentage of HL													
Snout length	28.0	27.8	28.1	27.7	28.7	28.4	29.2	25.3	30.3	30.6	30.6	29.1	28.1
Eye diameter	29.0	30.7	28.3	28.5	28.2	25.0	25.4	24.7	27.8	25.7	27.1	25.9	23.9
Interorbital width	19.7	19.7	25.9	22.4	22.6	23.1	26.4	23.6	21.4	21.8	21.9	23.7	26.1
Meristic													
Predorsal scales	28	28	27	27	26	27	27	28	28	28	26	27	28
Lateral line scales	78	76	75	78	75	76	75	77	77	78	76	77	77
Scales between lateral line and pelvic fin	11	11	11.5	11.5	11.5	11	11	11	11	11	11	11	11
Scales between lateral line and dorsal fin	14	14	13	13.5	13.5	13.5	14	14	14	14	13.5	13.5	13.5
Dorsal fin rays	I,8	I,8	I,8	I,8	I,8	I,8	I,8	I,8	I,8	I,8	I,8	I,8	I,8
Pectoral fin rays	i,14	i,14	i,13	i,14	i,14	i,14	i,14	i,14	i,14	i,14	i,14	i,14	i,14
Ventral fin rays	i,8	i,8	i,8	i,9	i,9	i,9	i,9	i,9	i,9	i,8	i,8	i,8	i,8
Anal fin rays	ii,23	ii,23	ii,23	ii,23	ii,22	ii,22	ii,23	ii,23	ii,22	ii,23	ii,23	ii,23	ii,23

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