



## *Hemimyzon luae*, a new species of balitorid fish (Teleostei: Balitoridae) from the Tzengwen River basin, southern Taiwan

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### Abstract

The new balitorid fish was collected in the Tzengwen river basin from southern Taiwan. The new species, *Hemimyzon luae* n. sp. can be well distinguished from other congeneric species by following combination of features: (1) dorsal fin rays 3 + 8; pectoral fin rays 11–12 + 9–11 (total 20–22; modally 22); (2) pelvic fin moderate large, extending to rear vertical of dorsal fin, pelvic simple rays modally 3 which fewer than any other endemic ones of Taiwan; (3) lateral-line scales 68–72 (modally 70); predorsal scales 39–42 (modally 40); (4) the position of anus with much larger distance of pelvic rear tip to anus about 2.4–3.2 times of that of anus to anal fin origin and (5) specific coloration: dorsum of body and head olive brown to greenish brown; predorsal region deep brown with several rounded or oblong cloudy deep brown patches; lateral body uniformly olive brown to deep brown; and pectoral, pelvic and anal fins pale white with deep brown rays. The morphological comparison of congeners and the diagnostic key of Taiwanese species would be also provided in this paper.

**Key words:** *Hemimyzon*, new species, Balitoridae, fish fauna, Taiwan

### Introduction

The freshwater and estuarine fish fauna of Taiwan has been reviewed by Chen and Fang, 1999. There are at least 224 freshwater and brackish fish species recorded in Taiwanese waters. Among them, there are three genera with 6 valid, endemic nominal species of balitorid loaches: *Formosania lacustre* (Steindachner, 1908); *Hemimyzon formosanus* (Boulenger, 1894); *Hemimyzon taitungensis* Tzeng & Shen, 1982; *Hemimyzon sheni* Chen & Fang, 2009; *Sinogastromyzon puliensis* Liang, 1974; and *Sinogastromyzon nantaiensis* Chen et al., 2002 (Shen 1993; Chen & Fang 1999; Chen & Chang 2005; Chen & Fang 2009).

Up to 2021–2022, many comprehensive fish collections of hill stream survey which have been conducted from the Kaoping river basin originating from southern slope of the Yushan mountain Ridge, Taiwan and the new balitorid fish describing as *Hemimyzon yushanensis* Chen, Harefa, Chang & Han, 2022.

More recently, an undescribed species of *Hemimyzon* were collected from the hill stream of Tzengwen River basin during our field survey for the different river basins around the Yushan National Park, Central Taiwan. The aim of this paper is to document the new species. Its morphological comparison with congeners and artificial key to all nominal species in Taiwan would be also addressed.

## Materials and methods

Type specimens were collected by hand-net. Other comparative, congeneric specimens were collected by casting-net or electro-fishing. The counts and measurement generally followed those of Kottelat and Chu (1988) and Doi and Kottelat (1998), except the anal fin base length followed Chen et al. (2002). Abbreviation used: NTOUP, the Pisces collection of National Taiwan Ocean University, Keelung; and NTUM, National Taiwan University, Taipei. Other comparative materials listed in the Appendix I.

## Systematics

### *Hemimyzon* **Regan, 1911**

(Type species, *Homaloptera formosana* Boulenger, 1894)

### *Hemimyzon luae* new species

(盧氏間爬岩鰍)

(Figs. 1–2)

## Materials examined

**Holotype.**—NTOUP-2022-10-361, 72.4 mm SL, coll. I-S. Chen, coll. Oct. 22 2022, Alishan District, Tzengwen River basin, Tainan City, Taiwan.

**Paratypes.**—NTOUP-2022-10-362, 9 specimens, 57.8–71.6 mm SL, the collection data same as holotype.

## Diagnosis

The new species can be well distinguished from other congeneric species by following combination of features: (1) dorsal fin rays 3 + 8; pectoral fin rays 11–12 + 9–11 (total 20–22; modally 22); (2) pelvic fin moderate large, extending to rear vertical of dorsal fin, pelvic simple rays modally 3 which fewer than any other endemic ones of Taiwan; (3) lateral-line scales 68–72 (modally 70); predorsal scales 39–42 (modally 40); (4) the position of anus with much larger distance of pelvic rear tip to anus about 2.4–3.2 times of that of anus to anal fin origin; and (5) specific coloration: dorsum of body and head olive brown to greenish brown; predorsal region deep brown with several rounded or oblong cloudy deep brown patches; lateral body uniformly olive brown to deep brown; and pectoral, pelvic and anal fins pale white with deep brown rays.

## Description

The morphometrics of this new species as percentages of standard length are listed in Table 1 and meristic features are listed in Table 2. Head and body very strongly depressed with flat ventral side anteriorly. Posterior trunk from anus to caudal peduncle rather compressed. See Table 1 for morphometric characters. Head with a few tiny tubercles. Upper lip with 9–12 small papillae; no distinct papillae on lower lip except a pair of somewhat crescent projections on inner side. Four rostral barbels and two barbels at both corners of mouth which anterior one similar to length of posterior one. The length of anterior barbels smaller than that of the eye diameter. Interorbital region rather wide. Gill-opening small and very restricted, merely extending above anterior origin of pectoral fin. The location of anus is closer to anal fin origin, with large distance of rear tip of pelvic fin to anus about 2.4–3.2 times to that of anus to anal fin origin.

Dorsal fin 3+8; anal fin 2+5; pectoral fin 11–12 + 9–11 (total rays 20–22; modally 22); pelvic fin 3–4 + 8–9 (simple rays modally 3; branched rays modally 8; total rays 11–13 modally 11). Origin of dorsal fin behind origin of pelvic fin origin. Pectoral fin rather large, its rear margin extending beyond origin of pelvic fin. Pelvic fin well

separate, the gap between the attachment of their innermost rays about 2.0–2.5 times of eye diameter; its rear margin extending to the rear tip of dorsal fin when depressed. Caudal fin forked, its lower lobe always longer than upper one.



**FIGURE 1.** *Hemimyzon luae*, holotype, NTOUP-2022-12-361, 72.4 mm SL, upper: dorsal view; middle: lateral view; lower: ventral view; Alishan, Tzengwen River basin, Tainan City, Taiwan, ROC.

**TABLE 1.** Morphometry of *Hemimyzon luae* from southern Taiwan.

Type	H	P	P	P	P
SL (mm)	72.4	68.8	71.2	70.0	71.6
Lateral head length	23.5%	23.4%	22.1%	23.8%	21.3%
Dorsal head length	21.7%	21.2%	21.5%	21.9%	21.0%
Ventral head length	12.3%	14.2%	12.9%	13.9%	12.9%
Head width	18.7%	20.2%	20.3%	19.5%	19.6%
Snout length	13.1%	13.9%	13.8%	13.5%	13.0%
Eye diameter	3.0%	4.4%	2.8%	3.2%	3.0%
Interorbital length	10.6%	11.2%	11.0%	10.1%	10.1%
Mouth width	10.8%	10.0%	10.1%	9.9%	10.7%
Body width at pectoral fin origin	18.9%	19.8%	18.7%	19.9%	19.3%
Body width at pelvic fin origin	22.9%	26.2%	26.5%	25.6%	24.6%
Body depth at dorsal fin origin	14.2%	17.7%	16.3%	14.8%	16.6%
Caudal peduncle length	12.5%	13.5%	14.8%	11.0%	10.8%
Caudal peduncle depth	9.5%	11.0%	9.9%	10.0%	10.8%
Length of last simple pectoral fin rays	16.0%	18.9%	17.9%	19.2%	14.2%
Pectoral fin length	33.0%	36.4%	32.8%	35.2%	32.6%
Pelvic fin length	27.2%	28.0%	26.9%	27.4%	24.8%
Length of upper caudal fin lobe	23.7%	26.6%	23.1%	22.7%	22.8%
Length of lower caudal fin lobe	28.1%	27.6%	24.3%	27.6%	24.6%
Distance between pelvic fin bases	8.8%	8.5%	7.9%	8.0%	8.6%
Predorsal length	48.9%	55.3%	50.7%	51.1%	51.0%
Prepectoral length	16.1%	17.0%	16.5%	16.7%	16.9%
Distance between pelvic and pectoral fins	20.8%	31.5%	29.6%	31.6%	29.4%
Anal fin base	6.0%	7.4%	7.1%	6.8%	7.7%
Anus to A origin	3.6%	3.8%	3.7%	3.6%	3.7%
Anus to Rear V	8.9%	9.0%	10.6%	9.0%	12.0%
Anus to Rear V / Anus to A origin	2.45	2.35	2.88	2.49	3.23

H: Holotype; P: Paratype.

Dorsal part of body with very small cycloid scales. Larger specimens with reduced, smaller size of predorsal scales. Ventral region between the paired fins naked. Body scales slightly larger posteriorly. Lateral-line scales 69–72 (modally 70) and predorsal scales 39–32 (modally 40).

### Coloration in fresh

Dorsum of body and head olive brown to greenish brown. Predorsal region olive brown to deep brown with several rounded or oblong cloudy deep brown patches with lighter margin. Lateral body uniformly olive brown to deep brown. Ventral side unique pale creamy white. Dorsal fin pale white with deep brown rays with about 2–3 rows of indistinct deep brown spots. Pectoral, pelvic and anal fins pale white with deep brown rays. Caudal fin with broad black outer margin with 3–4 oblique, zigzag creamy white streaks.

**TABLE 2** Comparison of distribution frequency of meristic features from five endemic nominal species of *Hemimyzon* in Taiwan.

Species	Pectoral fin																			
	Simple rays						Branched rays						total rays							
	10	11	12	13	14	M	9	10	11	12	13	M	20	21	22	23	24	25	26	M
<i>H. luae n. sp.</i>	<b>1</b>	<b>10</b>	<b>3</b>	-	-	<b>11.1</b>	<b>1</b>	<b>7</b>	<b>6</b>	-	-	<b>10.4</b>	<b>1</b>	<b>5</b>	<b>8</b>	-	-	-	-	<b>21.5</b>
<i>H. formosanus</i>	1	19	12	-	-	11.3	7	18	7	-	-	10.0	1	19	12	-	-	-	-	21.3
<i>H. sehni</i>	-	-	-	3	-	13.0	-	-	5	-	-	11.0	-	-	-	-	3	-	-	24.0
<i>H. taitungensis</i>	-	-	1	7	4	13.3	-	-	1	8	3	12.2	-	-	-	-	-	7	5	25.4
<i>H. yushanensis</i>	-	11	7	2	-	11.6	4	15	1	-	-	9.9	-	-	13	7	-	-	-	22.4

Species	Dorsal fin					Pelvic fin																
	Branched rays			Simple rays					Branched rays					total rays								
	7	8	M	3	4	5	6	7	M	8	9	10	11	M	11	12	13	14	15	16	17	M
<i>H. luae n. sp.</i>	-	<b>7</b>	<b>8.0</b>	<b>12</b>	<b>2</b>	-	-	-	<b>3.1</b>	<b>9</b>	<b>5</b>	-	-	<b>8.4</b>	<b>9</b>	<b>3</b>	<b>2</b>	-	-	-	-	<b>11.5</b>
<i>H. formosanus</i>	16	-	7.0	-	16	16	-	-	4.5	-	20	12	-	9.4	-	-	4	27	1	-	-	13.9
<i>H. sehni</i>	-	3	8.0	-	3	-	-	-	4.0	-	-	3	-	10.0	-	-	-	3	-	-	-	14.0
<i>H. taitungensis</i>	-	6	8.0	-	-	-	8	6	6.5	-	-	6	6	10.5	-	-	-	-	-	-	12	17.0
<i>H. yushanensis</i>	-	10	8.0	-	16	3	1	-	4.3	-	6	14	-	9.7	-	-	2	17	1	-	-	14.0

Species	Lateral line scales																					
	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	M
<i>H. luae n. sp.</i>	<b>2</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>3</b>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<b>70.1</b>
<i>H. formosanus</i>	1	8	9	6	5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70.5
<i>H. sehni</i>	-	-	-	-	-	-	-	-	-	-	1	2	1	-	-	-	-	-	-	-	-	79.0
<i>H. taitungensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	4	2	2	1	85.4
<i>H. yushanensis</i>	-	5	6	4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70.5

Species	Predorsal scales																					
	0	-	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	41	42	M
<i>H. luae n. sp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<b>1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>40.7</b>
<i>H. formosanus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	6	7	3	-	-	-	-	-	36.8
<i>H. sehni</i>	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	31.5
<i>H. taitungensis</i>	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
<i>H. yushanensis</i>	-	-	1	3	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	27.1

## Distribution

The new species *Hemimyzon luae* is merely found from the type locality of upper reaches of Tzengwen River basin, Taiwan. It may be only found in the Tzengwen River basin, not occurring in others.

## Etymology

The specific name, *luae* is named after the President of Yushan National Park - S.F. Lu, for the honor of her kindly supporting the ecological conservation and biodiversity research and also for all her great contribution for the National Park.



**FIGURE 2.** Ventral view of mouth structure of *Hemimyzon luae*, holotype, 72.4 mm SL, NTOUP-2022-10-361, Alishan District, Tzengwen River basin, Tainan City.



**FIGURE 3.** Alive specimen of *Hemimyzon luae*.

## Discussion

In the taxonomy of *Hemimyzon*, four nonimal species were documented in mainland China (Yue 2000) while recorded two endemic species of Taiwan (Tzeng & Chen 1982; Shen 1993) before 2000. After then, Chen and Fang (2009) described *Hemimyzon sheni* from eastern Taiwan added the third endemic species to Taiwan. More recently, Chen, Harefa, Chang & Han (2022) described the fourth species—*Hemimyzon yushanensis* from southern Taiwan. After the current new species accounted, the island river basins with 5 endemic species of Taiwan which is top diversity rather than others of mainland China. Even the disjunction of geographical distribution of Taiwan and mainland China, we still consider the Chinese species may be convergent adaptation to fast running waters but not directly belonging to true defined *Hemimyzon* species of Taiwan. The more detailed morphological evidence might be needed to clarify the whole generic limitation of the genus.

The new species *Hemimyzon luae* would be the new discovery of species boundary geographically separating the *Hemimyzon formosanus* and *Hemimyzon yushanensis*. Since their high endemicity in Taiwanese waters, the new species *H. luae* established, this species can be merely found from hill tributaries of the Tzengwen River basin in Tainan City. *H. yushanensis* can be found at least from Kaoping River basins in Kaohsiung City as well as Pingtung County. Therefore, the update, true range of *H. formosanus* would be more restricted to further northern regions as all river basins from the Ilan County, Taipei City, New Taipei City, Taoyuan City, Shinchu County, then southward to Charyi City which mainly in the western slope of Central Mountain Ridge. *H. taitungensis* can be seen from 3 main larger river basins from Hualian to Taitung County. *H. sheni* can only be seen in Tarchu river basin of Taitung County. Among them, all of them share allopatric distribution pattern without range overlapping.

Among the four congeneric, endemic species of Taiwan, about the differentiation of dorsal fin rays, there are apparently two groups of *Hemimyzon* in Taiwan. One group is dorsal fin rays 3+7 which now merely seen in wide distributed species, *H. formosanus*; another group is dorsal fin rays 3+8 which can be seen in the following three species as *H. taitungensis*, *H. sheni*, *H. yushanensis* as well as *H. yushanensis*. The 3+8 group only can be seen in eastern Taiwan as both *H. taitungensis* and *H. sheni*. *H. yushanensis* can be only found from the Kaoping River basin originating from southern slope of the Yushan mountain Ridge in southern Taiwan. *H. luae* can be merely regarded endemic in only one, Tzengwen River basin.

*H. luae* shares the same dorsal fin ray formula, 3+8 with *H. sheni* and *H. yushanensis* as well as *H. taitungensis*. However, it can be well distinguished from *H. taitungensis* by the pectoral fin rays 20–22 vs. 25–26; pelvic fin total rays 11 vs. 17. It also can be well distinguished from both *H. yushanensis* and *H. sheni* by the lower counts of pelvic fin simple rays modally 3 vs. 4 and its total rays 11 vs. 14. The limited distribution of current species is needed for further formal concern of its ecological conservation issue.

### An artificial key to 5 endemic species *Hemimyzon* in Taiwan:

1a	Dorsal fin rays 3+7. . . . .	<i>H. formosanus</i>
1b	Dorsal fin rays 3+8. . . . .	2
2a	Pelvic fin rays 17; inner gap between pelvic fins very narrow . . . . .	<i>H. taitungensis</i>
2b	Pelvic fin rays no more than 15; inner gap between pelvic fins wider than. . . . .	3
3a	Pelvic fin simple rays modally 3, total rays always 11 . . . . .	<i>H. luae</i> n. sp.
3b	Pelvic fin simple rays modally 4, total rays always 14 . . . . .	4
4a	Pectoral fin rays 24; lateral-line scales 78–80; the distance of pelvic rear tip to anus about 3 times to that of anus . . . . .	<i>H. sheni</i>
4b	Pectoral fin rays modally 22; lateral-line scales 69–72; the distance of pelvic rear tip to anus about 1.2–1.8 times to that of anus to anal fins . . . . .	<i>H. yushanensis</i>

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## Appendix I. Comparative materials of *Hemimyzon* species from Taiwan

### *Hemimyzon formosanus* (Boulenger)

NTOU P-2005-09-233, 6 specimens, 36.8–55.0 mm SL, fan-fan Brook, Lang-Yang River basin, I-Lan County, Taiwan, coll. M. Chang, Spt. 5, 2005.

NTOU P-2007-09-057, 59.2 mm SL, Kong-Long River basin, Maio-Li County, Taiwan, coll. I-S. Chen, July 12, 1999.

NTUM-05276, 10 specimens, Her-Sher, Jo-Shuei River, Nan-Tou County, Taiwan, coll. C.S. Tzeng, July 27, 1980.

NTUM-05278, 4 specimens, 50.2–58.0 mm SL, Pu-Li, Wu River basin, Nan-Tou County, Taiwan, coll. C.S. Tzeng, July 20, 1980.

NTUM-05283, 14 specimens, 32.1–61.6 mm SL, Tung-Shih, Ta-Chia River basin, Taiwan, coll. C.S. Tzeng, Jan 30, 1981.

NTUM-05307, 45.8 mm SL, Chow-Lan, Ta-An River basin, Maio-li County, Taiwan, coll. C.S. Tzeng, Jan 30, 1981.

### *Hemimyzon sheni* Chen & Fang

**Holotype.**—NTOU P-2007-07-077, 50.1 mm SL, small tributary (3 km south to Yi-Ting mountain) in upper reaches of the Tar-Ju River, Tar-Ren Village, Taitung County, Taiwan, ROC. Coll. S.H. Chen, July 11, 1993.

**Paratypes.**—NTOU P- 2007-07-078, 2 specimens, 11.2–30.6 mm SL, other data same as holotype.

### *Hemimyzon taitungensis* (Tzeng & Shen)

NTOU P-2007-05-273, 63.0 mm SL, Shin-wu-Liu River, Pei-Nan River basin, Taitung County, Taiwan, coll. I-S. Chen, May 16, 2005.

NTOU P-2007-09-051, 5 specimens, 46.0–59.2 mm SL, Shin-wu-Liu River, Pei-Nan River basin, Taitung County, Taiwan, coll. I-S. Chen, Oct. 25, 1994.

### *Hemimyzon yushanensis* Chen, Harefa, Chang, Han

**Holotype.**—NTOUP-2021-12-325, 55.3 mm SL, Nar-Mar-Shar County, Nan-Tsi-Shien River, Kaoping River basin, coll. C.C. Han, July, 20, 2021, Kaohsiung City, Taiwan, ROC.

**Paratypes.**—NTOUP-2021-12-326, 8 specimens, 51.9–66.6 mm SL, Nar-Mar-Shar County, Nan-Tsi-Shien River, Kaoping River basin, Coll. C.C. Han, July, 20, 2021, Kaohsiung City, Taiwan, ROC.