

**NOMORHAMPHUS REX, A NEW SPECIES OF VIVIPAROUS HALFBEAK
(ATHERINOMORPHA: BELONIFORMES: ZENARCHOPTERIDAE)
ENDEMIC TO SULAWESI SELATAN, INDONESIA**

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ABSTRACT. — *Nomorhamphus rex*, a new species of viviparous halfbeak, is described from three small rivers in Sulawesi Selatan, Indonesia. The new species differs from all other *Nomorhamphus* in anal-fin morphology of adult males. The third or fourth segment of the second anal-fin ray is composed of two rows of subsegments, giving the third or fourth segment the appearance of being split into two rays. The spiculus is curved dorsally and contacts the distal segments of the third anal-fin ray with its proximal and middle segments; the distal segments are curved ventrally, giving the spiculus a sickle-like shape. Appearance and colouration of *Nomorhamphus rex* are similar to *N. kolonodalis* and *N. ebrardtii*, from which it is distinguished by the shape of the andropodium and in having a relatively longer lower jaw. This description brings the number of *Nomorhamphus* endemic to Sulawesi to ten.

KEY WORDS. — *Nomorhamphus*, taxonomy, Sulawesi, Wewu River, Toletole River, Tana Toraja, freshwater fish

INTRODUCTION

Halfbeaks of the family Zenarchopteridae occur in freshwaters and estuaries of the Indo-West Pacific region (Lovejoy et al., 2004; Nelson, 2006). Fifty four species are currently included in the family and distributed across five genera, viz. *Dermogenys*, *Hemirhamphodon*, *Nomorhamphus*, *Tondanichthys*, and *Zenarchopterus*. *Dermogenys*, *Hemirhamphodon*, and *Nomorhamphus* possess internal fertilisation and are viviparous, whereas less is known about the reproductive biology of *Tondanichthys* and *Zenarchopterus* (Grier & Collette, 1987; Anderson & Collette, 1991; Collette, 1995; Meisner, 2001). Monophyly of Zenarchopteridae was first proposed by Anderson & Collette (1991), based on five synapomorphies and is further supported by evidence from sperm ultrastructure (Jamieson & Grier, 1993) and the pharyngeal jaw apparatus (Aschliman et al., 2005). Collette (1995, 2004) and Meisner (2001) recognised this group at the subfamily level within Hemirhamphidae, and Meisner (2001) provided further anatomical evidence

for its monophyly. Since the phylogenetic work based on molecular data by Lovejoy et al. (2004), the family status of Zenarchopteridae is widely accepted (e.g., Parenti, 2008).

The genus *Nomorhamphus* Weber & de Beaufort, 1922 is endemic to Sulawesi (nine species) and the islands of the Philippines (seven species; Meisner, 2001). In Sulawesi, *Nomorhamphus* occur (with some exceptions) in hillstream habitats; however, at least two species of the genus inhabit large freshwater lakes (Brembach, 1991; Kottelat et al., 1993; Meisner, 2001). The species known so far occur either in the highlands of Maros in south-west Sulawesi, the south-eastern peninsula, or in eastern central Sulawesi (Brembach, 1991; Meisner, 2001). Morphological species delineation of *Nomorhamphus* relies strongly on the structure of the andropodium, the male copulatory organ, which is composed of the anterior five to seven anal-fin rays (Mohr, 1936a, 1936b, 1936c; Brembach, 1976, 1991; Meisner & Burns, 1997; Meisner & Louie, 2000; Meisner, 2001). The fin rays forming the andropodium are greatly thickened,

compared to more posterior anal-fin rays, and are strongly curved. These rays are also surrounded by a sheath of thick skin, and appear to form a functional unit. The second anal-fin ray is most noticeably modified, with a pair of distal spines and a terminal structure referred to as the spiculus. Here, we describe a new species of *Nomorhamphus* from Sulawesi Selatan, characterised by unique features of the andropodium in adult males.

MATERIAL AND METHODS

Specimens of the new *Nomorhamphus* were obtained from three sites in Sulawesi Selatan, Indonesia, by electrofishing with a portable DEKA 3000 electroshocker or by dip-netting. Single individuals of both sexes were photographed immediately after catching to record live colouration. Subsequently, fish were preserved in 4% formalin and later transferred to 80% ethanol for storage; specimens from Tilanga were directly fixed in 70% Ethanol. All measurements (Fig. 1) were taken from point to point, recorded to the nearest 0.1 mm with a digital caliper. Data listed in Description and Comparisons refer to the type material. Abbreviations used include: SL – standard length; LJB – lower jaw length; LJB – length of the elongate part of the lower jaw (following Brembach, 1991); UJL – upper jaw length; UJW – upper jaw width; SN-P₁ – snout to pectoral fin distance; SN-P₂ – snout to pelvic fin distance; HDL – head length; BDP₁ – body depth at pectoral fin base; BDP₂ – body depth at

pelvic fin base; P₂-C – pelvic fin to caudal fin distance; TL – total length including beak. Counts of the unpaired fins and vertebrae (total = abdominal + caudal) were obtained from radiographs (Faxitron LX-60). In the caudal fin, all rays were counted and are reported below as upper principal rays / lower principal rays and upper procurrent rays / lower procurrent rays. Vertebral counts exclude the last centrum supporting the hypural complex. Scale counts follow Kottelat et al. (1993); the predorsal scales are counted from the dorsal mid-line between the occiput and dorsal origin. Counts obtained from holotype are listed in square brackets []. Terms used for describing the modified anal-fin rays of males follow Brembach (1976, 1991), Meisner & Burns (1997), and Meisner (2001). The anterior five to seven anal-fin rays that become thickened and curved are collectively referred to as the *andropodium* (Fig. 2). The terminal portion of the second anal-fin ray, distal to the paired spines, is referred to as the *spiculus*. The spines and the spiculus together constitute the *tridens flexibilis*. The *cryptoplica* is the fleshy covering that develops on both sides of the modified anal-fin rays; it extends down and overlaps the first seven rays ventrally forming a thick sheath. The *physa* is a membranous pouch (hypothesized to be involved in sperm storage; Brembach, 1976, 1991) that is situated between rays three and four and lies irregularly on one side of the fin; it covers a small portion of the first and second anal-fin rays. The presence of the *physa* and *cryptoplica* is an indication that the andropodium is functional. In not dissected specimens the first segments of each ray and entire anal-fin rays 4-7 are not clearly visible. For

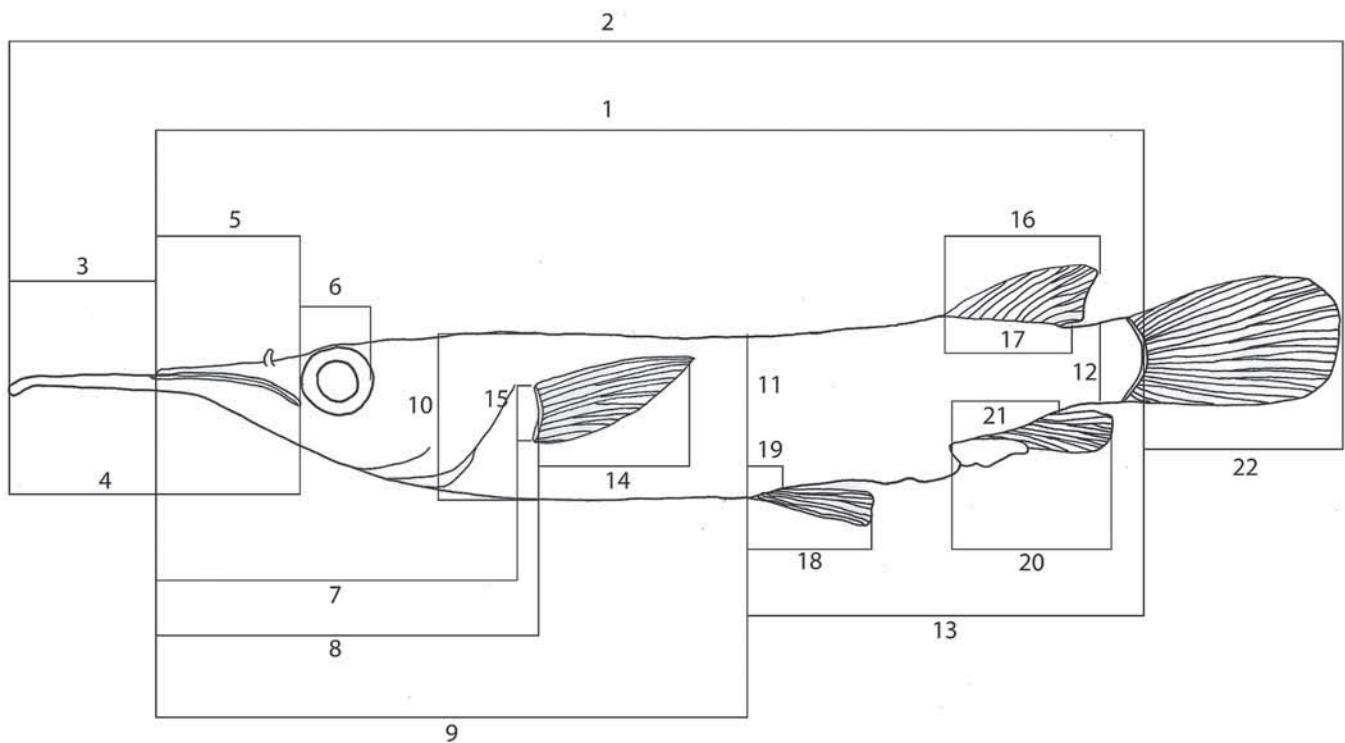


Fig. 1. Measurements taken on *Nomorhamphus*. 1, standard length (SL); 2, total length including beak (TL); 3, lower jaw length Brembach (LJB); 4, lower jaw length (LJL); 5, upper jaw length (UJL); 6, bony orbital diameter (ORBL); 7, head length (HDL); 8, snout to pectoral-fin distance (SN-P₁); 9, snout to pelvic-fin distance (SN-P₂); 10, body depth at pectoral-fin base (BDP₁); 11, body depth at pelvic-fin base (BDP₂); 12, depth of caudal peduncle; 13, pelvic-fin to caudal-fin distance (P₂-C); 14, length of pectoral fin; 15, length of pectoral-fin base; 16, length of dorsal fin; 17, length of dorsal-fin base; 18, length of pelvic fin; 19, length of pelvic-fin base; 20, length of anal fin; 21, length of anal-fin base; 22, length of caudal fin.

this reason, these details and details of the longest segment of the second anal-fin ray were completed by using radiographs and the cleared and stained male specimen ZFMK 44968 (31.5 mm SL). Comparative material of *Nomorhamphus* from Sulawesi Tenggara and Selatan was collected between 1978 and 2004 (see Comparative Material). Material examined is deposited in the Museum Zoologicum Bogoriense (MZB), Research and Centre for Biology, the Indonesian Institute of Sciences (LIPI), Cibinong, Indonesia, the Zoologisches Forschungsmuseum Alexander Koenig, Bonn (ZFMK), and the Bavarian State Collection of Zoology, Munich (ZSM).

TAXONOMY

Nomorhamphus rex, new species

(Figs. 2–8; Table 1)

Material examined. — *Holotype* – MZB 20724 (44.4 mm SL), male, Indonesia, Sulawesi, South Sulawesi Province, Wewu River which is a headwater of the Cerekang River drainage west of Lake Matano, sampling was conducted in a tributary at Village Laroeha, a small river few hundred meters upstream of the main river, 2°28.226'S, 121°04.125'E, F. Herder & R. K. Hadiaty, 4 May 2004.

Paratypes – ZFMK 44944–44955, 5 males (28.9–41.5 mm SL), 7 females (34.5–63.9 mm SL), all collected with the holotype; MZB 20725 and 20727–20730, 2 males (28.7–31.2 mm SL), 3 females (34.1–45.2 mm SL), all collected with the holotype; ZSM 41743a–d, 2 males (29.2–31.1 mm SL), 2 females (41.5–45.3 mm SL), all collected with the holotype; ZFMK 44956–44961, 2 males (35.7–36.8 mm SL), 4 females (30.4–60.2 mm SL), Indonesia, Sulawesi, South Sulawesi Province, Toletole River at the village of Toletole, at a truck washing place about 150 m upstream of a large river bridge at the road to Wasaponda, 2°31.664'S, 121°06.726'E, F. Herder & R. K. Hadiaty, 4 May 2004.

Additional non-type material – ZFMK 44962–44967, 2 males (38.0–42.5 mm SL), 4 females (55.1–62.5 mm SL), Indonesia, western central Sulawesi, Sulawesi Selatan, Tana Toraja, in a clearwater pool at an excavation of a small river with unknown name near the village of Tilanga, 3°02.126'S, 119°53.232'E, H.-G. Evers, J. Christian, P. Debold, T. Heinrich, 24 Sep.2010; ZFMK 44968–44979, 2 males (both 31.5 mm SL, of which 1 male has been cleared and counterstained), 3 immature males (24.4–26.7 mm SL), 2 females (27.9–35.4 mm SL), 2 immature females (23.7–24.1 mm SL), 3 undet. (17.2–20.4 mm SL), all collected with the holotype; ZFMK 44980–44982, 3 undet. (17.1–22.6 mm SL), same data as ZFMK 44956–44961.

Diagnosis. — *Nomorhamphus rex* is distinguished from all other *Nomorhamphus* by the shape of the andropodium in males: spiculus sickle-shaped, curved dorsally, its proximal and middle segments in contact with the distal tip of the third anal-fin ray; distal segments of spiculus curved ventrally, without contact to third anal-fin ray; second anal-fin ray in males with three or four segments proximal to paired spines, third or fourth segment with a dorsal and a ventral row of “subsegments” forming squares and rectangles of different sizes, so that the third or fourth segment appears to be subdivided into two separate rays, from the half of its length up to the spines, with a varying number of subsegments (≥ 5 subsegments per row; see Fig. 2); first segment of the first

anal-fin ray slightly constricted longitudinally, giving the appearance of two distinct rays; third anal-fin ray composed of two elongate segments, each approximately half the length of the entire ray, followed by a few short segments at the distal tip, which contact the spiculus; fourth anal-fin ray divided into three rows from approximately the third of its length, forming a kind of a covering for the third anal-fin ray with one dorsal and two lateral rows beneath. It is further distinguished from *Nomorhamphus ebrardtii* and *N. kolonodalensis* by having a relatively longer lower jaw (LJLB 5.7–11.3 times in SL vs. 13.4–15.9 in *N. ebrardtii* and 8.8–22.2 in *N. kolonodalensis*; Meisner, 2001).

Description. — Morphometric and meristic characters are provided in Tables 1, 2. Body deep. Lower jaw relatively long, upper jaw longer than wide. Eye relatively large. Specimens >35 mm SL with one row of conical teeth at the front of the upper and lower jaws, followed by two short rows of conical teeth, at the middle of the jaws three rows of conical teeth, followed again by two rows of conical teeth up to the end of the jaws; smaller specimens with one row of conical teeth at the front of the upper and lower jaws, followed by two rows of conical teeth up to the end of the jaws. Gill rakers tear-drop shaped, without teeth on the dorsal surface of the gill rakers. 45–51 [47] predorsal scales (76–83 predorsal scales in specimens from Tana Toraja, ZFMK 44962–44967). Fifth hypural fused to dorsal hypural plate. Caudal fin truncate, principal caudal-fin rays i,5–6/5–7,i (mode and holotype i,6/6,i), procurrent caudal-fin rays 5–6/5–6 (mode and holotype 5/6).

Life colouration. — Body yellowish brown to grey (Fig. 3). Lips and beak red. Black pigment along ventral surface of lower jaw. Iris iridescent blue. Pelvic fins and anal fin yellowish hyaline. Black pigment on distal tips of anal-fin rays. A red spot between black distal tips and yellowish cryptoplica in males (in some males the red spot and/or the black pigment is absent or restricted to a few anal-fin rays). Pelvic fins with distal red band. Distinct black, oval spot anterior to pectoral fin; base of pectoral-fin rays light yellow, which merges into light red distally (pectoral fins transparent in some specimens). Dorsal fin red to orange with black pigment on distal tips of posterior dorsal-fin rays (black pigment absent in some males). Base of caudal fin

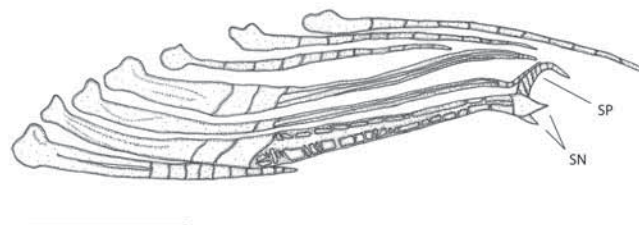


Fig. 2. Diagrammatic representation of the modified anal-fin rays (andropodium) of *Nomorhamphus rex*, MZB 20724, holotype, 44.4 mm SL, male. Fourth segment of the second ray with a dorsal and a ventral row of “subsegments” forming squares and rectangles of different sizes. The fourth ray is divided into three rows from approximately the third of its length, forming a kind of a covering for the third anal-fin ray with one dorsal and two lateral rows beneath. SN, Spinae; SP, Spiculus. Scale bar = 1 mm.

Table 1. Morphometric and meristic characters of *Nomorhamphus rex* (holotype and 27 paratypes).

	Holotype MZB 20724		Paratypes (males, n=11)		Paratypes (females, n=16)		Mode
	Min.	Max.	Min.	Max.	Min.	Max.	
SL (mm)	44.4		28.7	41.5	30.4	63.9	
Anal-fin rays (total)	14		14	15	14	15	14
Dorsal-fin rays (total)	12		11	13	11	13	12
Pectoral-fin rays	11		11	12	11	12	12
Pelvic-fin rays	6		6	6	6	6	6
Scales in predorsal row	47		45	50	45	51	46/47/50
Vertebrae	38		37	40	37	39	38
Dorsal-fin origin over anal-fin ray	5		4	5	3	4	3
% SL							
TL (with beak)	133.6		132.2	137.3	126.2	135.1	Mean
HDL	32.4		31.3	34.2	28.6	32.9	131.5
LJLB	12.6		11.3	17.5	8.8	13.6	30.9
LJL	27.3		23.6	30.8	19.9	26.3	11.1
UJL	14.6		12.6	16.1	11.4	15.4	23.4
UJW	8.3		7.0	8.8	7.9	8.7	13.0
SN-P1	36.5		34.3	39.1	31.4	36.1	8.2
SN-P2	62.2		58.7	62.9	55.6	62.1	34.3
BDP1	17.6		16.3	18.2	15.3	17.6	60.5
BDP2	16.9		16.1	17.8	14.5	17.9	16.3
P2-C	40.8		40.3	44.5	40.0	44.7	16.5
Length of pectoral fin	19.1		16.8	21.7	14.8	17.5	41.6
Length of pectoral-fin base	5.6		4.8	6.9	4.6	5.4	16.5
Length of pelvic fin	11.7		9.3	13.3	8.0	10.3	5.0
Length of pelvic-fin base	2.0		1.4	1.9	1.2	2.2	9.3
Length of anal fin	16.4		15.9	19.4	14.6	17.8	1.6
Length of anal-fin base	10.6		11.4	13.9	11.9	14.9	16.2
Length of dorsal fin	16.7		16.1	19.2	15.5	19.6	0.8
Length of dorsal-fin base	13.1		11.7	13.8	10.8	15.5	13.3
Length of caudal fin	22.1		18.3	22.6	18.8	23.1	17.0
Depth of caudal peduncle	8.7		8.0	8.7	7.8	9.2	12.6
% HDL							21.2
ORBL	16.0		16.7	23.0	14.7	21.4	8.4
INTORBL	24.3		22.5	25.5	23.1	28.0	0.4
Proportions							
LJLB in SL	7.9		5.7	8.8	7.3	11.3	18.2
LJL in SL	3.7		3.3	4.2	3.8	5.0	25.9
UJL/UJW	1.8		1.5	2.1	1.3	1.9	1.0
							0.3
							0.1

Table 2. Morphometric and meristic characters of *Nomorhamphus rex* from Tana Toraja (6 specimens, ZFMK 44962-44967, non-type material).

	Non-type material (males, n=2)		Non-type material (females, n=4)		Mode
	ZFMK 44962	ZFMK 44963	Min.	Max.	
SL (mm)	42.5	38.0	55.1	62.5	
Anal-fin rays (total)	15	14	15	16	15
Dorsal-fin rays (total)	12	11	11	12	11/12
Pectoral-fin rays	13	12	12	13	12/13
Pelvic-fin rays	6	6	6	6	6
Scales in predorsal row	77	76	81	83	82
Vertebrae	38	38	38	38	38
Dorsal-fin origin over anal-fin ray	5	5	3	4	4
% SL			Mean	SD(±)	Mean
TL (with beak)	131.8	128.7	130.2	2.2	130.2
HDL	33.9	32.1	33.0	1.3	32.1
LJLB	11.5	11.8	11.7	0.2	9.9
LJL	27.3	25.0	26.1	1.6	23.1
UJL	14.6	13.7	14.1	0.6	13.6
UJW	8.5	7.6	8.1	0.6	8.5
SN-P1	37.9	35.5	36.7	1.7	35
SN-P2	63.3	59.5	61.4	2.7	62.4
BDP1	17.4	15.8	16.6	1.1	15.5
BDP2	16.9	15.5	16.2	1.0	15.9
P2-C	40.5	42.1	41.3	1.2	38.8
Length of pectoral fin	20.2	18.7	19.5	1.1	17
Length of pectoral-fin base	7.3	5.3	6.3	1.4	5
Length of pelvic fin	12.0	10.5	11.3	1.0	9.3
Length of pelvic-fin base	1.9	1.8	1.9	0.0	1.6
Length of anal fin	17.6	17.1	17.4	0.4	16.1
Length of anal-fin base	12.5	12.4	12.4	0.1	12.8
Length of dorsal fin	14.8	16.1	15.4	0.9	17.7
Length of dorsal-fin base	10.1	10.5	10.3	0.3	11
Length of caudal fin	21.2	16.6	18.9	3.3	20.6
Depth of caudal peduncle	8.7	7.9	8.3	0.6	8.4
% HDL					
ORBL	18.8	21.3	20.0	1.8	18.1
INTORBL	22.2	23.8	23.0	1.1	25.4
Proportions					
LJLB in SL	8.7	8.4	8.6	0.2	10.1
LJL in SL	3.7	4	3.9	0.2	4.3
UJL/UJW	1.7	1.8	1.8	0.1	1.6
					0

yellowish hyaline, followed by a prominent red or orange part, distal band light dusky. Second half of thin midlateral stripe light reddish.

Preserved colouration. — Background colour brown (Fig. 4) with thin midlateral stripe from pectoral to caudal fin, more prominent posteriorly. Distinct oval spot anterior to pectoral fin. Black pigment along ventral surface of lower jaw. Black pigment on distal tips of posterior dorsal-fin rays (absent in some males and smaller females) and on distal tips of anal-fin rays (absent in some males and smaller females). Smoky black mark on distal band of caudal fin. Specimens from Toraja with a slightly darker background colour.

Sexual dimorphism. — Females grow larger than males (maximum SL recorded: 44.4 mm in males, 63.9 mm in females). Males on average with a longer lower jaw (SL/LJL 5.7–8.8 vs. 7.3–11.3 in females).

Distribution and habitat. — *Nomorhamphus rex* is known from two drainages leading to the same estuary at Bone

Bay, and one drainage leading to the Makassar Strait in Sulawesi Selatan, Indonesia (Fig. 6). The holotype and part of the paratypes were taken from a tributary of Wewu River near the village of Laroeha, a headwater of the Cerekang drainage sharing the estuary region with the Malili Lakes (Larona River) drainage and several small rivers, including the Kawata River. The tributary of Wewu River locality (2°28.226'S, 121°04.125'E) is a small, fast-flowing river of few meters width partially covered by forest canopy, with a bed of gravel and sand. Other sympatric fish species recorded include *Oryzias celebensis*, *Telmatherina* cf. *bonti*, and the introduced *Anabas testudineus*, *Channa striata*, and *Trichopodus pectoralis* (Herder & Chapuis, 2010). The second location is also in close vicinity of the Malili Lakes area: Toletole River at village Toletole, at a truck washing place about 150 m upstream of a bridge at the road to Wasaponda (2°31.664'S, 121°06.726'E). The Toletole River is a tributary of the comparatively small Kawata River, sharing the estuary with Rivers Cerekang and Larona (Malili Lakes drainage). The sample site is likewise a small, fast-flowing river with a bed of sand and gravel (Fig. 7); other fish species recorded at this site include *Mugilogobius* sp., and the introduced *Channa striata*, *Clarias* cf. *batrachus*, and *Aplocheilichthys panchax*. The third habitat is a natural clearwater pool, an excavation of a small stream with unknown name, located close by the village Tilanga in Tana Toraja. It is an approximately 4-m deep karst pond of 30–40 m length and up to 10 m width, used by local people as a natural “swimming pool”; other fish

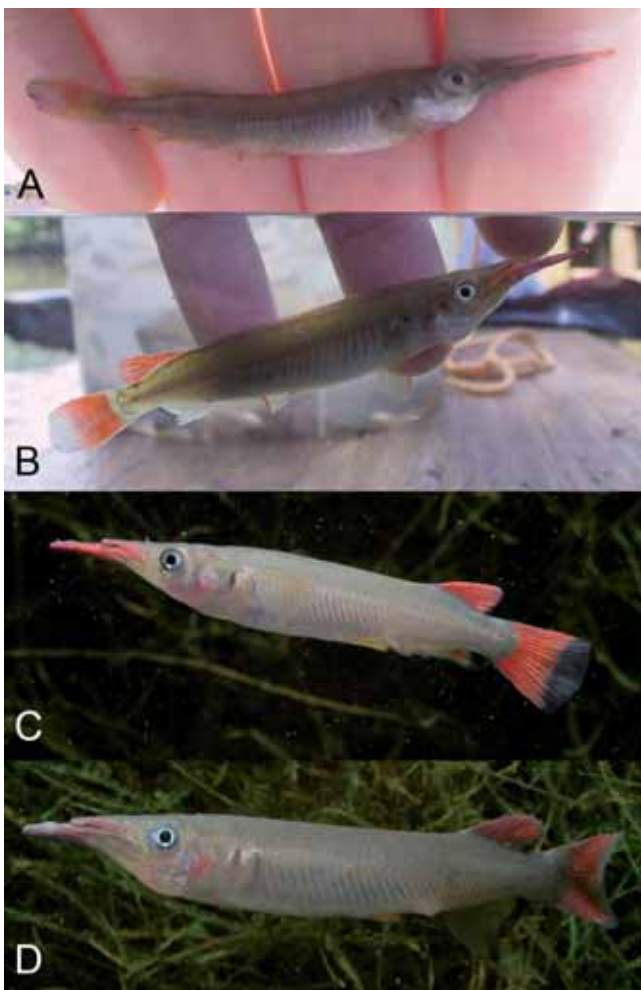


Fig. 3. **A, B**, *Nomorhamphus rex*; Indonesia, Sulawesi: Sulawesi Selatan; tributary of Wewu River near the village of Laroeha; 2°28.226'S, 121°04.125'E. **A** male; **B** female. **C, D**, *Nomorhamphus rex* from Tana Toraja; Indonesia, Sulawesi: Sulawesi Selatan; in a clearwater pool at an excavation of a small river near the village of Tilanga, 3°02.126'S, 119°53.232'E. **C** male; **D** female. (Photographs by: Hans-Georg Evers).



Fig. 4. **A**: *Nomorhamphus rex*, MZB 20724, holotype, 44.4 mm SL, male; **B**: ZFMK 44949, paratype, 63.9 mm SL, female.



Fig. 5. Radiograph of *Nomorhamphus rex*. **A**, *Nomorhamphus rex*, MZB 20724, holotype, 44.4 mm SL, male; **B**, ZFMK 44949, paratype, 63.9 mm SL, female.

species occurring at this site include *Oryzias* sp. (Herder et al., in prep.) and the introduced *Poecilia reticulata*.

Etymology. — From the Latin *rex*, a king, in allusion to the teeth of the new species, reminiscent of the dentition of the late Cretaceous *Tyrannosaurus rex*. A noun in apposition.

Comparisons. — In contrast to other *Nomorhamphus* species from Sulawesi, *N. rex* is characterised by having a characteristic elongated and subdivided third or fourth segment in the second anal-fin ray in males (Fig. 2). This clearly distinguishes *N. rex* from *N. rossi* and *N. bakeri*, in which the fifth or sixth segment is elongated, and from all remaining *Nomorhamphus* species described so far, having segments in this ray of approximately equal length (see Meisner, 2001). The new species is further distinguished from *N. megarrhamphus* and *N. weberi* by having a first anal-fin pterygiophore which is thickened and not angled anteriorly (see Meisner, 2001) and a less elongated lower jaw (lower jaw length following Brembach 5.7–11.3 times in SL in *N. rex*, vs. 4.0–5.7 times in SL in *N. megarrhamphus* and 3.7–4.9 times in SL in *N. weberi*; Meisner, 2001). The new species is distinguished from *N. brembachi*, *N. celebensis*, *N. kolonodalensis*, *N. liemi*, and *N. towoetii* by its characteristic sickle-shaped spiculus (Fig. 2). In *N. brembachi* and *N. liemi* the second anal-fin ray in males is curved at approximately $\frac{1}{4}$ its length so that the distal $\frac{1}{2}$ slopes ventrally (see Meisner, 2001). In addition, *N. brembachi*, *N. liemi*, *N. celebensis*, and *N. towoetii* are characterised by lacking an elongate lower jaw and instead, have an upper and lower jaw approximately equal in length (Meisner, 2001). *Nomorhamphus rex* is

further distinguished from *N. celebensis* by its upper jaw width being less than upper jaw length (UJL/UJW 1.3–2.1 in *N. rex* vs. 0.70–0.94) and from *N. towoetii* by its yellowish brown to grey body colouration (vs. olive body with a large concentration of melanophores on lateral and dorsal body surfaces, which gives females a dusky appearance whereas large males are completely melanistic in *N. towoetii*; Meisner, 2001).

Habitus and colouration of *N. rex* are most similar to *N. kolonodalensis* and *N. ebrardtii*. Among these species, *N. rex* is easily distinguished by features of the andropodium of males, including the sickle shaped spiculus, which contacts the distal segments of the third anal-fin ray with its proximal and middle segments, distal segments curved ventrally (vs. straight spiculus in *N. kolonodalensis* and elongated spiculus which is curved dorsally so that the expanded distal tip contacts the distal tip of the third anal-fin ray in *N. ebrardtii*;

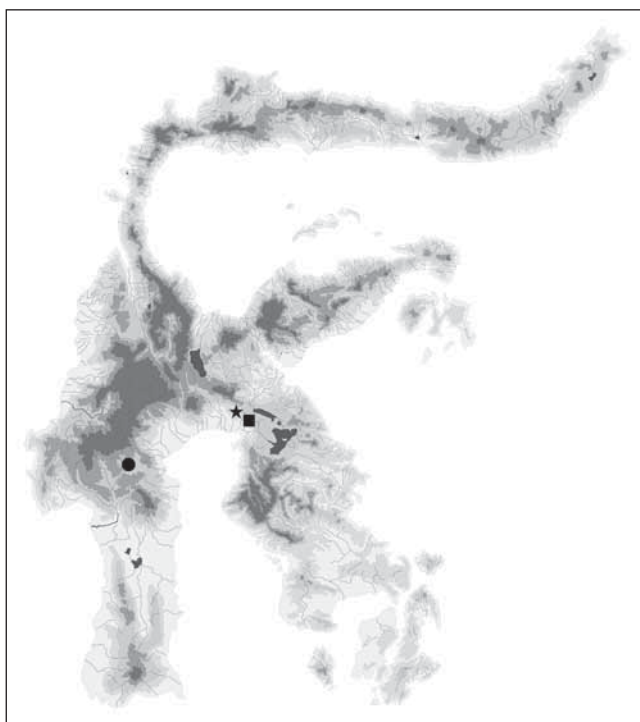


Fig. 6. Map of Sulawesi with highlighted sampling locations. Star, sampling location at a tributary of Wewu River near the village of Laroeha; Solid square, sampling location at Toletole River at village Toletole; Solid dot, sampling location close by the village Tilanga in Tana Toraja. (Map by: Thomas von Rintelen, modified).



Fig. 7. Toletole River, type locality of *Nomorhamphus rex*. (Photography by: Suzanne M. Gray).

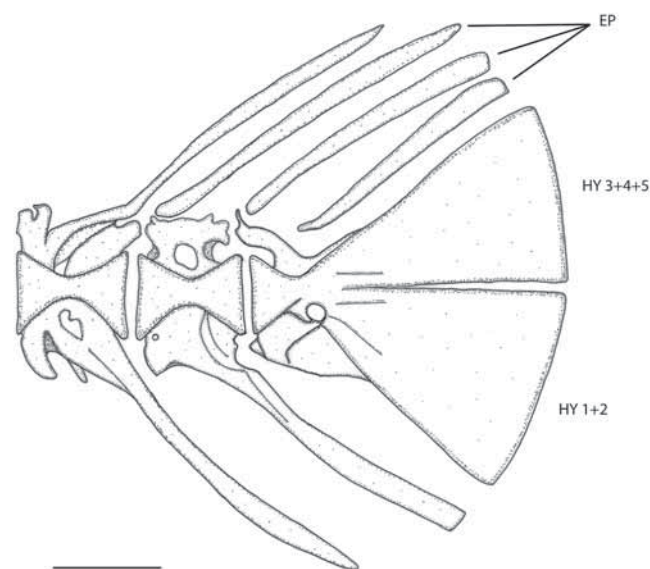


Fig. 8. Diagrammatic representation of the caudal skeleton of *Nomorhamphus rex*, MZB 20724, holotype, 44.4 mm SL, male. EP, Epural; HY, Hypural. Scale bar = 500 μ m.

Meisner & Louie, 2000) and the elongated third or fourth segment in third anal-fin ray (vs. segments approximately equal in length in *N. ebrardtii* and *N. kolonodalensis*; Meisner, 2001). It is further distinguished by its longer lower jaw (LJLB 5.7–11.3 times in SL vs. 13.4–15.9 in *N. ebrardtii* and 8.8–22.2 in *N. kolonodalensis*; Meisner & Louie, 2000; Meisner, 2001), the absence of teeth on the dorsal surface of gill rakers (vs. one to three teeth on the dorsal surface of some gill rakers on the second and third arches in *N. kolonodalensis* and *N. ebrardtii*; Meisner, 2001, p. 251), the fifth hypural plate completely fused to dorsal hypural plate (Fig. 8) (vs. fifth hypural partially separate from dorsal hypural plate along most of its length in *N. kolonodalensis*; Meisner & Louie, 2000), and black pigment on distal tips of posterior dorsal-fin rays and on distal tips of anal-fin rays (vs. no fin pigmentation in *N. ebrardtii*; Brembach, 1991). *Nomorhamphus rex* occurs only west of Lake Matano and in Tana Toraja, Sulawesi Selatan, vs. Kabaena, Wowoni, Penango and Rumbia in Sulawesi Tenggara (*N. ebrardtii*), the Kolonodale region in Sulawesi Tengah and sites near Lake Towuti, Sulawesi Selatan (*N. kolonodalensis*) (Popta, 1912; Brembach, 1991; Meisner & Louie, 2000, Meisner, 2001).

Remarks. — Following Meisner (2001), *Nomorhamphus rex* is clearly assigned to the genus *Nomorhamphus* (vs. *Dermogenys*, *Hemirhamphodon*, and *Zenarchopterus*) by exhibiting the following combinations of characters: oval lacrimal; elongate, expanded autopalatine; teeth along the extended portion of the lower jaw absent; uniserial teeth not extending medially in a concave row from outer row of teeth; modified anal-fin rays in males with a fleshy covering (cryptoplica); second anal-fin ray in males without a distinct geniculus; melanophores anterior to the anal fin in females not forming a distinct spot. Specimens of *N. rex* from the Toraja population differ from those of the Rivers Wewu and Toletole in having more predorsal scales (45–51 [47] predorsal scales vs. 76–83 predorsal scales in specimens from Tana Toraja). Nevertheless, we consider all three populations conspecific based on andropodium structure and the lack of obvious differences in the other characters examined. We consider the disjunct distribution pattern of *N. rex* to represent an artifact of the incomplete sampling coverage in Sulawesi, highlighting the need for continued ichthyological surveys of the island's freshwaters.

Comparative material. — *Nomorhamphus ebrardtii* Indonesia, Sulawesi Tenggara: Island of Wawoni; D. Vogt Jul.1979: ZMH 7150, 27 ex. (18 females, 39.1–60 mm SL, 9 males, of which two males are cleared and counterstained). — *Nomorhamphus towoetii* Indonesia, Sulawesi Selatan: Sungai Balambano, about 500 m above Balambano (road from Malili to Soroako); M. Kottelat & A. K. Kloetzli, 19 Jun.1988: MZB 5973, 6 ex. (2 females, 39.3–49.4 mm SL, 3 males, 38.5–41.6 mm SL, 1 juv., 14.6 mm SL). — *Nomorhamphus liemi* Indonesia, Sulawesi Selatan: Highlands of Maros; D. Vogt, Aug.1978: ZMH 7157, 35 ex. (paratypes of *Nomorhamphus liemi snijdersi* (synonym of *N. liemi* (Meisner, 2001), 21 females, 14 males). — *Nomorhamphus brembachi* Indonesia, Sulawesi Selatan: Highlands of South Sulawesi, smaller mountain streams; D. Vogt, May1978:

ZMH 7166, 2 ex (paratypes, 1 female, 36.7 mm SL, 1 male, 38.8 mm SL). — *Nomorhamphus brembachi* Indonesia, Sulawesi Selatan: Highlands of Maros; M. Brembach, Aug.1978: ZMH 7160, 13 ex. (paratypes of *Nomorhamphus ravnaki ravnaki*, synonym of *N. brembachi* (Meisner, 2001), 5 females, 57–77.6 mm SL, 4 males, 34.2–39 mm SL, 4 undet.). — *Nomorhamphus megarrhamphus* Indonesia, Sulawesi Selatan: Lake Towuti, inlet of River Tominanga; F. Herder & A. Nolte, 28 Nov.2002: ZFMK 44923, 1 ex. (female, 77.3 mm SL). Towuti, 02°41.335'S, 121°25.897'E; F. Herder & A. Nolte, 29 Nov.2002: ZFMK 44928–44931, 4 ex. (females, 61.2–65.6 mm SL). Towuti, Timampu, fish market: catch of commercial fishermen collecting small fishes in the pelagic areas of L. Towuti; F. Herder, 15 Apr.2004: ZFMK 44936–44937, 2 ex. (females, 73–75.7 mm SL). — *Nomorhamphus weberi* Indonesia, Sulawesi Selatan: Lake Matano, 02°30.149'S, 121°19.416'E; F. Herder, Oct.2002: ZFMK 44924–44927 and 44932–44935, 8 ex. (females, 64.1–73.4 mm SL).

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