

FURTHER DESCRIPTION OF THE HAGFISH *Nemamyxine krefftii* McMILLAN & WISNER, 1982 (AGNATHA, MYXINIDAE)

Michael Maia Mincarone

Museu Oceanográfico do Vale do Itajaí, Universidade do Vale do Itajaí, CP 360, CEP 88302-202, Itajaí, SC, Brazil. mike.mincarone@terra.com.br

The genus *Nemamyxine* comprises two species, *N. elongata* from New Zealand and *N. krefftii* from Argentina, each one described from a single specimen. This paper presents further data on *N. krefftii*, based on six new specimens collected off southern Brazil and Uruguay.

O gênero *Nemamyxine* compreende duas espécies, *N. elongata* da Nova Zelândia e *N. krefftii* da Argentina, cada uma descrita com base em apenas um espécime. Este trabalho apresenta dados adicionais sobre *N. krefftii*, com base em seis novos espécimes coletados no sul do Brasil e Uruguai.

The genus *Nemamyxine* was described by Richardson (1958) (type species *N. elongata*), based on one specimen collected 150 yards upstream from the mouth of the Kaituna River, Bay of Plenty, North Island, New Zealand. The diagnostic characters of this genus are an extremely slender body with the ventral finfold originating anteriorly to the pair of gill apertures.

Subsequently, McMillan & Wisner (1982) described a second species based on only one specimen collected off northern Argentina (36°51'S, 54°01'W, depth 800 m) and named it *N. krefftii*.

Research and fishing vessels have collected specimens of hagfish on the Brazilian and Uruguayan continental shelf for several years. This material has been deposited in museums, but only recently was examined. The aim of this paper is to present new data on six specimens of *N. krefftii*, all collected off southern Brazil and Uruguay.

MATERIALS AND METHODS

The studied material is deposited in the MACN – Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (Buenos Aires, Argentina), MOVI – Museu Oceanográfico do Vale do Itajaí (Itajaí, Brazil), MZUSP – Museu de Zoologia da Universidade de São Paulo (São Paulo, Brazil), NMNZ – National Museum of New Zealand (Wellington, New Zealand), and ZMH – Zoological Museum Hamburg (Hamburg, Germany). Terminology, measurements and counts were taken from McMillan & Wisner (1982, 1984). The names of some structures have been updated following Wisner & McMillan (1995). The pores that occur anterior to the origin of the ventral finfold are counted and named “prefinfold pores”.

Nemamyxine krefftii McMillan & Wisner, 1982

Figures 1-3

MATERIAL EXAMINED – Holotype: ZMH 1144/1966, 366 mm TL (400 mm TL in original description), immature female, bottom trawled by R/V “Walther Herwig”, sta. 244/66: 36°51'S, 54°01'W, 800 m depth, off Rio La Plata, Argentina, 14.vi.1966, bottom temperature 3.64°C and salinity 34.1 ‰. Additional material (six specimens in chronological order): MACN 439, 279 mm TL, sex not determined, caught by “Compania Argentina de Pesca A. Gardella”: 35°24'S, 53°10'W, 110 m depth, off Uruguay, vii.1927. MACN 2056 (damaged), 350 mm TL, immature female, caught by Steamer “Tito”: 35°34'S, 52°48'W, 172 m depth, off Uruguay, 6-12.vii.1937, collected by Aurelio Pozzi, bottom temperature 8.2°C, surface temperature 11°C. MZUSP 19136, 292 mm TL, immature male, bottom trawled by R/V “Prof. W. Besnard”, sta. 1880: 34°34'S, 52°25'W, 80 m depth, off Uruguay, 15.viii.1972, collected by Gilda de Quadros Benvegnú, bottom temperature 10.65°C and salinity 34.074 ‰. MZUSP 19135, 493 mm TL, mature male, bottom trawled by R/V “Prof. W. Besnard”, sta. 1881: 34°45'S, 52°05'W, 179 m depth, off Uruguay, 15.viii.1972, collected by Gilda de Quadros Benvegnú, bottom temperature 10.49°C and salinity 34.857 ‰. MOVI 01253, 376 mm TL, immature female, bottom trawled by fishing vessel, between 33°00'S to 33°30'S and 50°20'W to 51°00'W, 140-150 m depth, off State of Rio Grande do Sul, southern Brazil, 10.vii.1988, collected by Jules Marcelo Rosa Soto [adhered to lateral region of a codling *Urophycis cirrata* (Goode & Bean, 1896) (Gadiformes, Phycidae)]. MOVI 05591 (damaged), 412 mm TL, sex not determined, trapped by F/V “Iporanga”: 33°47'22”S, 51°14'56”W, 240 m depth, off



Figure 1. *Nemamyxine krefftii* MZUSP 19136, 292 mm TL.

State of Rio Grande do Sul, southern Brazil, 13.v.1995, collected by Valdenir Manoel Inêz.

DIAGNOSIS – Body extremely slender, depth about 2.4-2.9 % of TL; origin of the ventral finfold well anterior to pharyngocutaneous duct (PCD); 8 pairs of gill pouches; rostrum rounded; a 3-cusp multicusp on anterior set, a 2-cusp multicusp on posterior set of cusps; total cusps count 32-38; total pores 124-148; color light to dark brown, ventral finfold with unpigmented margin.

DESCRIPTION – Counts and proportions given in Table 1. Body cylindrical, extremely slender, depth 2.4-2.9 % of TL. Rostrum rounded; eyespots absent; ventral finfold 2-6 mm high, originating anterior to PCD and continuing towards cloaca; caudal finfold prominent, extending around tail to above cloaca; internal supporting rays of the caudal finfold are not visible in two specimens, which have a thick and opaque tail. Pores tiny, segmentally arranged on each side of the body, extending from behind head to beyond cloaca; one to three pores overlapping the cloaca; space between last trunk pore and first cloacal pore slightly greater than length of cloaca; cloacal and caudal pores forming a straight line.

Eight pairs of gill pouches lie posterior to tip of dental muscle (Fig. 2); ventral aorta unbranched; one pair of gill apertures; both apertures slit-like and very near to ventral finfold (Fig. 3); left gill aperture larger than right aperture, its opening confluent with the PCD.

Color in ethanol light to dark brown over the whole body; head slightly lighter than rest of body; barbels of same color as body; gill apertures with whitish margins; pores without whitish margin; distal margin of ventral finfold unpigmented throughout; caudal finfold without whitish margin.

REPRODUCTION – Of seven specimens examined, three are females, two males, and two (MACN 439 and MOVI 05591) are not possible to determine the sex. According to McMillan & Wisner (1982) the holotype is a young female 400 mm TL (now measuring 366 mm TL) with immature eggs ranging in length from about 0.1 to 1.5 mm. The MOVI 01253 specimen is an immature female 376 mm TL with several small eggs ranging in length from 0.4 to 2.5 mm. Both MZUSP specimens are males, one immature 292 mm TL and the other mature 493 mm TL. The MACN 2056 specimen is a female with eggs in initial stage of development.

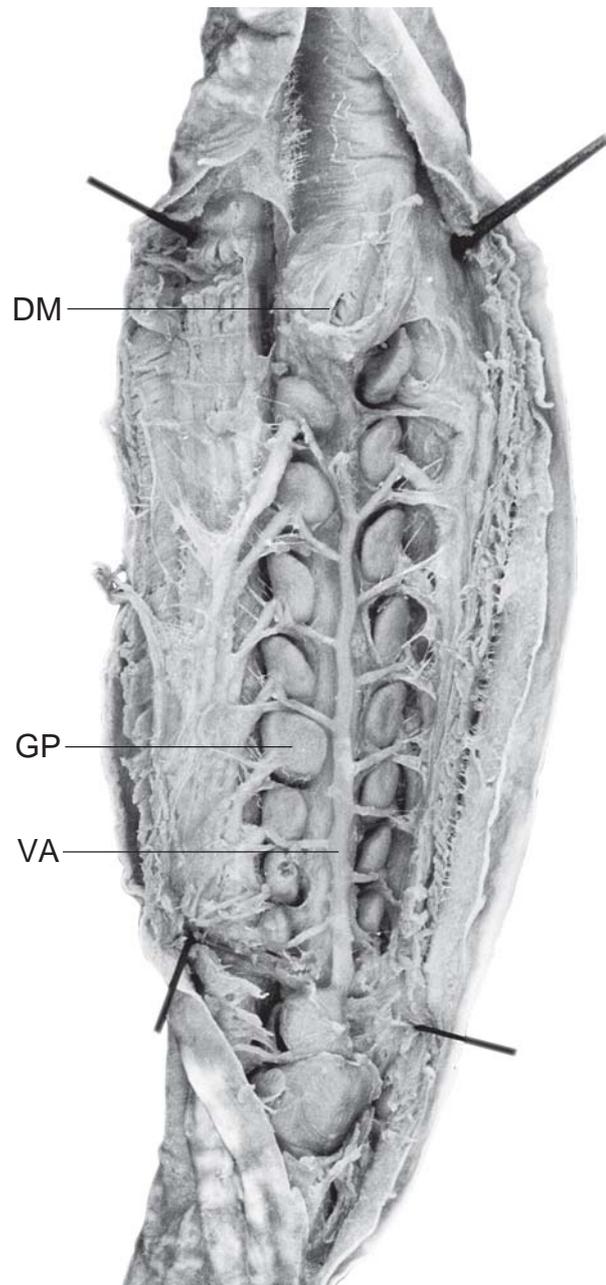


Figure 2. Branchial region of *Nemamyxine krefftii* (holotype), showing the posterior tip of dental muscle (DM), gill pouches (GP), and ventral aorta (VA).

Table 1. Body proportions (in thousandths of TL) and counts for all the known *Nemamyxine* specimens.

	<i>N. krefftii</i>								<i>N. elongata</i> holotype NMNZ 2006
	holotype ZMH 1144/1966	MOVI 01253	MOVI 05591	MZUSP 19135	MZUSP 19136	MACN 439	MACN 2056	range	
Total length (mm)	366	376	410	493	292	279	350	279-493	614
Prefinfol length	79	99	105	85	92	115	91	79-115	57
Prebranchial length	268	309	290	292	281	294	289	268-309	260
Trunk length	628	598	600	594	606	609	594	594-628	625
Tail length	104	93	110	114	113	97	117	93-117	114
Body width	22	24	22	22	24	23	26	22-26	-
Body depth:									
Incl. ventral finfold	30	29	37	34	34	27	46	27-46	15
Excl. ventral finfold	25	24	29	28	26	22	29	22-29	-
Over cloaca	25	23	29	24	26	25	23	23-29	-
Tail depth	30	32	28	26	34	25	33	25-34	-
Barbel length:									
First	5	8	7	8	7	4	11	4-11	-
Second	6	8	7	8	7	4	11	4-11	-
Third	9	9	9	9	9	5	12	5-12	-
Counts: *									
Cusps:									
Cusps on multicusps	3/2	3/2	3/2	3/2	3/2	3/2	3/2		2/2
Anterior unicusps	6+6	6+6	5+5	6+6	6+6	5+5	5+5	5-6	7+7
Posterior unicusps	7+7	7+8	6+6	8+7	8+8	6+6	6+6	6-8	7+7
Total cusps	36	37	32	37	38	32	32	32-38	36
Pores:									
Prefinfol	9+8	9+8	9+9	9+9	6+6	12+12	-	6-12	1+2 **
Prebranchial	40+40	44+41	38+36	40+42	40+41	40+40	-	36-44	52+55
Trunk	85+84	73+75	-	83+82	85+85	91+92	-	73-92	130+130
Cloacal	2+2	1+1	-	3+3	3+3	2+2	-	1-3	-
Tail	16+16	11+8	15+13	16+15	16+16	16+16	+15	8-16	18+16
Total pores	141+140	128+124	-	139+139	141+142	147+148	-	124-148	200+201
Gill pouches	8+8	8+8	-	8+8	8+8	-	8+8	8-8	-

* Left + right count.

** According Richardson's illustration (1958, fig. 2).

DISTRIBUTION – Known from southern Brazil to northern Argentina (33°00'S to 36°51'S), from 80 to 800 m depth (Fig. 4).

COMMENTS – The specimen MOVI 01253 was previously recorded off southern Brazil by Mincarone & Soto (1997), being also cited by Fernholm (1998) based on the same record. This specimen has a low slime pore count when compared with the six other known speci-

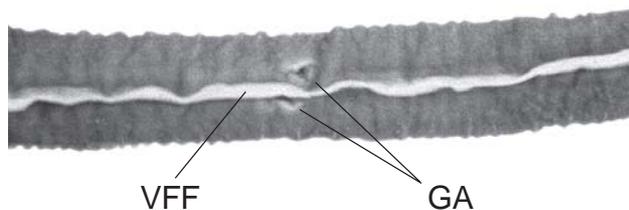


Figure 3. Ventral view of the branchial region of *Nemamyxine krefftii* MZUSP 19136, 292 mm TL, showing the gill apertures (GA) very near to ventral finfold (VFF).

mens (Tab. 1). However, most myxinids species have a wide range in the number of slime pores. In addition, the diagnostic characters are the same for every specimen examined.

Unfortunately, the specimen MOVI 05591 was partially eaten by a giant isopod, *Bathynomus giganteus* (Cirolanidae), while in the trap, which caused the partial destruction of the gill pouches, ventral aorta and reproductive apparatus. Therefore, it was not possible to determine the sex, number of gill pouches, and number of trunk pores. This damaged specimen has a grayish brown body and both the face and third pair of barbels whitish in color. Although given in descriptions of several species, color is normally a subjective feature and may change greatly with preservation.

All the specimens were caught in winter months, between May and August, a period of lower water temperature in this region due Falklands Current influence.

All hagfish species have a single tooth on the "palate", which usually is not described because it does



Figure 4. Records of *Nemamyxine kreffti*: A - ZMH 1144/1966 (holotype); B - MACN 439; C - MACN 2056; D - MZUSP 19136 E - MZUSP 19135; F - MOVI 01253; G - MOVI 05591.

not have systematic value. In all *Eptatretus*, *Myxine* and *Notomyxine* species examined by me, the palatine tooth has a conic shape like a bird's claw. However, in *N. kreffti* such tooth has a triangular dorsally compressed shape.

Both MACN and MZUSP specimens are the first myxinids recorded in Uruguayan waters.

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LITERATURE CITED

- Fernholm, B. 1998. Hagfish systematics. p.33-44. In: Jørgensen, J. M.; Lomholt, J. P.; Weber, J. P. & Malte, H. (eds). *The Biology of Hagfishes*. London. Chapman and Hall. 578p.
- McMillan, C. B. & Wisner, R. L. 1982. Results of the research cruises of FRV "Walther Herwig" to South America. LX. *Nemamyxine kreffti*, a new species of hagfish from off Argentina. *Arch. Fisch. Wiss.* 32(1/3): 33-38.
- McMillan, C. B. & Wisner, R. L. 1984. Three new species of seven-gilled hagfishes (Myxinidae, *Eptatretus*) from the Pacific Ocean. *Proc. Calif. Acad. Sci.* 43(16): 249-267.
- Mincarone, M. M. & Soto, J. M. R. 1997. Inclusão da classe Myxini (Agnatha) na ictiofauna do Brasil, com base na segunda ocorrência de *Nemamyxine kreffti* McMillan & Wisner, 1982 (Myxiniformes, Myxinidae). p.122. In: *Resumos do 12º Encontro Brasileiro de Ictiologia*. São Paulo. Instituto Oceanográfico da Universidade de São Paulo. 421 p.
- Richardson, L. R. 1958. A new genus and species of Myxinidae (Cyclostomata). *Trans. Royal Soc. New Zealand* 85 part 2: 283-287.
- Wisner, R. L. & McMillan, C. B. 1995. Review of new world hagfishes of the genus *Myxine* (Agnatha, Myxinidae) with descriptions of nine new species. *Fish. Bull.* 93(3): 530-550.

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