REVISÃO TAXONÔMICA DA FAMÍLIA MYXINIDAE RAFINESQUE, 1815 (MYXINIFORMES)

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TESE DE DOUTORADO

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SUMÁRIO

Dedico este trabalho a meus avós Arídes e Otília (*in memorian*), a meus pais Carlos e Terezinha, a minha esposa Milena e a meu filho Isaac.

Quando falares, cuida para que
tuas palavras sejam melhores que
o silêncio.

Provérbio Indiano

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RESUMO

Este trabalho contem informações extensivamente revisadas sobre a taxonomia e distribuição dos peixes-bruxa. Ele inclui todas as espécies nominais da família Myxinidae, a qual compreende 2 subfamílias, 6 gêneros e 69 espécies. Informações sobre cada espécies incluem: nomes válidos e descrições originais; sinônimos; material examinado; características diagnósticas; tamanho máximo; distribuição e habitat; interesse pesqueiro; observações (quando necessário); e nomes vernaculares. Pela primeira vez são apresentadas chaves de identificação e mapas de distribuição para todos os gêneros e espécies, observando-se ampliações na distribuição de muitas delas. As subfamília Paramyxininae Berg, 1947 e Quadratinae Wisner, 1999 são consideradas sinônimos júnior de Eptatretinae Bonaparte, 1850. O gênero *Quadratus* Wisner, 1999 é considerado sinônimo júnior de *Paramyxine* Dean, 1904. Uma espécie de *Eptatretus* e duas de *Myxine* são sinonimizadas. Duas novas espécies são descritas: *Eptatretus lakeside* Mincarone & McCosker, 2004, do Arquipélago de Galápagos, e *Eptatretus goliath* Mincarone & Stewart, 2006, da Nova Zelândia. A inclinação da curva acumulativa de diversidade temporal indica que o número de espécies de Myxinidae ainda está longe de ser conhecido. Cruzeiros de pesquisa direcionados a regiões pouco exploradas e o uso de novas tecnologias de coleta poderão revelar espécies ainda não descritas.

APRESENTAÇÃO

Esta tese é constituída de dois artigos científicos e de um livro, e cada um deles corresponde a um capítulo. Este trabalho é fruto de um projeto inicial que tinha como foco principal o conhecimento taxonômico sobre as espécies de peixe-bruxa do Brasil, sobre as quais nada havia sido publicado até então. Primeiramente, duas novas espécies foram identificadas e descritas: *Eptatretus menezesi* Mincarone, 2000 e *Myxine sotoi* Mincarone, 2001, ambas do talude continental brasileiro. Outras três espécies nominais foram também reportadas em águas brasileiras, quais sejam *Eptatretus multidens* Fernholm & Hubbs, 1981, da costa nordeste, *Myxine australis* Jenyns, 1842 e *Nemamyxine kreffti* McMillan & Wisner, 1982, ambas da plataforma continental do Rio Grande do Sul (Mincarone, 2001a, 2001b; Mincarone & Sampaio, 2004).

Após esta primeira fase do estudo e no âmbito do Programa de Doutorado em Zoologia da PUCRS, o projeto foi ampliado para contemplar uma revisão taxonômica compreendendo todas as espécies de Myxinidae. No decorrer deste trabalho, duas novas espécies foram identificadas: *Eptatretus lakeside* Mincarone & McCosker, 2004, do Arquipélago de Galápagos, publicada no *Proceedings of the California Academy of Sciences*, e mais recentemente, *Eptatretus goliath* Mincarone & Stewart, 2006, da Nova Zelândia, publicada na revista *Copeia*. Estes artigos constituem, respectivamente, o Capítulo I e II da presente tese.

Em junho de 2004, o autor foi convidado pela *Food and Agriculture Organization of the United Nations* (FAO) a publicar um catálogo sobre a família Myxinidae no seriado *FAO Species Catalogue for Fishery Purposes*, o que, em parte, coincidia com os objetivos da tese em si. Este catálogo constitui o Capítulo III da tese e segue as normas editoriais estipuladas pela FAO.

O Catálogo contém informações taxonômicas e distribucionais atualizadas e extensivamente revisadas sobre todas as espécies nominais de Myxinidae, incluindo sinonímias e novos arranjos nomenclaturais. O trabalho é direcionado principalmente àqueles interessados na sistemática, diversidade e distribuição dos myxinídeos, bem como nos poucos dados disponíveis sobre biologia e pesca. Apesar de muitas espécies de Myxinidae formarem densas populações e serem abundantes em seus habitats, o processo de identificação frequentemente apresenta grande dificuldade. Esta se deve principalmente ao pequeno número de caracteres disgnósticos e a grande variabilidade

morfológica intra-específica, o que explica o grande número de citações na literatura em nível de gênero ou família. Para facilitar o processo de identificação, pela primeira vez são apresentadas chaves para todos os gêneros e espécies. Da mesma forma, mapas distribucionais de todas as espécies tratadas são ilustrados no Catálogo.

A metodologia de medidas e contagens, incluindo nomenclatura das estruturas anatômicas e termos técnicos utilizados foram compilados de Fernholm & Hubbs (1981), McMillan & Wisner (1984), Wisner & McMillan (1995), e Mok (2001). Alguns termos foram modificados ou ganharam novo significado, mas todos são apresentados na forma de glossário.

Para cada espécie são apresentadas as seguintes informações: nome científico, material examinado, ilustração da espécie (quando disponível), caracteres diagnósticos, tamanho, distribuição e habitat, mapas de distribuição, interesse pesqueiro, observações, e nomes vernaculares. A lista de referências bibliográficas apresentada no final do Catálogo é fruto de uma extensa consulta em bibliotecas do Brasil e exterior, incluindo as bibliotecas do *National Museum of Natural History* (Washington, DC) e da *California Academy of Sciences* (San Francisco, CA), uma das mais completas bibliotecas de ictiologia do mundo.

Os resultados obtidos através da revisão taxonômica, foram, tanto quanto possível, incorporados ao formato e padrão editorial previstos pelos editores da FAO. Entretanto, o formato do catálogo, ainda que contemple os dados necessários para o seu propósito, exclui alguns aspectos importantes que fazem parte da construção desta tese, como, por exemplo, as conclusões gerais deste estudo. Com a finalidade de suprir esta carência, o Capítulo IV traz um apanhado sobre os principais resultados e conclusões.

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CAPÍTULO I

Eptatretus lakeside sp. nov., a new species of five-gilled hagfish (Myxinidae) from the Galápagos Islands

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Eptatretus lakeside sp. nov., a New Species of Five-Gilled Hagfish (Myxinidae) from the Galápagos Islands

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Eptatretus lakeside sp. nov., a New Species of Five-Gilled Hagfish (Myxinidae) from the Galápagos Islands

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We describe *Eptatretus lakeside* sp. nov. from a deepwater (762 m) specimen trapped off Fernandina Island, Galápagos Islands. The new species differs from all known *Eptatretus* in having: five pairs of gill pouches; 3-cusp multicusps in anterior and posterior rows; 6 unicusps in each anterior and posterior row; 36 total cusps; 19 tail pores; 88 total pores; palatine tooth triangular; and body coloration pinkish-orange. A key to the species of Galápagos hagfishes is provided.

The myxinoid fauna of the Galápagos Archipelago was unknown until 1995 when the California Academy of Sciences (CAS) / Harbor Branch Oceanographic Institute (HBOI) expedition made numerous deepwater collections using the submersible *Johnson Sea-Link*. During that cruise, three species of *Eptatretus*, *E. grouseri*, *E. mccoskeri*, and *E. wisneri* were trapped and all were described as new (McMillan 1999). A subsequent expedition in 1998 involving CAS, HBOI, and the National Museum of Natural History (USNM), again using the submersible *Johnson Sea-Link*, captured additional specimens of hagfishes, including a single remarkable specimen of *Eptatretus*, which is described herein as new.

Hagfishes are rare in the eastern tropical Pacific but abundant in the temperate and subtemperate eastern Pacific. In fact, the extensive deepwater collections off Central America and the Galápagos made by the U.S. Fish Commission Steamer *Albatross* in 1891 (Garman 1899) resulted in but one hagfish specimen. It was captured over a rocky bottom in 730 fathoms (1335 m) in the southern end of the Gulf of Panama and described as *Myxine circifrons* Garman, 1899. In contrast to the *Albatross*, the successful capture of hagfishes by the recent expeditions can be explained by the difficulty that the *Albatross* expedition had in trawling over unusually rocky terrain, and by the undeniable benefits provided by manned submersibles in exploring and collecting in complex deepwater habitats.

Currently, there are 30 recognized species of *Eptatretus*, 12 of which are known from the eastern Pacific (McMillan and Wisner 1984; Wisner and McMillan 1988, 1990; McMillan 1999). Undoubtedly more species remain to be discovered.

Materials and Methods

The type of the new species as well as the holotypes of all other hagfishes from the Galápagos Islands are deposited in the Department of Ichthyology of the California Academy of Sciences (CAS), San Francisco. Other type specimens examined are deposited in the Scripps Institution of Oceanography (SIO), La Jolla, and National Museum of Natural History (USNM), Washington, D.C.

Methods of measuring and counting follow those of Fernholm and Hubbs (1981) and McMillan and Wisner (1984). The names of anatomical structures follow Wisner and McMillan (1995) and Mok (2001). Length of the specimens (in mm) is given as total length (TL), the distance from the front of the rostrum to the end of the caudal finfold. All other measurements are given in percentage of TL. Counts of gill pouches (GP), gill apertures (GA), and cusps are taken for both sides, whereas slime pore counts are from the left side. Measurements and counts are given in Table 1 and compared with data of all other *Eptatretus* species previously known from the Galápagos Islands. We provide drawings from the anterior and posterior sets of cusps, including the palatine tooth, which are not usually useful characters to identify hagfish species, but in this case they aid in distinguishing species. We provide a key to the *Eptatretus* species from the Galápagos Islands, which was modified from McMillan (1999).

Eptatretus lakeside **Mincarone and McCosker, sp. nov.**
(Figs. 1, 3; Table 1)

Material examined.— Holotype: CAS 201880 (field number JM-155), an immature female, 275 mm TL, from off Cabo Douglas, NW Fernandina Island, Galápagos Islands, 00°17′30″S, 91°39′36″W, 762 m depth, collected on 17 July 1998 by David Pawson and Godfrey Merlen, using a baited metallic minnow trap, deployed while aboard the submersible R/V *Johnson Sea-Link* (JSL Dive 3101).

Diagnosis.— *Eptatretus lakeside* can be distinguished from its congeners by a combination of the followings characters: five pairs of gill pouches; 3-cusp multicusps in anterior and posterior rows; 6 unicusps in each anterior and posterior rows; 36 total cusps; 19 tail pores; 88 total pores; palatine tooth triangular; and body coloration pinkish-orange.

Description of the Holotype.— Body subcylindrical and slender, slightly deeper than wide at prebranchial, branchial, and trunk regions and strongly compressed at tail. Rostrum bluntly rounded; nasopharyngeal duct cylindrical, tube-like, slightly projecting. One pair of conspicuous nasal-sinus papillae on the inner dorsal surface of the nasal sinus. Three pairs of barbels on the head, the first two pairs about equal in size and adjacent to the nasopharyngeal duct; the third pair is immediately adjacent to the oral cavity. Ventral finfold (VFF) conspicuous, 2 mm high, beginning 25 mm behind the last gill aperture and extending backward to the cloaca. Caudal finfold quite thin and rounded, extending around tail to dorsal surface, ending about over cloaca.

Total length 275 mm; prebranchial length 68 mm; branchial length 17 mm; trunk length 145 mm; tail length 50 mm; body width at prebranchial region 14 mm; body depth at mid-trunk including VFF 20 mm; body depth excluding VFF 18 mm; body depth over cloaca 15 mm; tail depth 17 mm. Three-cusp multicusps in anterior and posterior rows of cusps; 6 unicusps in each anterior and posterior row; total cusps 36. Cusps long, slender, and pointed; palatine tooth triangular (Fig. 3). A segmentally arranged row of slime pores on each side, extending from beyond head to behind cloaca. Prebranchial pores 15; branchial pores 4; trunk pores 50; tail pores 19; total pores 88. Four branchial pores are intercalated with five gill apertures on both sides. No slime pore associated with the pharyngocutaneous duct. Five pairs of gill pouches corresponding to five pairs of gill apertures. Last branchial duct confluent with the pharyngocutaneous duct on the left side. First pair of gill pouches lies posterior to end of dental muscle; ventral aorta branches at the second gill pouch.

Body color in alcohol pinkish; barbels and face the same color as body; eyespots present but inconspicuous; ventral finfold pale; caudal finfold with a narrow pale margin. In life, the specimen was pinkish-orange.

Distribution.— Known only from the Galápagos Islands.

FIGURE 1. Dorsal view of preserved holotype of *Eptatretus lakeside* (CAS 201880; 275 mm TL).

ETYMOLOGY.— Named *lakeside*, a noun in apposition. We take great pleasure in honoring the Lakeside Foundation of California, which has generously supported the work of the senior author and many other foreign scholars.

Key to Galápagos Species of *Eptatretus*

1a. Five or six gill pouches and apertures on each side 2
1b. Eight gill pouches and apertures on each side 3

2a. Body coloration pinkish-orange; 3/3 multicusp pattern; 36 total cusps; 88 total pores . . . . . *Eptatretus lakeside*, new species
2b. Body coloration dark brown; 3/2 multicusp pattern; 44–48 total cusps; 71–79 total pores . . . . . *Eptatretus grouseri* McMillan, 1999

3a. Prebranchial length 24–26 % of TL; 3/3 multicusp pattern; 48–51 total cusps; 14–15 prebranchial pores . . . . . *Eptatretus mccoskeri* McMillan, 1999
3b. Prebranchial length 19–23 % of TL; 3/2 multicusp pattern; 44 total cusps; 9 prebranchial pores . . . . . *Eptatretus wisneri* McMillan, 1999

COMPARISON.— Three five-gilled species of *Eptatretus* were previously known: *E. grouseri* McMillan, 1999 from the Galápagos Islands, *E. profundus* (Barnard, 1923) from South Africa, and *E. eos* Fernholm, 1991 from the Tasman Sea. All have a 3/2 multicusp pattern, whereas *E. lakeside* has 3/3. *Eptatretus lakeside* also differs from *E. grouseri* in the following characters, respectively:

FIGURE 2. Left lateral view of preserved *Eptatretus grouseri* (CAS 201882; 420 mm TL).

number of unicusps on each row (6 *vs*. 8–10); total cusps (36 *vs*. 44–48); tail pores (88 *vs*. 71–79); shape of palatine tooth (triangular and depressed *vs*. conic [Fig. 3]); and its body coloration (pinkish-orange [Fig. 1] *vs*. dark brown [Fig. 2]). Also, the teeth of *E. lakeside* are more slender and more elongate than those of *E. grouseri* (Fig. 3). *Eptatretus lakeside* differs from *E. profundus* in the following characters, respectively (based on the redescription of the holotype of *E. profundus*

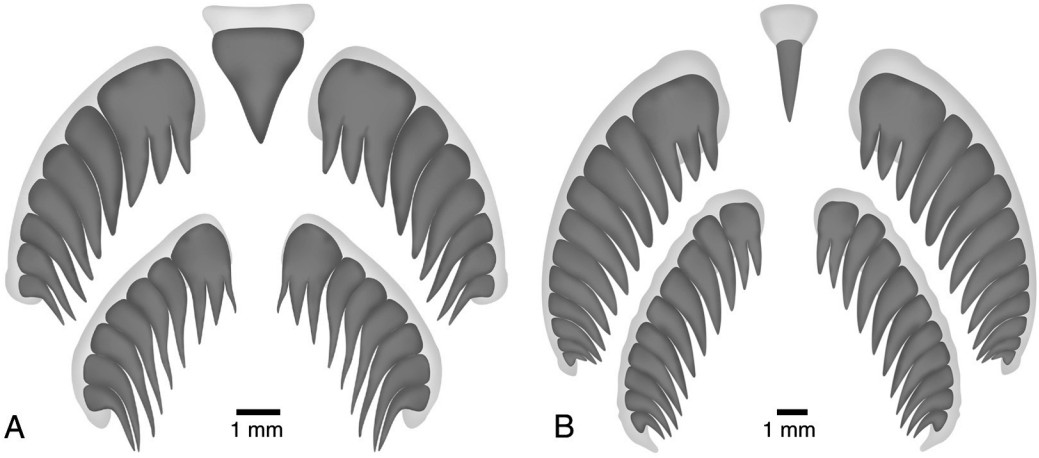

FIGURE 3. Dentition of (A) *Eptatretus lakeside* (CAS 201880, 275 mm TL), and (B) *Eptatretus grouseri* (CAS 201882, 420 mm TL).

TABLE 1. Measurements and counts of *Eptatretus* from the Galápagos Islands.

	E. lakeside	*E. grouseri*		*E. mccoskeri*	*E. wisneri*
	Holotype	Holotype	Non-types (2)	Holotype	Holotype
Total length TL (mm)	275	370	315–420	310	355
Measurements in % of TL					
Prebranchial length	4.7	20.3	21.0–22.2	25.8	18.9
Branchial length	6.2	8.1	6.3–6.5	10.0	12.1
Trunk length	50.9	57.0	54.0–55.7	48.4	51.3
Tail length	18.2	14.6	16.9–17.5	15.8	17.7
Body width	5.0	5.9	5.4–6.3	7.3	6.5
Body depth					
Inc. ventral finfold	7.2	6.8	7.9–9.0	8.2	8.0
Exc. ventral finfold	6.4	6.8	7.9–8.8	8.2	7.7
Over cloaca	5.4	5.7	6.4–6.5	7.3	6.5
Tail	6.0	6.8	7.6–7.9	8.9	8.3
Counts					
Cusps					
Multicusps	3/3	3/2	3/2	3/3	3/2
Anterior unicusps*	6+6	9+9	9–10	10+10	9+9
Posterior unicusps*	6+6	8+8	9–9	9+10	9+9
Total cusps	36	44	46–48	51	46
Slime pores, left side					
Prebranchial	15	12	11–12	13	9
Branchial	4	4	5–5	7	7
Trunk	50	46	42–48	43	43
Tail	19	15	13–14	10	14
Total pores	88	77	71–79	73	73
Gill apertures*	5+5	5+5	5–6	8+8	8+8
Gill pouches*	5+5	5+5	5–6	8+8	8+8

* Left + right count.

by Strahan 1975): number of unicusps on each row (6 *vs*. 8); tail pores (19 *vs*. 15); and its body coloration (pinkish-orange *vs*. dark brown). Despite the multicusp condition, *E. eos* shares some characters with *E. lakeside*: both have a pinkish body coloration; a long tail (about 18% of TL); an elongated tube-like nostril (longer in *E. eos*); and the same number of unicusps (six). However, *E. lakeside* differs from *E. eos* in the number of prebranchial pores (15 *vs*. 26), trunk pores (50 *vs*. 75–77), tail pores (19 *vs*. 26–27), and total pores (88 *vs*. 128–130) (based on the original description of the holotype of *E. eos* by Fernholm 1991). The other two *Eptatretus* species from the Galápagos Islands, *E. mccoskeri* and *E. wisneri*, can be easily separated from *E. lakeside* by their having eight pairs of gill pouches and a brownish-black body coloration. The triangular shape of

the palatine tooth is probably an autapomorphy of *E. lakeside* (Fig. 3A). *Nemamyxine kreffti* McMillan & Wisner, 1982, is the only other hagfish that has a similar palatine tooth, but its tooth is more depressed and has a rounded point (Mincarone 2001). In most hagfish species the palatine tooth has a conical shape like a bird's claw (Fig. 3B).

The Galápagos species of *Eptatretus*, albeit based on a very limited sample size, appear to be stratified by depth. The only known *E. mccoskeri* were trapped at 215 m on a seamount SE of San Cristobal Island on the eastern edge of the archipelago. The other species were captured off Fernandina Island (F), along the western edge of the archipelago, and from Seymour (S) Island (= James) in the center of the archipelago. They were trapped at the following depths: *E. wisneri*, 512–563 m (F); *E. grouseri*, 648–722 m (F and S); and *E. lakeside*, 762 m (F).

Remarks.— The location of capture, Cabo Douglas, is located along the NW corner of Fernandina Island and drops steeply into deep water (more than 1000 m depth at a distance less than 2 km from shore). The specimen was collected using a galvanized metal minnow trap baited with fish flesh and set from the submersible at 0845 and retrieved approximately one hour later. The bottom was nearly flat with a slight downward slope (<10°) and covered with fine gray sediment and occasional lava boulders (~ 0.5 m in diameter) in the vicinity of other large lava reefs. The temperature at depth was 8°C and there was a current of ~0.3 knot. The habitat is further described by Iwamoto and McCosker (2001) who described a new macrourid, *Coryphaenoides gypsochilus*, from that site. Also observed at and near that locality were several pelagic holothurians (*Pelagothuria nanatrix* Ludwig), hagfishes (*Eptatretus grouseri* McMillan and *E. wisneri* McMillan), catsharks (*Apristurus* spp.), combtooth dogfish (*Centroscyllium nigrum* Garman), chimaeras (*Hydrolagus* spp.), witch-eels (*Facciolella equatorialis* (Gilbert)), viperfish (*Chauliodus sloani* Bloch and Schneider), grenadier (*Nezumia loricata loricata* (Garman)), cardinalfish (*Epigonus merleni* McCosker and Long), batfishes (*Dibranchus erinaceus* (Garman)), ateleopodids (*Guentherus altivelis* (Osório)), bythitids (*Diplacanthopoma jordani* (Garman)), and an undescribed scorpionfish (*Phenacoscorpius* sp.).

Comparative Material.— *Eptatretus grouseri*: CAS 86428, holotype, 370 mm TL, Punta Espinosa, Fernandina Island, Galápagos Islands, 00°14′36″S, 91°26′36″W, 722 m; SIO 97–77, paratype, 138 mm TL, taken with holotype; CAS 201882, 2 specimens, 315–420 mm TL, Seymour Island, Galápagos Islands, 00°21′42″S, 90°15′00″W, 648 m, 25 July 1998, *Johnson Sea-Link* (JSL Dive 3113). *Eptatretus mccoskeri*: CAS 86431, holotype, 310 mm TL, San Cristobal Island, Galápagos Islands, 01°06′19″S, 89°06′56″W, 215 m; SIO 97–75, paratype, 290 mm TL, taken with holotype; USNM 344905, paratype, 284 mm TL, taken with holotype. *Eptatretus wisneri*: CAS 86429, holotype, 355 mm TL, Cabo Hammond, Fernandina Island, Galápagos Islands, 00°27′56″S, 91°37′33″W, 563 m; SIO 97–76, paratype, 316 mm TL, Galápagos Islands, 00°17′30″S, 91°38′54″W, 512 m.

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CAPÍTULO II

A new species of giant seven-gilled hagfish (Myxinidae: *Eptatretus*) from New Zealand

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A New Species of Giant Seven-gilled Hagfish (Myxinidae: *Eptatretus*) from New Zealand

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Eptatretus goliath **new species, is described from a specimen caught at the head of the Hauraki Canyon off the northeast North Island, New Zealand, at 811 m depth. It differs from all other seven-gilled *Eptatretus* in having three-cusp multicusps in anterior and posterior rows, 11–13 unicusps in anterior rows, nine unicusps in posterior rows, total cusps 54, 14–15 prebranchial pores, 57–58 trunk pores, 13–14 tail pores, 92 total pores, and a prominent ventral finfold. The single specimen, at 1275 mm TL and 6.2 kg, is the largest hagfish yet known.**

THE seven-gilled hagfishes of the genus *Eptatretus* (Myxinidae) from the Pacific Ocean have been previously studied by McMillan and Wisner (1984), who recorded four species: *E. carlhubbsi* from the northern Pacific, *E. cirrhatus* from southeastern Australia and New Zealand, *E. laurahubbsae* from Juan Fernández Islands, and *E. strahani* from the Philippines. Prior to the present account, *Eptatretus carlhubbsi* had been the largest known hagfish, with nine specimens measuring 810–1160 mm total length (McMillan and Wisner, 1984).

During exploratory commercial fishing for deep-water crabs in 2002, a single specimen of an extremely large hagfish was taken off northeastern New Zealand and returned to the Museum of New Zealand. Detailed study indicates this species belongs to an undescribed species. Herein we describe it as a new seven-gilled *Eptatretus*. Measuring 1275 mm total length, it is the largest hagfish reported to date.

MATERIALS AND METHODS

Methods for measurements and counts follow those of Fernholm and Hubbs (1981) and McMillan and Wisner (1984). Terminology of anatomical structures follows Wisner and McMillan (1995) and Mok (2001). Length of specimens (in mm) is given as total length (TL), defined as the distance from the front of the rostrum to the posterior margin of caudal finfold. All other measurements are given in millimeters and as percentage of TL. Counts of gill pouches (GP), gill apertures (GA), cusps, and slime pores were taken from both sides of the specimen. Institutional abbreviations are as listed in Leviton et al. (1985), except MOVI–Museu Oceanográfico do Vale do Itajaí (Itajaí, Brazil).

***Eptatretus goliath*, new species**

Goliath Hagfish

Figures 1, 2

Holotype.—NMNZ P.40729, adult female, 1275 mm TL, 6.2 kg, off New Zealand, northeastern North Island, from the head of the Hauraki Canyon, 35°27′54″S, 175°36′08″E, 811 m depth, collected in a crab pot, 22 March 2002, Greg Gibbs.

Diagnosis.—*Eptatretus goliath* can be distinguished from its congeners by the unique combination of the following characters: seven pairs of gill pouches; three-cusp multicusps in anterior and posterior rows; 11–13 unicusps in anterior rows; nine unicusps in posterior rows; total cusps 54; 14–15 prebranchial pores; 57–58 trunk pores; 13–14 tail pores; 92 total pores; ventral finfold prominent.

Description.—Body subcylindrical and extremely robust, slightly deeper than wide at prebranchial and branchial regions, laterally compressed at trunk, and strongly compressed at tail. Rostrum bluntly rounded, slightly projecting. One pair of conspicuous nasal-sinus papillae symmetrically placed on inner dorsal surface of nasal sinus. Three pairs of barbels on head, first two pairs about equal in size (15 mm) and adjacent to opening of nasopharyngeal duct; third pair longer (21 mm) and immediately adjacent to oral cavity. Ventral finfold (VFF) conspicuous, nine mm high, beginning 300 mm behind the last gill aperture and extending posteriorly to cloaca. Caudal finfold nearly rounded, extending around tail to dorsal surface, ending nearly over cloaca.

Total length 1275 mm; preocular length 55 mm (4.3% TL); prebranchial length 240 mm (18.8% TL); branchial length 85 mm (6.7% TL); trunk length 750 mm (58.8% TL);

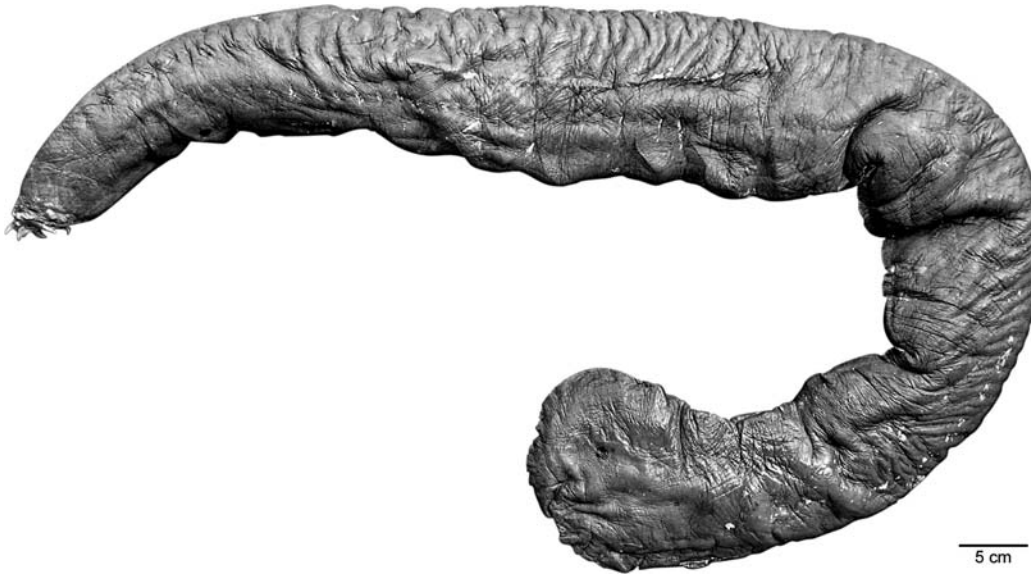

Fig. 1. *Eptatretus goliath,* new species, holotype NMNZ P.40729, 1275 mm TL.

tail length 200 mm (15.7% TL); body width at prebranchial region 82 mm (6.4% TL); body depth at mid-trunk including VFF 130 mm (10.2% TL); body depth excluding VFF 121 mm (9.5% TL); body depth at cloaca 104 mm (8.2% TL); tail depth 145 mm (11.4% TL). Three-cusp multicusps in anterior and posterior rows of cusps on each side; 13 unicusps in anterior and nine unicusps in posterior row on left side; 11 unicusps in anterior and nine unicusps in posterior row on right side; total cusps 54. Cusps proportionally small, slender, and pointed; palatine tooth conical (Fig. 2). Segmentally arranged row of slime pores on each side. Prebranchial pores (left/right) 14/15; branchial pores 6/7; trunk pores 58/57; tail pores 14/13; total pores 92/92. One slime pore associated with each gill aperture except for that of the pharyngocutaneous duct (PCD).

Seven pairs of gill pouches corresponding to seven pairs of gill apertures. Last branchial duct confluent with PCD on left side, forming a large aperture. Length of dental muscle 23% of total length; posterior tip of dental muscle reaches fourth gill pouch. Ventral aorta branches at seventh (last) gill pouch, very close to the heart; all afferent branchial arteries connected to branched portion of ventral aorta.

Body color in alcohol dark brown; rostrum and tip of barbels whitish; conspicuous eyespots; irregular white spots around mouth; gill apertures, slime pores, and VFF colored as body; caudal finfold with a narrow dark distal margin; dark spots of different sizes and shapes randomly distributed over entire body.

The holotype is an adult female containing dozens of small eggs, measuring about 45 × 14 mm. All eggs are still in the mesentery, which is attached to the body wall; terminal anchor filaments and hooks are not present on any of the eggs.

Distribution.—Known only from type locality.

Comparisons.—In the Pacific Ocean, four seven-gilled species of *Eptatretus* have been recorded: *E. carlhubbsi* from the northern Pacific, *E. cirrhatus* from southeastern Australia and New Zealand, *E. laurahubbsae* from the Juan Fernández Islands, and *E. strahani* from the Philippines.

Eptatretus goliath differs from *E. carlhubbsi* in the following characters: multicusp pattern (3/3 vs. 2/3), number of anterior unicusps (11–13 vs. 15–17), posterior unicusps (9 vs. 11–13), total cusps (54 vs. 63–71), trunk pores (57–58 vs. 60–70), and ventral finfold (present vs. absent). Whilst *E. goliath* seems to be more robust than *E. carlhubbsi*, the body proportions for both species are very similar, except the tail depth (11.4 vs. 8.9–10.5% TL, respectively). *Eptatretus goliath* and *E. carlhubbsi* are the only species of hagfish that attain more than one meter in length. Nine specimens of *E. carlhubbsi* examined by McMillan and Wisner (1984) measured between 813 and 1160 mm TL.

Eptatretus goliath and *E. cirrhatus* have the same multicusp pattern (3/3), but differ in the

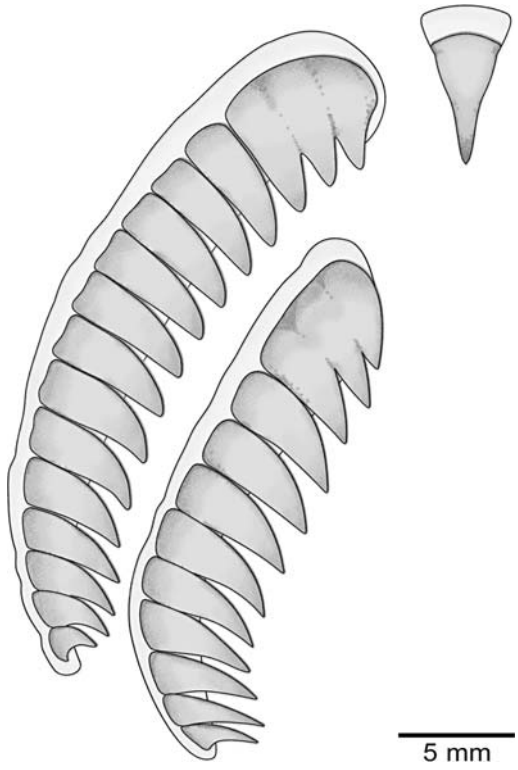

Fig. 2. Dentition (left side series and palatine tooth) of *Eptatretus goliath*, new species, holotype NMNZ P.40729, 1275 mm TL; anterior toward top.

following characters: preocular length (4.3 vs. 5.2–6.7% TL), prebranchial length (18.8 vs. 21.4–23.9% TL), trunk length (58.8 vs. 52.5–56.3% TL), body depth over cloaca (8.2 vs. 5.7–7.5% TL), tail depth (11.4 vs. 7.7–9.1%TL), number of anterior unicusps (11–13 vs. 8–11), total cusps (54 vs. 43–51), prebranchial pores (14–15 vs. 16–20), and total pores (92 vs. 83–90). The largest known specimen of *E. cirrhatus* is 830 mm TL (Fernholm, 1998).

Eptatretus goliath differs from *E. laurahubbsae* in the following characters: tail length (15.7 vs. 18.1–21.3% TL), tail depth (11.4 vs. 8.2–9.9% TL), multicusp pattern (3/3 vs. 2/2), number of anterior unicusps (11–13 vs. 13–17), posterior unicusps (9 vs. 11–16), total cusps (54 vs. 61–68), trunk pores (57–58 vs. 60–67), and total pores (92 vs. 97–105). *Eptatretus laurahubbsae* is also only known from juvenile specimens (maximum 375 mm TL), so its adult size is not known (McMillan and Wisner, 1984).

Eptatretus goliath differs from *E. strahani* in the following characters: preocular length (4.3 vs. 5.7–6.8% TL), prebranchial length (18.8 vs. 21.0–23.1% TL), trunk length (58.8 vs. 50.0–53.7% TL), tail length (15.7 vs. 17.4–20.0% TL), total cusps (54 vs. 47–52), trunk pores (57–58 vs. 45–48), and total pores (92 vs. 76–80). The largest known specimen of *E. strahani* is 520 mm TL (McMillan and Wisner, 1984).

Two seven-gilled species of *Eptatretus* occur in the western Atlantic Ocean: *E. caribbeaus* from the Caribbean Sea and *E. menezesi* from southeastern and southern Brazil. *Eptatretus caribbeaus* and *E. menezesi* share the same multicusp pattern (3/3) as *E. goliath*, but differ in the number of trunk pores (57–58 for *E. goliath* vs. 47–52 for *E. caribbeaus* and 48–55 for *E. menezesi*) and total pores (92 for *E. goliath* vs. 79–85 for *E. caribbeaus*). The maximum total lengths recorded for *E. caribbeaus* and *E. menezesi* are 385 and 900 mm, respectively (Fernholm, 1982; Mincarone, 2000, unpubl. data).

Besides *E. goliath* and *E. cirrhatus*, three other species of Myxinidae are known from the New Zealand region: *E. eos*, *Nemamyxine elongata*, and *Neomyxine biniplicata*. *Eptatretus eos* is a five-gilled species possessing a tube-shaped elongated snout and a very high slime pore count of 128–130, including 27 in the caudal series (Fernholm, 1991). In addition, the unique specimen known was bright fluorescent pink when first captured. *Nemamyxine elongata* possesses a very slender body, one pair of gill apertures, ten pairs of gill pouches, ventral finfold originating before gill apertures, 2/2 multicusp pattern, 36–38 total cusps, and 200–201 total pores (Richardson, 1958; Mincarone, unpublished data). It is only known from the 614-mm holotype and from another specimen (NMNZ P.37198, 790-mm female) recently trawled off north Canterbury Bight, South Island, 44°20.3′S, 172°00.5′E, at 132 m depth on 21 March 2000. *Neomyxine biniplicata* has one pair of gill apertures, seven pairs of gill pouches, one pair of ventro-lateral finfolds, 2/2 multicusp pattern, 30–34 total cusps, and 138–188 total pores (Richardson, 1953; Mincarone, unpubl. data).

Etymology.—Named *goliath*, the Philistine giant of biblical fame. A noun in apposition.

Remarks.—Where multiple specimens are available, species of New Zealand Myxinidae demonstrate wide depth ranges. Both *E. cirrhatus* and *N. biniplicata* are recorded from one to ~1100 m depth. The two known specimens of *N. elongata* are from the subtidal and 132 m depth. *Eptatretus eos*, known from only one specimen, was taken between 900–1013 m. The only known specimen of *E. goliath* was collected at 811 m.

Eptatretus cirrhatus and *N. biniplicata* can both form locally abundant populations; inshore, the former is often associated with reefs (A. L.

Stewart, pers. obs.). Generally these two species can be easily sampled by divers or inshore commercial trawling. The other three species, however, appear to either avoid being captured by trawl or are able to escape through the mesh. Added to that is the aversion of most fishermen to have these fishes on board their vessels, which has limited the number of specimens being returned to scientific institutions. As deepwater species are known just from a few specimens their distribution, abundance, and biology remains poorly understood.

Material Examined

Eptatretus carlhubbsi.—USNM 227440, paratype, 868 mm TL, 24°48′N, 167°14′W, 853 m, 9 Dec. 1980; USNM 233742, paratype, 940 mm TL, 14°59′N, 145°13′E, 1016 m, 5–6 Apr. 1981; CAS 50705, paratype, 1000 mm TL, Leeward Islands, Hawaii, Nov. –Dec. 1981; CAS 50706, paratype, 950 mm TL, Leeward Islands, Hawaii, 481 m, 19 Nov. 1981.

Eptatretus cirrhatus.—MOVI 27797, 1, 460 mm TL, 37°34.00′S, 178°20.00′E, 17 m, 28 June 1988; MOVI 27798, 1, 620 mm TL, 37°11.50′S, 176°10.00′E–37°10.50′S, 176°11.50′E, 190–265 m, 22 Jan. 1979; SAM F5363, 433 mm TL, 37°59′S, 150°05′E, 452 m, 14 Oct. 1984; SAM F5360, 439 mm TL, 37°44′S, 150°16′E, 620 m, 14 Oct. 1984; SAM F5356, 441 mm TL, 38°11′S, 149°58′E, 620 m, 15 Oct. 1984.

Eptatretus laurahubbsae.—USNM 227441, paratypes, 2, 185–200 mm TL, and CAS 49125, paratypes, 2, 225–270 mm TL, Juan Fernandes Island, 33°31′S, 78°50′W, 2400 m, 12–13 Dec. 1965.

Eptatretus strahani.—MNHN 1981-0722, paratype, 500 mm TL, SIO 81-116, paratype, 430 mm TL, and USNM 227442, paratype, 435 mm TL, South China Sea, near Lugbarg Island, Philippines, 14°00′N, 120°18.2′E, 189 m, 21–22 March 1976.

Eptatretus caribbeaus.—USNM 218405, paratype, 340 mm TL, Caribbean Sea, Nicaragua-Colombia, 200 fms (366 m), 5 July 1972; UF 27894, paratype, 334 mm TL, Caribbean Sea, Nicaragua, WSW of Quitasueño, 14°08′N, 81°55′W, 200–244 fms (366–446 m), 21 May 1962; UF 27895, paratype, 350 mm TL, Caribbean Sea, Honduras, W of Rosalind Bank, 16°50′N, 81°21′W, 200 fms (366 m), 7 June 1962.

Eptatretus menezesi.—MOVI 14729, holotype, 737 mm TL, off Santa Catarina, Brazil, 29°14′S, 48°02′W, 250 m, 31 July 1998; MZUSP 52492, paratypes, 2, 390–462 mm TL, off Rio de Janeiro, Brazil, 24°09′19″S, 43°14′13″W, 510 m, 6 Dec. 1997; MZUSP 52493, 12, 314–602 mm TL, off Santa Catarina, Brazil, 29°37′42″S, 48°00′30″W, 380 m, 27 April 1997.

Nemamyxine elongata.—NMNZ P.37198, 1, 790 mm TL, north Canterbury Bight, South Island, New Zealand, 44°20.3′S, 172°00.5′E, 132 m, F/V Sapun Gora, trawl, 21 March 2000, B. Liddle.

Neomyxine biniplicata.—AMS I.24337001, 1, 305 mm TL, no data (probably New Zealand), L. R. Richardson and J. P. Jowett, 1957; AMS I.24336001, 1, 324 mm TL, no data (probably New Zealand), 1958, L. R. Richardson; AMS IB.3806, 1, 314 mm TL, and AMS IB.3807, 1, 350 mm TL, 41°15′S, 172°34′E, 73 m, 1957, L. R. Richardson; MOVI 27795, 1, 380 mm TL, 41°44′S, 174°16′E, 146.3 m, 5 Nov. 1952; MOVI 27796, 1, 446 mm TL, 42°44.30–45.00′S, 176°02.40–00.20′E, 778–798 m, 8 Jan. 1989; NMNZ P.24787, 2, 410–450 mm TL, 42°44.30–45.00′S, 176°02.400–0.20′E, 778–798 m, 8 Jan. 1989; NMNZ P.1171, 1, 375 mm TL, 41°44′S, 174°16′E, 146.3 m, 5 Nov. 1952; SIO 94-1, 1, 333 mm TL, south of Cape Campbell, New Zealand, 40–50 fms (73–91 m).

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CAPÍTULO III

Hagfishes of the World
A catalogue of Myxinidae known to date

Michael M. Mincarone

Original manuscript to be submitted to FAO
FAO Species Catalogue for Fishery Purposes
275 pages, 95 figures
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Hagfishes of the World

A catalogue of Myxinidae known to date

by

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ABSTRACT

This catalogue contains the extensively revised and updated taxonomic and distributional information about the hagfishes of the world. It covers all the living nominal species of the family Myxinidae, which comprise 2 subfamilies, 6 genera, and 69 species. Information under each species account includes: valid modern names and original citation of the species; synonyms; material examined; diagnostic features; size; distribution and habitat; interest to fisheries; remarks (when necessary); and common names (when available). The volume includes sections on terminology and measurements, a glossary, a list of species by FAO Statistical Areas, and a dedicated bibliography.

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TABLE OF CONTENTS

1. INTRODUCTION

In this volume the readers will find the extensively revised and updated taxonomic and distributional information about the hagfishes of the world. It covers all the living nominal species of the family Myxinidae, including their synonyms, independently of their degree of importance for fisheries. The Catalogue is intended to form a comprehensive review of hagfishes of the world in a form accessible to researchers interested on hagfish systematics, biodiversity, distribution, as well as the little information available on fisheries. Many hagfish species are abundant in nature and play a significant role in the ecology of their habitats, but their identification often presents such great difficult that they are referred to family or genus level only. In order to provide a tool that improves the identification process, this Catalogue includes keys to and accounts for all genera and species.

Hagfishes comprise a uniform group of primitive, jawless, cartilaginous, eel-like craniates with an entirely marine distribution, inhabiting the cool or deep parts of the oceans of both hemispheres. They usually occupy burrows located in soft, mud-bottom habitats occurring in depths ranging from a few to at least 5000 m (Martini, 1998). In colder waters at the latitudinal extremes of their distributions, some species live in much shallower depths and can also be found among rocky habitats. The latitudinal range of hagfish distribution extends from inside the Arctic Circle (Wisner and McMillan, 1995) to the South Shetland Islands, near Antarctica (Norman, 1937) (Fig. 1). The limiting factors that determine the distribution of hagfishes appear to be salinity, temperature, and substrate preference. All known hagfishes require a high salinity and low temperature. Despite their frequent association with soft bottoms, the substrate preference varies from species to species. Depth does not appear to be a limiting factor for hagfishes, although some species have characteristic depth ranges, which are summarized in the Figure 2. For details on the environmental requirements see Martini (1998). Hagfishes show a nocturnal pattern of activity both in aquaria and in the field (Worthington, 1905; Fernholm, 1974). Seasonal migration in response to habitat shifts or reproductive function is an unusual phenomenon, which has been reported only for ***Eptatretus burgeri*** (Kobayashi *et al*., 1972; Fernholm, 1974; Tsuneki *et al*., 1983; Nozaki *et al*., 2000). For the rest of species from which

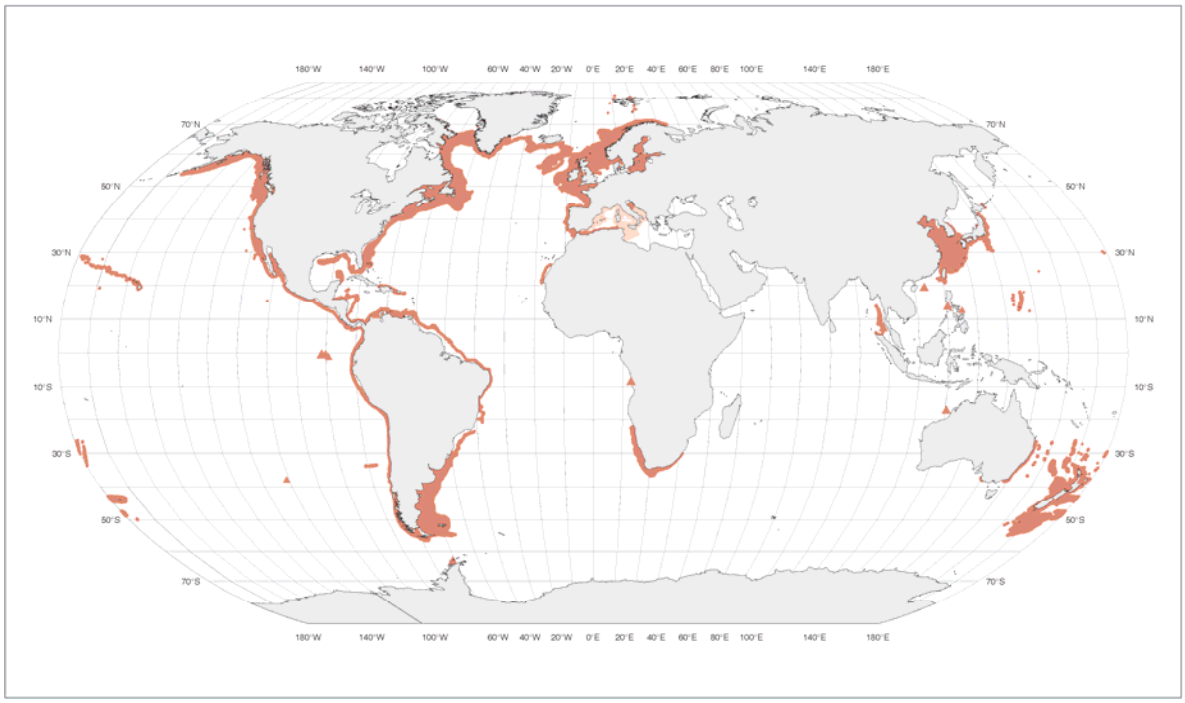


Fig. 1. Global distribution of family Myxinidae.

appropriate collections have been made, there appears to be no seasonally defined reproductive cycle. Because of their inaccessibility to observation at depths greater than 100 m, reproductive patterns of hagfishes are practically unknown, and only inferred. Although there is little information available concerning hagfish development, it is clear that it is direct, not involving a larval form (Gorbman, 1983, 1997).

Because most hagfishes are deep sea species, rare in collections, known only from a few specimens, and have a relatively small and often imprecise literature, the information available on their biology are very limited. Even the most basic aspects of their life histories, such as growth rate, age at sexual maturity, and longevity, remain unknown. Compilations and overviews on the available information include those published by Brodal and Fänge (1963) and Hardisty (1979), and more recently by Jørgensen *et al*. (1998).

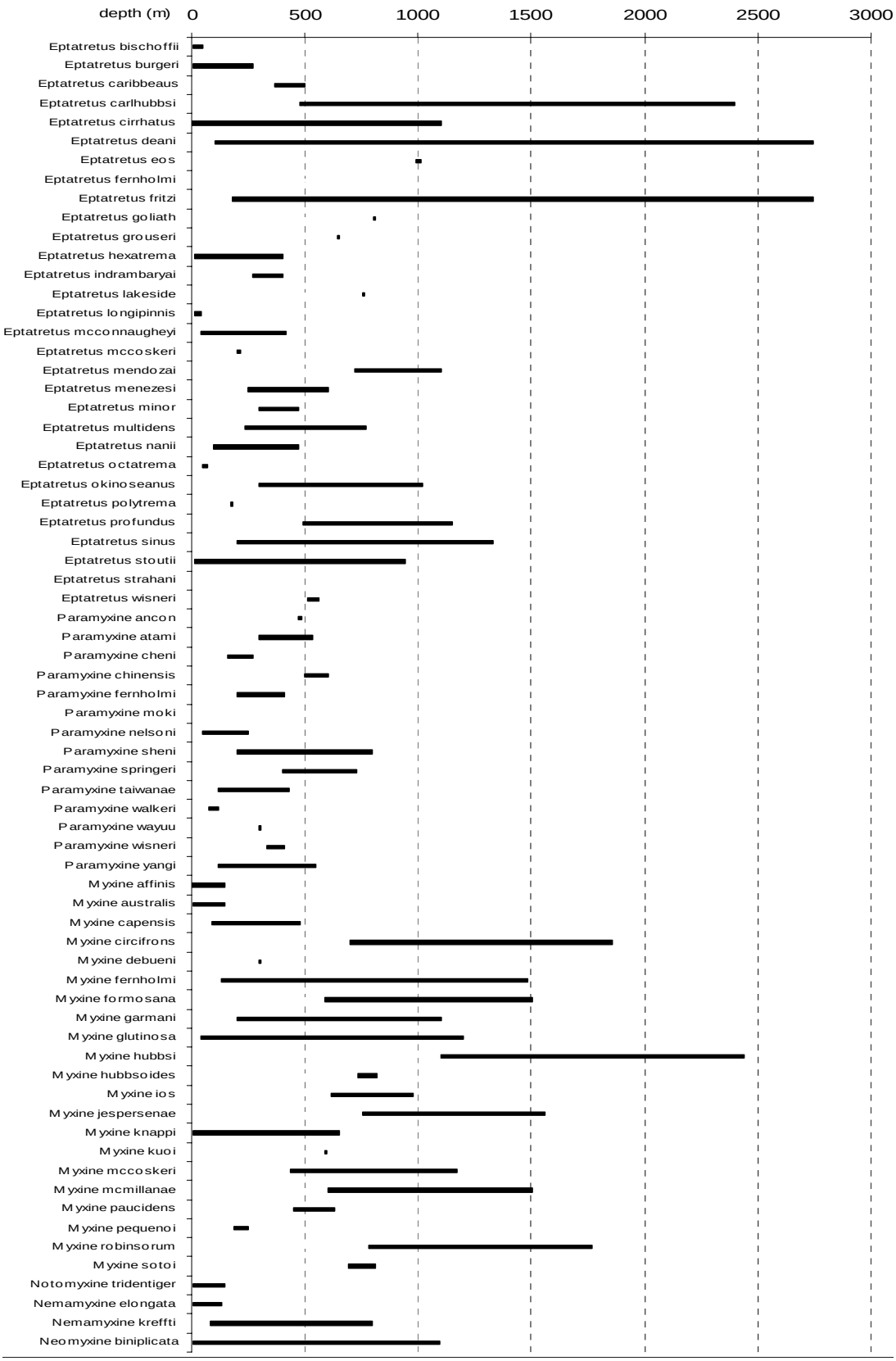


Fig. 2. Vertical distribution for all species of Myxinidae.

1.1 Classification and Systematic Arrangement

The superclass Myxinomorphi is thought to be the sister group of vertebrates and to be the basal craniate taxon. Extant hagfish are excluded from the Vertebrata primarily because they lack arcualia (embryonic or rudimentary ventebral elements) (Nelson, 2006). Hagfishes are noteworthy from an evolutionary standpoint because they represent the oldest extant clade among the craniates. Our current understanding of the systematics of hagfishes recognizes the class Myxini, comprising the order Myxiniformes. The order Myxiniformes contains the monophyletic family Myxinidae, which, in turn, is subdivided into the subfamilies Eptatretinae and Myxininae (Nelson, 2006). Wisner (1999) described two new subfamilies, Paramyxininae and Quadratinae; however, the family-group name Paramyxinidae was proposed earlier by Berg (1947). In the lack of phylogenetic studies that support the validity of the subfamilies proposed by Wisner (1999), both are herein rejected.

Studies about hagfishes have been developed since eighteenth century, when the first species was described by Linnaeus (1758) as ***Myxina glutinosa*** in the tenth and later editions of his *Systema Naturae* (Fernholm, 1998). Since then, hagfish systematics has been treated by many researches, mainly during the last century, period in which most of the known species were described. The number of valid species has been progressively compiled along the last century by Regan (1912, 1913a) n=19, Holly (1933) 20, Adam and Strahan (1963) 21, Fowler (1964) 17, Hardisty (1979) 22, and Fernholm (1998) 57. In spite of the expressive number of valid species, many of them were described based on few specimens and the available material in collections is quite scarce. The overall group has not received worldwide revision recently, although there are several important regional taxonomic reviews (e.g., Strahan, 1975; Fernholm and Hubbs, 1981; McMillan and Wisner, 1984, 2004; Kuo *et al*., 1994; Wisner and McMillan, 1988, 1990, 1995).

At present, 69 valid species of living hagfishes, and two fossil species (***Myxinikela siroka*** Bardack, 1991 from the Pennsylvanian of Illinois, USA, and ***Myxineidus gonororum*** Poplin, Sotty and Janvier, 2001 from the Late Carboniferous Konservant-Lagerstätte of Montceau-les-Mines, Allier, France) are recognized. Hagfishes are easily identifiable as a family due to their similarity in overall body appearance. Monophyly of

recent hagfishes in the family Myxinidae is supported by the following synapomorphies: single nostril leading respiratory water through the nasopharyngeal duct to pharynx and gill pouches; unique thread cells in numerous slime glands; adenohypophysis with little cellular differentiation and not divided into distinct regions; barbels around laterally biting mouth structures; pharyngocutaneous duct on the left side opening to the exterior.

Genera have typically been established on the basis of number of gill pouches and arrangement of gill apertures. The relative position of ventral finfold, confluence of the last gill aperture with pharyngocutaneous duct, and presence of paired finfolds, have also been used to distinguish genera. However, phylogenetic relationships among recent species of Myxinidae are still not defined and the number of recognized genera is controversial. Some authors recognize ***Eptatretus*** and ***Paramyxine*** (Honma, 1998; Mok, 2001) or ***Eptatretus***, ***Paramyxine***, and ***Quadratus*** (Wisner, 1999; McMillan and Wisner, 2004; Mok and McMillan, 2004), while others recognize only ***Eptatretus*** (Strahan, 1975; Fernholm and Hubbs, 1981; Fernholm, 1998; Kuo *et al*., 2003; Chen *et al*., 2005). Some few molecular phylogenetic studies suggested that both ***Paramyxine*** and ***Quadratus*** must be synonymized into ***Eptatretus*** (e.g. Kuo *et al*., 2003; Chen *et al*., 2005) in disagreement with Wisner (1999) who, on the basis of morphological studies, believes in the validity of the three genera. In the lack of consensus, I conservatively suggest maintaining current usage presented in the Figure 3 until the status of genera receive more conclusive cladistic studies.

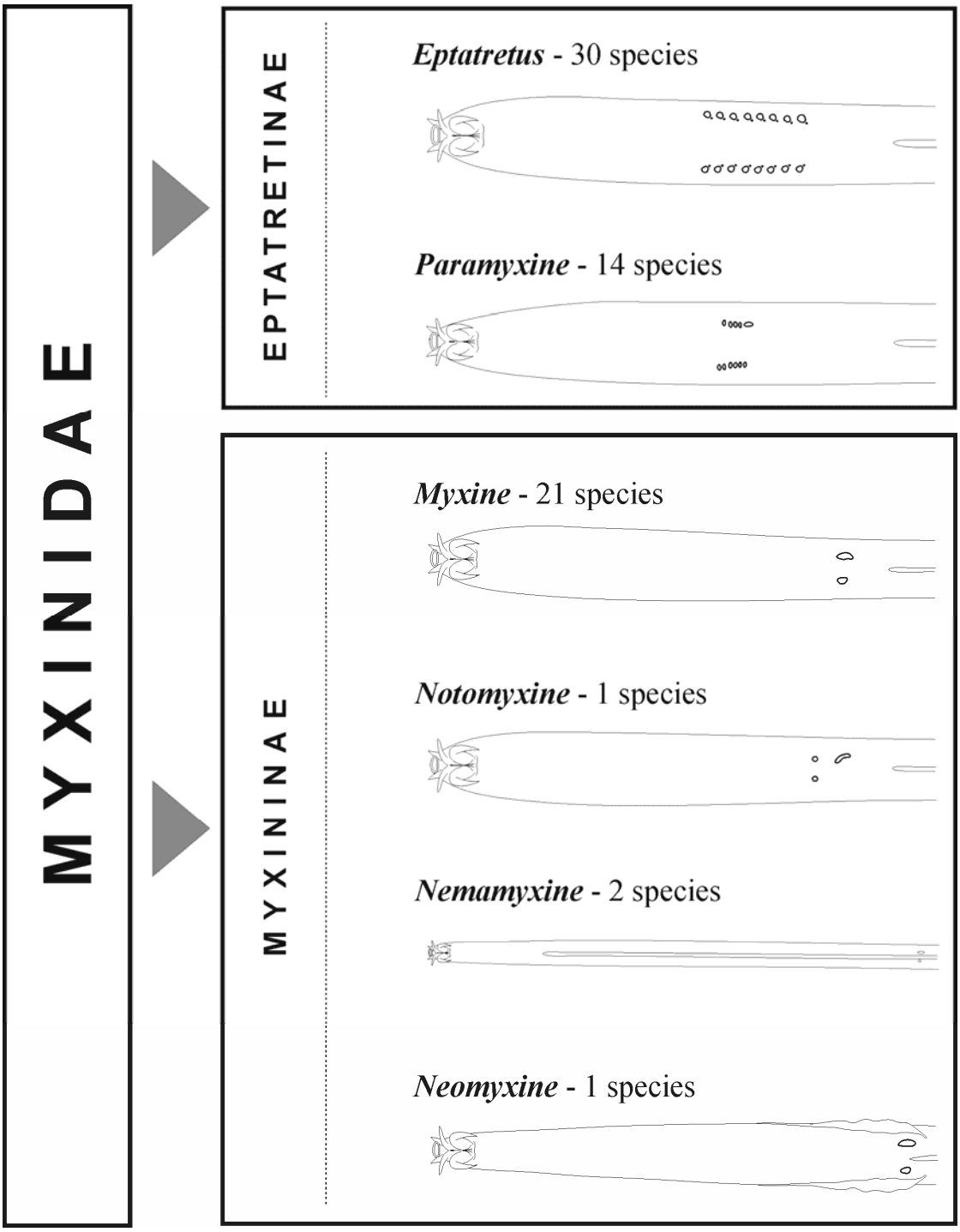


Fig. 3. Arrangement of Myxinidae followed in this catalogue.

1.2 Fisheries

Hagfishes are of limited importance in commercial fisheries and have served a minor role as food-fish in Asiatic countries bordering the northwest Pacific Ocean, principally Japan, and Korea. The manufacture of goods from hagfish leather is centered almost completely in South Korea, where they are relatively high-priced. The total size of the hagfishery in Japan and Korea is difficult to estimate because centralized records are not kept. In addition, due to the difficulty in identifying many of the hagfishes, separate catch statistics are not reported for most species and landings are usually summarized as a vernacular name, which often corresponds to two or more species. At least four species comprise the hagfishery in Japanese and Korean waters: ***Eptatretus burgeri*** and ***Paramyxine atami*** from the most commonly fished depths near 100 m, and ***E. okinoseanus*** and ***Myxine garmani*** from greater depths up to 500 m (Gorbman *et al*., 1990). However, we know today that species from Sea of Japan previously identified as ***Paramyxine atami*** belongs to more than one species of ***Paramyxine*** (McMillan and Wisner, 2004).

All commercial hagfishing predominantly employs baited traps that are placed on the bottom and strung on a long line. The traps are constructed of bamboo or plastic resin with one or more conical entrances. Each boat lays a single line, as much as 8,000 m or more in length and bearing as many as 500 traps, which are left on the bottom for about 4 hours (Gorbman *et al*., 1990). A few landings have been reported in California as being caught by line, otter trawls, and sea urchin dredges (Leask and Beamish, 1999).

The available information from the Izumozaki area provided by the Izumozaki Cooperative Fisheries Association, demonstrated that the hagfishery declined both in terms of number of boats and in size of catch (Table 1) (Gorbman *et al*., 1990; Honma, 1998). According to Honma (1998), it seems likely that the significant decreases in the hagfish landed at Izumozaki are the result of overfishing. The available information about hagfishing status in other Asian localities was provided by Okada *et al*. (1948), Strahan and Honma (1960), Gorbman *et al*. (1990), and Honma (1998).

Table 1. Hagfish landed at Izumozaki* (1962-1987 [Gorbman *et al*. 1990]; 1988-1995 [Honma, 1998]).

Year	Number of boats	Catch (kg)	Income (Yen)
1962		51 852	3,437,530
1963		32 510	3,937,530
1964		39 070	4,856,570
1965		36 842	3,886,659
1970		30 989	8,521,728
1971		28 521	10,163,102
1972		25 848	9,934,045
1973		36 683	13,209,487
1974	10	26 635	11,501,252
1975		21 088	11,598,729
1976		4 216	2,878,505
1977		23 184	12,751,407
1979		5 029	3,915,320
1980	1	10 590	6,444,830
1981		2 957	2,266,663
1982		473	423,085
1983		33	24,550
1986		1 554	965,800
1987		4 715	2,680,240
1988	1	1 225	767,500
1989	1	4 619	3,887,358
1990	1	3 927	4,758,600
1991	1	4 320	4,226,755
1992	1	1 885	2,623,822
1993	1	3 304	4,563,930
1994	1	2 566	3,962,925
1995	1	2 777	4,270,895

The demand for hagfish skins has become so great in the Asian market, that to serve this demand a hagfishery started in 1987 along the northeast Pacific coast in California, Oregon, and Vancouver Island. This North America fishery began with a sample sent from California to the Korea in 1987 (Barss, 1993). In 1988, British Columbia and Oregon joined California in supplying hagfish, primarily ***E. stoutii***, to Korean hagfish skin buyers. Fisheries started on the east coast of the North America in 1989 when Nova Scotia began supplying Atlantic hagfish, ***M. glutinosa***, to the same market. By 1993, the fisheries on the west coast were in decline and the fisheries from Maine and Massachusetts stepped in to maintain the supply to the Asian market. The highest recorded landings on the continent were 2,502 tonnes in 1990, mostly from the west coast, and 2,328 tonnes in 1996, mostly from the east coast fisheries (Table 2) (Leask and Beamish, 1999).

Despite a number of important studies on the life history of hagfishes, knowledge is still required about growth rates, age determination, life span, and many other aspects of the reproductive biology of the exploited species, in order to provide subsidies for the hagfishery development.

Table 2. Landings (in metric tonnes) for hagfish (Pacific *E. stoutii*, Black *E. deani*, and Atlantic *M. glutinosa*) in North America (from Leask and Beamish, 1999).

Year	BC	WA	OR	CA	**Pacific + Black**	NS	ME	MA	NH	**Atlantic**
1988	66.2		11.7	313.3	**391.2**					
1989	625.6		156.1	1 198.6	**1 980.3**	117.1				
1990	167.0	35.9	76.0	2 222.9	**2 501.8**	88.7				
1991	63.8		124.5	137.5	**325.8**	86.5				
1992	45.1	19.1	340.8	183.9	**588.9**	204.5				
1993			150.9	0.3	**151.2**	7.2	82.8	394.4		**484.4**
1994				0.6	**0.6**	107.7	29.3	1 075.9		**1 213.0**
1995			1.0	0.4	**1.4**	503.0		1 421.4		**1 924.4**
1996			17.4	82.7	**100.1**	268.7	410.1	1 549.1		**2 227.8**
1997				0.03	**0.03**	15.0	418.3		3.7	**437.0**
1998			3.7	0.2	**3.9**		875.4	572.2		**1 869.5**

BC, British Columbia; WA, Washington; OR, Oregon; CA, California; NS, Nova Scotia; ME, Maine; MA, Massachusetts; NH, New Hampshire.

1.3 Plan of the Catalogue

This Catalogue is based on original work on various species as well as my interpretation of data in the literature. Original descriptions of hagfish species were consulted when possible; when not, various authoritative works were consulted for consensus on citations. Some of the arrangements of genera and species used here disagree with those of previous workers, including those in my own papers, but in such cases the disagreements are discussed or reference is made to discussions of such problems in the literature. The bibliography covers as much as possible a wide selection of references used in writing the catalogue.

Family accounts. Include the type genus with author and date; Diagnostic Features; the number of recognized genera in the family; a Remarks section mostly with systematic comments; the available family vernacular names in several languages; and a Key to Genera.

Generic accounts. Include the valid modern form of the genus name with author and year; the original citation of the genus with its author, year, and pagination; the type species and means of designating it (for example, by original designation, monotypy, absolute tautonymy, or subsequent designation); the number of recognized species in the genus; the synonyms of genera, author, year, pagination, and genus they were described in if originally ranked as subgenera or equivalents; Diagnostic Features of the genus; a Key to Species if the genus has more than one species (not monotypic); and a Remarks section where necessary.

Species accounts. Information is presented for each species on the following subjects:

1. *Scientific name*. The valid modern name of the species, with author and date; the original citation of the species, with its author, year, reference pagination; all known type series; the type locality including the location, coordinates and depth if available; synonyms, other combinations of genera and species, misidentifications, and misspellings that have been used in the literature are also referenced.

2. *Material examined*. A list of material examined in museum collections and laboratories, in the following order: Institutional acronyms (according to Leviton *et al*., 1985); type status (if any); number of specimens examined, followed by total length (in parenthesis); location; coordinates; depth; vessel name; fishing gear; collector(s); and date.

3. *Species illustration*. Because most hagfishes have almost the same external morphology, only a few drawings are here provided based on specimens previously illustrated in the literature.

4. *Diagnostic Features*. A description of diagnostic characters.

5. *Size*. The maximum known total length is given.

6. *Distribution and habitat*. A summary statement is presented of geographical distribution. Although data on habitat are rare for most species, a summary is presented whenever possible.

7. *Map*. A distribution map is provided for each species. Two different shades of red, full and pale, were used to distinguish known and uncertain/probable distribution, respectively. For some areas, where distribution is too small to be visible at the scale of the map, a thicker outline was used. Distribution known only from single locality (or single station) was represented by a triangle. Maps are at scale of approx. 1:10.000.000, 1:30.000.000 or 90.000.000 (plus few intermediate scale). The areas shown in the maps include as much as possible familiar coastal shapes.

8. *Interest to fisheries*. Available data are presented for the few species that are commercially fished.

9. *Remarks*. Different kinds of information are here included such as taxonomic or biological notes.

10. *Common names*. Local or regional species names in various languages are generally listed. These were compiled from the literature, but what is presented here is not comprehensive and represents what was readily available. Many species have no vernacular names, while some hagfishes have more than one name. An English FAO name for each species is also suggested. FAO names are not intended to replace local species names, but are necessary to overcome the confusion caused by the use of a single name for more than one species or several names for one species.

1.4 Glossary of Technical Terms and Measurements

Methods of measurements and counts, including morphological nomenclature and technical terms used herein were compiled from Fernholm and Hubbs (1981), McMillan and Wisner (1984), Wisner and McMillan (1995), and Mok (2001). The most useful characters for systematic work in hagfishes are: arrangement of gill apertures and their relative position to the gill pouches; dental cusps and pattern of fused cusps; slime pores; relative position of ventral aorta bifurcation and gill pouches; nasal-sinus papillae; finfolds; and body proportions. Because most of body proportions are often strongly affected by preservation, counts have been emphasized in taxonomy. A synthesis of the most useful counts for each species of hagfish is given in the Tables 3, 4, and 5.

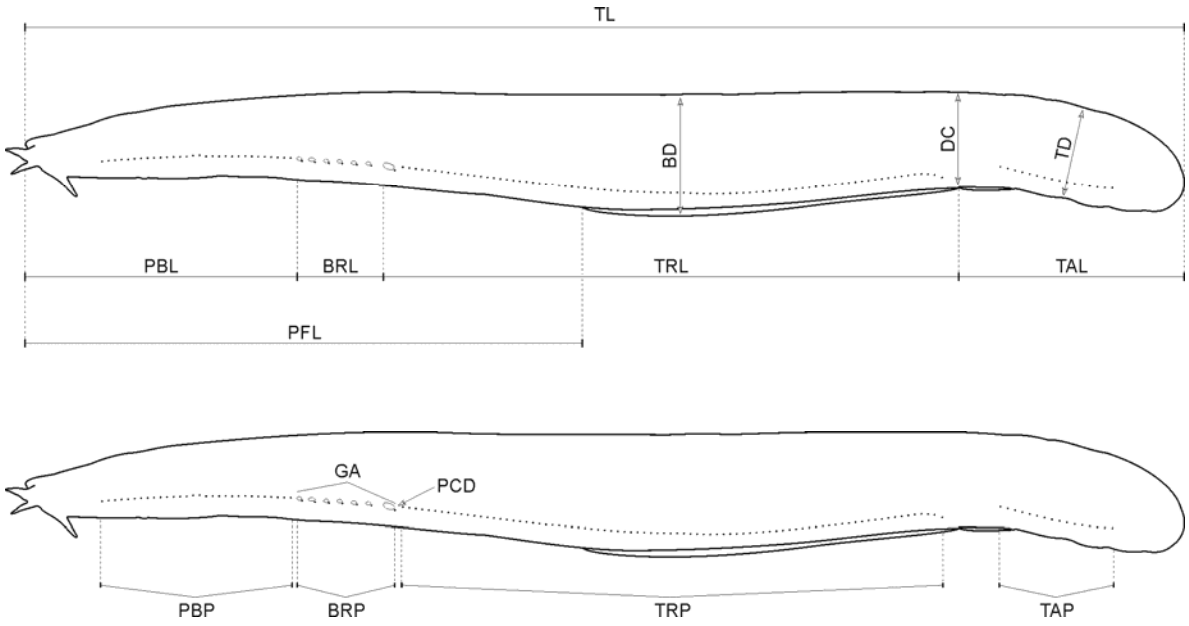


Fig. 4. Measurements and external morphology of body (see acronyms below).

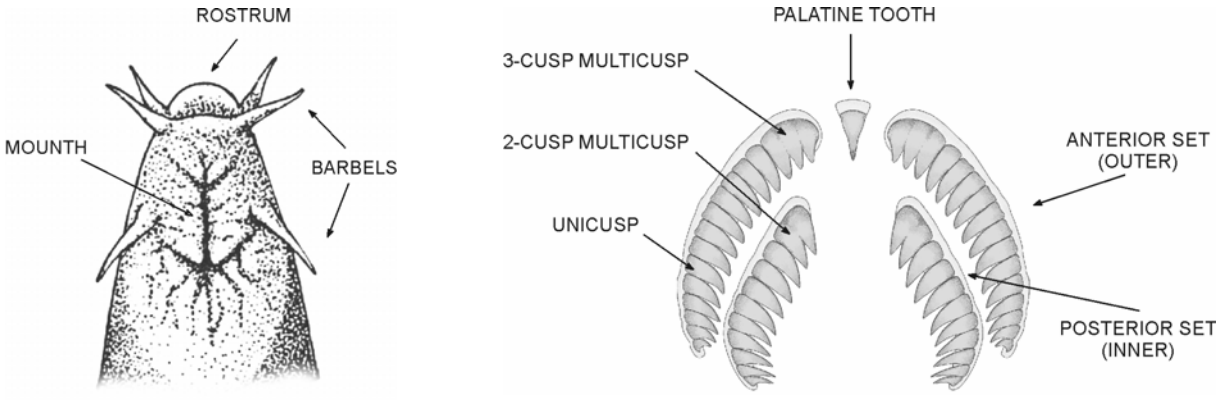


Fig. 5. Morphology of head and teeth.

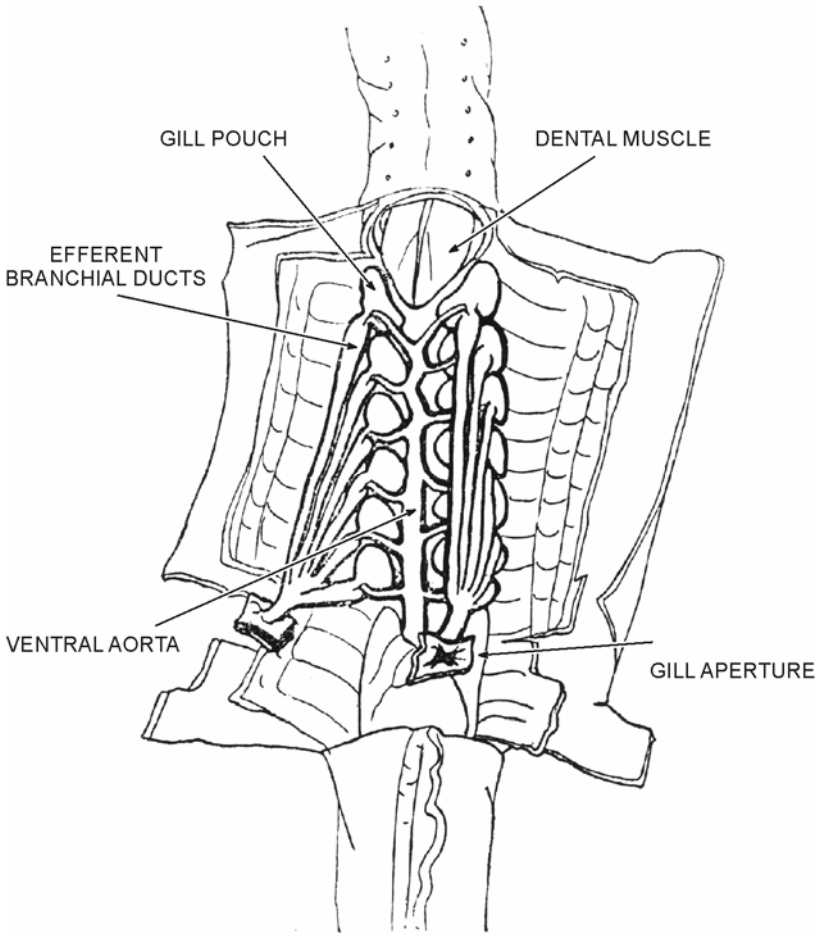


Fig. 6. Internal morphology of branchial region of *Myxine*.

Anatomical structures:

Rostrum – fleshy extension lying over the nasal orifice between the anteriormost pairs of barbels.

Barbels – three pairs of barbels on the head, the first two pairs about equal in size and adjacent to the nasal orifice; the third pair usually longer and immediately adjacent to the oral cavity.

Nasal-sinus papillae – one or more papillae or protrusions placed inside the nasal sinus (or nasal tube).

Multicusp – a unit of two or three cusps (teeth) fused together at bases.

Unicusp – a single cusp (tooth). There are two sets of cusps on each side, the anterior (outer) and posterior (inner), always starting with a multicusp.

Palatine tooth – the single tooth placed on the roof of the mouth.

Pharyngocutaneous duct (PCD) – the external opening of the PCD, always on the left side, usually confluent with the posteriormost (or single) gill aperture.

Gill aperture (GA) – the opening through which water discharges to the exterior after passing through the gill pouches.

Gill pouch (GP) – rounded, serially arranged structure along and posterior to the dental muscle.

Dental muscle (DM) – the firm, elongated cylindrical complex of muscles and cartilages that moves the dental plates and sets of cusps during feeding.

Ventral aorta (VA) – the portion between the heart (ventricle) and where it branches of each side of dental muscle.

Ventral finfold (VFF) – a band of thin, fleshy tissue extending along ventral midline of body.

Caudal fin (CF) – often called caudal finfold (CFF) by some authors. We prefer to use the current name because its structure is formed by supporting cartilaginous rays, different therefore from the VFF, which is just a fleshy tissue without rays.

Measurements:

Total length (TL) – the distance from the front of the rostrum to the posterior margin of caudal fin.

Prefinfold length (PFL) – front of rostrum to anterior margin of ventral finfold.

Prebranchial length (PBL) – front of rostrum to front of first, or unique, GA.

Branchial length (BRL) – front of first to front of last GA (also PCD). Used only for Eptatretinae.

Trunk length (TRL) – front of PCD to origin of cloaca.

Tail length (TAL) – origin of cloaca to posterior margin of caudal finfold.

Body width (BW) – maximum dimension about mid-way between rostrum and PCD.

Body depth (BD) – maximum depth at trunk, about mid-way between PCD and cloaca, including VFF, if present. Body depth excluding VFF should be taken at the same place.

Depth at cloaca (DC) – minimum depth at cloaca.

Tail depth (TD) – maximum depth at tail.

Counts:

Anterior multicusps (AMC) – number of fused cusps in the anterior (outer) series.

Posterior multicusps (PMC) – number of fused cusps in the posterior (inner) series.

Anterior unicusps (AUC) – number of not fused cusps in the anterior (outer) series.

Posterior unicusps (PUC) – number of not fused cusps in the posterior (inner) series.

Total cusps (TC) – total sum of all cusps, left plus right side.

Prebranchial pores (PBP) – from the anteriormost slime pore to last one before first GA.

Branchial pores (BRP) – those pores in immediate association with (usually below and behind of) each GA; often one less than GA count in ***Eptatretus***, and much less, or entirely absent, in ***Paramyxine***.

Trunk pores (TRP) – the pore series posterior to PCD, terminating just before cloaca; distinctly separated of the caudal series.

Tail pores (TAP) – the pore series that starts about over anterior margin of cloaca to the last pore on tail. Some authors artificially separate the TAP in cloacal pores and caudal pores, but there is no reason for this separation once it is not statistically useful.

Total pores (TP) – total sum of all pores on left side.

Table 3. Selected characters for species of *Eptatretus*.

Species	number of gill pouches	multicusp pattern	anterior unicusps	posterior unicusps	total cusps	prebranchial pores	branchial pores	trunk pores	tail pores	total pores	maximum TL (mm)
Eptatretus											
bischoffii	10 (11)	3/3	7-10	8-10	44-52	10-15	8-11	40-46	12-16	74-83	680
burgeri	6 (5)	3/2	6-8	7-9	35-42	18-23	4-5	45-51	11-14	81-92	623
caribbeaus	7	3/3	11-13	10-11	54-58	13-15	6	47-52	11-13	79-85	385
carlhubbsi	7	2/3	13-17	11-13	61-71	12-17	6-8	60-70	12-16	93-110	1160
cirrhatus	7	3/3	8-11	7-9	43-51	16-20	6-8	46-53	10-14	83-90	830
deani	11 (10-12)	3/2	6-10	7-9	37-46	4-10	8-13	39-49	9-15	67-80	635
eos	5	3/2	6	5-6	34	26	4-5	75-77	26-27	128-130	665
fernholmi	8	3/2	11	9-10	51	15	7	50	9	81	373
fritzi	11 (10-12)	3/2	7-10	7-9	38-46	10-15	9-12	40-49	8-15	74-85	592
goliath	7	3/3	11-13	9	54	14-15	6-7	57-58	13-14	92	1275
grouseri	5 (6)	3/2	9-10	8-9	44-48	11-13	4-5	42-48	13-15	71-79	420
hexatrema	6	3/2	8-10	8-10	40-48	23-28	5-6	50-60	11-14	91-107	800
indrambaryai	8	3/2	9-10	8-10	45-48	11-13	7-8	45-50	10-13	77-82	437
lakeside	5	3/3	6	6	36	15	4	50	19	88	275
longipinnis	6	3/2	5-6	5-6	32-34	25-29	5-6	58-63	8-10	97-105	627
mcconnaugheyi	13 (12-14)	3/2	7-9	7-9	38-45	6-11	11-16	39-50	8-13	67-84	482
mccoskeri	8	3/3	9-10	9-10	48-51	14-15	7	40-42	10-12	72-74	320
mendozai	6	3/3	11-13	10-12	56-61	13-15	5-6	45-48	12-15	77-82	450
menezesi	7	3/3	10-12	9-12	52-60	13-17	6-8	48-55	14-18	86-94	900
minor	6 (5)	3/3	8-11	8-10	46-54	15-18	4-6	41-48	11-14	74-82	395
multidens	6	3/3	10-12	9-12	50-58	14-16	5-7	52-55	15-16	88-93	815
nanii	13 (12)	3/3	9-12	8-11	49-55	8-12	11-13	38-47	11-15	72-82	664
octatrema	8	3/2	7	8	40	23	7	65	14	109	300
okinoseanus	8	3/2	7-10	7-10	40-49	13-17	6-8	54-61	10-14	87-97	800
polytrema	14 (13)	3/3	8-10	7-10	45-51	6-9	11-14	39-45	12-17	72-79	570
profundus	5	3/2	8-9	8-9	42-46	13-14	4-5	48-51	15-16	81-83	644
sinus	10 (9-12)	3/2	6-9	6-9	34-46	10-17	8-11	36-49	7-14	66-82	630
stoutii	12 (10-14)	3/2	6-10	6-9	36-46	10-16	9-14	39-51	8-14	71-88	670
strahani	7	3/3	9-11	8-10	47-52	13-16	6	45-48	10-12	76-80	520
wisneri	8	3/2	9	8	44	9-10	7	43-45	13-14	73-75	356

Table 4. Selected characters for species of *Paramyxine*.

Species	number of gill pouches	multicusp pattern	anterior unicusps	posterior unicusps	total cusps	prebranchial pores	branchial pores	trunk pores	tail pores	total pores	maximum TL (mm)
Paramyxine											
ancon	6	3/2	12-13	12-13	60	26	0	43-45	9-10	79-80	220
atami	6	3/3	9-10	8-10	47-52	17-19	0-1	43-47	9-12	71-78	610
cheni	5	3/3	9-11	8-11	50-53	24-27	0	41-46	7-10	75-81	386
chinensis	6	3/3	8-10	8-10	-	15-19	3-5	40-47	11-14	-	540
fernholmi	6	3/2	8-10	8-10	42-50	16-23	0	38-44	6-11	64-71	359
moki	6	3/2	6-8	7-9	38-42	18-21	0	44-50	10-14	75-82	470
nelsoni	5 (4)	3/2	5-8	5-7	32-38	14-20	0	35-39	6-10	57-67	260
sheni	6	3/3	9-12	8-11	48-53	12-18	0-2	39-47	8-12	62-74	436
springeri	6	3/2	10-11	9-10	49-52	16-19	1-4	53-57	10-13	83-90	590
taiwanae	6	3/2	6-8	5-9	32-37	16-19	0	36-42	6-9	60-68	334
walkeri	6 (5)	3/2	7-9	7-9	38-44	16-23	0	40-48	9-14	69-79	518
wayuu	5	3/2	7-8	8-9	41-43	24	2	38-40	9	73-75	216
wisneri	6	3/2	7-10	7-9	36-48	15-20	0-1	36-44	6-11	63-72	335
yangi	5	3/2	6-8	6-9	32-40	16-23	0	39-47	7-12	68-79	296

Table 5. Selected characters for species of *Myxine*, *Notomyxine*, *Nemamyxine*, and *Neomyxine*.

Species	number of gill pouches	multicusp pattern	anterior unicusps	posterior unicusps	total cusps	prebranchial pores	trunk pores	tail pores	total pores	maximum TL (mm)
Myxine										
affinis	6	2/2	7-10	7-10	38-46	26-42	57-79	9-14	99-124	659
australis	6	2/2	5-7	6-8	30-38	22-42	51-68	8-14	86-118	420
capensis	7	2/2	7-9	7-10	36-43	26-35	58-66	9-13	92-111	480
circifrons	5	3/2	7-13	8-12	43-56	18-33	48-62	7-13	80-102	650
debueni	6	3/2	6-7	7	37-38	21	76	7	104	570
fernholmi	6	3/2	6-7	6-7	34-37	23-26	80-83	7-9	113-121	846
formosana	5	3/2	8-12	8-12	42-58	20-44	42-66	10-20	80-117	768
garmani	6	3/2	8-9	8-9	42-46	27-29	52-61	12-13	95-101	610
glutinosa	6	2/2	4-8	5-8	29-42	20-40	50-69	8-16	85-118	950
hubbsi	6	2/2	5-9	5-8	32-42	18-28	57-73	8-14	90-111	522
hubbsoides	6	2/2	6-7	7	34-36	30-31	68-71	12-13	111-116	820
ios	7	2/2	8-11	8-11	44-51	28-36	63-73	9-13	103-116	522
jespersenae	6	2/2	7-9	8-10	38-44	28-37	65-74	11-15	107-121	498
knappi	6	2/2	6-8	7-9	34-40	30-38	54-74	7-14	98-126	565
kuoi	6	2/2	5-6	6-7	30-32	24-30	57-68	11-13	95-100	410
mccoskeri	5	3/2	6-9	7-10	36-48	22-27	43-53	9-14	77-92	286
mcmillanae	6	2/2	8-10	8-10	42-48	26-35	60-76	9-12	101-113	473
paucidens	6	2/2	4	5	26	24-28	52-59	10-11	88-97	305
pequenoi	7	2/2	4	5-6	26-28	22-23	52-55	8-9	82-86	183
robinsorum	5	3/2	11-13	11-12	56-58	25-32	59-61	7-11	94-104	540
sotoi	6	2/2	7-9	8-9	38-44	28-38	61-73	11-13	101-119	522
Notomyxine										
tridentiger	6	3/2	7-8	8-10	40-46	17-21	57-66	8-11	86-98	575
Nemamyxine										
elongata	10	2/2	7	7-8	36-38	52-55	126-130	16-21	200-201	790
kreffti	8	3/2	5-6	6-8	32-38	36-44	73-92	8-16	124-148	493
Neomyxine										
biniplicata	7	2/2	5-6	6-7	30-3	32-45	81-125	17-25	138-188	450

2. SYSTEMATIC CATALOGUE

FAMILY MYXINIDAE

Type Genus: ***Myxine*** Linnaeus 1758.

Diagnostic features: Body subcylindrical and slender, slightly deeper than wide at prebranchial and branchial regions, compressed at truck, and strongly compressed at tail. No scales. Lateral and dorsal fins absent. One semicircular canal. Endoskeleton cartilaginous. Postcranial skeleton consisting of large notochord without centra or ribs. Single nostril leading respiratory water through the nasopharyngeal duct to pharynx and gill pouches. Mouth jawless. Two sets of laterally everting and biting-scraping keratinous cusps (or teeth) attached to a dental plate, in turn attached to the anterior end of the dental muscle. A single palatal tooth. Three pairs of barbels on the head, the first two pairs about equal in size and adjacent to the nasopharyngeal duct; the third pair usually longer and immediately adjacent to the oral cavity. Vestigial eyes embedded in the flesh of the head and covered by integument. One to 14 pairs of external gill openings. Pharyngocutaneous duct on the left side opening to the exterior. A segmentally arranged row of mucus-secreting slime glands with pores occurs on each side, extending from beyond head to behind cloaca.

The family Myxinidae is subdivided into two subfamilies, Eptatretinae and Myxininae (with family status in some works). Hagfishes in the subfamily Eptatretinae present the following combinations of characters: efferent branchial ducts open separately to the exterior, resulting in 5-14 external gill apertures; lateral line system extensively reduced; degenerate eyes covered by skin (usually unpigmented); and caudal fin rays bifurcated at tip. On other hand, those in the subfamily Myxininae present: efferent branchial ducts open by a common gill aperture on each side; lateral line system completely absent; degenerate eyes covered by muscle tissue; and caudal fin rays not bifurcated.

Genera: The family comprises 6 genera: ***Eptatretus***, ***Paramyxine***, ***Myxine***, ***Notomyxine***, ***Nemamyxine***, and ***Neomyxine***.

Common names: babosa de mar, mixina (Sp), hagfish (En), inger, schleimaal (Ge), loisankerias (Su), miksinovye (Ru), missine (It), myxine (Fr), feiticeira, peixe-bruxa (Po), pirålen (Sv), slimaal (No), slimål (Da), slímáll, (Ic), slijmprik (Ho), sliznatka (Cs), sljepulja (Hr), slymslange (Af).

Key to Genera

1a. Efferent branchial ducts open separately to the exterior with 5-14 external gill apertures; caudal fin rays bifurcated at tip (Fig. 7A) (subfamily Eptatretinae) 2

1b. Efferent branchial ducts open by a common external aperture on each side, i.e. only one pair of branchial apertures; caudal fin rays not bifurcated (Fig. 7B) (subfamily Myxininae) 3

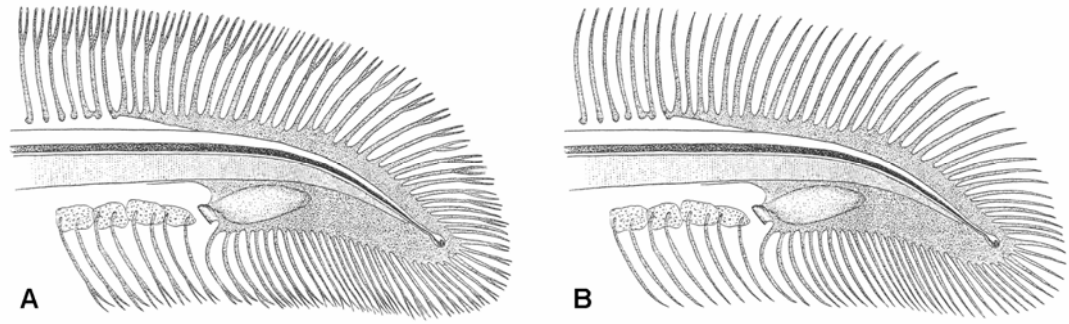


Fig. 7. Caudal fin rays of hagfish. A – Subfamily Eptatretinae. B – Subfamily Myxininae.

2a. Gill apertures well spaced in a linear configuration ..... ***Eptatretus***

2b. Gill apertures closely spaced in a nearly linear configuration or even crowded in a nonlinear pattern ..... ***Paramyxine***

3a. Ventral finfold beginning after the pharyngocutaneous duct 4

3b. Ventral finfold beginning before the pharyngocutaneous duct ..... ***Nemamyxine***

4a. Gill aperture on the left side confluent with the pharyngocutaneous duct 5

4b. Gill aperture on the left side not confluent with the pharyngocutaneous duct .... ***Notomyxine***

5a. A pair of ventro-lateral finfolds within the last quarter of the prebranchial region, just below the line of slime pores.....***Neomyxine***
5b. No paired finfolds.....***Myxine***

Eptatretus Cloquet, 1819

Eptatretus Cloquet (ex Duméril), 1819: 134 [type-species ***Gastrobranche dombey*** La Cepède, 1798; holotype: MNHN (dry skin, apparently lost); type by monotypy].

Homea Fleming 1822: 374 [type-species ***Homea banksii*** Fleming, 1822; type by monotypy].

Heptatrema Duméril in Voigt, 1832: 529 [subgenus of ***Myxine***; type-species ***Gastrobranche dombey*** La Cepède, 1798; type by being a replacement name].

Bdellostoma Müller, 1836: 79 [type-species ***Bdellostoma hexatrema*** Müller, 1836; type by subsequent designation].

Polistotrema Gill in Jordan & Gilbert, 1881: 458 [type-species ***Bdellostoma stoutii*** Lockington, 1878; type by monotypy].

Heptatretus Regan, 1912: 534 [type-species ***Gastrobranche dombey*** La Cepède, 1798; type by being a replacement name].

Dodecatrema Fowler, 1947: 3 [type-species ***Bdellostoma polytrema*** Girard 1855; type by original designation].

Diagnostic features: Efferent branchial ducts open separately to the exterior; 5-14 external gill apertures regularly spaced arranged in a straight line on each side.

Distribution: Circunglobal, except eastern North Atlantic, western Indian, and Southern Ocean (Fig. 8).

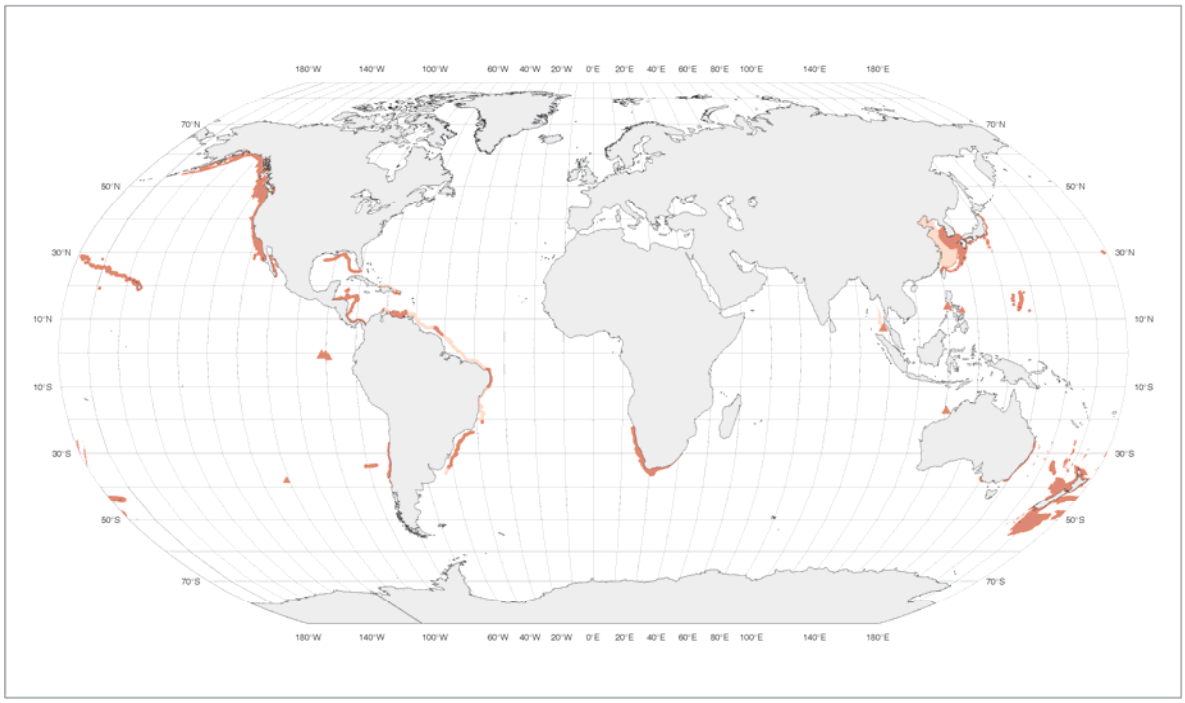


Fig. 8. Global distribution of the genus *Eptatretus*.

Species: The genus comprises 30 species.

Eptatretus bischoffii: Chile (eastern South Pacific)

Eptatretus burgeri: Japan to Taiwan (western North Pacific)

Eptatretus caribbeaus: Honduras to Panama (Caribbean Sea)

Eptatretus carlhubbsi: Hawaii, Wake, Tinian, and Juan Fernández (Pacific Ocean)

Eptatretus cirrhatus: Southeastern Australia to New Zealand (western South Pacific)

Eptatretus deani: Alaska to Mexico (eastern North Pacific)

Eptatretus eos: west of New Zealand (Tasman Sea)

Eptatretus fernholmi: Luzon Island, Philippines (western Pacific)

Eptatretus fritzi: Near Guadalupe Island, Mexico (eastern North Pacific)

Eptatretus goliath: North of New Zealand (western South Pacific)

Eptatretus grouseri: Galapagos Islands (eastern South Pacific)

Eptatretus hexatrema: Namibia to Natal (southern Africa)

Eptatretus indrambaryai: Thailand (Andaman Sea)

Eptatretus lakeside: Galapagos Islands (eastern South Pacific)

Eptatretus longipinnis: South Australia (eastern Indian Ocean)

Eptatretus mcconnaugheyi: California to Mexico (eastern North Pacific)

Eptatretus mccoskeri: Galapagos Islands (eastern South Pacific)

Eptatretus mendozai: Puerto Rico (Caribbean Sea)

Eptatretus menezesi: Brazil (western South Atlantic)

Eptatretus minor: Louisiana to Florida (Gulf of Mexico)

Eptatretus multidens: Venezuela to Brazil (western Atlantic).

Eptatretus nanii: Chile (eastern South Pacific)

Eptatretus octatrema: South Africa (eastern South Atlantic)

Eptatretus okinoseanus: Japan to Taiwan (western North Pacific)

Eptatretus polytrema: Chile (eastern South Pacific)

Eptatretus profundus: South Africa (eastern South Atlantic)

Eptatretus sinus: Gulf of California, Mexico (eastern North Pacific)

Eptatretus stoutii: Canada to Mexico (eastern North Pacific)

Eptatretus strahani: Lungang Islands, Philippines (western Pacific)

Eptatretus wisneri: Galapagos Islands (eastern South Pacific)

Remarks: The species name ***dombey*** La Cepède, 1798 is accepted here as a Latin name and as the type species of ***Eptatretus***. However, because the species is not identifiable, the International Commission on Zoological Nomenclature should be petitioned to suppress ***dombey*** and replace the type species of *Eptatretus*.

The type species of ***Polistotrema*** was listed as "***Gastrobranchus dombeyi*** (Müller) Gill" with mention of specimens from off California. Müller's (1836: 80) description was based on La Cepède's (1798) ***Gastrobranche dombey***, an unidentifiable species, but the specimens from California were ***Bdellostoma stoutii*** Lockington, 1878; therefore, the genus was based on a misidentified type species.

Three generic names attributed to Girard (1855: 251), ***Heterotrema***, ***Hexatrema***, and ***Polytrema***, were used only as hypothetical examples and were not proposed as new names.

Heptatretus Regan, 1912 is an unjustified emendation of ***Eptatretus*** Cloquet, 1819.

Key to Species of *Eptatretus*

1a. From 10 to 14 pairs of gill apertures 2
1b. Less then 10 pairs of gill apertures 9

2a. Three fused cusps on both anterior and posterior multicusps (3/3) 3
2b. Three fused cusps on anterior and two on posterior multicusps (3/2) 5

3a. Prebranchial and tail lengths each greater than branchial length; gill apertures usually 10(10-11) .....***Eptatretus bischoffii***
3b. Prebranchial and tail lengths each less than branchial length; gill apertures 14(13-14) . 4

4a. Prebranchial pores 6-9 .....***Eptatretus polytrema***
4b. Prebranchial pores 8-12 .....***Eptatretus nanii***

5a. Prebranchial length usually less than branchial length, very rarely equal to or even slightly greater; tail length always less than branchial length ....***Eptatretus mcconnaugheyi***
5b. Prebranchial and tail lengths always greater than branchial length 6

6a. Prebranchial slime pores 4-10 .....***Eptatretus deani***
6b. Prebranchial slime pores 10-17 7

7a. All barbels large, robust; third barbel 49% (42-59%) of preocular lengt .....
..... ***Eptatretus fritzi***
7b. All barbels small, not robust; third barbel 34% (31-37%) of preocular lengt 8

8a. Gill apertures usually 12(10-14); ventral finfold prominent, with wide pale margin .....
.....***Eptatretus stoutii***
8b. Gill apertures usually 10(9-12); ventral finfold vestigial or absent .....***Eptatretus sinus***

9a. Eight pairs of gill apertures..... 10
9b. Less then 8 pairs of gill apertures 15

10a. Three fused cusps on both anterior and posterior multicusps (3/3) .....
.....***Eptatretus mccoskeri***
10b. Three fused cusps on anterior and two on posterior multicusps (3/2) 11

11a. Prebranchial pores 23; trunk pores 65; total pores 109 .....***Eptatretus octatrema***
11b. Prebranchial pores 9-17; trunk pores 43-61; total pores 73-97 12

12a. Prebranchial pores 9-10; total pores 73-75 ..... ***Eptatretus wisneri***
12b. Prebranchial pores 11-17; total pores 77-97 13

13a. Trunk pores 54-61; total pores 87-97 .....***Eptatretus okinoseanus***
13b. Trunk pores 45-50; total pores 77-82 14

14a. Total cusps 45-48; prebranchial pores 11-13; tail pores 10-13 .....
.....***Eptatretus indrambaryai***
14b. Total cusps 51; prebranchial pores 15; tail pores 9 .....***Eptatretus fernholmi***

15a. Seven pairs of gill apertures 16
15b. From 5 to 6 pairs of gill apertures 21

16a. Total cusps 61-71; trunk pores 60-70; total pores 93-110 .....***Eptatretus carlhubbsi***
16b. Total cusps 43-60; trunk pores 45-58; total pores 76-94 17

17a. Total cusps 43-52..... 18
17b. Total cusps 52-60 19

18a. Total pores 76-80 ..... ***Eptatretus cirrhatus***
18b. Total pores 83-90 ..... ***Eptatretus strahani***

19a. Trunk pores 57-58 ..... ***Eptatretus goliath***
19b. Trunk pores 47-55 20

20a. Tail pores 11-13; total pores 79-85 ..... ***Eptatretus caribbeaus***
20b. Tail pores 14-18; total pores 86-94 ..... ***Eptatretus menezesi***

21a. Usually six (rarely five) pairs of gill pouches 22
21b. Usually five (rarely six) pairs of gill pouches 27

22a. Three fused cusps on both anterior and posterior multicusps (3/3) 23
22b. Three fused cusps on anterior and two on posterior multicusps (3/2) 25

23a. Trunk pores 52-55; total pores 88-93 ..... ***Eptatretus multidens***
23b. Trunk pores 41-48; total pores 74-82 24

24a. Anterior unicusps 8-11; total cusps 46-54; prebranchial pores 15-18 .....
..... ***Eptatretus minor***
24b. Anterior unicusps 11-13; total cusps 56-61; prebranchial pores 13-15 .....
..... ***Eptatretus mendozai***

25a. Posterior unicusps 5-6; total cusps 32-34 ..... ***Eptatretus longipinnis***
25b. Posterior unicusps 7-10; total cusps 35-48 26

26a. Anterior unicusps 6-8; prebranchial pores 18-23 ..... ***Eptatretus burgeri***
26b. Anterior unicusps 8-10; prebranchial pores 23-28 ..... ***Eptatretus hexatrema***

27a. Three fused cusps on both anterior and posterior multicusps (3/3).. ***Eptatretus lakeside***
27b. Three fused cusps on anterior and two on posterior multicusps (3/2) 28

28a. Total cusps 34; total pores 128-130 ..... ***Eptatretus eos***

28b. Total cusps 42-48; total pores 71-83 29

29a. Trunk pores 42-48; total pores 71-79 ..... ***Eptatretus grouseri***
29b. Trunk pores 48-51; total pores 81-83 ..... ***Eptatretus profundus***

Eptatretus bischoffii (Schneider, 1880)

Bdellostoma bischoffii Schneider, 1880: 116 [original description; type locality: unknown; holotype: unknown]. –Plate, 1896: 16 [description of eggs].

Bdellostoma polytrema (not Girard, 1855). –Putnam, 1874b: 160 [ten gills on each side; Chile].

Homea polytrema (not Girard, 1855). –Dean, 1904: 20 [in part, ten gills; Chile].

Heptatretus decatrema Regan, 1912: 535 [original description; type locality: Chile; syntypes: BMNH 1899.8.30.19-20 (2, 1 in poor condition)].

Bdellostoma* (*Polistotrema*) *decatrema. –Rauther, 1924: 685 [ten gill apertures; coast of Chile]. –Holly, 1933: 51 [identification key; Chile]. –Tortonese, 1951: 86 [San Vicente, Chile].

Eptatretus dombeyi (not Shaw, 1804). –Fowler, 1940: 743, Fig. 1 [illustrated with ten gill apertures; Napon Bay, Valparaiso].

Polistotrema decatrema. –Fowler, 1944: 475 [Chile]. –Mann, 1954: 90 [Chile].

Homea decatrema. –Fowler, 1951: 267 [identification key; erroneouly given as having six gill apertures; Chile]. –Fowler, 1964: 47 [catalog of world fishes].

Polistotrema polytrema (not Girard, 1855). –de Buen, 1961: 106 [in part, specimens with ten gill apertures; Valparaiso, Chile].

Bdellostoma decatrema. –Rauther, 1924: 685 [ten gill apertures; coast of Chile]. –Adam and Strahan, 1963: 6 [Chile].

Bdellostoma bischoffi. –Fowler, 1964: 49 [erroneously cited as nominal form based only on eggs].

Eptatretus decatrema. –Hardisty, 1979: 19 [Chile]. –Fernholm, 1998: 34 [junior synonymy of *Eptatretus bischoffii*].

Eptatretus bischoffii. –Wisner and McMillan, 1988: 236, Figs. 2, 3c [identification key; redescription; Cladera to Puerto Montt, Chile]. –Meléndez *et al*., 1993: 5 [MNHNC catalog of fishes]. –Fernholm, 1998: 34 [off Chile]. –Mok, 2001: 358 [nasal sinus papillae]. –Soto and Mincarone, 2004: 9 [MOVI catalog of fishes].

Eptatretus bischoffi. –Pequeño, 1989: 5 [list of Chilean fishes].

Material examined: 7 specimens. CHILE: BMNH 1899.8.30.19-20, syntypes of ***Eptatretus decatrema***, 2(430-480 mm), Southeast Pacific, coast of Chile, F. T. Delfin; MACN 2927, 1(264 mm), Valparaiso Bay, E. Reed, Mar. 1942; MOVI 03580-03581, 2(434-497 mm), Algarrobo, Santuario de la Naturaleza "Peñon Islote Pájaro Niño", 33º21'30"S, 71º40'W, 12 m, handline, J. M. R. Soto, J. L. Brito-M., 27 Feb. 1994; MOVI 27520-27521 (ex SIO 65-673), 2(200-290 mm), Valparaiso Harbor at dock, 33°02.0'S, 71°38.0'W, 30 ft (9 m), RV *Anton Bruun*, trap, W. Daldwin, D. Dockins, 23-24 Dec. 1965, 18:00-08:00 h.

Diagnostic features: Body elongated, its depth 7-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots small but prominent, margins sharply defined. Three pairs of barbels on head; first two about equal in size (1.5-1.7% TL), third one longer (1.9-2.4% TL). Ten (rarely 11) pairs of gill pouches corresponding to 10 (rarely 11) pairs of gill apertures. Gill apertures well spaced in a linear pattern. Posteriormost gill aperture on left side not confluent with pharyngocutaneous duct, but separated by a short distance. Dental muscle overlies gill pouches 4-10. Ventral aorta branches at gill pouches 9-10. Ventral finfold usually absent (a very low one occasionally present). Caudal finfold rounded, ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 17.6-22.4; branchial length 11.4-16.1; trunk length 45.0-54.2; tail length 14.0-21.8; body depth including VFF 7.6-11.2; body depth excluding VFF 7.1-11.2; body depth over cloaca 5.6-8.7; tail depth 5.6-8.3. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 7-10. Posterior unicusps 8-10. Total cusps 44-52. Prebranchial pores 10-15. Branchial pores 8-11. Trunk pores 40-46. Tail pores 12-16. Total pores 74-83.

Color in alcohol: body very dark brown to purplish-black with randomly scattered small pale spots extending to about cloaca; spots concentrated in the branchial area and particularly prominent near the mouth; tip of the barbels white; gill apertures and slime pores without pale margins.

Size: Maximum total length 680 mm (Wisner and McMillan, 1988).

Distribution and habitat: Eastern South Pacific, coast of Chile between about 27°S and 42°S (Caldera to Puerto Montt). Usually living on muddy bottoms and also among rocks in shallow coastal waters at depths from 6 to 50 m depth.

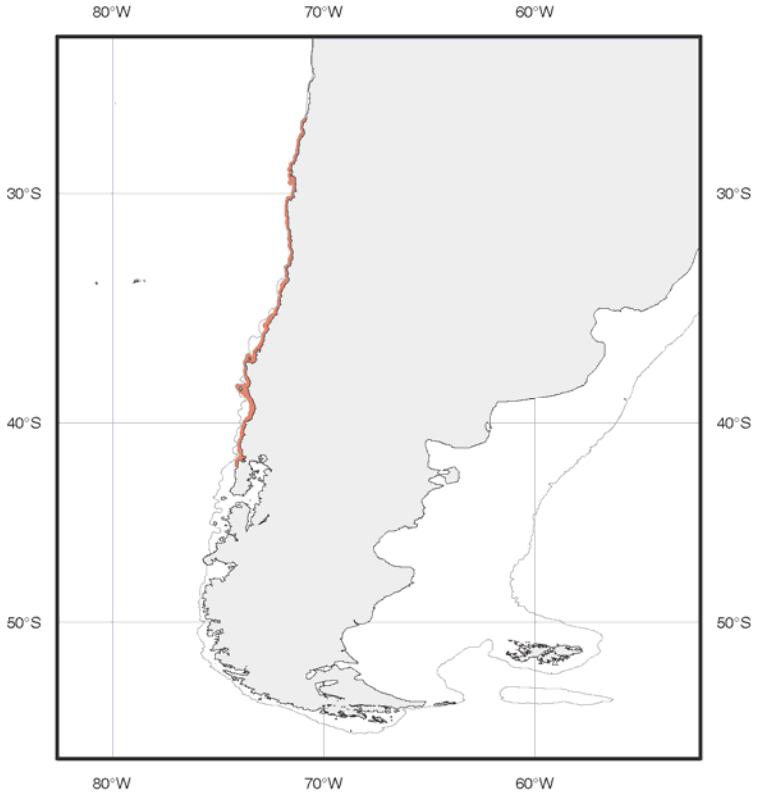


Fig. 9. Distribution of *Eptatretus bischoffii*.

Interest to fishery: None. It has been incidentally captured using different kinds of trawls and traps (Wisner and McMillan, 1988). Also collected with hook and line by artisanal fishermen (José L. Brito-M., pers. com.).

Remarks: On two occasions ***E. bischoffii*** was taken with ***E. polytrema***: off Valparaiso Harbor in traps at 30 m and in Bahía Inglesa in traps at 20 m depth (Wisner and McMillan, 1988).

Of the 18 females examined by Wisner and McMillan (1988), only three have well developed eggs: one 590-mm female has 40 eggs ranging from 20x5.8 mm to 23x6.5 mm; another 480-mm female has 12 eggs from 23x6.8 mm to 25x7.7 mm; a third 485-mm female has 10 eggs from 15x4.7 to 17.5x5.3 mm. No eggs have protruding anchor filaments, although polar caps were well developed on many.

Common names: CHILE: Anguila babosa, Murena; FAO: Ten-gilled hagfish.

Eptatretus burgeri (Girard, 1855)

Heptatrema cirrhatum (not Forster, 1801). –Temminck and Schlegel, 1850: 310, Pl. 143 [misidentification; Simibara Bay, Japan]. –Boeseman, 1947: 228 [fishes collected by Bürger].

Bdellostoma burgeri Girard, 1855: 252 [original description; type locality: Simibara Bay, Japan; holotype: unknown]. –Conel, 1931: 76 [general biology]. –Tortonese, 1939: 192 [Port Hamilton, Korea]. –Adam and Strahan, 1963: 6 [East coast of Japan].

Eptatretus burgeri. –Jordan and Snyder, 1901: 729, Pl. 30 [coast of Japan, from Tokyo southward]. –Jordan, 1905: 490 [Japan]. –Jordan and Starks, 1905: 193 [Fusan, Korea]. –Fowler, 1908: 461 [citation]. –Jordan and Metz, 1913: 3, Fig. 1 [Fusan, Korea]. –Jordan *et al*., 1913: 4, Fig. 1 [catalog; coast of Japan, from Tokyo southward]. –Jordan, 1925: 170 [Japan]. –Jordan and Hubbs, 1925: 97 [Misaki]. –Mori, 1928: 3 [Fusan]. –Mori and Uchida, 1934: [checklist; Korea]. –Kamohara, 1936: 307 [vicinity of Kôchi-shi]. –Mori, 1952: 13 [Fusan, Quelpart Island]. –Matsubara, 1955: 91 [identification key]. –Okada, 1955: 2 [Pacific coast of Japan, Sea of Japan from middle to South Korea]. –Mori, 1956: 2 [southern Japan]. –Lindberg and Legeza, 1959: 22, Figs. 10-12 [brief description; Japan, and Korea]. –Chyung, 1961: 8, Pl. 1(fig. 1) [Korea]. –Strahan, 1962: 801, Fig. 1 [further description]. –Strahan, 1963: 76 [behavior]. –Kamohara, 1964: 5 [Fukushima Pref. to Kyushu and

Korea]. –Tominaka, 1969: 51, Figs. 1-9 [anatomy]. –Fernholm, 1974: 351, Figs. 3-5 [variation in the behaviour]. –Fernholm, 1975: 199, Fig. 1 [ovulation and description of eggs]. –Fernholm and Holmberg, 1975: 253, Fig. 1 [eye morphology]. –Shen and Tao, 1975: 67, Fig. 1 [identification key; redescription; from Po-hai north-ward to Taiwan and east-ward to Korea and Japan]. –Strahan, 1975: 144, Fig. 2c [identification key; southern Japan, southern Korea]. –Hardisty, 1979: 19 [E. coast of Japan]. –Tsuneki *et al*., 1983: 429 [seasonal migration]. –Sato, 1984: 1, Pl. 1a [brief description; southern Japan and southern Korea]. –Shen, 1984a: 1, Pl. 1, Fig. 1-1a, 1-1b [southern Japan to Taiwan]. –Shen, 1984b: 45 [identification key; Taiwan]. –Yamakawa, 1984: 35 [comparison with ***Eptatretus okinoseanus***]. –Fernholm, 1985: 113 [lateral line system]. –Yamada *et al*., 1986: 2 [identification key]. –Gorbman *et al*., 1990: 15 [fishery]. –Iwata, 1993: 84 [pictorial key]. –Kim and Kang, 1993: 21, 115, Fig. 1 [Korea]. –Kuo *et al*., 1994: 128, Figs. 3c, 7c [identification key; redescription; Ta-chi, northeastern Taiwan]. –Morisawa, 1995: 6 [structure of spermatozoa]. –Iwata, 1997: 32, Fig. 1 [Honshu Island and southern Korean Peninsula]. –Fernholm, 1998: 34 [Japan, Korea, China, Taiwan]. –Honma, 1998: 50 [identification key; central and southern Japan, South Korea, northeast Taiwan]. –Iwata, 2000: 109 [pictorial key]. –Nozaki *et al*., 2000: 225 [seasonal development of gonads and migration]. –Paxton, 2000: 577 [South China Sea]. –Mok and Chen, 2001: 235 [northeastern and northern Taiwan]. –Shinohara *et al*., 2001: 286 [Tosa Bay, Japan]. –Nakabo, 2002: 109 [identification key; southern Japan, southern Korean Peninsula, northeast Taiwan]. –Youn, 2002: 465 [catalog of Korean fishes]. –McMillan and Wisner, 2004: 53, Fig. 2 [identification key; redescription; Japan, South Korea, China, Taiwan]. –Soto and Mincarone, 2004: 9 [MOVI catalog of fishes].

Homea burgeri. –Dean, 1904: 2, Figs. 1a-h, 2c, 4b, Pl. 1 (fig. 7) [notes on Japanese hagfishes; coast of Japan]. –Fowler, 1964: 46 [catalog of world fishes].

Heptatretus buergeri. –Regan, 1912: 536 [identification key; Yokohama Bay].

Bdellostoma* (*Eptatretus*) *burgeri. –Holly, 1933: 54 [identification key; Japan].

Heptatretus bürgeri. –Kamohara, 1938: 3 [Tosa, Shikoku, Japan].

Heptatretus burgeri. –Kamohara, 1952: 4 [Mimase]. –Kamohara, 1958: 3 [Fukushima Pref. and Niigata to Kyushyu and Korea].

Eptatretus bugeri. –Abe, 1963: 1 [catalog of Japanese fishes].

Paramyxine burgeri. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes].

Material examined: 33 specimens. JAPAN: AMS I.6631, 1(342 mm), Misaki, B. Dean, 1904; BSKU 1303, 1(320 mm), off Susaki city, Kochi Pref., 24 Jun. 1951; BSKU 39136, 1(390 mm), Mimase fish market, Kochi city, Kochi Pref., 18 Apr. 1983; BSKU 51642, 1(610 mm), Saga fishing port, Saga, Kochi Pref., 4 Aug. 2000; BSKU 51894, 1(357 mm), Kamikawaguchi fishing port, Ohgata, Kochi Pref., 26 Jun. 2000; BSKU 54056, 1(420 mm), Irino fishing port, Ohgata, Kochi Pref., 11 Jun. 1999; BSKU 56381-56383, 3(190-525 mm), Saga fishing port, Saga, Kochi Pref., 29 Jul. 2001; BSKU 64671, 1(405 mm), Kamikawaguchi fishing port, Ohgata Town, Kochi Pref., 21 Apr. 2003; BSKU 65181, 1(485 mm), and BSKU 65183, 1(410 mm), Saga fishing port, Saga, Kochi Pref., 16 Apr. 2003; BSKU 65763-65765, 3(360-530 mm), Saga fishing port, Saga, Kochi Pref., 22 Jun. 2003; BSKU 65785, 1(435 mm), Kamikawaguchi fishing port, Ohgata, Kochi Pref., 28 Mar. 2002; MOVI 33993 (ex BSKU uncat.), 1(505 mm), Kochi Pref., Kamikawaguchi fish market, 31 Jul. 1997; MOVI 33994 (ex BSKU uncat.), 1(390 mm), Tosa Bay, no date; NSMT-P 61188, 4(267-368 mm), Sea of Japan, Honshu, Shimane Pref., off Yunotsyu-machi, 130 m, tube trap, 19-20 Sep. 2000; NSMT-P 2218, 4(364-444 mm), southern Japan, 1905; SU 6790, 1(435 mm), Honshu Island, Sagamy Bay, D. S. Jordan, J. O. Snyder, 1900; SU 6791, 1(320 mm), Honshu Island, Wakanoura (Kii), D. S. Jordan, J. O. Snyder, no date; SU 26515, 1(293 mm), Hakodate, Hokkaido Island, D. S. Jordan, J. O. Snyder, 1906. KOREA: MOVI 36929 (ex USNM 45218), 1(318 mm), Fusan, P. Jouy, no date. TAIWAN: MOVI 16709, 1(359 mm), 25°13'00"N, 121°44'58"E, 90-100 m, H.-K. Mok, 28 Mar. 1990; SIO 80-215, 1(366 mm), Ta-chi, otter trawl, L. Chen, 18 Mar. 1977; SIO 80-299, 1(295 mm), Ta-chi, L. Chen, 24 May 1977.

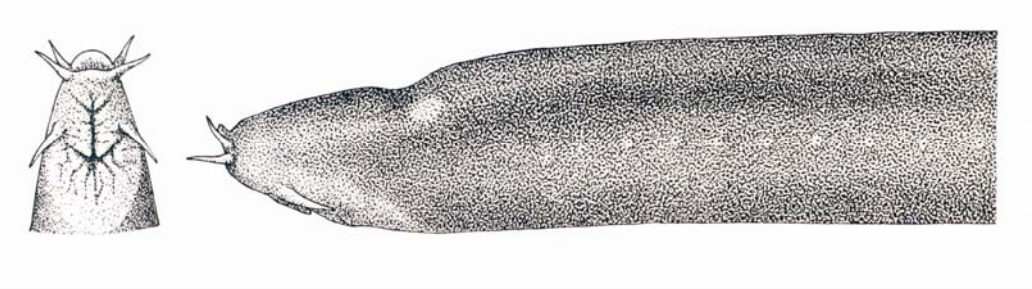


Fig. 10. ***Eptatretus burgeri*** **(after Jordan and Snyder, 1901).**

Diagnostic features: Body elongated, its depth 4-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent, margins sharply defined. Three pairs of barbels on head; first two about equal in size (1.0-1.5% TL), third one longer (1.4-2.0% TL). Six (rarely 5) pairs of gill pouches corresponding to 6 (rarely 5) pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last gill aperture usually confluent with pharyngocutaneous duct on left side. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 3-4. Ventral finfold low, 1-3 mm high, beginning within anterior 20-37% of trunk, extending backward to the cloaca. Caudal finfold rounded, well developed, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 25.2-29.6; branchial length 6.2-7.8; trunk length 47.6-55.0; tail length 13.2-17.0; body width 3.2-3.7; body depth including VFF 4.7-8.5; body depth excluding VFF 4.0-8.3; body depth over cloaca 4.5-5.8; tail depth 5.1-8.5. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-8. Posterior unicusps 7-9. Total cusps 35-42. Prebranchial pores 18-23. Branchial pores 4-5. Trunk pores 45-51. Tail pores 11-14. Total pores 81-92.

Color in alcohol: body brownish tan dorsally, lighter ventrally, with a prominent mid-dorsal white stripe; tip of barbels pale; gill apertures occasionally with whitish margins; slime pores the same color as body; ventral and caudal finfold lighter than body or with narrow pale margins.

Size: Maximum total length 623 mm (McMillan and Wisner, 2004).

Distribution and habitat: Western North Pacific, off southern Japan, South Korea, northern and northwestern Taiwan, on shallow waters at depths from 5 to 270 m. It probably occurs also in all Yellow Sea.

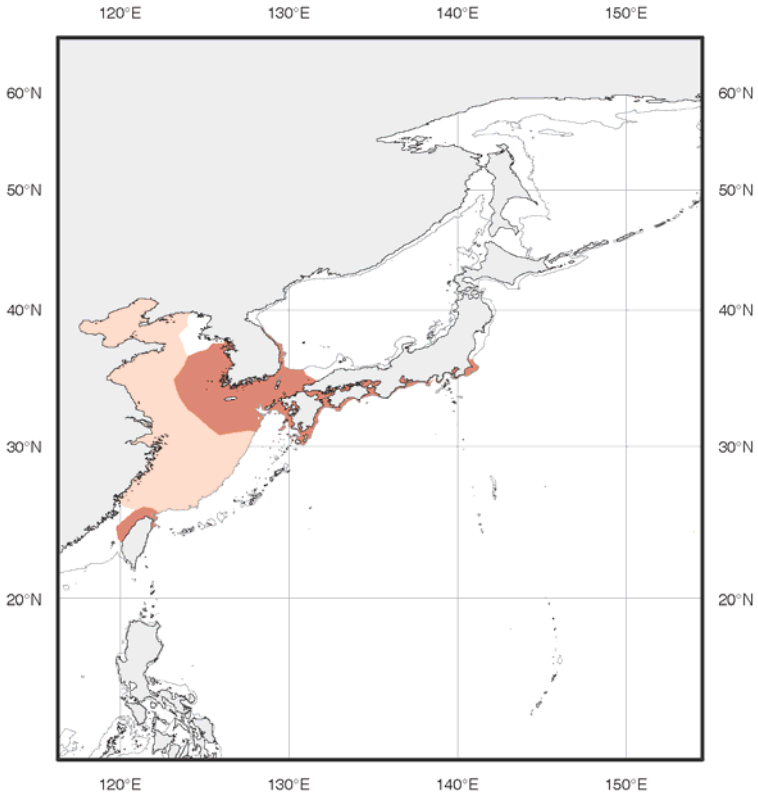


Fig. 11. Distribution of *Eptatretus burgeri.*

Interest to fishery: It is of economic importance because of the demand for the ell-skin leather industry in Korea, the damage to fishes in nets, and its use as food in Taiwan, China, and Japan. It has been so intensively fished off Korea and Japan that populations are threatened, as shown by greatly reduced catches in fish size and number over the last 20 years (McMillan and Wisner, 2004).

Remarks: ***Eptatretus burgeri*** was briefly described by Girard (1855) based on an illustration of a single specimen from Simabara Bay, which was misidentified as ***Heptatrema cirrhatum*** by Temminck and Schlegel (1850: 310, pl. 143).

Eptatretus burgeri is a nocturnally active animal, with about 70% of the observed individuals uncovered and out of the burrows as compared to about 3% by day (Fernholm, 1974). It is, so far, the only species of hagfish that has been found to have a certain spawning time at the population level and an annual migration to spawning grounds (Dean, 1904; Kobayashi *et al*., 1972; Fernholm, 1974; Nozaki *et al*., 2000). A population living at 6-10 m depth on a muddy bottom in Koajiro Bay, Kanagawa Prefecture, Japan, was not found from July to September in the shallow waters of the bay. In this period, individuals from the same population were caught in deeper waters of 50 and 100 m, where they presumably spawn (Fernholm, 1974; Nozaki *et al*., 2000). Tsuneki *et al*. (1983) described the same behavior for specimens from Kamo Bay (about 20 m depth), south end of Dogo Island, Japan, which migrates to adjascent deepest waters (50 m) outside the bay for breeding in September. According to Tsuneki *et al*. (1983), of 362 specimens collected, 167 (46%) were males, 188 (52%) females, and 7 (2%) hermaphrodites. Mean length was 50.8 cm for males and 48.9 cm for females. There were 44 mature eggs per female in average. For detailed information on the seasonal development of gonads for males and females see Conel (1931) and Nozaki *et al*. (2000).

Common names: JAPAN: Nuta-unagi; KOREA: Meog-jang-eo; RUSSIA: Миксина Бургера; FAO: Inshore hagfish.

Eptatretus caribbeaus Fernholm, 1982

Eptatretus multidens? –Fernholm and Hubbs, 1981: 82, Fig. 9 [misidentification; specimens MCZ 40409 and USNM 218405].

Eptatretus caribbeaus Fernholm, 1982: 435 [original description; type locality: Caribbean Sea, 16°55'N, 81°12'W, 500 m, Oregon sta. 1886; type series: holotype, MCZ 40409, paratypes, UF 27892 (1), UF 27894 (1), UF 27895 (1), USNM 218405 (1). –Hensley, 1985: 866 [identification key]. –Fernholm, 1998: 34 [Caribbean Sea]. –Mincarone, 2000: 816 [identification key; comparison with ***Eptatretus menezesi***]. –Fernholm, 2003: 355 [W. Caribbean]. –Mincarone and Sampaio, 2004: 33 [citation]. –Mincarone and Stewart, 2006: 227 [comparison with ***Eptatretus goliath***].

Eptatretus caribbeanus. –Mok, 2001: 358 [nasal sinus papillae].

Material examined: 3 specimens. HONDURAS: UF 27895, paratype, 1(350 mm), Caribbean Sea, W of Rosalind Bank, 16°50'N, 81°21'W, 200 fm (366), RV *Oregon*, sta. 3627, 7 Jun. 1962. NICARAGUA: UF 27894, paratype, 1(334 mm), Caribbean Sea, WSW of Quitasueño, 14°08'N, 81°55'W, 200-244 fm (366-446 m), RV *Oregon*, sta. 3570, 21 May 1962; USNM 218405, paratype, 1(340 mm), Caribbean Sea, Nicaragua-Colombia, 200 fm (366), FV *Canopus*, trawl, 5 Jul. 1972.

Diagnostic features: Body elongated, its depth 7-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots rarely discernible. Three pairs of barbels on head; first two about equal in size (1.3-1.8% TL), third one longer (2.0-2.9% TL). Seven pairs of gill pouches corresponding to seven pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 5-6. Ventral aorta branches at gill pouch 7. Ventral finfold low, 2 mm high, originates about midway between the last gill apertures and the cloaca, extending backward to the cloaca. Caudal finfold quite thin and rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 21.4-23.6; branchial length 5.8-7.8; trunk length 50.4-56.0; tail length 16.5-19.6; body width 4.8-7.7; body depth including VFF 7.7-11.4; body depth excluding VFF 7.4-10.6; body depth over cloaca 6.9-9.2; tail depth 7.5-10.9. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 11-13. Posterior unicusps 10-11. Total cusps 54-58. Prebranchial pores 13-15. Branchial pores 6-6. Trunk pores 47-52. Tail pores 11-13. Total pores 79-85. No slime pore associated with the pharyngocutaneous duct.

Color in alcohol: light to very light tan over whole body; eyespots present but inconspicuous; no pale areas on the body.

Size: Maximum total length 385 mm (Fernholm, 1998).

Distribution and habitat: Caribbean Sea, from Honduras to Panama. On the upper slope at depths from 365 to 500 m.

Fig. 12. Distribution of *Eptatretus caribbeaus.*

Interest to fishery: None.

Remarks: ***Eptatretus caribbeaus*** is known only from five specimens sexually immature.

Common names: FAO: Caribbean hagfish.

***Eptatretus carlhubbsi* McMillan and Wisner, 1984**

Eptatretus carlhubbsi McMillan and Wisner, 1984: 256, Figs. 2, 3(1), 5(1-9), 6 [original description; type locality: Western Wake Island, 19°18'N, 166°33.5'E, 1574 m; type series: holotype, SIO 68-473, paratypes, BPBM 27848 (1), BPBM 27851 (1), CAS 50705 (1), CAS 50706 (1), SIO 68-473 (1), SIO 82-63 (1), USNM 227440 (1),

USNM 233742 (1)]. –Kuo and Mok, 1994: 248 [selected characters]. –Fernholm, 1998: 34 [Hawaii, Wake, Guam]. –Fernholm and Paxton, 1998: 1192 [catalog]. –Mok, 2001: 358 [nasal-sinus papillae]. –Nelson, 2006: 23 [citation; 1.1 m]. –Mincarone and Stewart, 2006: 226 [comparison with ***Eptatretus goliath***].

Eptatretus laurahubbsi McMillan and Wisner, 1984: 261, Figs. 3(2-3), 5(10). [original description; type locality: near Más a Tierra, Juan Fernández Island, 33°31'S, 78°50'W, 2400 m; type series: holotype, SIO 65-643, paratypes, CAS 49125 (2), MNHNC P. 6383 (1), SIO 65-643 (2), USNM 227441 (2)]. –Pequeño, 1989: 5 [list of Chilean fishes]. –Meléndez *et al*., 1993: 6 [type catalog]. –Kuo and Mok, 1994: 248 [selected characters].

Eptatretus laurahubbsae. –Wisner and McMillan, 1988: 232 [identification key; name corrected to ***laurahubbsae***]. –Fernholm, 1998: 34 [Juan Fernández Islands]. –Mincarone and Stewart, 2006: 227 [comparison with ***Eptatretus goliath***].

Material examined: 11 specimens. HAWAII ISLANDS (USA): BPBM 33933, 2(915-954 mm), Hawaii, 9 miles off Pepe'ekeo Point, 529 fm (967 m), shrimp trap, L. Chow, 20 May 1988; BPBM 33934, 1(1070 mm), Oahu, about 18 miles offshore near HH boy, 1800 ft (540 m), FV *Anela*, E. Bowers (captain) and crew, 25 Jul. 1988; CAS 50705 (ex BPBM 27847), paratype, 1(1000 mm), Leeward Islands, shrimp trap, P. J. Struhsaker, Nov.-Dec. 1981; CAS 50706 (ex BPBM 27849), paratype, 1(950 mm), Leeward Islands, French Fregate Shoals (Mokupāpapa), East Plateau, north side, 481 m, shrimp trap, 19 Nov. 1981; USNM 227440, paratype, 1(868 mm), North Pacific, 24°48'N, 167°14'W, 853 m, RV *Townsend Cromwel*, 9 Dec. 1980. NORTHERN MARIANA ISLANDS (USA): USNM 233742 (ex NMFS P-0289), paratype, 1(940 mm), off Tinian, Esmeralda Bank, 14°59'N, 145°13'E, 1016 m, 5-6 Apr. 1981. JUAN FERNÁNDEZ ISLANDS (CHILE): CAS 49125, paratypes of ***Eptatretus laurahubbsae***, 2(225-270 mm), and USNM 227441, paratypes of ***Eptatretus laurahubbsae***, 2(185-200 mm), Pacific, Juan Fernández Island, near Mas a Tierra, 33°31'S, 78°50'W, 2400 m, RV *Anton Bruun*, free vehicle trap, A. J. Stover, R. L. Wisner, 12-13 Dec. 1965, 20:30-08:30 h.

Diagnostic features: Body elongated, its depth 8-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots large, prominent, ranging from nearly round to square rectangular, margins poor defined. Three pairs of barbels on head; first two about equal in size (1.0-1.6% TL), third one longer (1.2-2.3% TL). Seven pairs of gill pouches corresponding to seven pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct usually confluent with the pharyngocutaneous duct on the left side (not confluent in just one specimen). Dental muscle overlies gill pouches 2-5. Ventral aorta branches at gill pouches 5-6. No ventral finfold, but an intermittent vague line resembling a median suture extends from well behind pharyngocutaneous duct nearly to cloaca. Caudal finfold thick, its outline shape varying considerably from rounded to truncated, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 16.8-19.7; branchial length 5.5-7.7; trunk length 57.7-62.3; tail length 14.5-17.6; body width 3.6-6.2; body depth 7.8-10.6 (no ventral finfold); body depth over cloaca 6.5-8.5; tail depth 8.9-10.5. Two-cusp (rarely 3-cusp) multicusps on the anterior row and 3-cusp multicusps on the posterior row of cusps. Anterior unicusps 13-17. Posterior unicusps 11-13. Total cusps 61-71. Prebranchial pores 12-17. Branchial pores 6-8. Trunk pores 60-70. Tail pores 12-16. Total pores 93-110.

Color in alcohol tan to purplish brown; irregular pale areas and patches occasionally occur mainly on the anterior portion of the body; tip of the barbels white; mouth and gill apertures with white margins.

Size: Maximum total length 1160 mm (McMillan and Wisner, 1984).

Distribution and habitat: Known from North Pacific islands and sea mounts, including Hawaii, Wake, and Tinian (Northern Mariana Islands). A deep-water species living on the slopes at depths from 481 to 1574 m. Also from eastern South Pacific, Juan Fernández Islands, at 2400 m depth.

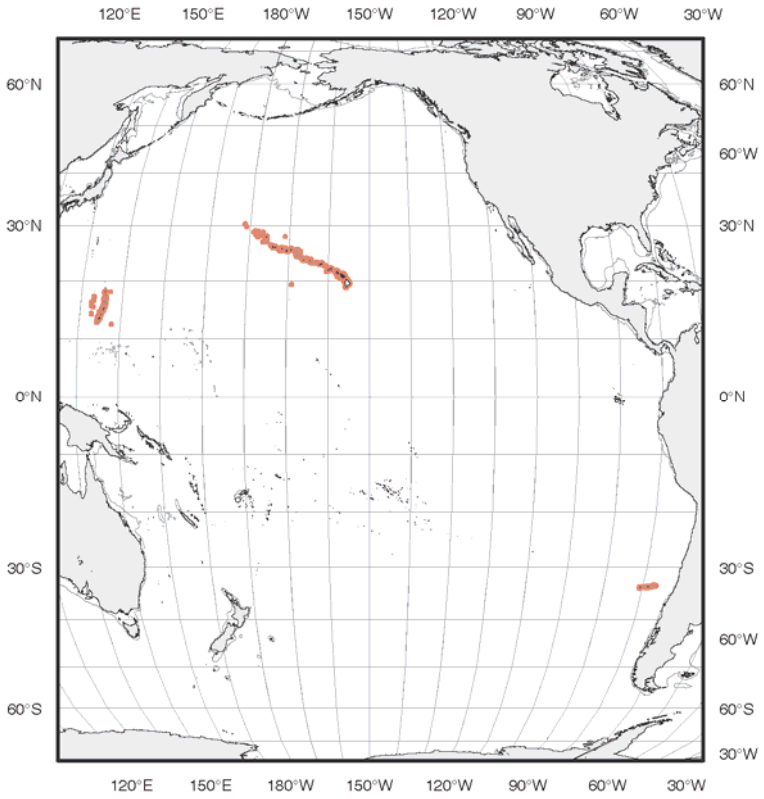


Fig. 13. Distribution of *Eptatretus carlhubbsi.*

Interest to fishery: None.

Remarks: ***Eptatretus laurahubbsae*** McMillan and Wisner, 1984 was described from eight juvenile specimens (240-375 mm TL) from Juan Fernández Island, southeastern Pacific. It was considered different from ***Eptatretus carlhubbsi*** from North Pacific islands based on the presence of a ventral finfold (absent in ***E. carlhubbsi***). All other characters are equal for both species (McMillan and Wisner, 1984). However, I and other previous authors observed that when the ventral finfold is well developed in juveniles, it becomes lower or even disappear in adult specimens. Based on this evidence and on the lack of any other distinguishable character, I conclude that specimens of ***E. laurahubbsae*** are in fact juveniles of ***E. carlhubbsi***.

Adult females (961-1160 mm TL) examined by McMillan and Wisner (1984) presented 21 to 32 eggs ranging in size from 58.5 x 14.4 mm to 75.5 x 16.5 mm. Although all were extremely large, none of the eggs had terminal hooks.

Common names: FAO: Pacific giant hagfish.

Eptatretus cirrhatus (Forster, 1801)

Petromyzon cirrhatus Forster in Bloch and Schneider, 1801: 532 [original description; type locality: New Zealand; holotype: unknown]. –Cuvier, 1831: 298 [synonymy]. –Valenciennes, 1837: 383 [citation].

Homea banksii Fleming, 1822: 375 [original description; type locality: South Seas; holotype: unknown].

Bdellostoma heptatrema Müller, 1836: 79 [original description; type locality: South seas; holotype: unknown].

Bdellostoma forsteri Müller, 1836: 80 [original description; type locality: Queen Charlotte Sound, New Zealand; holotype: unknown]. –Conel, 1931: 76 [hermaphroditism].

Bdellostoma forsteri var. ***heptatrema***. –Müller, 1838: 174 [new combination].

Bdellostoma cirrhatum. –Günther, 1870: 511 [in part, seven gill apertures; New Zealand]. –Hutton, 1872: 87 [in part, seven gill apertures; Australia]. –Putnam, 1874b: 160 [in part, specimens with seven gill apertures; New Zealand]. –Günther, 1880: 27 [Queen Charlotte Sound]. –Schneider, 1880: 115 [citation]. –Sherrin, 1886: 307 [New Zealand]. –Hutton, 1890: 285 [checklist of New Zealand fishes]. –Adam and Strahan, 1963: 6 [in part, 7 pairs of gills; New Zealand].

Homea cirrhata. –Garman, 1899: 350 [in part, survey report]. –Dean, 1904: 21 [in part, New Zealand]. –Fowler, 1964: 46 [in part, catalog of world fishes].

Heptatrema cirrata. –Hutton, 1904: 55 [New Zealand].

Eptatretus forsteri. –Jordan, 1905: 490 [Australia]. –Jordan, 1925: 170 [Australia].

Heptatretus banksii. –Regan, 1912: 536 [identification key; southern Pacific].

Heptatretus cirratus. –Regan, 1912: 536 [identification key; D'Urville Is., Queen Charlotte Sound; New Zealand].

Heptatretus cirrhatus. –Phillipps, 1927b: 6 [bibliography]. –Doogue *et al*., 1961: 297 [widespread in both New Zealand islands].

Bdellostoma* (*Eptatretus*) *cirrhatum. –Holly, 1933: 53 [identification key; South Pacific Ocean, New Zealand].

Eptatretus cirrhatus. –Waite, 1907: 5 [checklist of New Zealand fishes]. –Waite, 1909: 132, Pl. 13 [description, biology, and ecology; off Timaru and the Chatham Islands]. –Phillipps, 1927a: 10 [checklist of New Zealand fishes]. –Norman, 1935: 3 [New Zealand]. –Graham, 1974: 51 [aquarium maintenance, biological and ecological notes]. –Heath and Moreland, 1967: Fig. 47 [illustration]. –Whitley, 1968: 4 [checklist of New Zealand fishes]. –Whitley, 1974: 397, Appendix [checklist of New Zealand fishes]. –Fernholm and Holmberg, 1975: 253 [eye morphology]. –Strahan, 1975: 145, Fig. 2b [identification key]. –Hardisty, 1979: 19 [S. Pacific]. –Fernholm, 1982: 436 [identification key, comparison with ***Eptatretus caribbeaus***]. –McMillan and Wisner, 1984: 264, Figs. 3(5), 4, 5(12) [identification key, redescription]. –Fernholm, 1985: 113 [lateral line system]. –May and Maxwell, 1986: 81 [southern Queensland, New South Wales, and Victoria]. –Francis, 1988: 16, Pl. 1 [brief description; North Cape to Snares Islands, Chatham Island, most common south of Cook Strait]. –Paulin *et al*., 1989: 9, Fig. 2.1 [identification key; New Zealand]. –Shimizu, 1990: 53 [brief description; New Zealand]. –Gomon, 1994: 85 [comparison with ***Eptatretus longipinnis***]. –Kuo and Mok, 1994: 248 [selected characters]. –Francis, 1996: 16, Pl. 1 [most abundant around South Island, New Zealand]. –Fernholm, 1998: 34 [New Zealand, S and E Australia]. –Fernholm and Paxton, 1998: 1192 [catalog]. –Paul, 2000: 23 [catalog of New Zealand fishes]. –Francis, 2001: 18, Pl. 1 [brief description; New Zealand]. –Soto and Mincarone, 2004: 9 [MOVI catalog of fishes]. –Mincarone and Stewart, 2006: 226 [comparison with ***Eptatretus goliath***].

Material examined: 10 specimens. AUSTRALIA: AMS I.34746001, 1(150 mm), off Wollongong, 34°32.06'S, 151°17.40'E, 400 m, crustacean traps, J. K. Lowry, K. Dempsey, 28-29 Mar. 1994, 06:00-17:00h; AMS I.35437001, 2(435-455 mm), Due E of Mooloolaba, 26°35'S, 153°43'E, 302 m, Capricorn 1, trap, J. K. Lowry, K. Dempsey, 3-4 Aug. 1994; SAM F5356, 1(441 mm), 38°11'S, 149°58'E, 620 m, *Soela*, 15 Oct. 1984; SAM F5360, 1(439 mm), 37°44'S, 150°16'E, 620 m, *Soela*, 14 Oct. 1984; SAM F5363, 1(433 mm), 37°59'S, 150°05'E, 452 m, *Soela*, 14 Oct. 1984. NEW ZEALAND: MOVI 27797 (ex NMNZ P. 23404), 1(460 mm), Matakaoa, East Cape, North Island, Gisborne, 37°34.00'S, 178°20.00'E, 17 m, rotenone, G. S. Hardy, 28 Jun. 1988; MOVI 27798 (ex NMNZ P.

10211), 1(620 mm), North Island, Bay of Plenty, 11 km NW of Mayor Island, 37°11.50'S, 176°10.00'E–37°10.50'S, 176°11.50'E, 190-265 m, RV *Tangaroa*, trawl, 22 Jan. 1979; NMNZ 7831, 1(600 mm), off Matakoa Point, 37°29.80'S, 178°21.70'E, 527-680 m; NMNZ 19677, 1(782 mm), SE of North Cape, 34°36.30'S, 173°59.00'E, 871-914 m.

Diagnostic features: Body elongated, its depth 7-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots small, prominent, margins well defined. Three pairs of barbels on head; first two about equal in size (1.1-1.7% TL), third one longer (2.0-2.7% TL). Seven pairs of gill pouches corresponding to seven pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct usually confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 4-5. Ventral aorta branches at gill pouches 6-7. Ventral finfold vestigial, 1 mm high, beginning within anterior 22-37% of trunk, extending backward to the cloaca. Caudal finfold rounded, thick, its ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 21.4-23.9; branchial length 6.9-8.9; trunk length 52.5-56.3; tail length 13.5-16.8; body depth including VFF 6.9-10.2; body depth excluding VFF 6.9-10.2; body depth over cloaca 5.7-7.5; tail depth 7.7-9.1. Three cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 8-11. Posterior unicusps 7-9. Total cusps 43-51. Prebranchial pores 16-20. Branchial pores 6-8. Trunk pores 46-53. Tail pores 10-14. Total pores 83-90.

Color in alcohol: body light to dark brown with irregular pale spots and patches; tip of the barbels white; mouth and gill apertures with white margins; ventral and caudal finfolds the same color as body but occasionally with whitish margins.

Size: Maximum total length 830 mm (Fernholm, 1998).

Distribution and habitat: Southeastern Australia and around New Zealand (most abundant around South Island, Francis, 1996). Known from shallow to deep waters, on

shelves and slopes at depths from 1 to approx. 1100 m. It can form locally abundant populations and is often associated with inshore reefs (Mincarone and Stewart, 2006).

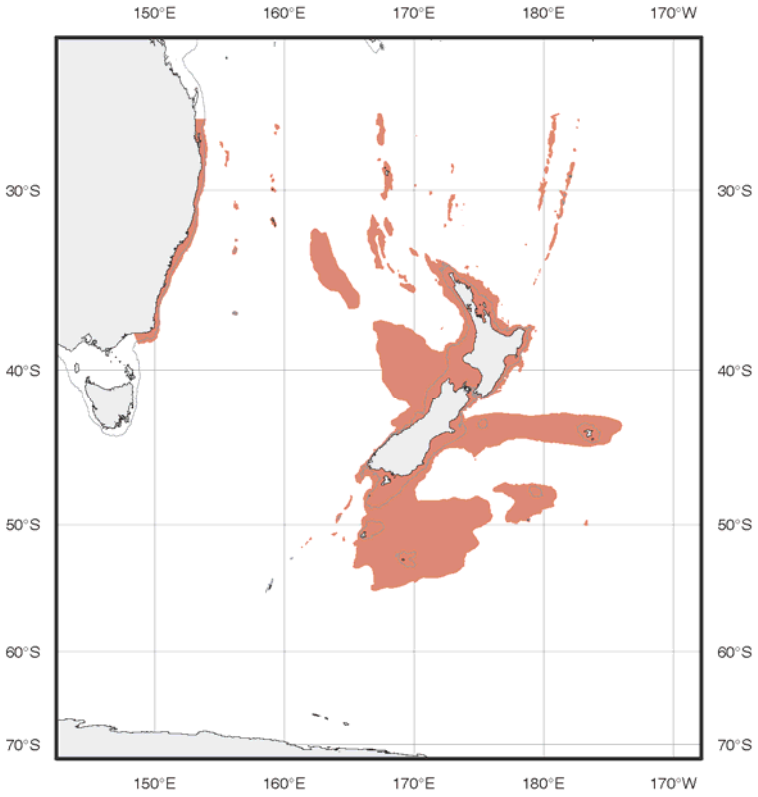


Fig. 14. Distribution of *Eptatretus cirrhatus*.

Interest to fishery: None.

Remarks: Of eight specimens examined by McMillan and Wisner (1984), a 655-mm female had about 50 large eggs ranging from 29 to 32 mm long, which is a unusually large number of maturing eggs. All were still in the mesentery; terminal anchor filaments were not present on any egg.

Common names: AUSTRALIA: Broadgilled hagfish; NEW ZEALAND: Blind eel; CHATHAM ISLAND (Maori name): Tuere; FAO: New Zealand hagfish.

Eptatretus deani (Evermann and Goldsborough, 1907)

Polistotrema deani Evermann and Goldsborough, 1907: 225, Fig. 1 [original description; type locality: Behm Canal off Nose Point, Alaska, 229-231 fm (419-422 m); type series: holotype, USNM 57820, paratypes, USNM 61162 (2), SU 20012 (1)]. –Hubbs, 1928: 10 [Oregon and Washington]. –Ulrey, 1929: 2 [checklist of fishes of California]. –Jordan *et al*., 1930: 8 [Alaska to Santa Barbara, California]. –Böhlke, 1953: 8 [type catalog, paratype SU 20012]. –Wilimovsky, 1954: 281 [checklist of Canadian fishes]. –Roedel, 1962: 21 [vernacular names of Californian fishes]. –Barham *et al*., 1967: 780 [Coronado Canyon, San Diego Trough].

Heptatretus deani. –Regan, 1912: 535 [identification key; Alaska].

Polistotrema curtiss-jamesi Townsend and Nichols, 1925: 4, Fig. 1. [original description; type locality: off California, 35°35'N, 121°39'W, 485 fm (887 m), Albatross sta. 5697; type series: holotype, USNM 87551 (poor condition), paratypes, AMNH 12843 (1), AMNH 12858-61 (1, 1, 1, 1)].

Bdellostoma* (*Polistotrema*) *deani. –Holly, 1933: 51 [identification key; Alaska].

Bdellostoma deani. –Adam and Strahan, 1963: 6 [Alaska].

Dodecatrema stoutii. –Fowler, 1964: 45 [in part, synonymy].

Eptatretus deani. –Bourne and McAllister, 1969: 3246, Fig. 1 [range extension; British Columbia]. –Kukowski, 1972: 7 [Monterey Bay]. –Miller and Lea, 1972: 32 [Cedros Island, Baja California to SE Alaska, including Guadalupe Island]. –Fitch, 1973: 815 [off Eureka, California]. –Hart, 1973: 17 [identification key, brief description; southern Alaska to southern California]. –Hardisty, 1979: 19 [Alaska to British Columbia]. –Hubbs *et al*., 1979: 3 [checklist of Californian fishes]. –Eschmeyer *et al*., 1983: 10 [field guide; SE Alaska to Baja California]. –Fernholm, 1985: 113 [lateral line system]. –McAllister, 1990: 25 [checklist of Canadian fishes]. –Wisner and McMillan, 1990: 793, Fig. 2e [identification key, redescription; southeastern Alaska to near Guadalupe Island, Mexico]. –Barss, 1993: 19 [Oregon fishery, 1988-1992]. –Fernholm, 1998: 34 [W coast of North America]. –Mecklenburg *et al*., 2002: 54 [identification key, brief description; southern Alaska to central Baja California at Guadalupe Island]. –Peden, 2002: 6 [British Columbia]. –Arimitsu *et al*., 2003: 60

[survey report; Alaska]. –Soto and Mincarone, 2004: 9 [MOVI catalog of fishes]. – Love *et al*., 2005: 1 [calalog; Southeastern Alaska to Isla Guadalupe, Baja California].

Material examined: 26 specimens. ALASKA (USA): SU 20012, paratype, 1(485 mm), Behm Canal off Nose Point (Nose Point, S. 66°E., 1.6 miles), 229-231 fm (417-422 m), RV *Albatross*, 8 Jul. 1903. UNITED STATES OF AMERICA: CAS 14815, 3(112-370 mm), Oregon, 45°58'30"N–45°58.8'N, 124°38'W-124°37'48"W, 205 m, *Yaquina*, 22' otter trawl, W. N. Eschmeyer, 16 Aug. 1972; CAS 20404, 1(390 mm), California, off Santa Cruz, E. F. Ricketts, 6 Aug. 1925; CAS 42563, 1(200 mm), California, off Cypress Pt., 500-600 fm (914-1097 m), trap, *Sallie Boy II*, Monterey Sablefish Fishery, 6 Jan. 1979; CAS 81385, 1(390 mm), California, 500 ft (152 m), Farallones Oceanic Research Expedition, 19 Sep. 1991; CAS 98609, 1(415 mm), California, 2.1 miles SSW of east of Anacapa Island, 33°59'18"N, 119°23'W, 125 fm (229 m), prawn trap, California State Fisheries Lab., 2 Apr. 1969; CAS 98611, 1(430 mm), California, 3.8 miles SSW of west end of Anacapa Island, 33°57'30"N, 119°28'54"W, 130 fm (238 m), prawn trap, California State Fisheries Lab., 3 Apr. 1969; CAS 98612, 1(360 mm), California, 4 miles SSW of west end of Anacapa Island, 33°57'24"N, 119°29'42"W, 130 fm (238 m), prawn trap, California State Fisheries Lab., 3 Apr. 1969; MOVI 27530-27533 (ex SIO 86-31), 4(315-410 mm), California, 34°33.3´N, 121°06.8´W, 497-503 fm (909-919 m), RV *David Starr Jordan*, otter trawl, R. Snodgrass, 6 Mar. 1986, 09:11-11:05h; MOVI 30908-30911 (ex SU 28782), 4(332-432 mm), California, San Diego, off Point Loma, USS *Albatross*, U.S. Fish Commission, 9 Mar. 1904; MOVI 30912-30917 (ex CAS 214879), 6(268-384 mm), California, off Point Sur, 600 m, 1 Oct. 1984; SU 35314, 2(348-384 mm), NE Pacific, USA, California, off Point Sur, 36°20'45"N, 122°06'15"W, 208 fm (380 m), R. L. Bolin, P. L. Budd, 12 Nov. 1935.

Fig. 15. *Eptatretus deani* (after Evermann and Goldsborough, 1907).

Diagnostic features: Body elongated, its depth 5-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent. Three pairs of barbels on head; first two about equal in size (1.0-1.8% TL), third one longer (1.4-2.9% TL). Eleven (rarely 10 or 12) pairs of gill pouches corresponding to 11 (rarely 10 or 12) pairs of gill apertures. Gill apertures well spaced in a linear pattern. Posteriormost gill aperture on left side confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 3-6. Ventral aorta branches at gill pouches 4-8. Ventral finfold usually low (1-3 mm high), occasionally absent, beginning within anterior 11-25% of trunk, extending backward to the cloaca. Caudal finfold rounded, ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 14.4-20.4; branchial length 12.7-18.2; trunk length 48.0-55.5; tail length 12.6-19.2; body width 3.8-8.3; body depth including VFF 4.7-10.5; body depth excluding VFF 4.5-10.5; body depth over cloaca 3.8-8.5; tail depth 5.2-10.3. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-10. Posterior unicusps 7-9. Total cusps 37-46. Prebranchial pores 4-10. Branchial pores 8-13. Trunk pores 39-49. Tail pores 9-15. Total pores 67-80.

Color in alcohol: body very dark brown to purplish-black; specimens with a brownish base color show variable amounts of pale spots and patches; head near tip of rostrum and barbels usually unpigmented; gill apertures, slime pores, and cloaca with narrow pale margins; ventral e caudal finfolds usually without pale margins.

Size: Maximum total length 635 mm (Hart, 1973).

Distribution and habitat: Eastern North Pacific, from southern Alaska to near Guadalupe Island, Mexico. On the continental shelf, slope and deep-sea floor at depths from 107 to 2743 m (Wisner and McMillan, 1990).

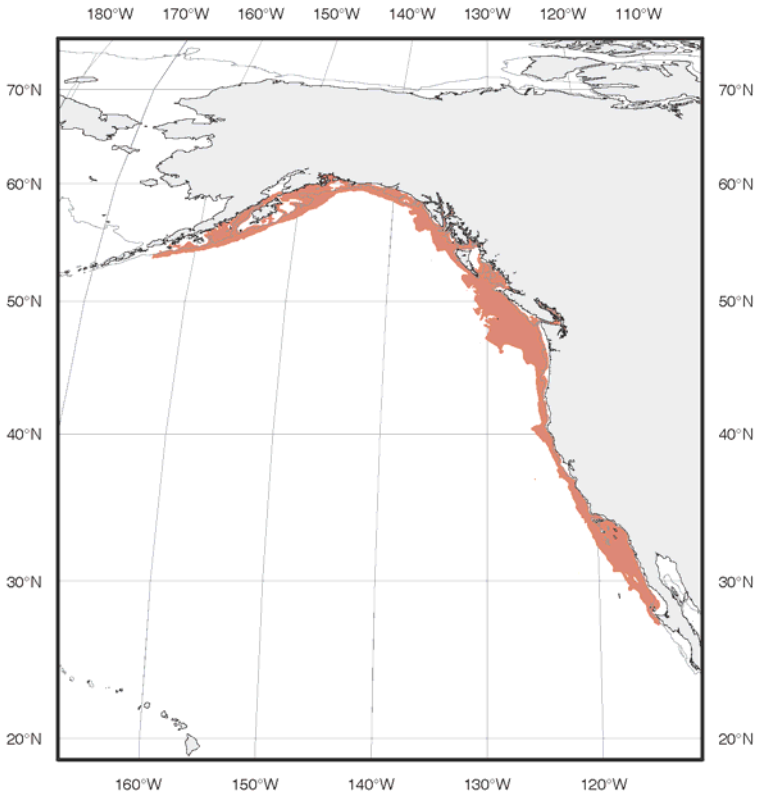


Fig. 16. Distribution of *Eptatretus deani.*

Interest to fishery: See ***Eptatretus stoutii***.

Remarks: Based on Oregon hagfish fishery, Barss (1993) sampled 897 specimens of ***Eptatretus deani*** from commercial and research catches, from 1988 through 1989. Mean length of fish sampled from commercial landings was 34.5 cm. Fifty percent maturity for male and female was 34 cm and 38 cm, respectively. Examination of gonads indicates that spawning occurs throughout the year. Mature black hagfish females averaged 14 eggs over 5 mm in length.

Of a total of 480 specimens sexed by Wisner and McMillan (1990), 74% were female and 26% male. The largest egg found measured 52.3 x 10.5 mm and was among 14 large eggs in a 500-mm female. Very few eggs mature at same time from the many hundreds of tiny, round to slightly ovoid eggs. No more than 15 nor fewer than 8 large eggs (30 mm and longer) were present in any female. Anchor filaments were visible on all eggs of 35 mm length or more.

The description above was based on the material examined, combined with data from 460 specimens examined by Wisner and McMillan (1990).

Common names: CANADA: Myxine noire, Black hagfish; USA, FAO: Black hagfish.

Eptatretus eos Fernholm, 1991

Eptatretus eos Fernholm, 1991: 115, Fig. 1 [original description; type locality: Tasman Sea, west of New Zealand, 39°47.7-50.3'S, 167°15.7-13.5'E, 991-1013 m; holotype: NMNZ P. 24262 (not in NMNZ)]. –Fernholm, 1998: 34 [Tasman Sea]. –Mok *et al*., 2001: 1028 [comparison with ***Eptatretus wayuu***]. –Mincarone and McCosker, 2004: 166 [comparison with ***Eptatretus lakeside***]. –Mincarone and Stewart, 2006: 227 [comparison with ***Eptatretus goliath***].

Material examined: None.

Diagnostic features: Body elongated, its depth about 5% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Nasopharyngeal duct cylindrical forming a tube-shaped elongated snout. Three pairs of barbels on head; first two about equal in size, third one longer. Five pairs of gill pouches corresponding to five pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Ventral finfold inconspicuous. Caudal finfold originates dorsally halfway between the cloaca and the posterior tip of tail, extending around tail to posterior end of cloaca.

Body proportions (in percentage of TL): prebranchial length 23.5; branchial length 4.7; trunk length 54.0; tail length 18.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6. Posterior unicusps 5-6. Total cusps 34. Prebranchial pores 26. Branchial pores 4-5. Trunk pores 75-77. Tail pores 26-27. Total pores 128-130.

Color in alcohol: light pink over all body, except on the nostril, barbels, mouth, and margin of caudal finfold, which are whitish; eyespots inconspicuous; lighter lines following the ventral rows of slime pores and gill apertures. Color in life unknown but probably darker.

Size: Known from a single specimen, 665 mm TL (Fernholm, 1991).

Distribution and habitat: Know only from the type locality: Tasman Sea, west of New Zealand, 39°47.7-50.3'S, 167°15.7-13.5'E, from 991 to 1013 m depth.

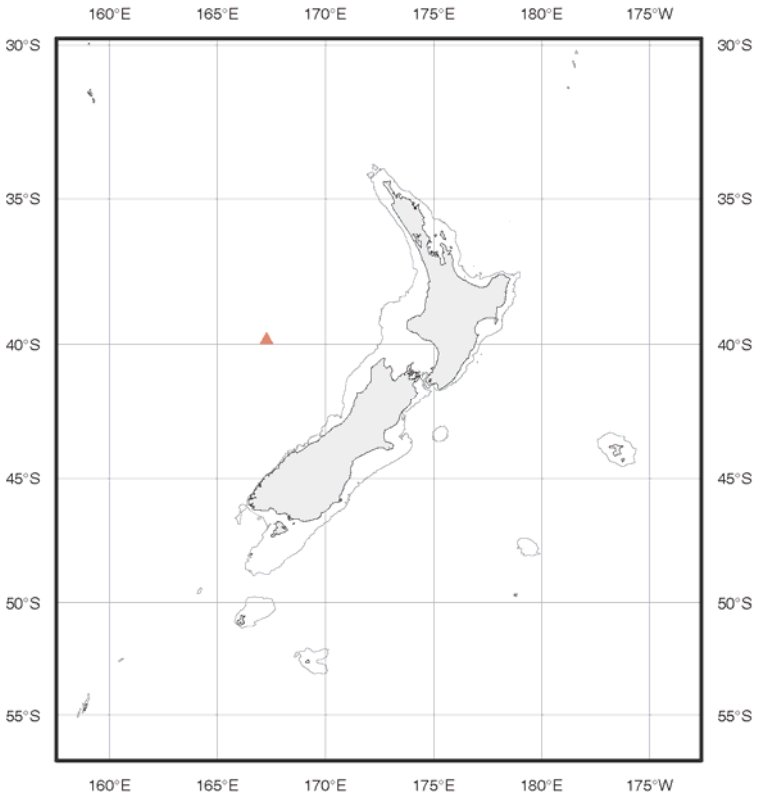


Fig. 17. Distribution of *Eptatretus eos.*

Interest to fishery: None.

Remarks: The unique specimen known was collected in the trawl fishery for the holacanthid ***Hoplostethus atlanticus*** on Westpack bank, Western Challenger Plateau, Tasman Sea. According to Fernholm (1991), an alert was put out to scientists and fisheries observers in the area to try to acquire more specimens, but after more than one year no additional material was collected.

Common names: NEW ZEALAND, FAO: Long-nose hagfish.

Eptatretus fernholmi McMillan and Wisner, 2004

Eptatretus fernholmi McMillan and Wisner, 2004: 55, Fig. 3 [original description; type locality: Philippines, E of the southern end of Luzon Island, 5.1 miles off Atalaya Pt., 12°43'51"N, 124°58'50"E, 563 m, Albatross sta. D5444; holotype: USNM 207761 (apparently lost)].

Material examined: None.

Diagnostic features: Body elongated, its depth 8 % TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Eyespots not visible. Three pairs of barbels on head. Eight pairs of gill pouches corresponding to 8 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last gill aperture confluent with pharyngocutaneous duct on left side. Ventral finfold vestigial. Caudal finfold rounded, well developed, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 21.2; branchial length 8.0; trunk length 56.3; tail length 14.9; body depth including VFF 8.0; body depth excluding VFF 8.0; body depth over cloaca 6.0; tail depth 8.6. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 11.

Posterior unicusps 9-10. Total cusps 51. Prebranchial pores 15. Branchial pores 7. Trunk pores 50. Tail pores 9. Total pores 81.

Color in alcohol: body brownish, deteriorated, with most skin missing.

Size: Known from a single specimen, 373 mm TL (McMillan and Wisner, 2004).

Distribution and habitat: Known only from the type locality: Luzon Island, Philippines.

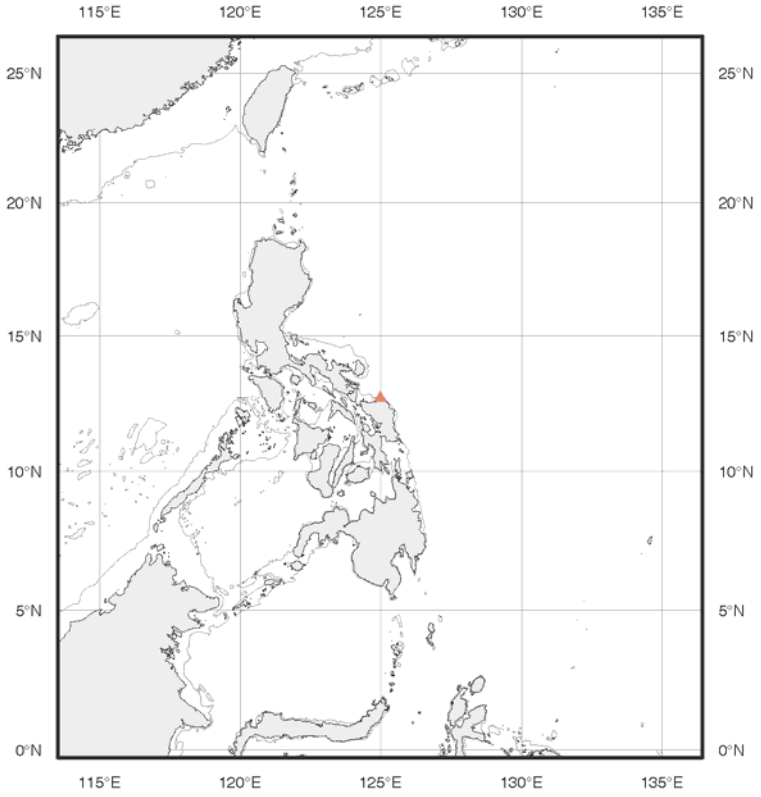


Fig. 18. Distribution of *Eptatretus fernholmi.*

Interest to fishery: None.

Remarks: ***Eptatretus fernholmi*** was described based on unpublished notes of Bo Fernholm, taken from a single damaged specimen about 30 years ago. McMillan and Wisner (2004) did not examined this specimen, which was left in the National Museum of Natural History but could not be found when H.-K. Mok whished to study it in 2001.

Common names: FAO: Luzon hagfish.

Eptatretus fritzi Wisner and McMillan, 1990

Eptatretus fritzi Wisner and McMillan, 1990: 791, Fig. 2b [original description; type locality: vicinity of Guadalupe Island, Mexico, 28°51'N, 118°14'W, 512 m; type series: holotype, SIO 66-26, paratypes, CAS 63201 (15), LACM 44407-1 (15), MOVI 27528-27529 (formerly SIO 68-664), SIO 66-26 (30), SIO 63-177 (20), SIO 66-22 (36), SIO 66-23 (195), SIO 66-36 (2), SIO 67-60 (120), SIO 68-664 (2), SIO 72-294 (4), USNM 296318 (15)]. –Fernholm, 1998: 34 [Guadalupe Island]. –Mok, 2001: 358 [nasal-sinus papillae]. –Soto and Mincarone, 2004: 9 [type catalog]. –Love *et al*., 2005: 1 [calalog; Isla Guadalupe, central Baja California].

Material examined: 6 specimens. MEXICO: CAS 63201 (ex SIO 66-26), paratypes, 3(430-510 mm), Pacific, Isla Guadalupe, 28°52'N, 118°14'W, 512 m, bottom trap, 3-4 Apr. 1966; MOVI 27528-27529 (ex SIO 68-664), 2(410-510 mm), paratypes, 1.9 miles off W coast of Guadalupe Island, 29°06.5'N, 118°23.5'W, 100 fm (183 m), RV *Velero IV*, setline, R. McConnaughey, 16 Nov. 1968, 15:40-09:11 h; USNM 296318 (ex SIO 66-26), paratype, 1(485 mm), Pacific, Isla Guadalupe, 28°51'N, 118°14'W, 512 m, 3-4 Apr. 1966.

Diagnostic features: Body elongated, its depth 5-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded and wide. No nasal-sinus papillae. Eyespots prominent, margins poor defined. Three pairs of barbels on head; first two about equal in size (1.9-2.3% TL), third one longer (2.5-3.0% TL). Barbels proportionaly longer and thicker than any other hagfish. Eleven (10-12) pairs of gill pouches corresponding to 11 (10-12) pairs of gill apertures (variation occurs in the number of gill apertures between left and right sides, the higher number always on the left side). Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 3-6. Ventral aorta branches at gill pouches 5-9. Ventral finfold usually absent; when present (8.2% of the 341 specimens examined by Wisner and McMillan, 1990) it is intermittent and weakly developed along its length, extends from well behind pharyngocutaneous duct to cloaca.

Caudal finfold variably thin to thick, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 17.6-24.5; branchial length 11.5-15.8; trunk length 46.2-55.6; tail length 13.2-18.1; body depth 5.3-10.2 (no ventral finfold); body depth over cloaca 4.5-7.2; tail depth 5.8-9.2. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-10. Posterior unicusps 7-9. Total cusps 38-46. Prebranchial pores 10-15. Branchial pores 9-12. Trunk pores 40-49. Tail pores 8-15. Total pores 74-85.

Color in alcohol: body dark purple to black, rarely with pale spots; gill apertures, slime pores, ventral finfold (when present), and caudal finfold without pale margins.

Size: Maximum total length 592 mm (Wisner and McMillan, 1990).

Distribution and habitat: Vicinity of Guadalupe Island, Mexico. On the slopes and deep-sea floor at depths from 183 to 2743 m.

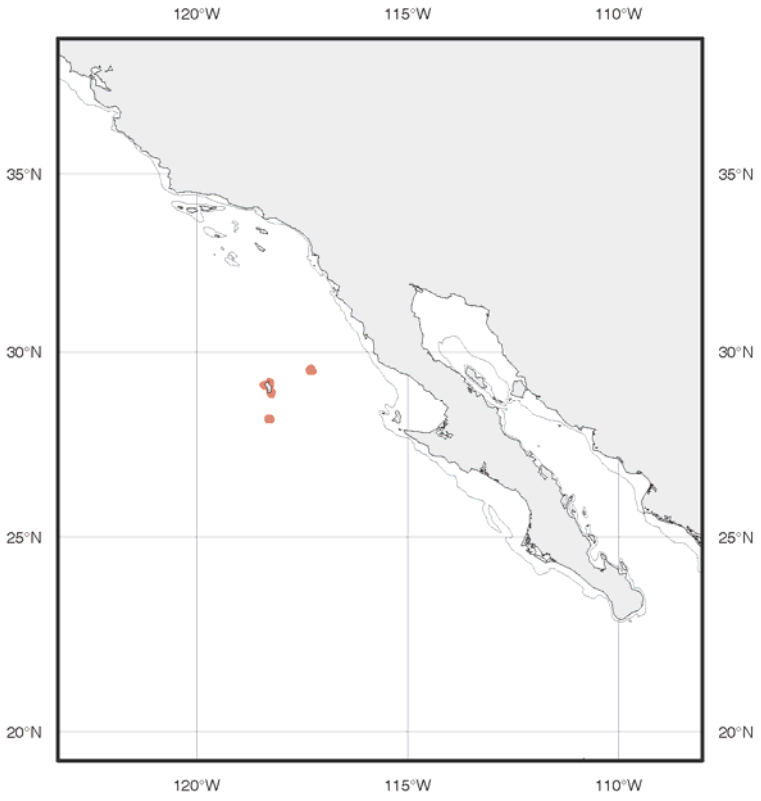


Fig. 19. Distribution of *Eptatretus fritzi.*

Interest to fishery: None.

Remarks: ***Eptatretus fritzi*** and ***E. deani*** occur sympatrically near Guadalupe Island, Mexico, where they were taken in the same trap on two occasions (Wisner and McMillan, 1990).

According to Wisner and McMillan (1990), of a total of 358 specimens for which sex could be reliably determined, 60% were female and 40% male. The largest egg, 33.8 x 8.5 mm, occurred among 14 eggs in a 386-mm female. No more than 16 and as few as 10 almost fully developed eggs were found in any female. No eggs had free anchor filaments.

Common names: FAO: Guadalupe hagfish.

Eptatretus goliath Mincarone and Stewart, 2006

Eptatretus goliath Mincarone and Stewart, 2006: 225, Fig. 1-2 [original description; type locality: off New Zealand, northeastern North Island, from the head of the Hauraki Canyon, 35°27'54"S, 175°36'08"E, 811 m; holotype: NMNZ P.40729].

Material examined: 1 specimen. NEW ZEALAND: NMNZ P.40729, holotype, 1275 mm, northeastern North Island, from the head of the Hauraki Canyon, 35°27'54"S, 175°36'08"E, 811 m, crab pot, G. Gibbs, 22 Mar. 2002.

Diagnostic features: Body elongated, its depth 9.5% of TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded, slightly projecting. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots conspicuous. Three pairs of barbels on head; first two about equal in size (1.2% TL), third one longer (1.7% TL). Seven pairs of gill pouches corresponding to 7 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last gill aperture on left side confluent with pharyngocutaneous duct. Dental muscle overlies gill pouch 4. Ventral aorta branches at gill pouch 7. Ventral finfold prominent, 9 mm high, beginning 300 mm behind the last gill aperture, extending backward to the cloaca. Caudal finfold

nearly rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 18.8; branchial length 6.7; trunk length 58.8; tail length 15.7; body width 6.4; body depth including VFF 10.2; body depth excluding VFF 9.5; body depth over cloaca 8.2; tail depth 11.4. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 11-13. Posterior unicusps 9-9. Total cusps 54. Prebranchial pores 14-15. Branchial pores 6-7. Trunk pores 57-58. Tail pores 13-14. Total pores 92.

Color in alcohol: body dark brown; rostrum and tip of barbels whitish; irregular white spots around mouth; gill apertures, slime pores, and ventral finfold colored as body; caudal finfold with a narrow dark distal margin; dark spots of different sizes and shapes randomly distributed over entire body.

Size: Known from a single specimen, 1275 mm TL (Mincarone and Stewart, 2006).

Distribution and habitat: Known only from type locality, northeastern North Island, from the head of the Hauraki Canyon, New Zealand, at 811 m.

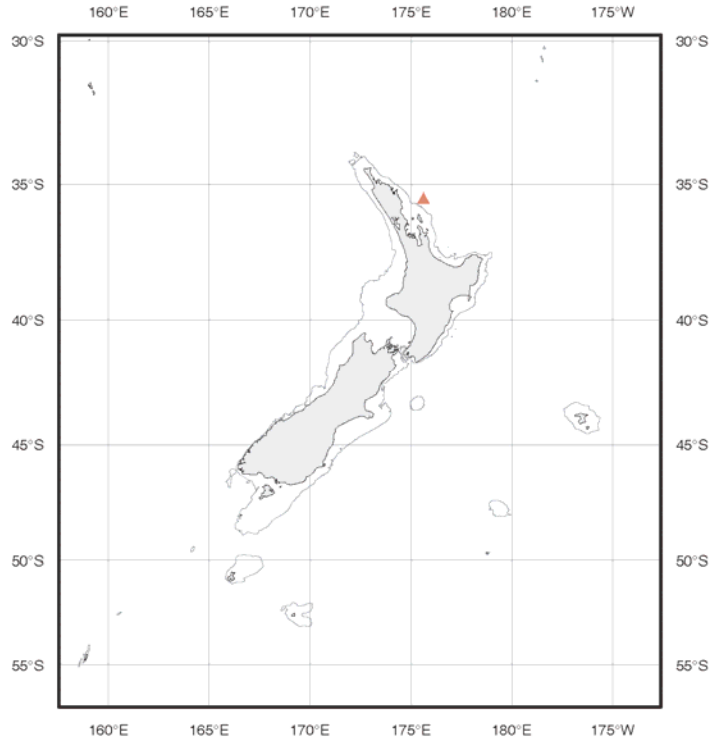


Fig. 20. Distribution of *Eptatretus goliath*.

Interest to fishery: None.

Remarks: The single specimen, at 1275 mm TL and 6.2 kg, is the largest hagfish yet known.

Common names: NEW ZEALAND, FAO: Goliath hagfish.

Eptatretus grouseri McMillan, 1999

Eptatretus grouseri McMillan, 1999: 114, Fig. 2a [original description; type locality: Galapagos Islands, 0°14.6'S, 91°26.6'W, 2370 ft (722 m); type series: holotype, CAS 86428; paratype, SIO 97-77 (1)]. –Mincarone and McCosker, 2004: 164, Figs. 2, 3b [identification key, further description, illustrations; Seymour Island].

Material examined: 4 specimens. GALAPAGOS ISLANDS (ECUADOR): CAS 86428, holotype, 370 mm, Fernandina Island, Punta Espinosa, 0°14'36"S, 91°26'36"W, 722 m, *Johnson Sea Link*, J. E. McCosker, R. G. Gilmore, 17 Nov. 1995; CAS 201882, 2(315-420 mm), Seymour Island, 0°21'42"S, 90°15'00"W, 648 m, *Johnson Sea Link*, C. Baldwin, J. E. McCosker, 25 Jul. 1998; SIO 97-77 (ex CAS 86428), paratype, 1(138 mm), taken with holotype.

Diagnostic features: Body elongated, its depth 6-9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent, with margins well defined. Three pairs of barbels on head; first two about equal in size (1.5-2.2% TL), third one longer (1.8-3.0% TL). Five (or 6) pairs of gill pouches corresponding to 5 (or 6) pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouch 5. Ventral finfold usually absent (when present it is vestigial), beginning within anterior 36-45% of trunk, extending backward to the cloaca. Caudal finfold thin, well

developed, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 20.3-23.9; branchial length 6.3-8.1; trunk length 53.5-57.0; tail length 14.6-17.5; body width 5.4-6.3; body depth including VFF 4.9-9.0; body depth excluding VFF 4.2-8.8; body depth over cloaca 4.8-6.5; tail depth 6.3-7.9. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 9-10. Posterior unicusps 8-9. Total cusps 44-48. Prebranchial pores 11-13. Branchial pores 4-5. Trunk pores 42-48. Tail pores 13-15. Total pores 71-79.

Color in alcohol: body dark brown; occasional pale spots on the ventral region of head; barbels with white tip; mouth, gill apertures, slime pores, ventral finfold (when present), caudal finfold, and cloaca variably with narrow pale margins.

Size: Maximum total length 420 mm (Mincarone and McCosker, 2004).

Distribution and habitat: Known only from two locations in Galapagos Islands: Fernandina Island and Seymour Island. On the steep, sediment-laden slopes at depths from 648 to 722 m.

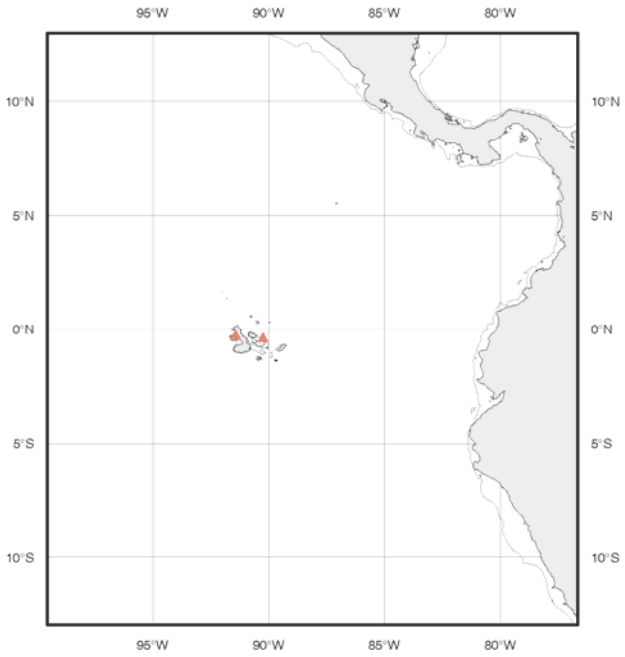


Fig. 21. Distribution of *Eptatretus grouseri.*

Interest to fishery: None.

Remarks: ***Eptatretus grouseri*** was originally described from only two specimens, both collected at 0°14.6'S, 91°26.6'W, 722 m, in Bolivar Channel, Fernandina Island, on 17 November 1995 (McMillan, 1999). On 25 July 1998, two additional specimens of *E. grouseri* were collected at 0°21'42"S, 90°15'00"W, 648 m, off Seymour Island (Mincarone and McCosker, 2004).

The 378-mm holotype has tiny round eggs less than one mm in diameter, no ellipsoidal developing eggs and no tissue indicating previous large eggs (McMillan, 1999).

Common names: FAO: Grouser's hagfish.

Eptatretus hexatrema (Müller, 1836)

Bdellostoma hexatrema Müller, 1836: 79 [original description; type locality: Table Bay, Cape of Good Hope, South Africa; holotype: ZMB 4698]. –Adam and Strahan, 1963: 6 [South Africa]. –Paepke and Schmidt, 1988: 159 [type catalog].

Bdellostoma heterotrema Müller, 1836: 79, Pl. 1, 3 (figs. 1-7), 6 (figs. 1-5), 7 (figs. 1-5), 8 (figs. 1-5), and 9 (figs. 2, 4) [original description; type locality: Table Bay, Cape of Good Hope, South Africa; holotype: ZMB 31647]. –Paepke and Schmidt, 1988: 158 [type catalog].

Bdellostoma forsteri var. ***heterotrema***. –Müller, 1838: 174 [new combination]. –Paepke and Schmidt, 1988: 158 [type catalog].

Bdellostoma forsteri var. ***hexatrema***. –Müller, 1838: 174 [new combination]. –Paepke and Schmidt, 1988: 158 [type catalog].

Bdellostoma cirrhatum. –Günther, 1870: 511 [in part, synonymy; South Africa]. –Putnam, 1874b: 160 [in part, South Africa]. –Günther, 1880: 14 [Simon's Bay].

Homea cirrhata. –Garman, 1899: 350 [in part, synonymy]. –Dean, 1904: 21 [in part, South Africa]. –Fowler, 1964: 46 [in part, synonymy].

Heptatretus hexatrema. –Regan, 1912: 536 [identification key; Simon's Bay, Table Bay, False Bay]. –Barnard, 1947: 1 [South African coast]. –Smith, 1950: 25, Fig. B [South Africa].

Bdellostoma* (*Eptatretus*) *hexatrema. –Holly, 1933: 53, Fig. 57 [identification key; South Africa].

Eptatretus hexatrema. –Norman, 1935: 36 [Simon's Town, False Bay]. –Smith, 1975: 9 [common name]. –Strahan, 1975: 144, Fig. 2g [identification key, further description]. –Hardisty, 1979: 19 [South Africa]. –Fernholm, 1986: 35, Fig. 1.1 [identification key, diagnosis; Walvis Bay to Durban]. –Kuo and Mok, 1994: 248 [selected characters]. –Fernholm, 1998: 34 [off Cape of Good Hope]. –Bianchi *et al*., 1999: 69 [catalog of Namibian fishes]. –Mok, 2001: 358 [nasal-sinus papillae]. –Soto and Mincarone, 2004: 10 [MOVI catalog of fishes].

Material examined: 4 specimens. SOUTH AFRICA: MOVI 27540 (ex RUSI 63619), 1(770 mm), off Port Nolloth, Orange Shelf, 119 m, *Africana*, 60' bottom trawl, 19 Jul. 1985; SIO 80-257, 1(702 mm), Algoa Bay, Port Elizabeth harbor, 33°58.0'S, 25°40.0'E, 40 ft (12 m), hook & line, J. L. B. Smith, 15 Aug. 1971; RUSI 2333, 2(635-690 mm), Cape Province, no date.

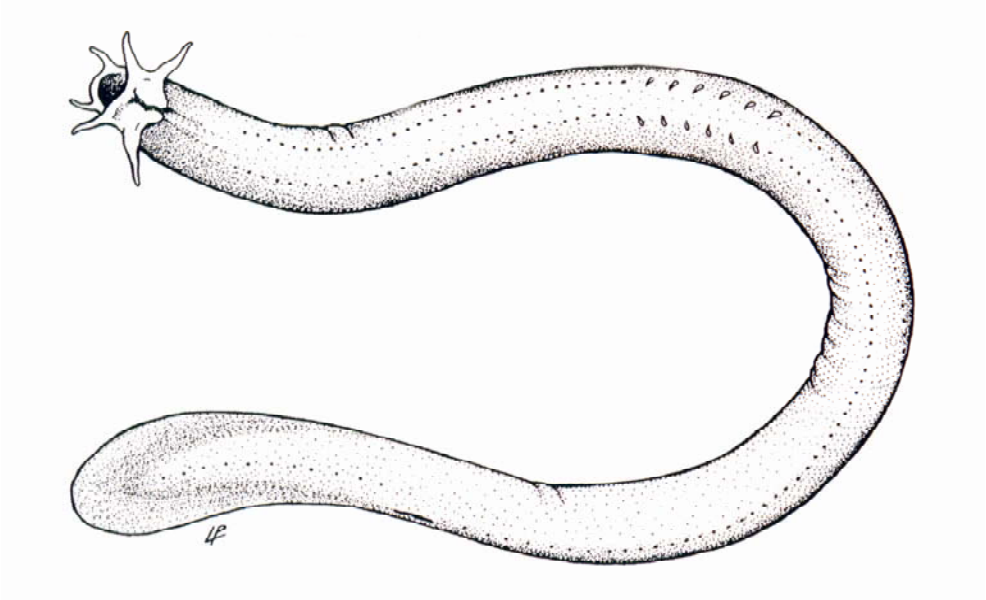


Fig. 22. *Eptatretus hexatrema* (after Smith and Heemstra, 1986).

Diagnostic features: Body elongated, its depth 5-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots prominent. Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct usually confluent with the pharyngocutaneous duct on the left side (rarely not confluent). Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouch 4. Ventral finfold low (1-3 mm high), beginning within anterior 31-37% of trunk, extending backward to the cloaca. Caudal finfold well developed, thin, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 27.2-32.8; branchial length 5.2-6.8; trunk length 48.0-53.6; tail length 12.4-12.6; body width 4.0-5.2; body depth including VFF 5.5-7.4; body depth excluding VFF 5.1-7.1; body depth over cloaca 4.3-6.5; tail depth 5.7-7.4. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 8-10. Posterior unicusps 8-10. Total cusps 40-48. Prebranchial pores 23-28. Branchial pores 5-6. Trunk pores 50-60. Tail pores 11-14. Total pores 91-107.

Color in alcohol: body dark brown dorsally, lighter ventrally; barbels usually with white tip; mouth, gill apertures and ventral finfold with pale margins, slime pores and caudal finfold without pale margins.

Size: Maximum total length 800 mm (Bianchi *et al*., 1999).

Distribution and habitat: Known only off southern Africa, from Walvis Bay (Namibia) to Durban (Natal). On muddy bottoms of the continental shelf and slope, at depths from 12 to 626 m (Sarah Walmsley, pers. com.).

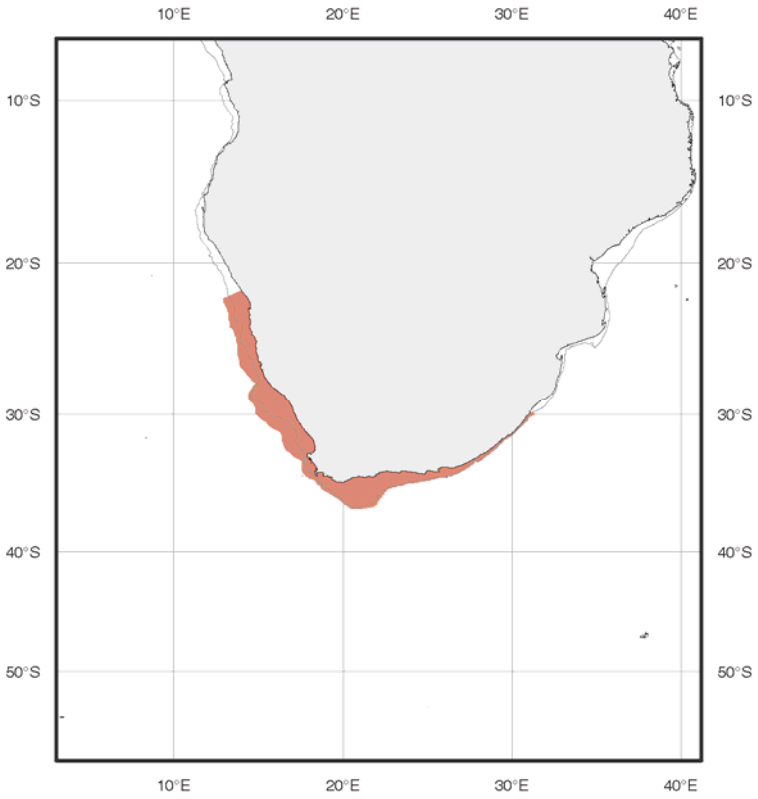


Fig. 23. Distribution of *Eptatretus hexatrema.*

Interest to fishery: None.

Remarks: ***Bdellostoma hexatrema*** was briefly described by Müller (1836) as having six gill apertures on both left and right sides. Based on this character, he also described ***Bdellostoma heterotrema***, which had seven and six gill apertures on the left and right sides, respectively. However, in some specimens of ***E. hexatrema***, the last branchial duct is not confluent with the pharyngocutaneous duct on the left side. This is the case of the type of ***Bdellostoma heterotrema***, which has six gill apertures plus the pharyngocutaneous opening on the left side.

In the second part of his work, Müller (1838) believed that all the species described by him in 1836, including ***Bdellostoma heptatrema*** from southern seas, were just simple varieties of ***Bdellostoma forsteri*** Müller, 1836 (junior synonymy of ***Eptatretus cirrhatus***). Recently, the combinations ***Bdellostoma forsteri*** var. ***heterotrema*** and ***Bdellostoma forsteri*** var. ***hexatrema*** were treated incorrectly as original description in Müller (1838) by Paepke and Schmidt (1988).

The morphological data above were those provided by Strahan (1975) based on the examination of 14 specimens (112-720 mm), combined with data from the material examined.

Common names: SOUTH AFRICA: Seskief-slymslang, Six-gill hagfish; FAO: Six-gill hagfish, Myxine à six trous, Pez moco de seis agallas.

Eptatretus indrambaryai Wongratana, 1983

Eptatretus indrambaryai Wongratana, 1983: 141, Fig. 1 [original description; type locality: Bay of Bengal, 7°37'02"N, 97°52'00"E, 267-400 m; type series: holotype, CUB uncat., paratypes, AMS 123661-001 (1), BMNH 1983.3.24.1 (1), DEF uncat. (7)]. – Fernholm, 1998: 34 [Andaman Sea]. –Monkolprasit *et al*., 1997: 20 [catalog; Andaman Sea].

Material examined: 2 specimens. THAILAND: AMS I.23661001, paratype, 1(188 mm), and BMNH 1983.3.24.1, paratype, 1(175 mm), Eastern Indian, Andaman Sea, 07°37'02"N, 97°52'00"E, 267-400 m, RV *Nagasaki Maru*, deep sea shrimp trap, T. Wongratana, 9-10 Nov. 1981, 19:00-06:30h.

Diagnostic features: Body elongated, its depth 7-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent, their margins occasionally well defined. Three pairs of barbels on head; first two about equal in size (1.6-2.1% TL), third one longer (2.6-2.7% TL). Eight pairs of gill pouches corresponding to 8 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Posteriormost gill aperture on left side confluent with pharyngocutaneous duct. Ventral finfold vestigial (in adults) to 1-2 mm high (in juveniles), beginning within anterior 16-23% of trunk, extending backward to the cloaca. Caudal finfold quite thin, ventrally straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface (rounded), ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 21.2-22.7; branchial length 8.6-10.6; trunk length 51.7-57.0; tail length 15.8-18.4; body depth including VFF 8.3-10.3; body depth excluding VFF 7.5-10.1; body depth over cloaca 6.1-8.9; tail depth 7.6-9.9. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 9-10. Posterior unicusps 8-10. Total cusps 45-48. Prebranchial pores 11-13. Branchial pores 7-8. Trunk pores 45-50. Tail pores 10-13. Total pores 77-82.

Color in life dark violet; rostrum and margin of mouth whitish in adults; barbels the same color as body in juveniles and much paler in adults; gill apertures with whitish margins; ventral and caudal finfolds the same color as body. Color in alcohol purplish brown to brownish gray.

Size: Maximum total length 437 mm (Wongratana, 1983).

Distribution and habitat: Andaman Sea, Thailand. Known only from 11 specimens, of which four were caught from *Nagasaki-maru* deep-sea shrimp station 3 (7°37'02"N, 97°52'00"E), on 10 November 1981, in the third and final overnight catch experiment in a series of 80 shrimp traps. The experiments were randomly distributed on the continental slope of 45-60°, at depths of about 267-400 m, and bottom temperature 12.2-11.1°C, respectively. The bottom was recorded as sandy mud with patches of rocks or possibly boulders. Each specimen was caught in a separate trap without accompanying fauna. Other fishes captured in the same haul included ***Cephaloscyllium fasciatum***, ***C. umbratile*** (Scyliorhinidae), ***Squalus acanthias*** (Squalidae), ***Uroconger lepturus*** (Congridae), ***Gymnothorax fimbriatus*** (Muraenidae), ***Therapon theraps*** (Therapontidae), and ***Neobythites fasciatus*** (Ophididae). Other dominant animals were several species of deep-sea shrimps and hermit crabs. Seven other specimens of ***E. indrambaryai*** were taken deep-sea shrimp hauls of the RV *Exploratory 2*, cruise 1/1975, on 8 March 1975 in the Andaman Sea, at depths of 300-308 m. Water temperature was about 11.4°C, oxygen about 0.68 ppt, and pH about 7.8 (Wongratana, 1983).

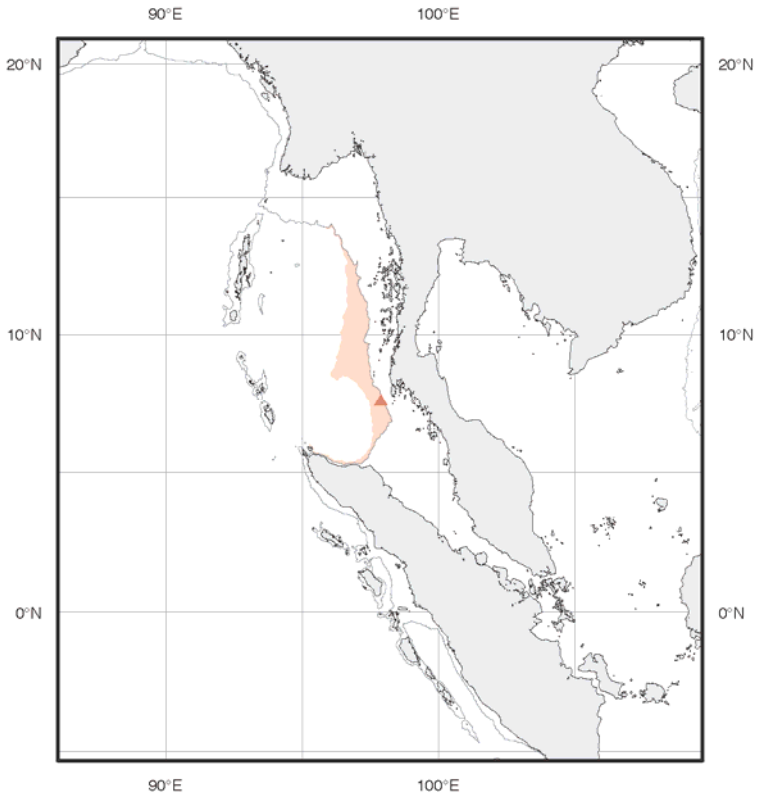


Fig. 24. Distribution of *Eptatretus indrambaryai.*

Interest to fishery: None.

Remarks: The species names was misspelled once by Wongratana (1983) as ***indambaryai*** in species heading and ***indrambaryi*** in Table 1. Named after Mr. Boon Indrambarya, so ***indrambaryai*** is the correct name.

Common names: FAO: Andaman hagfish.

Eptatretus lakeside Mincarone and McCosker, 2004

Eptatretus lakeside Mincarone and McCosker, 2004: 163, Figs. 1, 3a [original description; type locality: Galapagos Islands, NW Fernandina Island, off Cabo Douglas, 0°17'30"S, 91°39'36"W, 762 m; holotype: CAS 201880].

Material examined: 1 specimen. GALAPAGOS ISLANDS (ECUADOR): CAS 201880, holotype, 275 mm, Isla Fernandina, Cabo Douglas, 0°17'30"S, 91°39'36"W, 640-770 m, RV *Johnson Sea Link*, baited metallic minnow trap, D. Pawson, G. Merlen, 17 Jul. 1998.

Diagnostic features: Body elongated, its depth 6.4% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Nasopharyngeal duct cylindrical, tube-like, slightly projecting. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots present but inconspicuous. Three pairs of barbels on head; first about 2.1% TL, second about 1.6% TL, and third about 2.3% TL. Five pairs of gill pouches corresponding to 5 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at gill pouch 2. Ventral finfold conspicuous, 2 mm high, beginning 25 mm behind the last gill aperture and extending backward to the cloaca. Caudal finfold quite thin and rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 24.7; branchial length 6.2; trunk length 50.9; tail length 18.2; body width 5.0; body depth including VFF 7.2; body depth excluding VFF 6.4; body depth over cloaca 5.4; tail depth 6.0. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 6. Posterior unicusps 6. Total cusps 36. Prebranchial pores 15. Branchial pores 4. Trunk pores 50. Tail pores 19. Total pores 88. Four branchial pores are intercalated with five gill apertures on both sides. No slime pore associated with the pharyngocutaneous duct.

Color in alcohol: body pinkish; barbels and face the same color as body; ventral finfold pale; caudal finfold with a narrow pale margin. In life, the body is pinkish-orange.

Size: Known only from an immature female, 275 mm TL (Mincarone and McCosker, 2004).

Distribution and habitat: Known only from type locality, off Cabo Douglas, NW Fernandina Island, Galapagos Islands. Cabo Douglas is located along the NW corner of

Fernandina Island and drops steeply into deep water (more than 1000 m depth at a distance less that 2 km from shore). The bottom is nearly flat with a slight downward slope (< 10°) and covered with fine gray sediment and occasional lava boulders (~0.5 m in diameter) in the vicinity of other large lava reefs. The temperature at depth (762 m) was 8°C and there was a current of ~0.3 knot at moment of capture of the holotype (Mincarone and McCosker, 2004).

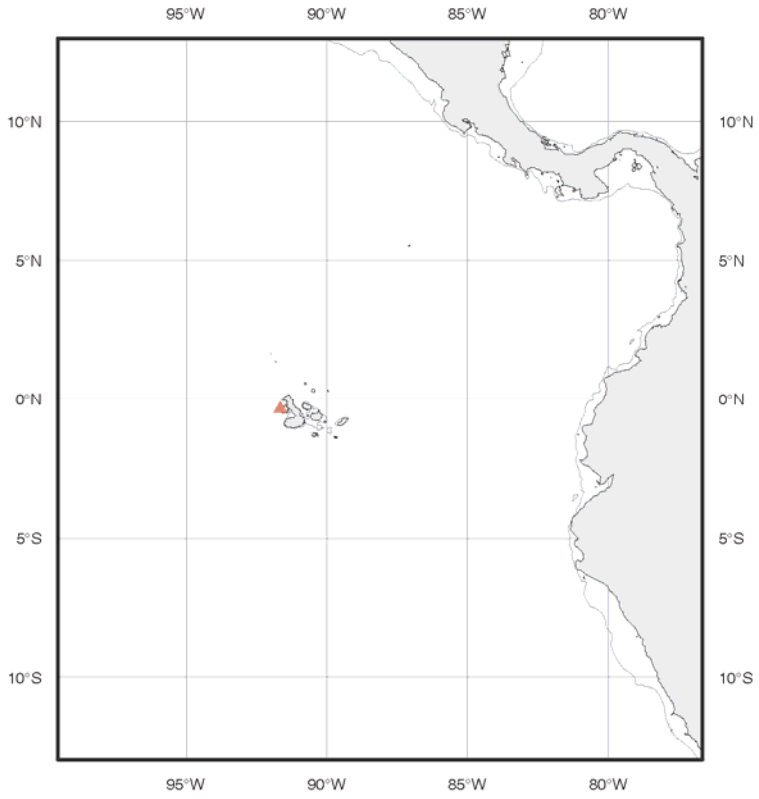


Fig. 25. Distribution of *Eptatretus lakeside.*

Interest to fishery: None.

Common names: FAO: Short-nose pink hagfish.

Eptatretus longipinnis Strahan, 1975

Eptatretus longipinnis Strahan, 1975: 137, Figs. 1, 2a [original description; type locality: Southeastern Indian Ocean off Robe, South Australia, 37°10'S, 149°43'E, 40 m;

holotype: SAMA F4042]. –Glover, 1976: 1 [type catalog]. –Hardisty, 1979: 19 [Australia]. –Maxwell, 1980: 7 [catalog]. –May and Maxwell, 1986: 81 [off southeast South Australia]. –Gomon, 1994: 85, Fig. 19 [catalog; between Robe and Port MacDonnell]. –Fernholm, 1998: 34 [SE Indian Ocean off South Australia]. –Soto and Mincarone, 2004: 10 [MOVI catalog of fishes].

Material examined: 8 specimens. AUSTRALIA: SAM F4042, holotype, 406 mm, near Robe, South Australia, approx. 2 mi. SW of "Pinnacle", 20+ fm (37+ m), found burrowed in soft tail flesh of crayfish, R. B. Hawes, 2 Sep. 1971; SAM F3611, 1(434 mm), Cape Douglas, SE of South Australia, H. Holmes, 1971; SAM F4255, 1(~500 mm), Rivoli Bay, SE of South Australia, M. Feddern, 22 Nov. 1976; SAM F4507, 1(390 mm), SW of Cape Buffon, SE of South Australia, M. Feddern, 3 Feb. 1979; SAM F5366, 1(~340 mm), Port MacDonnell, SE of South Australia, G. Millstead, early 1982; SAM F5676, 1(350 mm), Port MacDonnell, SE of South Australia, 12 Nov. 1971; SAM F7540, 1(560 mm), and MOVI 31063 (ex SAM F7540), 1(627 mm), Port MacDonnell (out of), SE of South Australia, G. Millstead, 3 Mar. 1994.

Fig. 26. *Eptatretus longipinnis* (after Strahan, 1975).

Diagnostic features: Body elongated, its depth 4-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots inconspicuous. Three pairs of very slender barbels on head; first two about equal in size (1.5-2.0% TL), third one longer (1.7-2.3% TL). Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. First pair of gill pouches lies posterior to end of dental muscle. Ventral finfold conspicuous,

2-5 mm high, beginning anterior to the first pair of gill apertures (within anterior 27-28% of body length), extending backward to the cloaca. Caudal finfold quite thin and rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 28.9-30.5; branchial length 4.4-5.3; trunk length 55.8-57.7; tail length 9.4-10.3; body width 2.7-3.8; body depth including VFF 4.4-6.6; body depth excluding VFF 3.8-5.7; body depth over cloaca 3.4-4.7; tail depth 4.1-4.9. Three-cusp multicusps on the anterior row and 2-cusp multicusp on the posterior rows of cusps. Anterior unicusps 5-6. Posterior unicusps 5-6. Total cusps 32-34. Prebranchial pores 25-29. Branchial pores 5-6. Trunk pores 58-63. Tail pores 8-10. Total pores 97-105.

Color in alcohol: body dark brown; tip of barbels and mouth whitish; ventral area of the prebranchial region lighter than body; gill apertures and slime pores the same color as body; ventral finfold whitish; caudal finfold and cloaca with a narrow white margin.

Size: Maximum total length 627 mm (Soto and Mincarone, 2004).

Distribution and habitat: Southeast coast of South Australia, between Robe and Port MacDonnell, on shallow waters, at depths from 14 to 40 m.

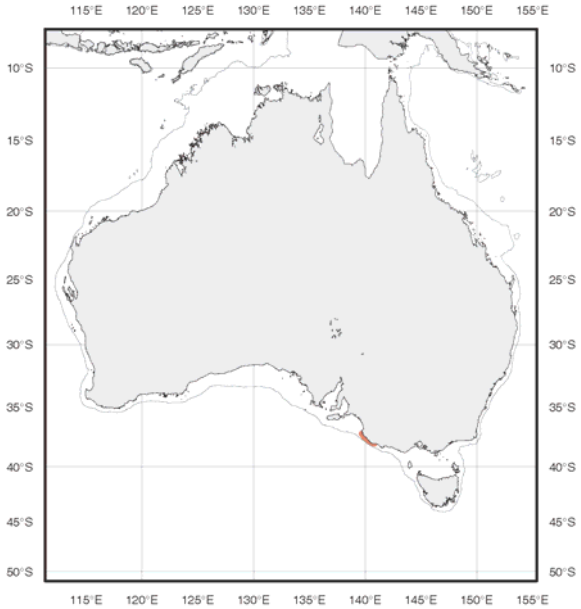


Fig. 27. Distribution of *Eptatretus longipinnis.*

Interest to fishery: None.

Remarks: Strahan (1975) described ***Eptatretus longipinnis*** based on the holotype (SAM F4042) and an additional specimen (SAM F3611). The description above is based on the re-examination of these and other six specimens listed in "material examined" section. `

Common names: AUSTRALIA, FAO: Longfin hagfish.

Eptatretus mcconnaugheyi Wisner and McMillan, 1990

Eptatretus mcconnaugheyi Wisner and McMillan, 1990: 790, Figs. 2a, 3 [original description; type locality: off south California, 32°32'00"N, 117°21'07"W, 148 m; type series: holotype, SIO 69-231E, paratypes, CAS 63203 (7), LACM 44409-1 (6), SIO 68-126 (5), SIO 69-228B (14), SIO 69-231E (7), SIO 71-114 (7), USNM 29630 (7)]. –Fernholm, 1998: 34 [off south California, lower Gulf of California]. –Mok, 2001: 358 [nasal-sinus papillae]. –Soto and Mincarone, 2004: 10 [MOVI catalog of fishes]. –Love *et al*., 2005: 1 [calalog; Santa Monica Bay, southern California to Islas Cedros and San Benito, central Baja California and lower portion of the Gulf of California].

Material examined: 13 specimens. UNITED STATES OF AMERICA: CAS 63203 (ex SIO 73-419), paratype, 7(205-287), California, San Diego, off Coronado Island, 32°31'48"N, 117°21'06"W, 80 fm (146 m), minnow trap, T. Matsui, 25 Sep. 1972; MOVI 27522-27523 (ex SIO 69-181), 2(135-285 mm), California, off La Jolla, 32°51'40-46"N, 117°19'18-19"W, 40-100 fm (73-183 m), MV *Miss Behavior*, shrimp traps, R. Green, 31 Jan. 1969. MEXICO: USNM 296320 (ex SIO 69-225D), paratype, 4(237-380 mm), Baja California, 31°48'N, 116°50'W, 371 m, 8-9 Apr. 1969.

Diagnostic features: Body elongated, its depth 5-9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No

nasal-sinus papillae. Eyespots rather prominent, with margins well defined. Three pairs of barbels on head; first two about equal in size (1.3-1.8% TL), third one longer (1.8-2.3% TL). Thirteen (12-14) pairs of gill pouches corresponding to 13 (12-14) pairs of gill apertures (small variation occurs in the number of gill apertures between left and right sides). Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 5-10. Ventral aorta branches at gill pouches 9-11. Ventral finfold low (1-3 mm high), beginning within anterior 19-29% of trunk, extending backward to the cloaca. Caudal finfold thin, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 14.7-18.1; branchial length 15.5-21.6; trunk length 48.2-55.7; tail length 12.2-16.1; body depth including VFF 6.1-9.8; body depth excluding VFF 5.5-9.0; body depth over cloaca 4.7-7.1; tail depth 6.0-8.8. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-9. Posterior unicusps 7-9. Total cusps 38-45. Prebranchial pores 6-11. Branchial pores 11-16. Trunk pores 43-50 (southern California) and 39-46 (Gulf of California). Tail pores 8-13. Total pores 72-84 (southern California) and 67-79 (Gulf of California).

Color in alcohol: body dark brown; tip of barbels white; mouth, gill apertures, ventral finfold, caudal finfold, and cloaca with pale margins. In life, the body is dark reddish brown, without pale spots.

Size: Maximum total length 482 mm (Wisner and McMillan, 1990).

Distribution and habitat: According to Wisner and McMillan (1990) ***E. mcconnaugheyi*** appears to consist of two disjunct populations, one from Santa Monica Bay, California, to the Cedros and San Benito Islands, Mexico, and other apparently restricted to the lower portion of the Gulf of California. Collecting efforts between the Cedros and San Benito Islands and the mouth of the Gulf have failed to take the species. It lives on the continental shelf and slope at depths from 42 to 384 m off Baja California and from 177 to 415 m in the Gulf of California.

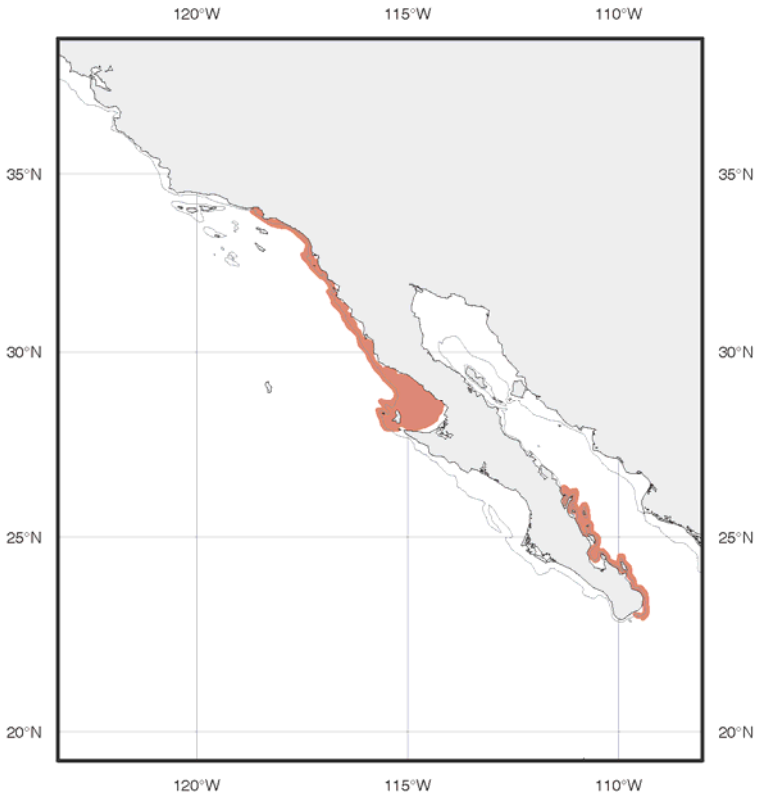


Fig. 28. Distribution of *Eptatretus mcconnaugheyi.*

Interest to fishery: None.

Remarks: All body proportions and most counts for the two populations are very similar, but significant differences occur in number of trunk and total pores (Wisner and McMillan, 1990).

Eptatretus mcconnaugheyi and ***E. stoutii*** occur sympatrically off southern California. They are readily separable by the number of prebranchial pores, 6-11 in ***E. mcconnaugheyi*** and 10-16 in ***E. stoutii***.

According to Wisner and McMillan (1990), of a total of 58 specimens for which sex could be reliably determined, 64% were female and 36% male. The largest egg found in any female is 26 x 8 mm. The smallest female with round or slightly ovoid eggs is 267 mm TL. It is possible that females of the Gulf of California population mature at a smaller size than do those from southern California. In the Gulf of California, females measuring from 267 to 352 mm TL had eggs ranging in size from 15.8 to 20.8 mm. In contrast, in the southern California population, eggs larger than 15 mm occur only in females larger than

400 mm TL. The holotype contains 18 mature eggs, the largest 25.2 x 9.0 mm, all linked in rows by anchor filaments.

The description above was based on the material examined, combined with data from 460 specimens examined by Wisner and McMillan (1990).

Common names: FAO: Short-head hagfish.

***Eptatretus mccoskeri* McMillan, 1999**

Eptatretus mccoskeri McMillan, 1999: 115, Figs. 2d-g [original description; type locality: Galapagos Islands, 1°06.3'S, 89°06.9'W, 704 ft [correct depth 660 ft (201 m)]; type series: holotype, CAS 86431, paratypes, SIO 97-75 (2), USNM 344905 (1)]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mincarone and McCosker, 2004: 166 [identification key, comparison with ***Eptatretus lakeside***].

Material examined: 3 specimens. GALAPAGOS ISLANDS (ECUADOR): CAS 86431, holotype, 310 mm, Pacific, Ecuador, Galapagos Islands, San Cristobal Island, 01°06'19"S, 89°06'56"W, 660 ft (201 m), RV *Johnson Sea Link*, baited metallic minnow trap, J. E. McCosker, R. G. Gilmore, 6 Nov. 1995; SIO 97-75 (ex CAS 86431), paratype, 1(290 mm), and USNM 344905, (ex CAS 86431), paratype, 1(284 mm), taken with the holotype.

Diagnostic features: Body elongated, its depth 9-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots conspicuous. Three pairs of barbels on head; first two about equal in size (1.8-2.2% TL), third one longer (2.1-2.9% TL). Eight pairs of gill pouches corresponding to 8 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 4-6. Ventral aorta branches at gill pouch 6-7. Ventral finfold usually vestigial, 1 mm high (occasionally absent), beginning within anterior 31-37% of trunk, extending

backward to the cloaca. Caudal finfold well developed, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 23.7-26.2; branchial length 9.3-10.1; trunk length 48.7-50.0; tail length 15.6-17.7; body width 6.9-7.3; body depth including VFF 9.4-10.6; body depth excluding VFF 9.4-10.6; body depth over cloaca 7.8-8.8; tail depth 8.7-10.2. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 9-10. Posterior unicusps 9-10. Total cusps 48-51. Prebranchial pores 14-15. Branchial pores 7. Trunk pores 40-42. Tail pores 10-12. Total pores 72-74.

Color in alcohol: body purplish to brownish black, head region slightly lighter than body; barbels all white; mouth, gill apertures, ventral finfold (when present), caudal finfold, and cloaca with pale margins.

Size: Maximum total length 320 mm (McMillan, 1999).

Distribution and habitat: Known only from four specimens collected southeast of San Cristobal Island, on the eastern edge of the Galapagos Archipelago. The known specimens were taken from a minnow trap set on sand bottom at the top of a seamount at about 201 m depth.

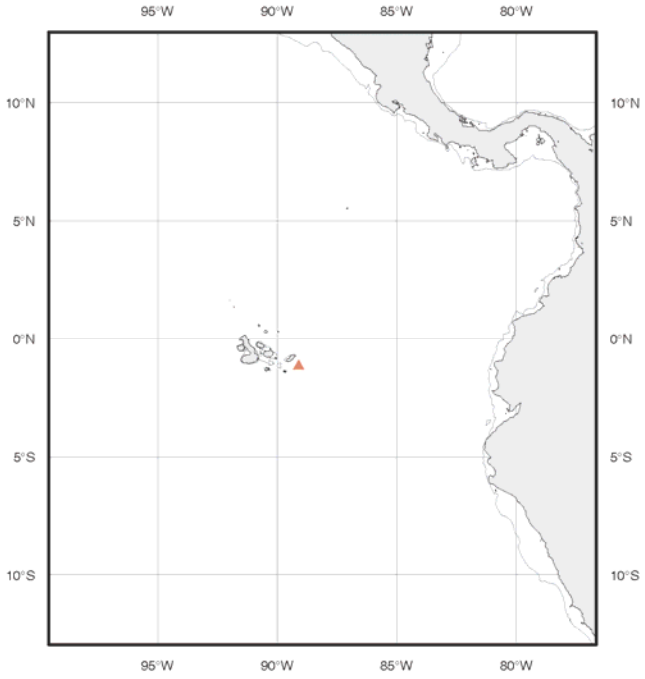


Fig. 29. Distribution of *Eptatretus mccoskeri.*

Interest to fishery: None.

Common names: FAO: McCosker's eight-gilled hagfish.

***Eptatretus mendozai* Hensley, 1985**

Eptatretus mendozai Hensley, 1985: 866, Figs. 1-2 [original description; type locality: off southwest coast of Puerto Rico, 17°50.4'N, 66°59.8'W, approx. 1100 m; type series: holotype, USNM 268923, paratypes, FMNH 96416 (3), SIO 85-30 (1), UF 42100 (2), UPR 3650 (1), USNM 268923 (4)]. –Kuo and Mok, 1994: 248 [comparison with congeners]. –Fernholm, 1998: 34 [Caribbean Sea]. –Mincarone, 2000: 816 [identification key]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok *et al*., 2001: 1028 [comparison with ***Eptatretus wayuu***]. –Fernholm, 2003: 355 [SW of Puerto Rico].

Eptatretus sp. C. –Fernholm and Hubbs, 1981: 77, Fig. 6 [brief description; off the north coast of Haiti; USNM 218400].

Material examined: 7 specimens. PUERTO RICO: USNM 268923, holotype, 423 mm, Caribbean, Puerto Rico, off south coast, 17°50'24"N, 66°59'48"W, 1100 m, small minnow trap, D. A. Hensley, 1-2 Dec. 1983; USNM 268924, paratypes, 4(352-400 mm), taken with holotype; UF 42100, paratypes, 2(367-376 mm), Caribbean, Puerto Rico, off southwest coast, 17°51'30"N, 66°59'54"W, 933 m, D. A. Hensley, 17 Nov. 1983.

Diagnostic features: Body elongated, its depth 8-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots conspicuous, with well defined margins. Three pairs of barbels on head; first two about equal in size (1.4-1.9% TL), third one longer (2.0-2.5% TL). Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 2-4. Ventral aorta branches at gill pouches 5-6. Ventral finfold well developed (3-6 mm high), beginning within anterior 32-45% of trunk, extending backward

to the cloaca. Caudal finfold well developed, straight and thick ventrally, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 22.2-25.2; branchial length 4.7-6.6; trunk length 51.0-54.5; tail length 16.2-19.3; body width 5.6-7.4; body depth including VFF 9.1-11.6; body depth excluding VFF 8.0-10.9; body depth over cloaca 6.5-8.2; tail depth 8.0-9.4. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 11-13. Posterior unicusps 10-12. Total cusps 56-61. Prebranchial pores 13-15. Branchial pores 5-6. Trunk pores 45-48. Tail pores 12-15. Total pores 77-82.

Color of live and preserved specimens bluish gray; barbels variably white tip; mouth and distal margin ventral finfold whitish; gill apertures and cloaca usually lighter than surrounding surface.

Size: Maximum total length 450 mm (Hensley, 1985).

Distribution and habitat: Off the southwest coast of Puerto Rico and probably off the north coast of Haiti. All known specimens (n=12) were collected on mud and clay bottoms at depths from 720 to 1100 m.

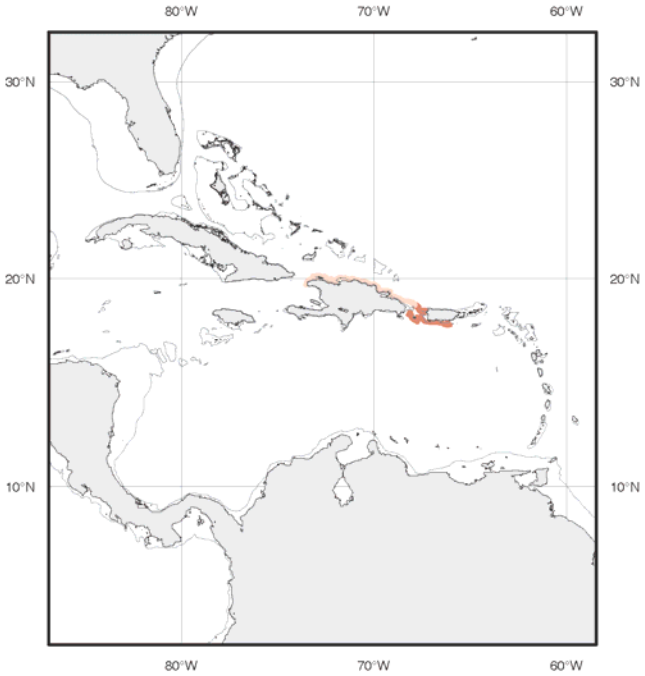


Fig. 30. Distribution of *Eptatretus mendozai.*

Interest to fishery: None.

Remarks: Fernholm and Hubbs (1981) discussed and presented a photograph of a specimen (USNM 218400) named "***Eptatretus*** sp. C" from off the north coast of Haiti, which they were hesitant to describe as new until more material became available. Hensley (1985) reexamined this specimen and concluded that, in spite of some meristic variations, it could be identified as ***E. mendozai***.

According to Hensley (1985), of 11 specimens examined, 8 females (309-450 mm) were mature (contained vitellogenic oocytes and/or atretic material indicating previous vitellogenesis) and inactive, containing oocytes of 0.2-1.5 mm. Ooocytes of 1.0-1.5 were becoming ellipsoid. This probably reflects an early stage of oocyte maturation. Males (3, 350-384 mm) were mature, containing cysts in various stages of maturation but very few spermatozoa.

Common names: FAO: Mendoza's hagfish.

Eptatretus menezesi **Mincarone, 2000**

Eptatretus sp. –Vieira *et al*., 1997: 208 [experimental fishing notes].

Eptatretus menezesi Mincarone, 2000: 816, Fig. 2 [original description; type locality: off southern Brazil, 29°14'S, 48°02'W, 250 m; type series: holotype, MOVI 14729, paratypes, MCP 21156 (1), MOVI 06064 (1), MOVI 06081 (1), MOVI 13347 (1), MOVI 13349 (1), MOVI 14730 (1), MZUSP 51418 (1), MZUSP 51419 (1), MZUSP 51422 (1), MZUSP 52492 (2)]. –Mincarone, 2003: 21 [catalog of Brazilian marine fishes; from Cabo Frio to Chuí]. –Haimovici *et al*., 2004: 31 [listed]. –Mincarone and Sampaio, 2004: 35 [citation]. –Mincarone *et al*., 2004: 131 [survey report; from Rio de Janeiro to Rio Grande do Sul]. –Soto and Mincarone, 2004: 10 [type catalog]. –Bernardes *et al*., 2005: 54 [catalog; Rio de Janeiro to Rio Grande do Sul]. –Mincarone and Stewart, 2006: 227 [comparison with ***Eptatretus goliath***].

Material examined: 79 specimens. BRAZIL: MOVI 14729, holotype, 737 mm, off Santa Catarina, 29º14'S, 48º02'W, 250 m, FV *Margus II*, bottom longline, 31 Jul. 1998; MOVI 14730, paratype, 1(616 mm), taken with holotype; LIUEFS 5094, 1(410 mm), off Cabo de Santa Marta, 510 m, FV *Espadarte*, bottom longline, Jun. 1998; MCP 21156, paratype, 1(495 mm), MOVI 06081, paratype, 1(490 mm), MZUSP 51418, paratype, 1(532 mm), and MZUSP 51419, paratype, 1(492 mm), off Santa Catarina, 28º34'49"S, 47º01'32"W, 490 m, RV *Diadorim*, baited trap, 10 Dec. 1996; MOVI 05056, 1(680 mm), off Rio Grande do Sul, Santa Vitória do Palmar, 34º22'35"S, 51º59'28"W, 250 m, FV *Iporanga*, baited trap, J. Ramos, V. M. Inêz, 6 Jul. 1995; MOVI 06084, paratype, 1(496 mm), and MZUSP 51422, paratype, 1(517 mm),off Santa Catarina, 28º26'04"S, 46º56'50"W, 530 m, RV *Diadorim*, baited trap, 11 Dec. 1996; MOVI 13344-13346, 3(286-363 mm), and MZUSP 52494, 9(277-545 mm), off Santa Catarina, 29º18'52"S, 47º52'30"W, 490 m, RV *Diadorim*, baited trap, 23 Apr. 1997; MOVI 13347, paratype, 1(613 mm), MOVI 13348, 1(376 mm), and MZUSP 52493, 12(314-602 mm), off Santa Catarina, 29º37'42"S, 48º00’30”W, 380 m, RV *Diadorim*, baited trap, 27 Apr. 1997; MOVI 13349, paratype, 1(520 mm), and MZUSP 52492, paratypes, 2(390-462 mm), off Rio de Janeiro,24º09'19"S, 43º14'13"W, 510 m, RV *Prof. W. Besnard*, baited trap, 6 Dec. 1997; MOVI 17333, 1(900 mm), off Rio Grande do Sul, 32°27'24"S, 50°15'31"W–32°38'20"S, 50°20'51"W, 340 m, FV *Saga de Thor*, bottom trawl, M. V. Kitahara, 28 May 2001; MOVI 17334, 1(705 mm), off Rio Grande do Sul, 32°19'51"S, 50°11'37"W–32°27'24"S, 50°15'25"W, 300 m, FV *Saga de Thor*, bottom trawl, M. V. Kitahara, 1 Jun. 2001; MOVI 17335, 1(816 mm), off Rio Grande do Sul, 32°40'59"S, 50°21'15"W–32°50'43"S, 50°24'53"W, 400 m, FV *Saga de Thor*, bottom trawl, M. V. Kitahara, 4 Jun. 2001; MOVI 22672-22675, 4(594-635 mm), off Rio Grande do Sul, 32°41.280'S, 50°20.762'W–32°27.085'S, 50°12.249'W, 400 m, FV *Sambaqui III*, bottom trawl, C. E. N. Consulim, 8 May 2002; MOVI 37880-37887, 8(580-705 mm), off Rio de Janeiro, 23°47.769'S, 42°24.695'W–24°21.316'S, 43°45.113'W, 547-579 m, RV Diadorim, baited trap, E. B. Fagundes-Neto, 19-25 Apr. 2004; MZUSP 78138, 3(341-379 mm), 26°18'55"S, 45°52'48"W, RV *Soloncy Moura*, bottom trawl, 7 Oct. 1999; MZUSP 78140, 14(402-521 mm), 27°04'04"S, 46°31'47"W, RV *Soloncy Moura*, bottom trawl, 15 Oct. 1999; MZUSP 78141, 8(354-600 mm), 29°23'27"S, 47°52'03"W, RV *Soloncy Moura*, bottom trawl, 24 Nov. 1999.

Diagnostic features: Body elongated, its depth 7-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots conspicuous. Three pairs of barbels on head; first two about equal in size (0.8-1.3% TL), third one longer (1.3-2.0% TL). Seven pairs of gill pouches corresponding to 7 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 2-5. Ventral aorta branches at gill pouches 5-6. Ventral finfold absent (in adults) to vestigial, 1-2 mm high (in juveniles), beginning about middle trunk region (one-half of distance between pharyngocutaneous duct and anterior edge of cloaca), extending backward to the cloaca. Caudal finfold quite thin and rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 19.1-27.3; branchial length 5.0-8.3; trunk length 51.2-64.8; tail length 14.6-22.0; body width 3.9-6.1; body depth including VFF 7.4-11.0; body depth excluding VFF 7.1-10.6; body depth over cloaca 6.6-9.1; tail depth 6.6-10.6. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 10-12. Posterior unicusps 9-12. Total cusps 52-60. Prebranchial pores 13-17. Branchial pores 6-8. Trunk pores 48-55. Tail pores 14-18. Total pores 86-94.

Color in alcohol: light brown over the body and dark brown over the tail; mouth margin variably white; tip of the barbels white; face the same color as body; gill apertures, pharyngocutaneous duct and slime pores the same color as body; ventral finfold with pale margin; caudal finfold without pale margin. In life, the body is slightly darker.

Size: Maximum total length 900 mm (Soto and Mincarone, 2004).

Distribution and habitat: Off southeastern and southern Brazil, from Cabo Frio (Rio de Janeiro) to Barra do Chuí (Rio Grande do Sul). On irregular bottoms of the continental slope, covered with mud, corals, and rock reefs, at depths from 250 to 600 m. It is probable that it also occurs off northern Uruguay.

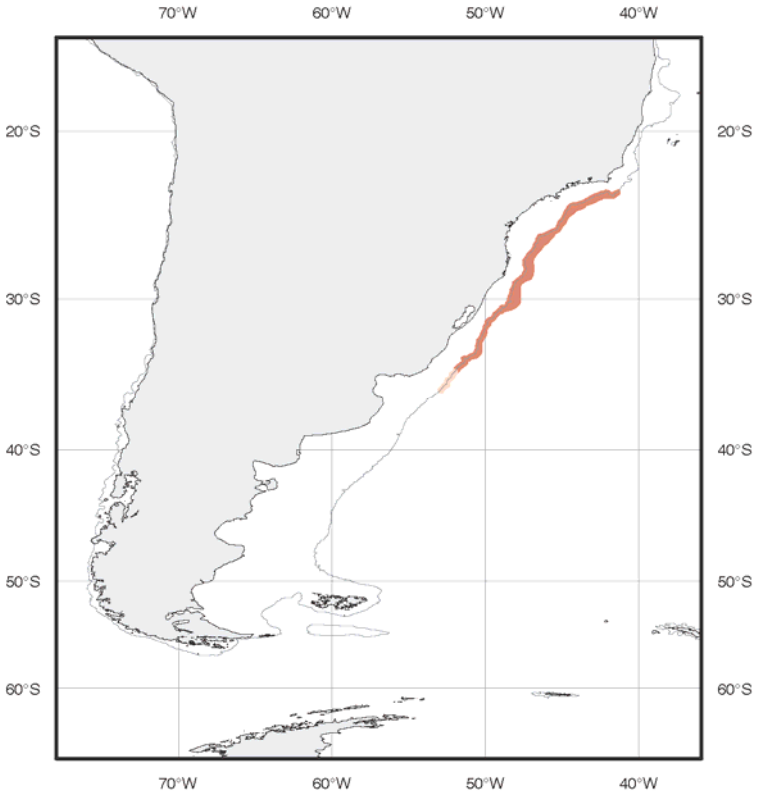


Fig. 31. Distribution of *Eptatretus menezesi.*

Interest to fishery: It has been incidentally collected by bottom trawlers, trappers and longliners. During eight research cruises conduced by the REVIZEE Program (Program for Assessment of the Sustainable Yield of Living Resources of the Exclusive Economic Zone) off southern Brazil, ***E. menezesi*** was the second more abundant resource trapped (Vieira *et al*., 1997).

Remarks: Females larger than 550 mm present dozens of large eggs. A 737-mm female contained 44 encapsulated eggs without anchor filaments, the largest measuring 41 x 11 mm (Mincarone, 2000).

Common names: BRAZIL: peixe-bruxa, FAO: Menezes' hagfish.

Eptatretus minor Fernholm and Hubbs, 1981

Paramyxine springeri Bigelow and Schroeder, 1952: 5 [in part, the 338-mm specimen in "additional material" (paratype USNM 161513)].

Eptatretus minor Fernholm and Hubbs, 1981: 78, Figs. 2c-d, 7 [original description; type locality: Gulf of Mexico, 24°34'N, 83°34'W, 370 m, Oregon sta. 1009; type series: holotype, USNM 164119, paratypes, USNM 218399 (2)]. –Fernholm, 1982: 434 [identification key]. –Hensley, 1985: 866 [identification key]. –Kuo and Mok, 1994: 248 [comparison with ***Eptatretus chinensis***]. –Fernholm, 1998: 34 [Gulf of Mexico]. –McEachran and Fechhelm, 1998: 32 [identification key, brief description; northern Gulf of Mexico]. –Mincarone, 2000: 816 [identification key]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok *et al*., 2001: 1028 [comparison with ***Eptatretus wayuu***]. –Fernholm, 2003: 355 [W of Florida].

Material examined: 9 specimens. UNITED STATES OF AMERICA: USNM 164119, holotype, 355 mm, Gulf of Mexico, off Florida, W of Key West, 24°34'N, 83°34'W, 200 fm (366 m), RV *Oregon*, 14 Apr. 1954; USNM 218399, paratypes, 2(300-325 mm), taken with holotype; SIO 76-250 (ex UMML 15042), 2(360-380 mm), 24°28´N, 83°29´W, 210 fm (384 m), shrimp trawl, 29 Jul. 1963; TCWC 7048.31, 3(230-325 mm), northern Gulf of Mexico, continental slope, 27°45'32"N, 91°13'37"W, 457-472 m, LGL, 11 Jun. 1985; USNM 161513, paratype of ***Paramyxine springeri***), 1(330 mm), Gulf of Mexico, off Florida, 29°27'N, 87°19'W, 220 fm (402 m), RV *Oregon*, 28 Apr. 1951.

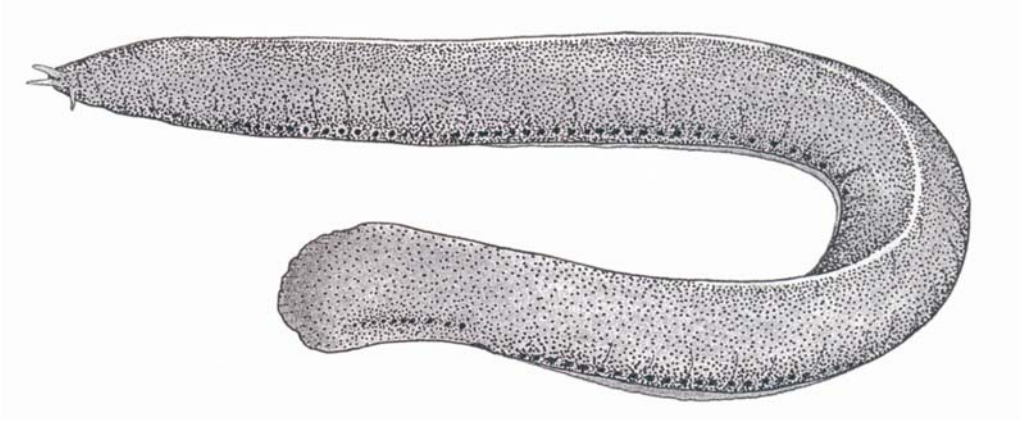


Fig. 32. *Eptatretus minor* (after McEachran and Fechhelm, 1998).

Diagnostic features: Body elongated, its depth 7-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots inconspicuous. Three pairs of barbels on head; first two about equal in size (1.2-2.2% TL), third one longer (2.4-3.2% TL). Six (rarely 5) pairs of gill pouches corresponding to 6 (rarely 5) pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 3-4. Ventral aorta branches at gill pouches 5-6. Ventral finfold vestigial (1 mm in adults) to low (3 mm in juveniles), beginning within anterior 34-48% of trunk, extending backward to the cloaca. Caudal finfold thin, slightly straight ventrally, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 20.1-25.9; branchial length 5.1-7.2; trunk length 50.6-55.9; tail length 13.9-18.3; body width 4.8-7.8; body depth including VFF 7.1-11.4; body depth excluding VFF 7.1-10.8; body depth over cloaca 5.2-7.9; tail depth 5.3-11.6. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 8-11. Posterior unicusps 8-10. Total cusps 46-54. Prebranchial pores 15-18. Branchial pores 4-6. Trunk pores 41-48. Tail pores 11-14. Total pores 74-82.

Color in alcohol: body light brown; mouth, barbels, gill apertures, and slime pores the same color as body; ventral finfold and caudal finfold with pale margins; a thin, white middorsal stripe, extending from the head to the tail.

Size: Maximum total length 395 mm (Fernholm and Hubbs, 1981).

Distribution and habitat: Northern Gulf of Mexico, from Louisiana to Florida. On the upper continental slope at depths from 300 to 472 m. According to Fernholm and Hubbs (1981), the bottom temperature in the distribution area is about 8.9-11.5°C, and the bottom type includes mud, sand, gravel, and corals. The northernmost records indicate an overlap in distribution of ***E. minor*** and ***P. springeri*** in the northeastern Gulf of Mexico, however it appears that ***E. minor*** lives at shallower depths (300-472 m) than ***P. springeri*** (400-730 m).

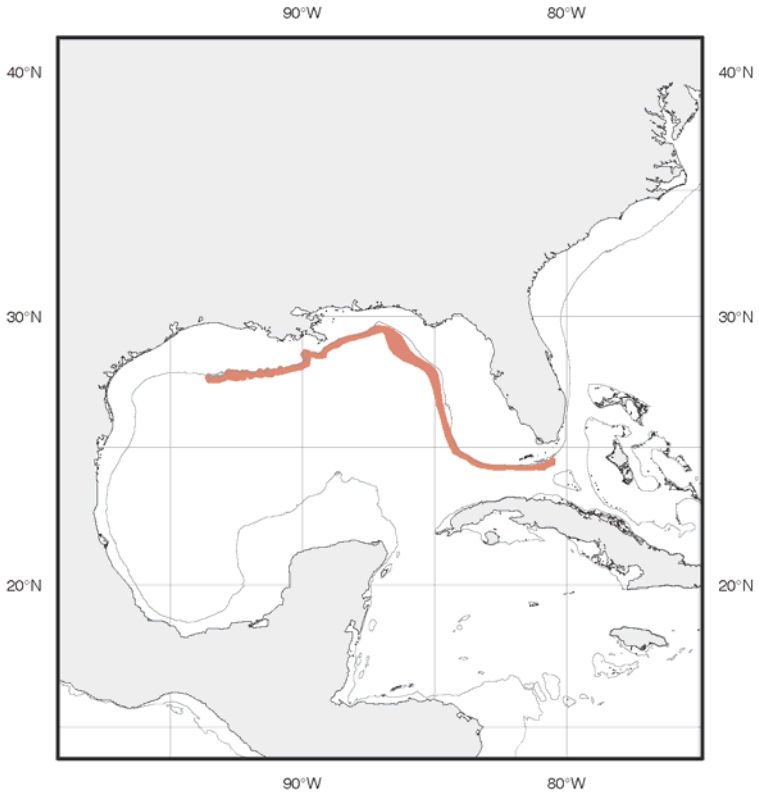


Fig. 33. Distribution of *Eptatretus minor*.

Interest to fishery: None.

Remarks: The 338-mm female USNM 161513 (paratype of ***P. springeri***) in fact is an ***E. minor***, as previously reported by Fernholm and Hubbs (1981) and confirmed on recent examination.

Eptatretus minor is a relatively short and stout species, maturing at a small size. The shortest known specimens are two mature males, 223 mm each, and a ripe female, 310 mm, with 12 eggs measuring about 31 x 10 mm. Some females contained ripe eggs (25-33 mm) in April, June, July, September, October, and November, suggesting that population spawned throughout the year (Fernholm and Hubbs, 1981).

Common names: FAO: Pygmy Gulf hagfish.

Eptatretus multidens Fernholm and Hubbs, 1981

Eptatretus multidens Fernholm and Hubbs, 1981: 80, Fig. 8 [original description; type locality: Caribbean Sea, 12°52'N, 70°43'W, 510 m; type series: holotype, USNM 218401, paratypes, USNM 218402 (1), USNM 218403 (1), USNM 218404 (1)]. – Fernholm, 1982: 436 [identification key, comparison with ***Eptatretus caribbeaus***]. – Hensley, 1985: 866 [identification key]. –Kuo and Mok, 1994: 248 [comparison with ***Eptatretus chinensis***]. –Fernholm, 1998: 34 [Caribbean Sea]. –Mincarone, 2000: 816 [identification key]. –Mok *et al.*, 2001: 1028 [comparison with ***Eptatretus wayuu***]. – Fernholm, 2003: 355 [off N coast of South America]. –Mincarone and Sampaio, 2004: 33 [further description; off northeastern Brazil]. –Soto and Mincarone, 2004: 12 [MOVI catalog of fishes].

Material examined: 16 specimens. VENEZUELA: USNM 218401, holotype, 560 mm, 12°52'N, 70°43'W, 510 m, RV *Oregon II*, 23 Nov. 1970; USNM 218402, paratype, 1(375 mm), 12°38'N, 70°26'W, 550 m, RV *Oregon II*, 23 Nov. 1970. FRENCH GUIANA: USNM 218403, paratype, 1(467 mm), 07°18'N, 52°56'W, 630-710 m, RV *Oregon II*, 19 Nov. 1969; USNM 218404, paratype, 1(647 mm), 07°13'N, 52°52'W, 770 m, RV *Oregon II*, 12 May 1969. BRAZIL: MOVI 24539-24540, 2(691-750 mm), off Ceará, 07°13.509'S, 34°26.604'W–07°13.530'S, 34°26.652'W, 423-437 m, RV *Natureza*, 29 Nov. 2001; MOVI 25349-25350, 2(731-815 mm), and UFPB 5296, 1(700 mm), off Ceará, 06°39.650'S, 34°41.801'W–06°39.521'S, 34°41.766'W, 340-530 m, RV *Natureza*, 27 Nov. 2001; MOVI 25351-25353, 3(571-768 m), off Rio Grande do Norte, 04°35.080'S, 36°50.199'W–04°35.221'S, 36°50.169'W, 239-354 m, RV *Natureza*, 11 Nov. 2001; MOVI 37891, 1(602 mm), off Espirito Santo, 20º03.0’S, 38º20.8’W–19º50.1’S, 38º27.8’W, 370 fm (676 m), FV *Kayar 1*, bottom trawl, C. M. Lima-Silva, 14 Jun. 2005; MOVI 37910-37911, 2(647-744 mm), off Espírito Santo, FV *Kayar 1*, bottom trawl, C. M. Lima-Silva, 17 Jun. 2005; UFPB 5295, 1(670 mm), off Alagoas, 10º05.245'S, 35º46.234'W–10º05.253'S, 35º45.934'W, 660-700 m, RV *Natureza*, 16.xii.2001; UFPB 5297, 1(410 mm), off Rio Grande do Norte, 06º14.044'S, 34º51.533'W–06º13.990'S, 34º51.560'W, 259-430 m, RV *Natureza*, 26 Nov. 2001.

Diagnostic features: Body elongated, its depth 7-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots conspicuous but poorly delimited. Three pairs of barbels on head; first two about equal in size (0.9-1.4% TL), third one longer (1.3-2.4% TL). Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct usually confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 2-3. Ventral aorta branches at gill pouch 6. Ventral finfold vestigial (1-2 mm high), beginning within anterior 40-57% of trunk, extending backward to the cloaca. Caudal finfold thin, slightly straight ventrally, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 18.4-22.2; branchial length 5.4-8.1; trunk length 53.3-57.1; tail length 17.3-19.1; body width 4.9-7.4; body depth including VFF 7.9-11.6; body depth excluding VFF 7.7-11.2; body depth over cloaca 6.4-9.6; tail depth 7.1-10.4. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 10-12. Posterior unicusps 9-12. Total cusps 50-58. Prebranchial pores 14-16. Branchial pores 5-7. Trunk pores 52-55. Tail pores 15-16. Total pores 88-93.

Color in alcohol: light brown over the body and dark brown over the tail; mouth margin variably white; tip of the barbels white; gill apertures usually with a narrow whitish margin; pharyngocutaneous duct and slime pores same color as body; ventral finfold and caudal finfold without pale margins. In life, the body is slightly darker.

Size: Maximum total length 815 mm (Mincarone and Sampaio, 2004).

Distribution and habitat: Along north and east coast of South America, including Venezuela, French Guiana, and northeastern Brazil (Rio Grande do Norte to Alagoas), on the continental slope at depths from 239 to 770 m (Fernholm and Hubbs, 1981; Mincarone and Sampaio, 2004). Also, it was recently collected from southeastern Brazil, off Espírito Santo (western Vitória-Trindade Seamounts Chain) at 676 m depth.

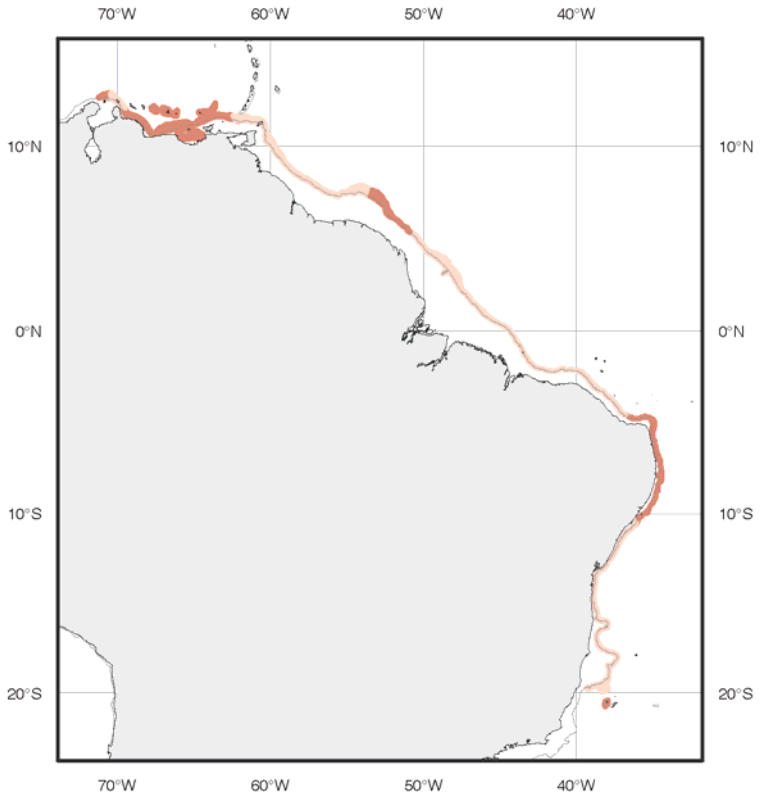


Fig. 34. Distribution of *Eptatretus multidens.*

Interest to fishery: None.

Remarks: In the original description (Fernholm and Hubbs, 1981), two specimens were refered as "***E. multidens***?" to indicate their close relationship to that species. Later, with three more specimens available, Fernholm (1982) described a new species then named ***E. caribbeaus***.

Notably, the sixth (and last) gill aperture on the left side is separate from pharyngocutaneous duct in two specimens, paratypes USNM 218403 and 218404. This character is common in some ***Eptatretus*** species but was not mentioned by Fernholm and Hubbs (1981).

Common names: FAO: Black tail six-gilled hagfish.

Eptatretus nanii Wisner and McMillan, 1988

Eptatretus nanii Wisner and McMillan, 1988: 234, Fig. 3b [original description; type locality: about 33.4 km off Valparaíso, Chile, 274 m; type series: holotype, SIO 65-675, paratypes, CAS 5612 (2), GCRL 12464 (1), LACM 43776-1 (2), MNHNC P. 6378 (1), MNHNC P. 6381 (1), MNHNC P. 6382 (1), SIO 65-675 (4), SIO 81-104 (1), SIO 84-244 (1), SIO 85-60 (1), USNM 272583 (6)]. –Pequeño, 1989: 5 [list of Chilean fishes]. –Meléndez *et al*., 1993: 6 [type catalog]. –Fernholm, 1998: 34 [off Valparaiso, Chile]. –Mok, 2001: 358 [nasal-sinus papillae].

Material examined: 5 specimens. CHILE: CAS 56512, paratypes, 2(455-565 mm), off Valparaiso, 33°22'S, 71°52'W, 260-270 m, RV *Anton Bruun*, shrimp trawl, L.W. Knapp, 1 Aug. 1966; SIO 65-675, paratypes, 2(478-534 mm), 18 miles off Valparaiso Harbor, 33°02.0'S, 71°38.0'W, 150 fm (274 m), RV *Anton Bruun*, shrimp trawl, A. Chapman, 23 Dec. 1965; USNM 272583, paratype, 1(558 mm), vicinity of Valparaiso, 33°09'S, 71°21'W, 170-180 m, RV *Anton Bruun*, shrimp trawl, L. W. Knapp, 1 Aug. 1966.

Diagnostic features: Body elongated, its depth 7-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum very short or absent. No nasal-sinus papillae. Eyespots large but margins poorly defined. Three pairs of barbels on head; first two about equal in size (0.7-1.3% TL), third one longer (1.2-1.7% TL). Thirteen (occasionally 12) pairs of gill pouches corresponding to 13 (occasionally 12) pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side in the majority of the specimens (91% of the specimens examined by Wisner and McMillan, 1988). Dental muscle overlies gill pouches 4-7. Ventral aorta branches at gill pouches 5-9. Ventral finfold usually absent or vestigial (usually present only as a thin pale line). Caudal finfold rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 12.8-15.6; branchial length 17.5-22.0; trunk length 47.5-52.9; tail length 15.2-17.3; body depth including VFF

7.3-10.2; body depth excluding VFF 7.3-9.9; body depth over cloaca 4.2-7.6; tail depth 6.2-9.2. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 9-12. Posterior unicusps 8-11. Total cusps 49-55. Prebranchial pores 8-12. Branchial pores 11-13. Trunk pores 38-47. Tail pores 11-15. Total pores 72-82.

Color in alcohol: body very dark brown to purplish-black; no pale spots or areas evident; tip of the barbels white; gill apertures and most of slime pores with narrow pale margins; caudal finfold usually with a narrow pale margin.

Size: Maximum total length 664 mm (Wisner and McMillan, 1988).

Distribution and habitat: Off Chile, from about 28°S to 36°S. Usually found on muddy bottoms on outer shelf and upper slope at depths from 100 to 470 m.

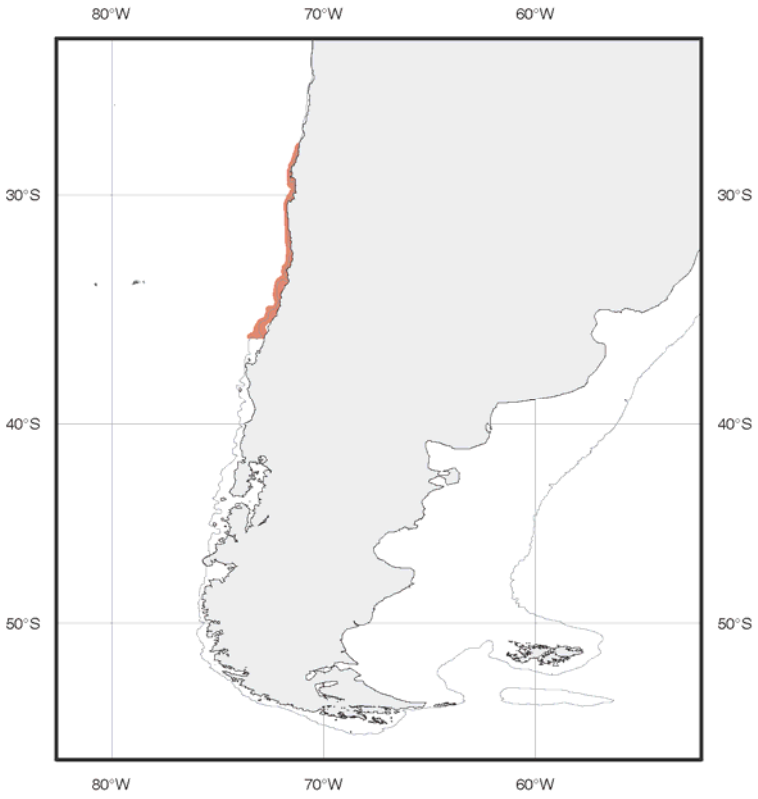


Fig. 35. Distribution of *Eptatretus nanii.*

Interest to fishery: None.

Remarks: Wisner and McMillan (1988) stated that the holotype and four paratypes were collected in a commercial shrimp trawl, a different information from that on the original labels: "RV Anton Bruun, sta. MV 65-IV-85 (W66-60): 18 miles off Valparaiso Harbor, 33°02'S, 71°38'W, 150 fm (274 m), A. Chapman, shrimp trawl, 23 Dec. 1965".

Six females (561-664 mm TL) examined by Wisner and McMillan (1988) had 22 to 38 well developed eggs, ranging in size from 16x3.5 to 27x6.5 mm. No eggs have protruding anchor filaments, although polar caps were well developed on many.

Eptatretus nanii was taken once with ***E. polytrema*** at 33°22'S, 71°52'W, in a 72 ft shrimp trawl between 260 and 270 m depth (Wisner and McMillan, 1988).

Common names: FAO: Nani's hagfish.

Eptatretus octatrema (Barnard, 1923)

Heptatretus octatrema Barnard, 1923: 439 [original description; type locality: Agulhas Bank, South Africa, 25-40 fm (for updated data on type locality see remarks section); syntypes: SAM 13030 (1), BMNH 1927.12.6.1 (1) (formerly SAM 13031)]. – Barnard, 1947: 2 [Agulhas Bank].

Bdellostoma* (*Eptatretus*) *octatrema. –Holly, 1933: 53 [identification key; Agulhas Bank].

Bdellostoma octatrema. –Adam and Strahan, 1963: 6: [on the Agulhas Bank].

Homea octatrema. –Fowler, 1964: 47 [catalog of world fishes].

Eptatretus octatrema. –Smith, 1975: 9 [common name]. –Hardisty, 1979: 19 [South Africa]. –Fernholm, 1986: 36 [identification key, diagnosis; Agulhas Bank]. –Kuo and Mok, 1994: 248 [selected characters]. –Fernholm, 1998: 34 [Agulhas Bank, South Africa].

Material examined: 1 specimen. SOUTH AFRICA: BMNH 1927.12.6.1 (ex SAM 13031), syntype, 1(280 mm), Cape Saint Blaize, West 3/4 North, 4 miles, 27 fm (49 m), RV *Pieter Faure*, trawl, 25 Jan. 1900.

Diagnostic features: Body elongated, its depth about 4% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots inconspicuous. Three pairs of barbels on head; first two about equal in size 1.3% TL), third one longer (1.6% TL). Eight pairs of gill pouches corresponding to 8 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouch 1. Ventral finfold prominent (2.8 mm high), beginning 8-10 mm after last gill aperture, extending backward to the cloaca. Caudal finfold thin, rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 22.5; branchial length 6.8; trunk length 56.8; tail length 13.2; body width 3.5; body depth including VFF 5.3; body depth excluding VFF 4.3; body depth over cloaca 4.5; tail depth 5.7. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7. Posterior unicusps 8. Total cusps 40. Prebranchial pores 23. Branchial pores 7. Trunk pores 65. Tail pores 14. Total pores 109.

Color in alcohol: body brown, slightly lighter ventrally (no pale area was noted on preserved specimens).

Size: Know just from two specimens, both measuring about 300 mm TL (Barnard, 1923; present study).

Distribution and habitat: Known only from type locality, off Cape Saint Blaize, South Africa, at depths from 49 to 66 m.

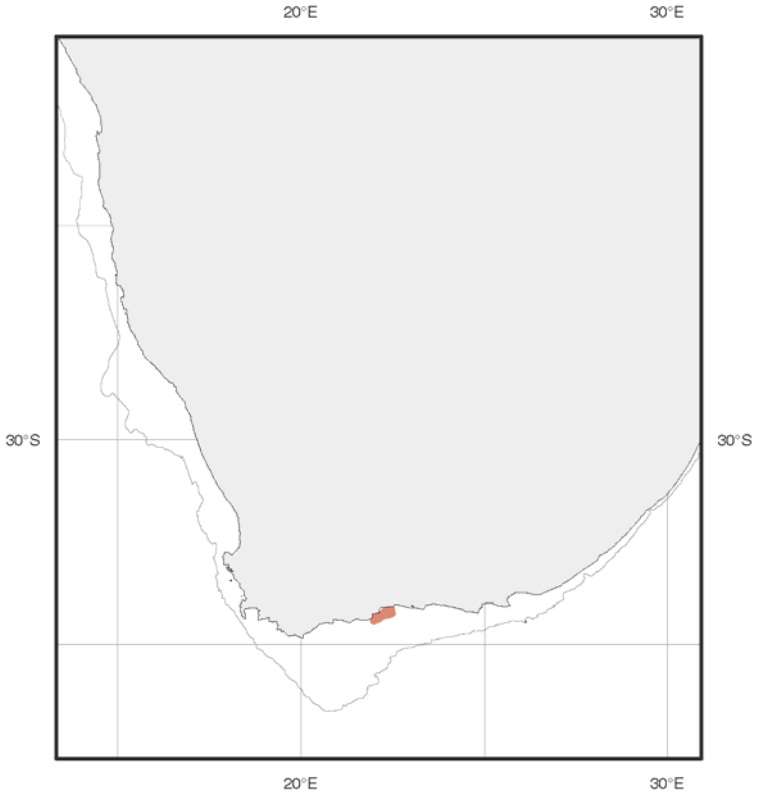


Fig. 36. Distribution of *Eptatretus octatrema.*

Interest to fishery: None.

Remarks: According to Fernholm (1986, 1998), ***E. octatrema*** was only known from the 300-mm holotype. In the original description, Barnard (1923) apparently described only one specimen, but he stated "…ventral fin ending only a short distance (8-10 mm) behind last gill-opening". The range "8-10 mm" could be evidence that there were at least two specimens available for description. In addition, the only other known specimen BMNH 1927.12.6.1 (formerly SAM 13031) is listed as "co-type" in the original register. According to SAM database (Michael Bougaardt, pers. comm.), the station data for these specimens are: SAM 13030, Cape Saint Blaize, North 1/4 North, 6.5 miles, 36 fm (66 m), 28 Jun. 1899, shrimp trawl, RV *Pieter Faure*; and BMNH 1927.12.6.1 [ex SAM 13031], Cape Saint Blaize, West 3/4 North, 4 miles, 27 fm (49 m), 25 Jan. 1900, trawl, RV *Pieter Faure*. Based on these evidences, I am considering here both specimens as syntypes of ***E. octatrema***. Also, I assume the type locality provided in the Barnard's (1923) original description ("Agulhas Bank, 25-40 fm") was an approximation.

Barnard's (1923) original description was very short, providing data on the number of gill openings, teeth, and some body proportions. The description above was based on the recent examination of the syntype BMNH 1927.12.6.1, now measuring 280 mm TL. The syntype SAM 13030, now with 263 mm TL (Michael Bougaardt, pers. comm.), was not available for examination. Both specimens are in good condition.

Common names: SOUTH AFRICA: Agkief-slymslang, Eight-gill hagfish; FAO: Eight-gill hagfish.

***Eptatretus okinoseanus* (Dean, 1904)**

Homea okinoseana Dean, 1904: 8, 20, Figs. 1i-l, 2b, 3b, Pl. 1 (fig. 1-2) [original description; type locality: off Misaki, Sagami Sea, Japan, 400 fm (731 m); syntypes: Columbia University uncat. (1), ZUMT (2, lost)]. –Fowler, 1964: 47 [catalog of world fishes].

Heptatretus okinoseanus. –Regan, 1912: 535 [identification key; Japan]. –Kamohara, 1943: 125 [off Kannoura]. –Kamohara, 1952: 4 [off Kannoura]. –Kamohara, 1958: 3 [Choshi, Chiba Pref. to Kochi and Toyama].

Eptatretus okinoseanus. –Jordan *et al*., 1913: 5 [catalog; Sagami Sea]. –Jordan and Hubbs, 1925: 97 [Japan]. –Matsubara, 1955: 91 [identification key]. –Kamohara, 1964: 5 [Choshi, Chiba Pref. to Kochi and Toyama]. –Kanayama, 1982: 34, Fig. 1 [brief description, Okinawa Trough]. –Sato, 1984: 1, Pl. 1b [brief description; southern Japan]. –Yamakawa, 1984: 34, 292 [southern Japan]. –Yamada *et al*., 1986: 2 [identification key]. –Siming, 1988: 16, Fig. 15 [East China Sea]. –Iwata, 1993: 84 [pictorial key]. –Kuo *et al*., 1994: 127, Figs. 3a-b, 7b [identification key, redescription]. –Masuda and Kobayashi, 1994: 3, Fig. 1 [color variation]. –Iwata, 1997: 32, Fig. 2 [Pacific coast south Choshi to Okinawa]. –Fernholm, 1998: 34 [Japan, Taiwan]. –Honma, 1998: 50 [identification key; central and southern Japan to northeast Taiwan]. –Iwata, 2000: 109 [pictorial key]. –Paxton, 2000: 577 [South China Sea]. –Ohta and Kim, 2001: 666 [Iheya Ridge, Mid Okinawa Trough, Japan]. –Shinohara *et al*., 2001: 286 [Tosa Bay, Japan]. –Nakabo, 2002: 109 [identification

key; southern Japan, Okinawa Trough, and Northeast Taiwan]. –Froese and Sampang, 2004: 1 [list of seamount fishes; Taiwan and southern Japan]. –McMillan and Wisner, 2004: 56, Fig. 4 [identification key, redescription; Tokyo Bay, Japan and SW coast of Taiwan]. –Soto and Mincarone, 2004: 12 [MOVI catalog of fishes].

Bdellostoma* (*Eptatretus*) *okinoseanum. –Holly, 1933: 52, Fig. 56 [identification key; Sagami, Japan].

Bdellostoma okinoseanum. –Adam and Strahan, 1963: 6 [off Tokyo Bay].

Eptatretus okinoseanum. –Hardisty, 1979: 19 [Japan].

Material examined: 6 specimens. JAPAN: BSKU 44343, 1(510 mm), Mimase fish market, off-shore trawl, 26 Nov. 1987; BSKU 44349, 1(515 mm), Mimase fish market, off Okitsu, 28 Nov. 1987; MOVI 37392 (ex BSKU 51886), 1(519 mm), Mimase fish market, Kochi, off-shore trawl, 1 Mar. 2000; NSMT-P 65670, 1(324 mm), East China Sea, 31°25.3'N, 128°24.1'E–31°22.1'N, 128°31.1'E, 461-500 m, RV *Yoko-maru*, T. Kubodera, H. Namikawa, 8 Nov. 2002, 06:55-08:29 h; NSMT-P 11000, 1(580 mm), Honshu Boso Peninsula, off Choshi, trawl, 12 Apr. 1971; SU 23522, 1(402 mm), Misaki, Sagami, K. Aoki (obtained by D. S. Jordan in 1911).

Diagnostic features: Body elongated, its depth 5-8 % TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots small, not prominent. Three pairs of barbels on head; first two about equal in size (1.4-1.6% TL), third one longer (2.0-2.4% TL). Eight pairs of gill pouches corresponding to 8 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last gill aperture confluent with pharyngocutaneous duct on left side. Dental muscle overlies gill pouches 1-3. Ventral aorta branches at gill pouches 6-8. Ventral finfold well developed, to 6 mm high, beginning within anterior 12-18% of trunk, extending backward to the cloaca. Caudal finfold rounded, well developed, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 19.2-22.6; branchial length 6.2-9.2; trunk length 50.4-59.4; tail length 12.7-15.5; body width 5.0-6.4; body

depth including VFF 5.7-8.1; body depth excluding VFF 5.5-7.9; body depth over cloaca 6.0; tail depth 6.2-9.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-10. Posterior unicusps 7-10. Total cusps 40-49. Prebranchial pores 13-17. Branchial pores 6-8. Trunk pores 54-61. Tail pores 10-14. Total pores 87-97.

Color in alcohol: body brown; tip of barbels whitish; gill apertures and slime pores the same color as body; ventral and caudal finfold lighter than body but without pale margins. Dean (1904) described the body as "dark purplish-brown in life".

Size: Maximum total length 800 mm (Dean, 1904).

Distribution and habitat: Eastern and southern Honshu, Japan, and northeast Taiwan, from 300 to 1020 m. Also reported by Ohta and Kim (2001) among rocks on the Iheya Ridge, Mid Okinawa Trough, near a hydrothermal vent.

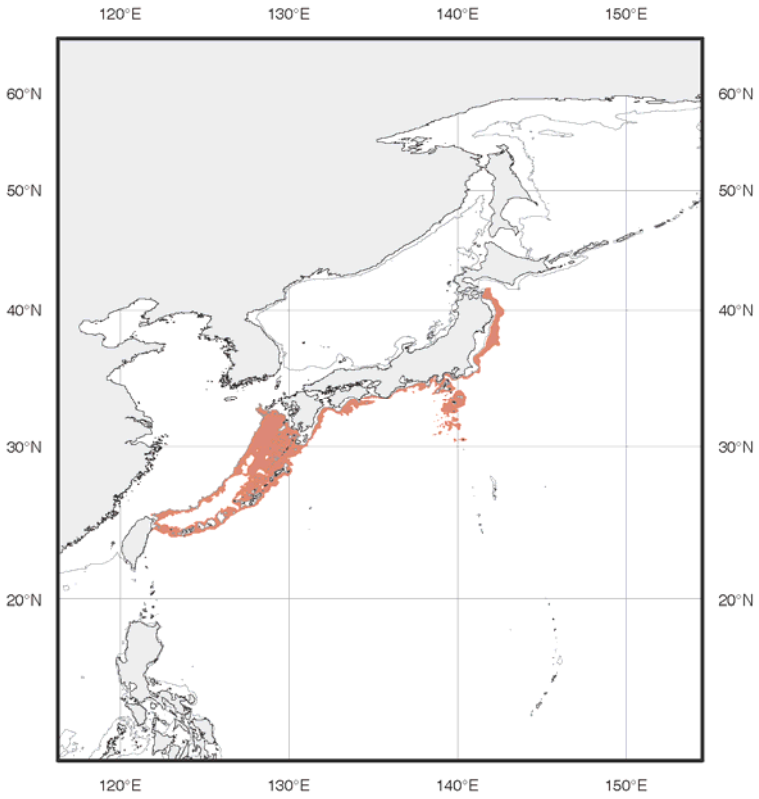


Fig. 37. Distribution of *Eptatretus okinoseanus*.

Interest to fishery: None.

Remarks: A 800-mm female reported by Dean (1904) had 44 well-developed eggs, with an average size of 32 x 12 mm.

Common names: JAPAN: Murasaki-nuta-unagi; FAO: Japanese hagfish.

Eptatretus polytrema (Girard, 1855)

Bdellostoma polytrema Girard, 1855a: 199 [original description; type locality: Valparaiso Bay, Chile, 350 m; neotype: SIO 84-243 (designated by Wisner and McMillan, 1988)]. –Girard, 1855b: 48, Pl. 32 [further description; Valparaiso]. –Günther, 1870: 512 [coast of Chile]. –Lockington, 1878: 793 [comparison with ***Bdellostoma stoutii***; Chile]. –Günther, 1880: 25 [Valparaiso]. –Schneider, 1880: 116 [citation]. –Reed, 1897: 22 [Valparaiso]. –Delfin, 1900: 186 [Talcahuano and Valparaiso]. –Porter, 1903a: 193 [Valparaiso]. –Porter, 1903b: 223 [Valparaiso]. –Adam and Strahan, 1963: 5 [Chile].

Homea polytrema. –Garman, 1899: 407 [off Chile]. –Delfin, 1901: 12 [catalog of Chilean fishes]. –Delfin, 1902a: 3 [vernacular name]. –Delfin, 1902b: 218 [ecology]. –Dean, 1904: 20 [coast of Chile].

Polistotrema polytrema. –Fowler, 1908: 461 [citation]. –Fowler, 1944: 475 [Bahia de Concepcion, Talcahuano, Valparaiso]. –Fowler, 1951: 267 [identification key; Chile]. –Mann, 1954: 90 [Chile]. –Bahamonde and Pequeño, 1975: 5 [checklist of Chilean fishes]. –Pequeño, 1977: 78 [museum catalog; Chiloé].

Heptatretus polytrema. –Regan, 1912: 534 [identification key; Valparaiso].

Bdellostoma* (*Polistotrema*) *polytrema. –Holly, 1933: 51 [identification key; Chile].

Dodecatrema polytrema. –Fowler, 1947: 3 [new combination; Valparaiso]. –Fowler, 1964: 45 [Valparaiso Bay].

Eptatretus polytrema. –Hardisty, 1979: 19 [Chile]. –Wisner and McMillan, 1988: 238, Figs. 3a, 4 [redescription; identification key; designation of neotype]. –Pequeño, 1989: 5 [list of Chilean fishes]. –Meléndez *et al*., 1993: 6 [MNHNC fish catalog]. –

Fernholm, 1998: 34 [off Valparaiso, Chile]. –Wisner, 1999: 308, Fig. 2 [description of subfamilies]. –Mok, 2001: 358 [nasal-sinus papillae]. –Acuña *et al*., 2002: 63 [Caldera, Chile]. –Soto and Mincarone, 2004: 12 [MOVI catalog of fishes].

Material examined: 6 specimens. CHILE: CAS 56511, 2(380-430 mm), and MOVI 30906-30907 (ex CAS 56511), 2(367-422 mm), Pacific, Chile, Chile, 33°22'S, 71°53'W, 240-260 m, RV *Anton Bruun*, 72 ft shrimp trawl, L. W. Knapp, 1 Aug. 1966; SIO 65-676, 2(279-278 mm), Valparaiso, Chile, 33°02'S, 71°38'W, 30 ft (9 m), RV *Anton Bruun*, W. Baldwin, 24 Dec. 1965.

Diagnostic features: Body elongated, its depth 7-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent, the margins well defined. Three pairs of barbels on head; first two about equal in size (1.2-1.4% TL), third one longer (1.7-2.2% TL). Fourteen (occasionally 13) pairs of gill pouches corresponding to 14 (occasionally 13) pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct on left side usually not confluent with the pharyngocutaneous duct (confluent in 39% of the specimens examined by Wisner and McMillan, 1988). Dental muscle overlies gill pouches 5-10. Ventral aorta branches at gill pouches 10-13. Ventral finfold variably developed, ranging from absent to prominent. Caudal finfold nearly rounded, its ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 13.9-16.9; branchial length 16.8-20.1; trunk length 47.8-53.0; tail length 12.7-17.9; body depth including VFF 6.8-10.9; body depth excluding VFF 6.8-10.9; body depth over cloaca 4.9-8.0; tail depth 5.7-8.6. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 8-10. Posterior unicusps 7-10. Total cusps 45-51. Prebranchial pores 6-9. Branchial pores 11-14. Trunk pores 39-45. Tail pores 12-17. Total pores 72-79.

Color in alcohol: body highly variable, with few to many pale blotches against a dark background; extreme variation in the piebald condition (even on specimens taken together); tip of the barbels white; margin of ventral finfold occasionally whitish.

Size: Maximum total length 570 mm.

Distribution and habitat: Coast of Chile, from Bahía Inglesa to Talcahuano (about 27° to 37°S). Usually living on muddy and rocky bottoms from shallow coastal waters to upper slope and seamounts at depths from 10 to 350 m. One specimen reported from the O'Higgins seamount group, eastern Juan Fernandez Islands, 33°27'S, 77°52'W, 175-180 m depth.

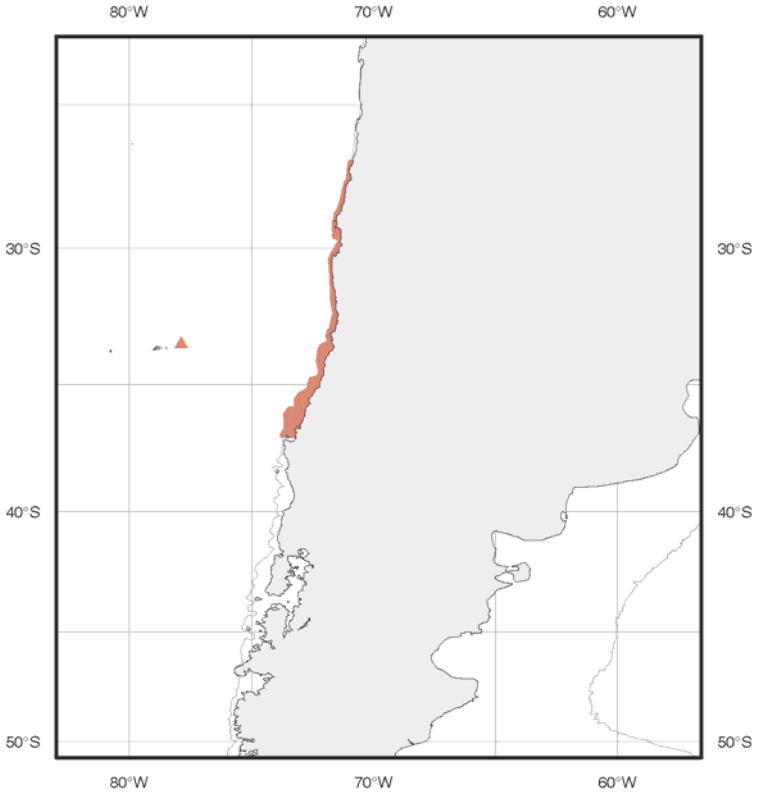


Fig. 38. Distribution of *Eptatretus polytrema.*

Interest to fishery: None.

Remarks: Many authors reported the occurrence of a polibranchiated hagfishes in Chilean waters under the species name ***polytrema***. However, these citations pertain to unrecognizable species in that neither counts, no useful proportions, or color notes were provided. A complete list of names and references of these unassignable records was

provided by Wisner and McMillan (1988), which contains also citations under the species name ***dombey*** (***Gastrobranche dombey*** La Cepède, 1798) or *dombeyi* (***Gastrobranchus dombeyi*** Shaw, 1804), an unrecognizable myxinid from Chile (see Remarks on the genus ***Eptatretus***).

Of the 19 specimens examined by Wisner and McMillan (1988), 13 were mature females with developing eggs. Four females (385-447 mm TL) had from 24 to 40 well developed eggs ranging from 16 to 27.5 mm in length and about 4.5 to 7 mm in diameter. One 289-mm female was considered immature.

On two occasions ***E. polytrema*** was taken with ***E. bischoffii***: off Valparaiso Harbor in traps at 30 m and in Bahía Inglesa in traps at 20 m depth. Also, it was taken once with ***E. nanii*** at 33°22'S, 71°52'W, in a 72 ft shrimp trawl at 260-270 m depth (Wisner and McMillan, 1988).

Common names: CHILE: Anguila babosa, Babosa, Anguila negra; FAO: Fourteen-gill hagfish.

Eptatretus profundus (Barnard, 1923)

Heptatretus profundus Barnard, 1923: 439 [original description; type locality: Cape Point, Northeast 3/4 North, 39 miles, South Africa, 310-560 fm (567-1024 m) (SAM database, Michael Bougaardt, pers. comm.); holotype: SAM 13035]. –Barnard, 1947: 2 [off Cape Point].

Bdellostoma* (*Eptatretus*) *profundum. –Holly, 1933: 54 [identification key; Cap Point].

Bdellostoma profundum. –Adam and Strahan, 1963: 6 [Cape of Good Hope].

Homea profunda. –Fowler, 1964: 47 [catalog of world fishes].

Eptatretus profundus. –Smith, 1975: 9 [common name]. –Strahan, 1975: 142, Fig. 2f [identification key, redescription of the holotype]. –Fernholm, 1986: 36 [identification key, diagnosis; Cape Point]. –Kuo and Mok, 1994: 248 [selected characters]. –Fernholm, 1998: 34 [off Cape Point, South Africa]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mincarone and McCosker, 2004: 164 [comparison with ***Eptatretus lakeside***]. –Soto and Mincarone, 2004: 12 [MOVI catalog of fishes].

Eptatretus profundum. –Hardisty, 1979: 19 [Cape of Good Hope].

Material examined: 3 specimens. SOUTH AFRICA: MOVI 27536 (ex RUSI 47239), 1(576 mm), Western Cape, south of Cape Agulhas, 35°58'S, 19°34'E, M. E. Anderson, 8 Jan. 1995; RUSI 22520, 1(644 mm), off west coast, 34°48'S, 18°16'E, 515 m, *Africana*, 10 Jul. 1984; RUSI 47212, 1(570 mm), Western Cape, off Cape Columbine, 32°22'S, 16°09'E, 1150 m, *Africana*, trawl, M. E. Anderson, 14 Jan. 1995.

Diagnostic features: Body elongated, its depth 9-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent, the margins poorly defined. Three pairs of barbels on head; first two about equal in size (1.0-1.9% TL), third one longer (1.7-2.6% TL). Five pairs of gill pouches corresponding to 5 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouch 2. Ventral aorta branches at gill pouch 4. Ventral finfold prominent (2-4 mm high), beginning within anterior 29-32% of trunk, extending backward to the cloaca. Caudal finfold rounded, its ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 20.2-22.5; branchial length 5.0-5.6; trunk length 54.3-55.8; tail length 18.6-19.2; body width 6.0-6.6; body depth including VFF 9.3-10.0; body depth excluding VFF 8.9-9.5; body depth over cloaca 7.3-8.1; tail depth 9.0-10.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 8-9. Posterior unicusps 8-9. Total cusps 42-46. Prebranchial pores 13-14. Branchial pores 4-5 (they are placed above the gill apertures). Trunk pores 48-51. Tail pores 15-16. Total pores 81-83.

Color in alcohol: body dark brown; tip of barbels and margin of mouth white; gill apertures and ventral finfold variably with pale margins; caudal finfold without pale margin.

Size: Maximum total length 644 mm (present study).

Distribution and habitat: South Africa, from off Lambert's Bay to Cape Agulhas. On the continental slope at depths from 490 to 1150 m.

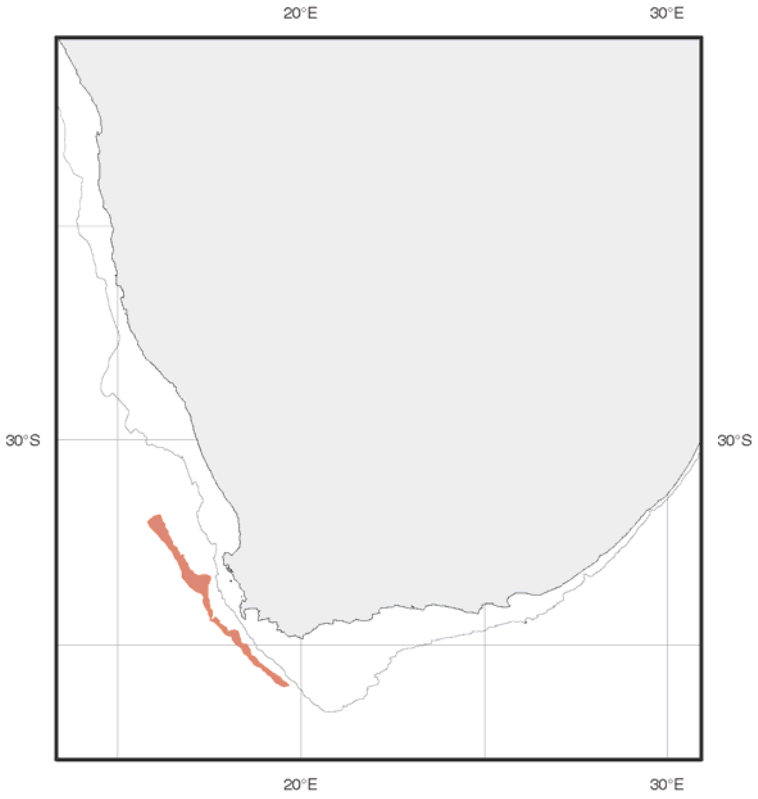


Fig. 39. Distribution of *Eptatretus profundus.*

Interest to fishery: None.

Remarks: According to SAM database, the station data of the holotype are: Cape Point, Northeast 3/4 North, 39 miles, 310-560 fm (567-1024 m), shrimp trawl, RV *Pieter Faure*, 17 Sep. 1903 (Michael Bougaardt, pers. comm.). I assume the 400 fm depth provided in the Barnard's (1923) original description was an approximation.

Until recently, *Eptatretus profundus* was known just from the 620-mm holotype. The description above was based on this specimen (data provided by Strahan, 1975), now measuring 580 mm (Michael Bougaardt, pers. comm.), and the examination of three additional specimens listed above.

Common names: SOUTH AFRICA: Vyfkief-slymslang, Five-gill hagfish; FAO: Five-gill hagfish.

Eptatretus sinus Wisner and McMillan, 1990

Eptatretus sinus Wisner and McMillan, 1990: 792, Fig. 2c [original description; type locality: Gulf of California, Mexico, 25°49'N, 110°44'W, 708 m; type series: holotype, SIO 68-108, paratypes, CAS 63202 (15), LACM 44408-1 (14), SIO 68-94 (29), SIO 68-100 (60), SIO 68-108 (31), USNM 296319 (15)]. –Fernholm, 1998: 34 [Gulf of California, Mexico]. –Mok, 2001: 358 [nasal-sinus papillae]. –Soto and Mincarone, 2004: 12 [MOVI catalog of fishes].

Material examined: 19 specimes. MEXICO: CAS 63202 (ex SIO 69-202), paratypes, 15(360-386), and USNM 296319 (ex SIO 69-202), paratype, 1(280 mm), Gulf of California, Sonora, 29°42'N, 112°59'W, 207 m, bottom trap, 1-2 Mar. 1969; MOVI 27517-27519 (ex SIO 62-240), 3(258-366 mm), Baja California North, off Bahía de Los Angeles, Isla Cabeza de Caballo, 28°59.0'N, 113°28.7'W, 419 ft (128 m), trap, C. L. Hubbs, A. J. Storer, W. J. Baldwin, 28 Apr. 1962, 08:50-09:15h.

Diagnostic features: Body elongated, its depth 5-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent, the margins well defined. Three pairs of barbels on head; first two about equal in size (0.9-1.8% TL), third one longer (1.8-2.5% TL). Ten (9-12) pairs of gill pouches corresponding to 10 (9-12) pairs of gill apertures (small variation occurs in the number of gill apertures between left and right sides). Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 1-6. Ventral aorta branches at gill pouches 4-10. Ventral finfold low (occasionally absent), beginning within anterior 9-20% of trunk, extending backward to the cloaca. Caudal finfold nearly spatulate, its ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 19.7-27.8; branchial length 9.2-17.2; trunk length 45.0-54.0; tail length 10.2-17.4; body depth including VFF 4.9-10.4; body depth excluding VFF 4.6-10.1; body depth over cloaca 3.9-8.6; tail depth 4.8-9.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-9. Posterior unicusps 6-9. Total cusps 34-46. Prebranchial pores 10-17. Branchial pores 8-11. Trunk pores 36-49. Tail pores 7-14. Total pores 66-82.

Color in alcohol: body reddish brown; tip of the barbels white; mouth, slime pores, and caudal finfold occasionally with pale margins; gill apertures, ventral finfold and cloaca with narrow pale margins.

Size: Maximum total length 630 mm (Wisner and McMillan, 1990).

Distribution and habitat: Gulf of California, Mexico, between the islands Ángel de la Guarda and San José. Known from shallow waters to deep channels in the mid-riff area of the gulf, at depths from 198 to 1330 m.

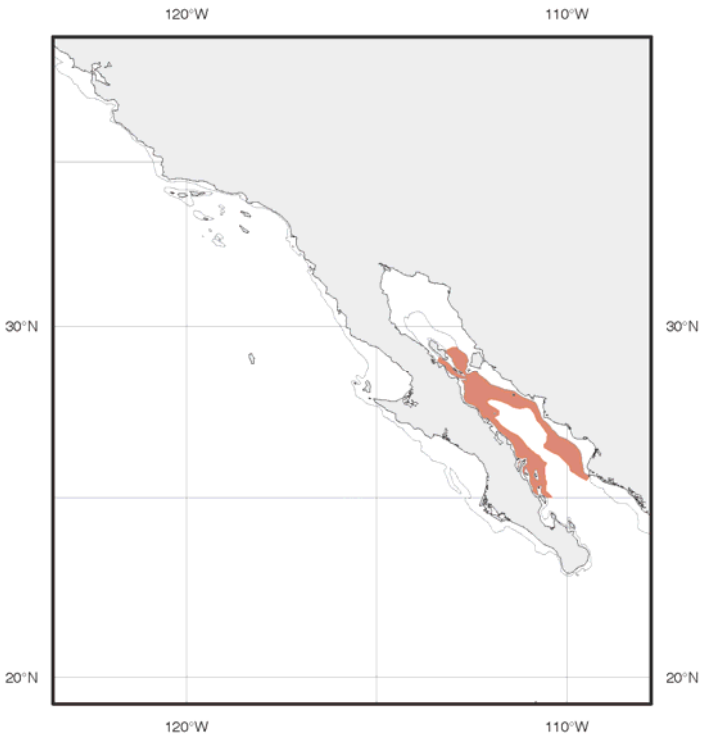


Fig. 40. Distribution of *Eptatretus sinus*.

Interest to fishery: None.

Remarks: ***Eptatretus sinus*** matures at a short total length, 130 mm for males and 142 for females, when compared to other *Eptatretus* species. Of a total 424 specimes for wich sex was reliably determined, 35% were male and 65% female. Encapsulated anchor filaments are visible on eggs of 20 mm. The largest egg found (among 21 large ones) was 32 x 7.5 in a female of 371 mm TL (Wisner and McMillan, 1990).

Common names: FAO: Cortez hagfish.

Eptatretus stoutii **(Lockington, 1878)**

Bdellostoma stoutii Lockington, 1878: 793 [original description; type locality: two miles southwest of whistler buoy at entrance to Humboldt Bay, California, 38-44 m; neotype: SIO 68-426 (designated by Wisner and McMillan, 1990)].

Polistotrema dombeyi (not Shaw, 1804). –Jordan and Gilbert, 1881: 458 [San Francisco and Monterey Bay]. –Jordan and Gilbert, 1882: 29 [Santa Barbara to Eel River].

Bdellostoma stouti. –Jordan and Gilbert, 1883: 6 [coast of California]. –Dean, 1897: 35 [very common in the Monterey Bay]. –Conel, 1931: 77 [general biology]. –Gudger and Smith, 1931: 47, Figs. 1-3, Pls. 1-2 [segmentation off the eggs]. –Adam and Strahan, 1963: 6 [California].

Polistotrema stouti. –Smith, 1895: 288 [Monterey Bay and vicinity]. –Jordan and Evermann, 1896b: 6 [coast of California, and north to Cape Flattery]. –Greene, 1900: 366 [anatomy and physiology of the caudal heart]. –Jordan, 1905: 489, Fig. 291 [California]. –Evermann and Goldsborough, 1907: 226 [comparison with ***Polistotrema deani***]. –Halkett, 1913: 11 [checklist of fishes from Canada and Newfoundland]. –Jordan, 1925: 169, Fig. 117 [California]. –Townsend and Nichols, 1925: 4 [comparison with ***Polistotrema curtiss-jamesi***]. –Hubbs, 1928: 10 [Oregon and Washington]. –Wilimovsky, 1954: 281 [checklist of Canadian fishes]. –Roedel, 1962: 21 [vernacular names of Californian fishes]. –Cox, 1963: 286, Fig. 14

[description of egg case]. –Barham *et al*., 1967: 780 [Coronado Canyon, San Diego Trough]. –McInerney and Evans, 1970: 966 [habitat characteristics; Mayne Bay, Vancouver Island].

Homea stouti. –Garman, 1899: 407 [off California]. –Dean, 1904: 14, Fig. 4a [comparison with Japanese hagfishes; coast of California]. –Dean, 1912: 173 [exhibition].

Eptatretus stouti. –Starks and Morris, 1907: 161 [catalog; from San Diego to Cape Flattery]. –Strahan, 1963: 76 [behavior]. –Kukowski, 1972: 7 [Monterey Bay]. –Kukowski, 1973: 17 [Monterey Bay]. –Hart, 1973: 18 [identification key, brief description; southern California to southern Alaska (not confirmed)]. –Hardisty, 1979: 19 [California]. –Antonelis and Fiscus, 1980: 75 [prey of ***Mirounga angustirostris***; California]. –DeMartini and Allen, 1984: 123 [southern California]. –McAllister, 1990: 25 [checklist of Canadian fishes]. –Barss, 1993: 19 [Oregon fishery]. –Peden, 2002: 6 [British Columbia].

Polistotrema stoutii. –Fowler, 1908: 461 [citation]. –Ulrey, 1929: 2 [checklist of fishes of California]. –Jordan *et al*., 1930: 8 [coast of California]. –Clemens and Wilby, 1949: 49, Fig. 10 [identification key; brief description; southern California to southeastern Alaska]. –Clemens and Wilby, 1961: 67, Fig. 11 [identification key; brief description; southern California to southeastern Alaska].

Heptatretus stouti. –Regan, 1912: 535 [identification key; California].

Bdellostoma* (*Polistotrema*) *stouti. –Holly, 1933: 51 [identification key; California].

Dodecatrema stoutii. –Fowler, 1947: 3 [new combination; California, Oregon, Washington, British Columbia, Alaska]. –Fowler, 1964: 45 [in part; catalog of world fishes].

Eptatretus stoutii. –Jensen, 1959: 798 [notes on albino and piebald specimens]. –McAllister, 1960: 4 [checklist of Canadian fishes]. –Hubbs, 1963: 941, Fig. 1b [illustration]. –Jensen, 1966: 82 [general biology]. –Bourne and McAllister, 1969: 3248 [comparison with ***Eptatretus deani***]. –Linthicum, 1971: 19 [hagfish immunity]. –Miller and Lea, 1972: 32 [Pt. San Pablo, Baja California to SE Alaska]. –Hubbs *et al*., 1979: 3 [checklist of Californian fishes]. –Eschmeyer *et al*., 1983: 11, Pl. 1, Fig. 20 [field guide; SE Alaska to Baja California]. –Fernholm, 1985: 113 [lateral line system]. –Wisner and McMillan, 1990: 795, Fig. 2d [identification key; redescription;

designation of neotype]. –Fernholm, 1998: 34 [W coast of North America]. –Leask and Beamish, 1999: 1 [fishery; British Columbia]. –Benson *et al*., 2001: 5 [British Columbia experimental fishery]. –Mecklenburg *et al*., 2002: 55 [identification key; brief description; southeastern Alaska records not confirmed]. –Yoklavich *et al*., 2002: 128 [Big Creek Marine Ecological Reserve, off California]. –Arimitsu *et al*., 2003: 41 [Glacier Bay, Alaska]. –Soto and Mincarone, 2004: 12 [MOVI catalog of fishes]. –Hyland *et al*., 2005: 12 [Olympic Coast National Marine Sanctuary, Washington]. –Love *et al*., 2005: 1 [calalog; Nootka Bay, Vancouver Island, British Columbia to Punta San Pablo, central Baja California].

Material examined: 21 specimens. UNITED STATES OF AMERICA: CAS 14815, 1(375 mm), Oregon State, 45°58.5'N-45°58.8'N, 124°38.0'W-124°37.8'W, 205 m, RV *Yaquina*, 22' otter trawl, W. N. Eschmeyer, 16 Aug. 1972, 21:17-21:31 h; CAS 15078, 2(310-390 mm), Oregon State, 45°59'06"N-45°58'36"N, 124°28'06"W-124°28'00"W, 48 m, RV *Yaquina*, 22' otter trawl, W. N. Eschmeyer, 17 Aug. 1972, 01:37-01:52 h; CAS 218776, 4(430-460 mm), California, 2.7 mi SSE of Pt. Fermin, 150 fm (274 m), NB *Scofield*, prawn trap, W. Dalhstrom, 10 Apr. 1969; CAS 218779, 2(410-510 mm), California, 0.8 mi SSE of Gull Island, 33°56.2'N, 119°49.5'W, 140 fm (256 m), NB *Scofield*, prawn trap, W. Dalhstrom, 4 Apr. 1969; MOVI 27524-27526 (ex SIO 69-231), 3(340-395 mm), Pacífico Norte, off Coronado Island, 32°32.8'N, 117°21.8'W, 76 fm (139 m), no date; MOVI 30918-30922 (ex CAS 218659), 5(390-427 mm), California, 0.9 miles SW of Gull Island, 33°56.6'N, 119°50.5'W, 145 fm (265 m), NB *Scofield*, prawn trap, W. Dahlstrom, 4 Apr. 1969; MOVI 30923-30926 (ex CAS 218657), 4(332-438 mm), California, 4.0 miles SSW of west end of Anacapa Island, 33°57'24"N, 119°29'42"W, 130 fm (238 m), NB *Scofield*, prawn trap, W. Dahlstrom, 3 Apr. 1969.

Diagnostic features: Body elongated, its depth 4-9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent, small, the margins well defined. Three pairs of barbels on head; first two about equal in size (0.9-1.4% TL), third one longer (1.6-2.4% TL). Twelve (10-14) pairs of gill pouches corresponding to 12 (10-14) pairs of gill

apertures (small variation occurs in the number of gill apertures between left and right sides). Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 1-6. Ventral finfold well developed (1-4 mm high), beginning within anterior 19-29% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 18.7-25.3; branchial length 11.5-14.2; trunk length 47.0-53.5; tail length 10.4-17.8; body depth including VFF 5.0-9.7; body depth excluding VFF 4.1-9.0; body depth over cloaca 3.8-7.9; tail depth 4.5-8.3. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-10. Posterior unicusps 6-9. Total cusps 36-46. Prebranchial pores 10-16. Branchial pores 9-14. Trunk pores 39-51. Tail pores 8-14. Total pores 71-88.

Color in alcohol: ranges from light purplish-gray to reddish brown, with occasional pinkish overtones; tip of barbels whitish; gill apertures, ventral and caudal finfolds with narrow pale margins. In life, the body is pinkish to purple grey, lighter ventrally. Complete albinism and piebaldness were reported by Jensen (1959) and Dean (1903) described and figured a specimen with large pale areas on head and anterior ventral surface.

Size: Maximum total length 670 mm (Barss, 1993).

Distribution and habitat: Eastern North Pacific, from Nootka Bay, Vancouver, Canada to Pt. San Pablo, Baja California, Mexico, on the continental shelves and upper slopes at depths from 16 to 966 m (Wisner and McMillan, 1990). Hart (1973) and Mecklenburg *et al*. (2002) reported that Alaskan records had not been confirmed. Environmental information from Mayne Bay on Barkley Sound, Vancouver Island, indicates that ***Eptatretus stoutii*** occurs on substrates consisting mainly by silt and in waters characterized by high near-bottom salinity (31-32‰) but low surface salinity (24‰) into which they occasionally swim (McInerney and Evans, 1970).

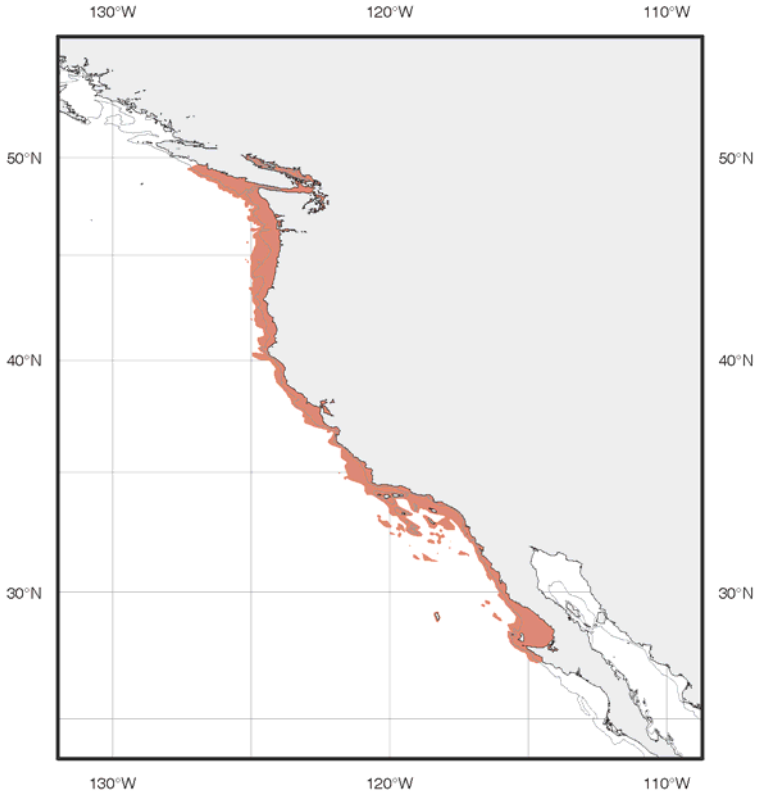


Fig. 41. Distribution of *Eptatretus stoutii*.

Interest to fishery: According to Barss (1993) in 1988, the Oregon Department of Fish and Wildlife began sampling and monitoring the development of a new fishery for Pacific hagfish ***Eptatretus stoutii*** and black hagfish ***E. deani***. Hagfish landings by Oregon trap vessels have ranged from 11,695 kg in 1988 to 340,774 kg in 1992. Whole frozen fish were shipped to South Korea for the "eel skin" leather market. Oregon's hagfish fishery began in October 1988 when two trap vessels landed 11,625 kg at Newport. About 4,165 kg was black hagfish, the rest was Pacific hagfish. The estimate of catch per trap using "Korean traps" was 1.4 kg. In 1989, three vessels landed 156,123 kg of hagfish at Newport and Astoria, with a catch of about 0.8 kg of hagfish per trap. In 1990, Oregon hagfish landings dropped, but since that reduction in poundage, there has been a modest increase in landings, mostly of Pacific hagfish, with 11 vessels landing 75,924 kg of hagfish from 102 trips. In 1991, 12 vessels landed 124,506 kg from 131 trips, and in 1992, 15 vessels landed 340,774 kg of hagfish from 310 trips (Table 6).

Table 6. Oregon hagfish landings 1988-1992 (from Barss, 1993).

Year and month		Weight (kg)	Number of landings	Number of vessels	Year and month		Weight (kg)	Number of landings	Number of vessels
1988	Oct.	4,664	3	1	**1991**	Jan.	21,864	28	3
	Nov.	7,031	1	1		Feb.	8,068	7	3
						Mar.	26,175	25	4
1989	Jul.	24,978	4	1		Apr.	29,989	33	4
	Aug.	5,321	4	2		Jun.	8,550	11	3
	Sep.	37,375	10	3		Jul.	2,275	4	1
	Oct.	44,255	11	6		Sep.	2,520	1	1
	Nov.	28,394	1	1		Dec.	24,066	22	4
	Dec.	14,800	1	1					
					1992	Jan.	30,792	34	8
1990	Apr.	2,828	4	2		Feb.	66,112	64	10
	May	2,049	3	2		Mar.	87,501	86	11
	Jul.	647	2	1		Apr.	55,492	40	10
	Aug.	16,048	24	4		May	30,960	20	8
	Sep.	9,646	16	3		Jun.	10,316	10	5
	Oct.	4,636	8	4		Jul.	3,752	7	3
	Nov.	22,026	27	4		Aug.	26,411	22	4
	Dec.	18,063	18	3		Sep.	18,078	16	3
						Nov.	6,631	6	2
						Dec.	4,729	5	2

Remarks: Based on Oregon hagfish fishery, Barss (1993) sampled 924 Pacific hagfish from commercial and research catches, from 1988 through 1989. Mean length of fish sampled from commercial landings was 39.6 cm. Fifty percent maturity for male and female was 35 cm and 42 cm, respectively. Examination of gonads indicates that spawning occurs throughout the year. Mature Pacific hagfish females averaged 28 eggs over 5 mm in length.

Of 309 specimens examined by Howard Ayres, 182 (59%) were males, 121 (39%) females, and 6 (2%) hermaphrodites (Conel, 1931). Also, of 870 specimens examined by Wisner and McMillan (1990), in which the sex was reliably determined, 51% were male and 49% female. These ratios contrast notably with other eastern Pacific hagfishes, in which females dominated by 60-74%. The largest egg found measured 28.6 x 7.5 mm, obtained from a 435-mm female. The number of developed eggs (20 mm or longer) varies from 11 (23 x 7 mm) in a 330-mm female to 48 (20 x 6 mm) in one of 515 mm TL.

Like others hagfishes ***Eptatretus stoutii*** is a serious nuisance to fishing operations by destroying large commercial fishes caught in various fixed gears. At Monterey, California, losses of up to 41% of lingcod caught in trammel nets and 19-28% of other species such as salmon were reported (Hart, 1973).

Common names: USA, FAO: Pacific hagfish; CANADA: Myxine brune, Pacific hagfish.

Eptatretus strahani McMillan and Wisner, 1984

Eptatretus strahani McMillan and Wisner, 1984: 262, Figs. 3(4), 4, 5(11) [original description; type locality: South China Sea, near Lubang Islands, Philippines, 14°00'N, 120°18.2'E, 189 m; type series: holotype, MNHN 1978-462, paratypes, MNHN 1981-722 (1), SIO 81-116 (2), USNM 227442 (1)]. –Kuo and Mok, 1994: 248 [selected characters]. –Fernholm, 1998: 34 [South China Sea, Philippines]. –Fernholm and Paxton, 1998: 1192 [catalog]. –Mok, 2001: 358 [nasal-sinus papillae]. –McMillan and Wisner, 2004: 57 [identification key, redescription; Philippines]. –Mincarone and Stewart, 2006: 227 [comparison with ***Eptatretus goliath***].

Material examined: 4 specimens. PHILIPPINES: MNHN 1981-0722, paratype, 1(500 mm), SIO 81-116, paratype, 1(430 mm), and USNM 227442, paratype, 1(435 mm), near Lugbarg Island, 14°00'N, 120°18.2'E, 189 m, NO *Vauban*, trap, 21-22 Mar. 1976, 18:00-06:00h. AUSTRALIA: NMV A 13506, 1(500 mm), Western Australia, W of King Sound, 16°54'S, 120°22'E, 405 m, FV *Striker*, scampi net, S. Morris, 4 Apr. 1989.

Diagnostic features: Body elongated, its depth 9-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots inconspicuous. Three pairs of barbels on head; first two about equal in size (1.4-1.8% TL), third one longer (2.4-2.5% TL). Seven pairs of gill pouches corresponding to 7 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill

pouches 3-5. Ventral aorta branches at gill pouch 7. Ventral finfold well developed (3-8 mm high), beginning within anterior 35-42% of trunk, extending backward to the cloaca. Caudal finfold thin, its ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 21.0-23.1; branchial length 6.9-8.3; trunk length 50.0-53.7; tail length 17.4-20.2; body width 6.0-7.7; body depth including VFF 10.1-11.7; body depth excluding VFF 9.4-10.5; body depth over cloaca 7.7-9.4; tail depth 10.9-12.5. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 9-11. Posterior unicusps 8-10. Total cusps 47-52. Prebranchial pores 13-16. Branchial pores 6-7. Trunk pores 45-51. Tail pores 10-12. Total pores 76-86.

Color in alcohol: body light to dark brown; tip of barbels and margin of gill apertures occasionally pale; slime pores and ventral finfold the same color as body; caudal finfold with a narrow pale margin.

Size: Maximum total length 520 mm (McMillan and Wisner, 1984).

Distribution and habitat: Known from type locality, off northwestern Lungang Islands, Philippines, 14°00'N, 120°18.2'E, at 189 m depth. Also reported off Western Australia, based on a single specimen collected at 16°54’S, 120°22’E, 405 m. It is probable that it also occurs along other islands between Philippines and Australia.

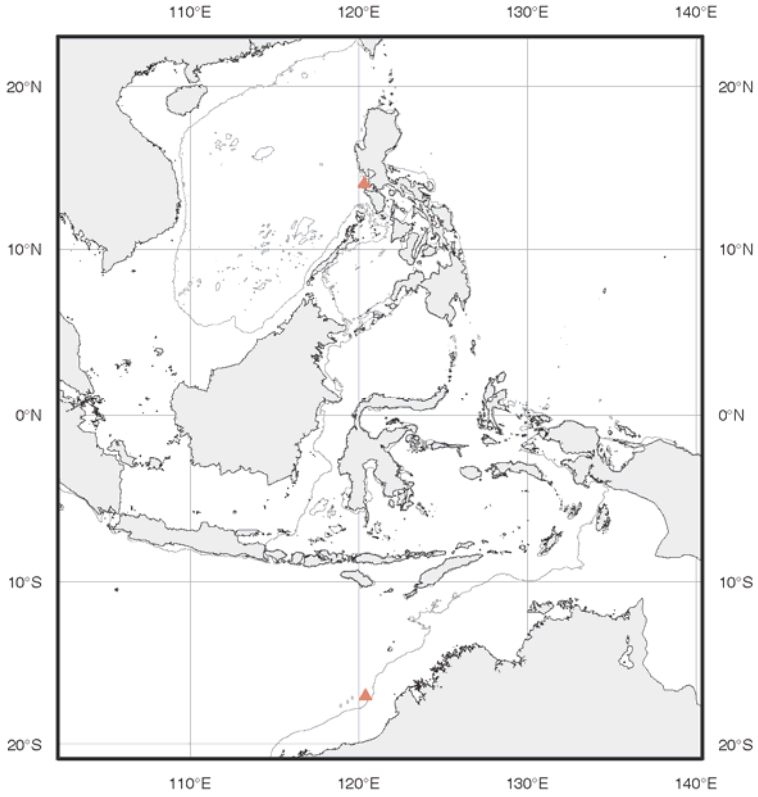


Fig. 42. Distribution of *Eptatretus strahani.*

Interest to fishery: None.

Remarks: In his overview on the Asian hagfishes, Honma (1998) apparently omitted the occurrence of ***E. strahani***.

Common names: FAO: Strahan's hagfish.

Eptatretus wisneri McMillan, 1999

Eptatretus wisneri McMillan, 1999: 116, Figs. 2b-c [original description; type locality: Galapagos Islands, 0°28.0'S, 91°37.2'W, 1848 ft (563 m); type series: holotype, CAS 86429, paratype, SIO 97-76 (1)]. –Mincarone and McCosker, 2004: 166 [identification key, comparison with ***Eptatretus lakeside***].

Material examined: 2 specimens. GALAPAGOS ISLANDS (ECUADOR): CAS 86429, holotype, 355 mm, Fernandina Island, 0°27'56"S, 91°37'33"W, 1848 ft (563 m), RV *Johnson Sea Link*, minnow trap, J. E. McCosker *et al*., 14 Nov. 1995, 11:56-14:01h; SIO 97-76 (ex CAS 86430), paratype, 1(316 mm), Fernandina Island, 0°17.5'S, 91°38.9'W, 1680 ft (512 m), RV *Johnson Sea Link*, minnow trap, J. E. McCosker *et al*., 16 Nov. 1995.

Diagnostic features: Body elongated, its depth 8-9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly round. Eyespots prominent and large. No nasal-sinus papillae. Three pairs of barbels on head; first two about equal in size (1.9-2.0% TL), third one longer (2.4% TL). Eight pairs of gill pouches corresponding to 8 pairs of gill apertures. Gill apertures well spaced in a linear pattern. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouch 3. Ventral aorta branches at gill pouch 6. Ventral finfold appears only as a pale line, beginning within anterior 30-40% of trunk, extending backward to the cloaca. Caudal finfold thin, rounded, well developed, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 19.4-22.9; branchial length 10.0-11.1; trunk length 50.3-52.8; tail length 16.7-17.1; body width 6.5-7.9; body depth including VFF 8.5-9.2; body depth excluding VFF 8.5-8.9; body depth over cloaca 7.2-7.3; tail depth 7.6-7.8. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 9. Posterior unicusps 8. Total cusps 44. Prebranchial pores 9-10. Branchial pores 7. Trunk pores 43-45. Tail pores 13-14. Total pores 73-75.

Color in alcohol: body brownish black, head region slightly lighter than body; barbels with white tip; mouth, gill apertures, and cloaca with pale margins; tip of caudal finfold with pale margin; ventral finfold appears only as a pale line.

Size: Known only from two specimens, 328 and 356 mm TL (McMillan, 1999).

Distribution and habitat: West of Fernandina Island, Galapagos Archipelago. On the slope at depths from 512 to 563 m.

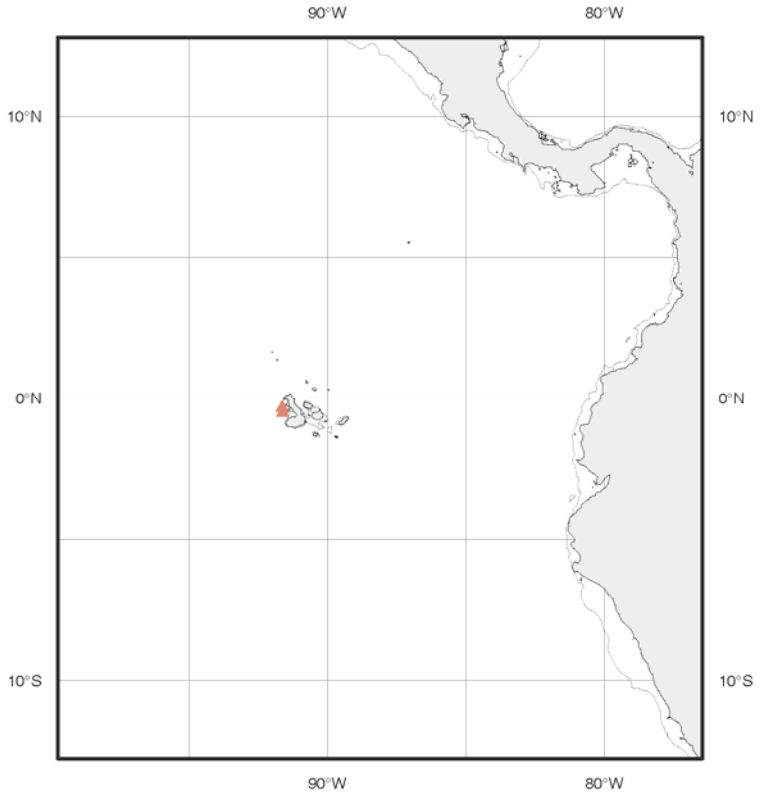


Fig. 43. Distribution of *Eptatretus wisneri*.

Interest to fishery: None.

Remarks: The holotype is a 356-mm juvenile female with round eggs of less than 1 mm, with no ellipsoidal oocytes. The paratype is a 328-mm male with well-developed testes (McMillan, 1999).

Common names: FAO: Wisner's eight-gilled hagfish.

***Paramyxine* Dean, 1904**

Paramyxine Dean, 1904: 14 [type species ***Paramyxine atami*** Dean, 1904; type by original designation].

Quadratus Wisner, 1999: 309 [type species ***Paramyxine taiwanae*** Shen and Tao, 1975; type by original designation].

Diagnostic features: Efferent branchial ducts open separately to the exterior; 5-6 external gill apertures closely spaced in a linear or non-linear pattern; first efferent branchial duct much longer than the last; branchial pores in reduced number or totally absent.

Distribution: Western Central Atlantic and western North Pacific (Fig. 44).

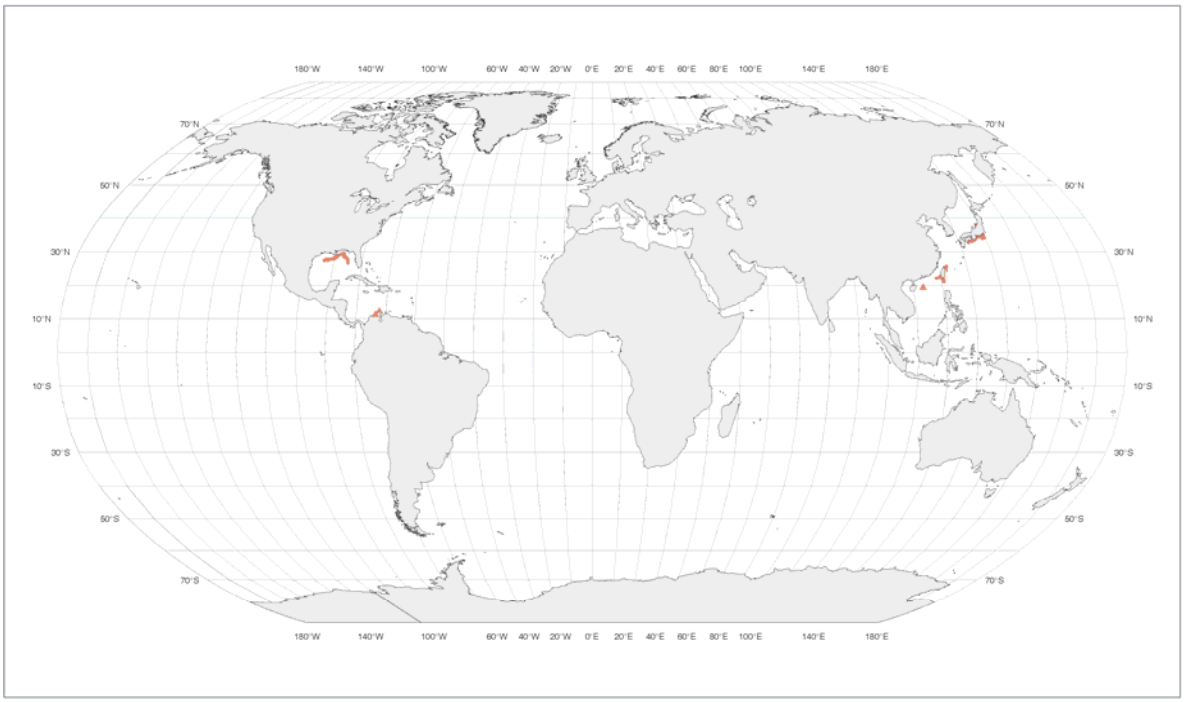


Fig. 44. Global distribution of the genus *Paramyxine*.

Species: The genus comprises 14 species.

Paramyxine ancon: Colombia (Caribbean Sea)

Paramyxine atami: Japan (western North Pacific)
Paramyxine cheni: Taiwan (western North Pacific)
Paramyxine chinensis: Hainan Island (South China Sea)
Paramyxine fernholmi: Taiwan (western North Pacific)
Paramyxine moki: Japan (western North Pacific)
Paramyxine nelsoni: Taiwan (western North Pacific)
Paramyxine sheni: Taiwan (western North Pacific)
Paramyxine springeri: Gulf of México (western Central Atlantic)
Paramyxine taiwanae: Taiwan (western North Pacific)
Paramyxine walkeri: Japan (western North Pacific)
Paramyxine wayuu: Colombia (Caribbean Sea)
Paramyxine wisneri: Taiwan (western North Pacific)
Paramyxine yangi: Taiwan and South China Sea (western North Pacific)

Remarks: Wisner (1999) divided the genus ***Paramyxine*** Dean, 1904 in two distinct groups of species. In the first group, named ***Paramyxine***, the gill apertures are arranged in a linear or nearly linear pattern, with one or two gill apertures slightly above or below a straight line through the series. In the second group, named ***Quadratus*** new genus, the gill aperture arrangement is non-linear, but forms patterns of nearly square, rectangular, or rhomboidal shapes. However, based on the wide range of variation in the arrangement of gill apertures of both groups, I decide to consider ***Quadratus*** as junior synonym of ***Paramyxine***. The lack of consistence on the gill apertures arrangements is observed even on a single specimen, with a square or rhomboidal pattern on the left side and a nearly linear pattern on the right side of body (pers. obs.).

Wisner (1999) designated ***Paramyxine taiwanae*** Shen and Tao, 1975 as type species for the genus ***Quadratus***. Subsequently, McMillan and Wisner (2004) designated ***Paramyxine yangi*** Teng, 1958 as type species of ***Quadratus***, apparently ignoring the former original designation of Wisner (1999).

According to Strahan and Honma (1960), ***Paramyxine*** has been fished in Sado Strait for some generations but was only eaten in the fishing villages and neighboring communities until de Second World War, when extreme food shortage led to an expansion of the industry. From 1943 to 1945, about 50 boats were engaged in the fishery. In 1960, only six or seven remain fishing seasonally from April to October; the highest catches being taken in July. The best fishing grounds were at the southern end of Sado Strait and between Niigata City and Awashima.

Key to Species of *Paramyxine*

1a. Six pairs of gill pouches 2
1b. Five (rarely four) pairs of gill pouches 11

2a. Three fused cusps on both anterior and posterior multicusps (3/3) 3
2b. Three fused cusps on anterior and two on posterior multicusps (3/2) 5

3a. Branchial pores 3-5 ..... ***Paramyxine chinensis***
3b. Branchial pores 0-1 4

4a. Tail length 11.1-14.2% of TL; tail depth 7.4-8.8% of TL; total pores 71-78; 1-2 gill pouches along the dental muscle ..... ***Paramyxine atami***
4b. Tail length 14.4-16.7% of TL; tail depth 8.3-10.0% of TL; total pores 62-74; 3-4 gill pouches along the dental muscle ..... ***Paramyxine sheni***

5a. Gill apertures crowded in a nonlinear configuration 6
5b. Gill apertures not crowded, but closely spaced in a nearly linear configuration 7

6a. Total cusps 12-13, total pores 79-80 ..... ***Paramyxine ancon***
6b. Total cusps 6-8, total pores 60-68 ..... ***Paramyxine taiwanae***

7a. Branchial pores 1-4; trunk pores 53-57; total pores 83-90 ..... ***Paramyxine springeri***

7b. Branchial pores 0-1; trunk pores 36-50; total pores 63-82 8

8a. Ventral finfold well developed, about 1-2 % of TL ..... ***Paramyxine moki***
8b. Ventral finfold low, vestigial, about 0.2-0.5% of TL 9

9a. Last gill aperture on left side not confluent with PCD ..... ***Paramyxine fernholmi***
9b. Last gill aperture on left side confluent with PCD 10

10a. Branchial length 2.0-3.1% of TL; trunk length 53-58% of TL; tail depth 7.1-8.3% of TL; 1-2 gill pouches along the dental muscle ..... ***Paramyxine walkeri***
10b. Branchial length 4.6; trunk length 49.4% of TL; tail depth 10.5% of TL; 2-4 gill pouches along the dental muscle ..... ***Paramyxine wisneri***

11a. Three fused cusps on both anterior and posterior multicusps (3/3) .. ***Paramyxine cheni***
11b. Three fused cusps on anterior and two on posterior multicusps (3/2) 12

12a. Gill apertures not crowded, but closely spaced in a nearly linear configuration; total cusps 41-43; branchial pores 2 ..... ***Paramyxine wayuu***
12b. Gill apertures crowded in a nonlinear configuration; total cusps 32-40; no branchial pores 13

13a. Trunk pores 35-39; total pores 57-67 ..... ***Paramyxine nelsoni***
13b. Trunk pores 39-47; total pores 68-79 ..... ***Paramyxine yangi***

***Paramyxine ancon* (Mok, Saavedra-Diaz and Acero-P., 2001)**

Quadratus ancon Mok, Saavedra-Diaz and Acero-P., 2001: 1031, Figs. 1-3 [original description; type locality: Caribbean coast of Colombia, off La Punta de los Remedios, between 11°29’31.8”N, 73°27’6.6”W and 11°29'47.4"N, 73°26'44.4"W, 470-488 m; holotype: INVEMAR-PEC 2412]. –Saavedra-Diaz *et al*., 2003: 967 [endemic species].

Material examined: None.

Diagnostic features: Body elongated, its depth about 7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Eyespots faint. Three pairs of barbels on head; first two about equal in size, third one longer. Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures crowded, closely spaced in a nonlinear pattern. Last gill aperture on left side not confluent with pharyngocutaneous duct. Ventral aorta branches at gill pouches 4-5. Ventral finfold low. Caudal finfold rounded, poorly developed, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 37.3; branchial length 1.9; trunk length 47.6; tail length 12.0; body width 6.6; body depth including VFF 7.6; body depth excluding VFF 6.8; body depth over cloaca 7.7; tail depth 7.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps in the posterior row of cusps. Anterior unicusps 12-13. Posterior unicusps 12-13. Total cusps 60. Prebranchial pores 26. No branchial pores. Trunk pores 43-45. Tail pores 9-10. Total pores 79-80.

Color in alcohol: body uniformly light brown; margins of gill apertures the same color as body.

Size: Known only from the holotype, 220 mm TL (Mok *et al*., 2001).

Distribution and habitat: Know only from type locality, off La Punta de los Remedios, Colombia, Caribbean Sea, on the upper continental slope at depths from 470 to 488 m.

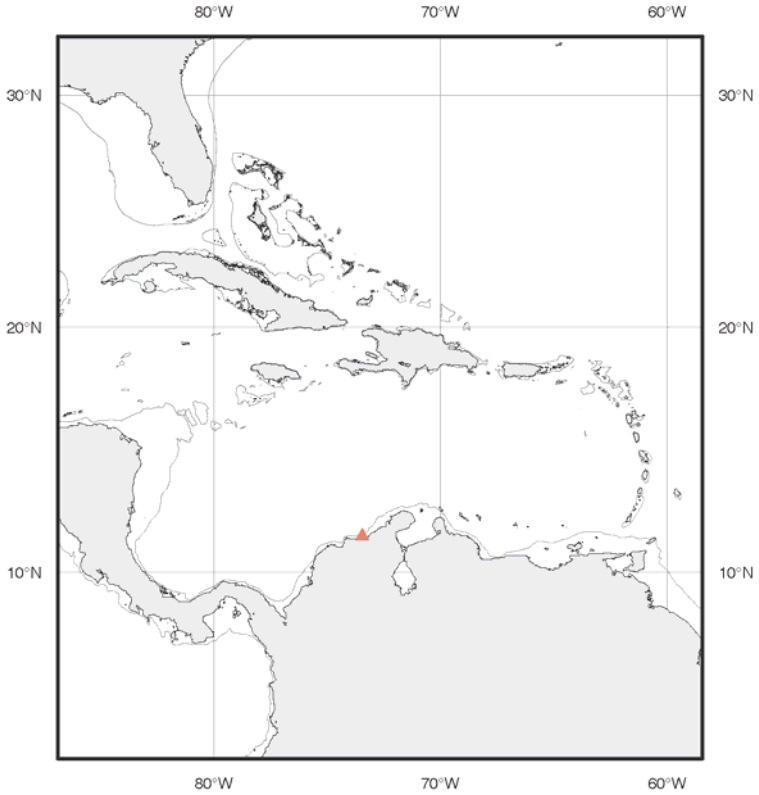


Fig. 45. Distribution of *Paramyxine ancon.*

Interest to fishery: None.

Remarks: The description above was based on data provided by Mok *et al*. (2001).

Common names: FAO: Ancon hagfish.

***Paramyxine atami* Dean, 1904**

Paramyxine atami Dean, 1904: 14, Figs. 1m-n, 2d, 3a, 4c, Pl. 1 (figs. 3-5) [original description; type locality: off Cape Manazuru, near hot springs of Atami, Sagami Sea, 270 fm (494 m); holotype: ZUMT uncat. (lost)]. –Jordan *et al*., 1913: 6 [catalog; Sagami Sea]. –Jordan, 1920: 506 [type species]. –Jordan and Hubbs, 1925: 97 [Misaki]. –Holly, 1933: 49, Fig. 55 [Japan]. –Matsubara, 1937: 13, Fig. 2 (right) [in part, only data from the holotype]. –Bigelow and Schroeder, 1952: 3 [comparison with ***Paramyxine springeri***]. –Kamohara, 1952: 4 [Mimase]. –Mori, 1956: 2

[southern Japan]. –Kamohara, 1958: 3 [in part, Kochi]. –Teng, 1958: 6 [identification key]. –Strahan and Honma, 1960: 27 [in part, only data on the holotype]. –Adam and Strahan, 1963: 7 [Japan]. –Fowler, 1964: 49 [catalog of world fishes]. –Kamohara, 1964: 5 [in part, Kochi]. –Sato, 1984: 1, Fig. 1 [in part, specimens with 3/3 multicusp pattern]. –Gorbman *et al*., 1990: 14 [in part, collections from eastern Japan]. –Iwata, 1993: 84 [in part, specimens with 3/3 multicusp pattern]. –Honma, 1998: 50 [in part, specimens with 3/3 multicusp pattern from eastern Japan]. –Wisner, 1999: 309, Figs. 3, 5 [description of subfamilies]. –Iwata, 2000: 109 [in part, specimens with 3/3 multicusp pattern]. –Mok, 2001: 358 [nasal-sinus papillae]. –Shinohara *et al*., 2001: 286 [catalogue; Tosa Bay]. –McMillan and Wisner, 2004: 57, Fig. 5 [identification key, redescription; eastern Japan]. –Soto and Mincarone, 2004: 15 [MOVI catalog of fishes].

Eptatretus atami. –Hardisty, 1979: 19 [Japan]. –Fernholm, 1998: 34 [Sagami and Suruga Bay, Japan]. –Nakabo, 2002: 109 [in part, specimens with 3/3 multicusp pattern from eastern Japan].

Material examined: 3 specimens. JAPAN: MNHN 1989-1201 (ex HUMZ 49309), 1(595 mm), Honshu Island, Sagami Bay off Sakagawa river, T. Shimizu and T. Kanayama, 10 Nov. 1975; SU 23480, 1(400 mm), Misaki, Sagami Bay, K. Aoki (obtained by D. S. Jordan in 1911); USNM 161442, 1(495 mm), Suruga Gulf, Ose Saki, S. 50 degrees E., 6.5 miles, 35°05'50"N, 138°41'15"E, 293 fm (536 m), RV *Albatross*, sta. 5067, 15 Oct. 1906.

Diagnostic features: Body elongated, its depth 7-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots inconspicuous. Three pairs of barbels on head; first two about equal in size (0.7-1.1% TL), third one longer (1.6-1.9% TL). Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture confluent with pharyngocutaneous duct on left side. Dental muscle overlies gill pouches 2-3. Ventral aorta branches at gill pouches 5-6. Ventral finfold well developed (2 to 10 mm high), beginning within anterior 10-22% of trunk, extending backward to the cloaca. Caudal finfold rounded, well developed, beginning

immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26.6-30.2; branchial length 1.3-4.2; trunk length 53.9-56.1; tail length 11.1-14.2; body depth including VFF 8.1-9.0; body depth excluding VFF 7.9-8.0; body depth over cloaca 6.3-8.8; tail depth 7.4-8.8. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 9-10. Posterior unicusps 8-10. Total cusps 47-52. Prebranchial pores 17-19. Branchial pores 0-1. Trunk pores 43-47. Tail pores 9-12. Total pores 71-78.

Color in alcohol: body uniformly dark purplish-brown; mouth with occasional pale margin; branchial area with a prominent white rectangle caused by the merging of the pale rings around the closely spaced gill apertures; no other pale areas.

Size: Maximum total length 610 mm (McMillan and Wisner, 2004).

Distribution and habitat: Southeastern Japan, from Sagami Bay to Tosa Bay, at depths from 300 to 536 m.

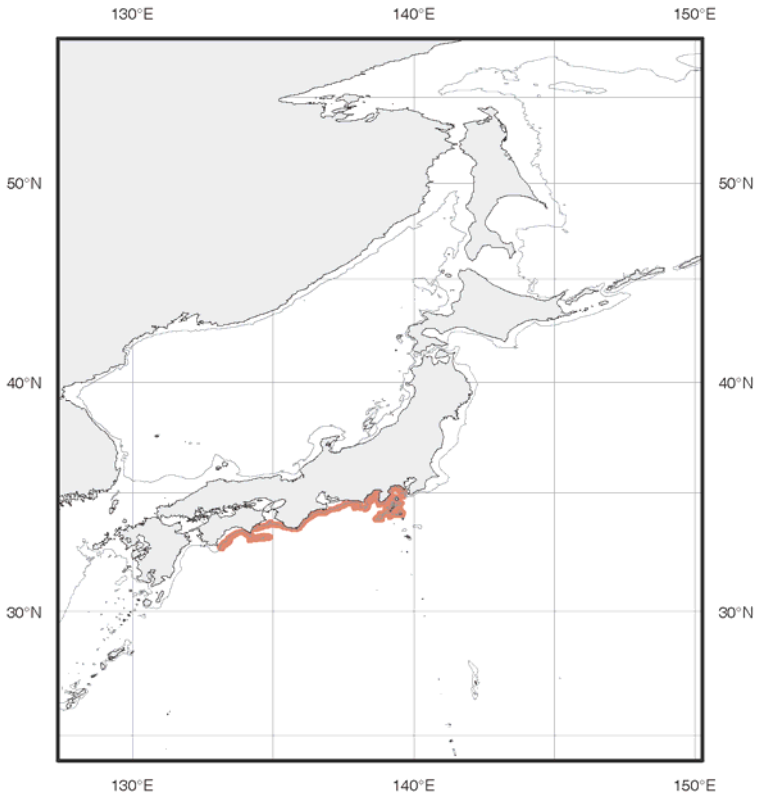


Fig. 46. Distribution of *Paramyxine atami.*

Interest to fishery: See Introduction accounts on Fisheries.

Remarks: Some six-gilled ***Paramyxine*** species previously misidentified (at all or in part) as ***P. atami*** have frequently been reported from Taiwanese, Japanese or Korean waters (e.g., Matsubara, 1937, 1955; Mori, 1952; Lindberg and Legeza, 1959; Strahan and Homna, 1960, 1961; Strahan, 1962, 1975; Shen and Tao, 1975; Sato, 1984; Yamada *et al*., 1986; Iwata, 1993, 2000; Honma, 1998; Nakabo, 2002, Youn, 2002). Those from Taiwan were described by Kuo *et al*. (1994) as ***P. fernholmi***, ***P. sheni***, or ***P. wisneri***. Those from Japan have been recently described by McMillan and Wisner (2004) as ***P. moki*** or ***P. walkeri***.

In the specimens of ***P. atami*** examined by McMillan and Wisner (2004) the caudal finfold becomes a fleshy ridge along dorsal mid-line extending anteriorly to about 1/3 of trunk length. Bigelow and Schroeder (1952) noted the presence of a low dermal ridge along dorsal mid-line of a single specimen. However, this character was not observed on the specimens examined by me, or even by previous authors, and probably it was result of the preservation process.

The description above was based on data provided by McMillan and Wisner (2004) in combination with those from the material examined.

Common names: JAPAN: Kuro-mekura-unagi; FAO: Brown hagfish.

Paramyxine cheni Shen and Tao, 1975

Paramyxine cheni Shen and Tao, 1975: 71, Fig. 3a-e [original description; type locality: southwestern Taiwan, Tong-Kong, 20°25.0'N, 120°26.3'E, 100 fm (183 m); type series: holotype, NTUM 02723 (formerly NTU 7502711), paratypes, NTUM 02724 (2)]. –Shen, 1984a: 1, Pl. 1, Fig. 1-4 [southwestern Taiwan]. –Shen, 1984b: 45 [identification key; Taiwan]. –Kuo *et al*., 1994: 132, Fig. 7f [identification key, redescription]. –Honma, 1998: 50 [identification key; southwest Taiwan]. –Paxton, 2000: 577 [South China Sea]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes]. –McMillan and Wisner, 2004:

59 [identification key, redescription; Taiwan].

Eptatretus cheni. –Fernholm, 1998: 34 [SW Taiwan].

Material examined: 8 specimens. TAIWAN: SIO 84-14, 2(280-391 mm), Ming-Tenn Yu, Tungkong, no date; SIO 00-31, 2(148-211 mm), 22°35.625'N, 120°14.148'E, 156 m, 15 Nov. 1996; USNM 359309, 2(298-370 mm), 22°14'09"N, 120°35'38"E, H.-K. Mok, 5 Jun. 1996; USNM 359310, 2(161-177 mm), 22°23'17"N, 120°15'31"E, 225 m, H.-K. Mok, 9 May 1998.

Diagnostic features: Body elongated, its depth 7-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Eyespots absent. Three pairs of barbels on head; first two about equal in size (0.6-1.5% TL), third one longer (1.0-2.0% TL). Five pairs of gill pouches corresponding to 5 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture on left side not confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 3-4. Ventral finfold absent or vestigial (less than 1 mm high), beginning within anterior 16-30% of trunk, extending backward to the cloaca. Caudal finfold rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 33.3-35.5; branchial length 2.2-3.4; trunk length 45.9-50.8; tail length 13.2-16.7; body width 4.8-6.3; body depth including VFF 8.1-9.9; body depth excluding VFF 7.7-9.6; body depth over cloaca 7.8-9.9; tail depth 7.6-10.2. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 9-11. Posterior unicusps 8-11. Total cusps 50-53. Prebranchial pores 24-27. No branchial pores. Trunk pores 41-46. Tail pores 7-10. Total pores 75-81.

Color in alcohol: body dark brown dorsally, lighter ventrally; tip of barbels pale; gill apertures and slime pores without pale margins; ventral finfold (when present) with narrow whitish margin; caudal finfold occasionally with a narrow pale margin.

Size: Maximum total length 473 mm (Mok and Chen, 2001).

Distribution and habitat: Southwestern Taiwan, at depths from 156 to 268 m.

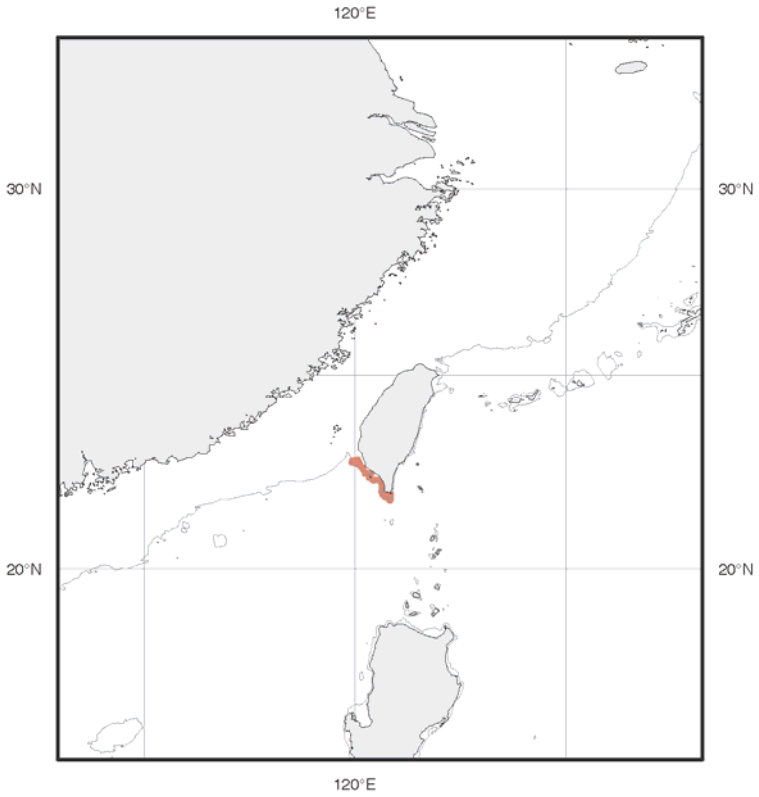


Fig. 47. Distribution of *Paramyxine cheni.*

Interest to fishery: None.

Remarks: The multicusp pattern was given as 3/2 by Shen and Tao (1975), but later corrected to 3/3 by Kuo *et al*. (1994). According to McMillan and Wisner (2004) a 333-mm male had developing testes and a 313-mm female had eggs to 4 mm.

Common names: FAO: Chen's hagfish.

Paramyxine chinensis (Kuo and Mok, 1994)

Eptatretus chinensis Kuo and Mok, 1994: 246, Figs. 2-3 [original description; type locality: South China Sea, 19°37'N, 113°14'E, 600 m; type series: holotype, NSYSU 2866, paratypes, NSYSU 2867 (2)]. –Fernholm, 1998: 34 [South China Sea]. –Honma, 1998: 50 [identification key; South China Sea]. –Paxton, 2000: 577 [South China Sea]. –Mok, 2001: 358 [nasal-sinus papillae]. –McMillan and Wisner, 2004: 54 [South China Sea and SW Taiwan]. –Chen *et al*., 2005: Figs. 1, 3 [redescription].

Material examined: None.

Diagnostic features: Body elongated; prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Three pairs of barbels on head; the first two about equal in size, the third one longer. Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last branchial duct confluent with the pharyngocutaneous duct on the left side. Dental muscle overlies gill pouches 2-3. Ventral aorta branches at gill pouch 6. Ventral finfold usually present; it extends from well behind pharyngocutaneous duct to cloaca. Caudal finfold thickened ventrally, thinner around tail, ending dorsally about over cloaca.

Body proportions (in percentage of TL): prebranchial length 24.7-35.3; branchial length 4.8-8.0; trunk length 45.6-53.1; tail length 13.9-18.6; tail depth 7.1-10.2. Three-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 8-10. Posterior unicusps 8-10. Prebranchial pores 15-19. Branchial pores 3-5 (not all gill apertures have an associated slime pore and, when a slime pore did not occurs, it is more often in the posterior gill apertures; slime pores never found next to the last pair of gill apertures). Trunk pores 40-47. Tail pores 11-14.

Color in alcohol: body brownish gray; gill apertures with pale margins; ventral finfold white; slime pores without pale margins.

Size: Maximum total length 540 mm (Chen *et al*., 2005).

Distribution and habitat: East of Hainan Island (19°37'N, 113°14'E), and other localities in the South China Sea (not specified on the map). On the slopes at depths from 500 to 600 m.

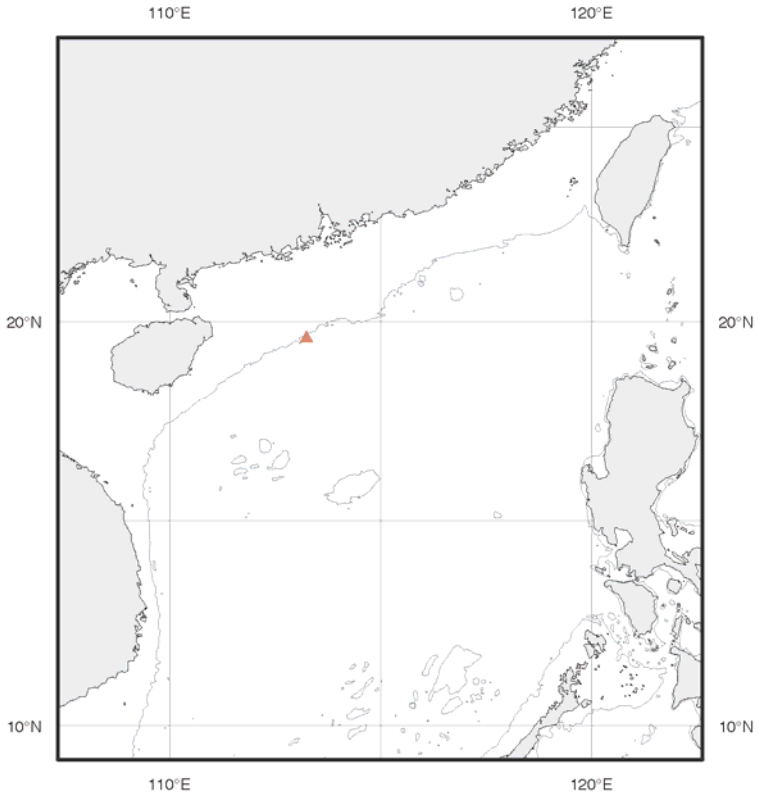


Fig. 48. Distribution of *Paramyxine chinensis.*

Interest to fishery: Fishermen at Tungkang, southern Taiwan, have trapped hagfishes from the South China Sea and their catches of ***P. chinenses*** have been sold in the fish market at Tungkang (Chen *et al*., 2005).

Remarks: Based on molecular studies, Chen *et al*. (2005) stated that ***Paramyxine chinensis***, originally described in ***Eptatretus***, is more closely related to ***Paramyxine*** and ***Quadratus*** species. In spite of no specimen was available for examination, some morphological data provided by Kuo and Mok (1994) and Chen *et al*. (2005) can also support this conclusion.

Paramyxine chinensis was originally described from five specimens colleted to east of Hainan Island, at 600 m depth (Kuo and Mok, 1994), and later redescribed by Chen *et al*. (2005) based on 30 additional specimens trapped from the South China Sea, at depths of approximately 500 m. The description above was based on the combination of data presented by these authors. Chen *et al*. (2005) stated that ***P. chinensis*** was described based on five type specimens. However, there are only three type specimens listed in the original description and other two that were used in molecular studies, which have no type status (Kuo and Mok, 1994).

Common names: FAO: Chinese hagfish.

Paramyxine fernholmi Kuo, Huang and Mok, 1994

Paramyxine fernholmi Kuo, Huang and Mok, 1994: 135, Figs. 3e, 7g, 9a [original description; type locality: southwest coast of Taiwan; type series: holotype, NSYU 2864, paratypes, NSYU 2863 (2)]. –Honma, 1998: 50 [identification key; east and southeast Taiwan]. –Paxton, 2000: 577 [South China Sea]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes]. –Mok *et al.*, 2001: 1031 [comparison with ***Quadratus ancon***]. –McMillan and Wisner, 2004: 59 [identification key, redescription; Taiwan].

Eptatretus fernholmi. –Fernholm, 1998: 34 [Taiwan].

Material examined: 2 specimens. TAIWAN: SIO 00-183, 1(330 mm), and USNM 363248, 1(310 mm), 22°23'25"N, 120°14'08"E, 384 m, H.-K. Mok, 10 May 1996.

Diagnostic features: Body elongated, its depth 5-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots inconspicuous. Three pairs of barbels on head; first two about equal in size, third one longer. Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture on left side not confluent with pharyngocutaneous duct. Dental muscle overlies

gill pouches 1-3. Ventral aorta branches at gill pouches 3-4. Ventral finfold vestigial, 1 mm high, beginning within anterior 26-36% of trunk, extending backward to the cloaca. Caudal finfold rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 29.8-32.5; branchial length 2.0-2.9; trunk length 49.8-51.3; tail length 14.4-16.3; body depth including VFF 6.2-8.0; body depth excluding VFF 5.6-8.0; body depth over cloaca 5.2-6.3; tail depth 7.0-9.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 8-10. Posterior unicusps 8-10. Total cusps 42-50. Prebranchial pores 16-23. No branchial pores. Trunk pores 38-44. Tail pores 6-11. Total pores 64-71.

Color in alcohol: body light brown dorsally and grayish white ventrally; mouth, gill apertures, and ventral finfold with narrow whitish margins; barbels and slime pores the same color as body.

Size: Maximum total length 359 mm (McMillan and Wisner, 2004).

Distribution and habitat: Southwestern Taiwan, at depths from 200 to 412 m.

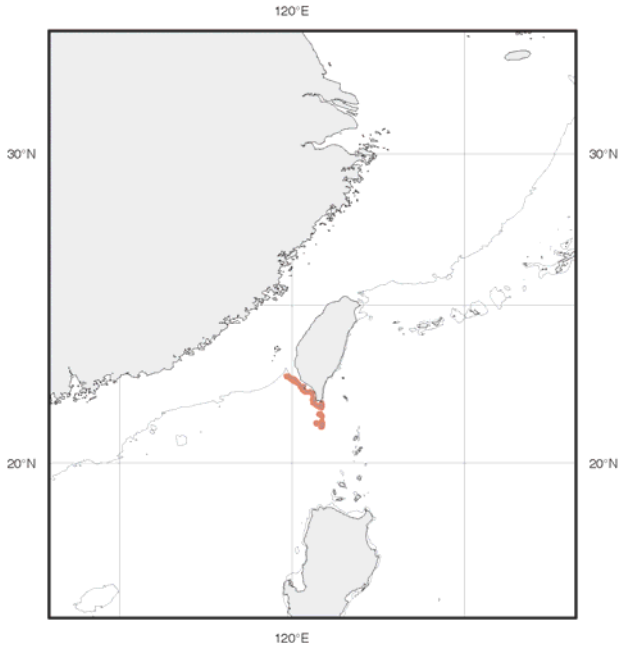


Fig. 49. Distribution of *Paramyxine fernholmi.*

Interest to fishery: None.

Remarks: According to Kuo *et al*. (1994), in February, 12.2% of the specimens from the southeast region carried eggs, the largest one was 28.3 mm, taken from a 357-mm female. The smallest adult female with eggs was 275 mm TL.

Common names: Fernholm's hagfish.

Paramyxine moki McMillan and Wisner, 2004

Paramyxine moki McMillan and Wisner, 2004: 60, Fig. 6 [original description; type locality: Koajiro-wan, off Kanagawa-ken, Sagamy Bay, E coast of Honshu, Japan, 100 m; type series: holotype, SIO 87-104, paratypes, SIO 87-104 (8)].

Material examined: None.

Diagnostic features: Body elongated, its depth 5-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Eyespots faint or absent. Three pairs of barbels on head; first two about equal in size, third one longer. Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture on left side confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 3-4. Ventral finfold well developed. Caudal finfold rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26.8-30.9; branchial length 1.4-3.0; trunk length 49.2-55.1; tail length 15.4-19.5; body depth including VFF 6.7-10.3; body depth excluding VFF 5.2-8.2; body depth over cloaca 4.6-5.7; tail depth 7.7-9.7. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of

cusps. Anterior unicusps 6-8. Posterior unicusps 7-9. Total cusps 38-42. Prebranchial pores 18-21. No branchial pores. Trunk pores 44-50. Tail pores 10-14. Total pores 75-82.

Color in alcohol: body dark brown, slightly lighter ventrally; small pale area around mouth; barbels the same color as body; gill apertures with narrow whitish margins; slime pores without pale margins; ventral finfold with wide pale margin; caudal finfold without pale margin.

Size: Maximum total length 470 mm (McMillan and Wisner, 2004).

Distribution and habitat: Known only from Misaki, Sagami Bay, Japan, on shallow waters at 100 m depth.

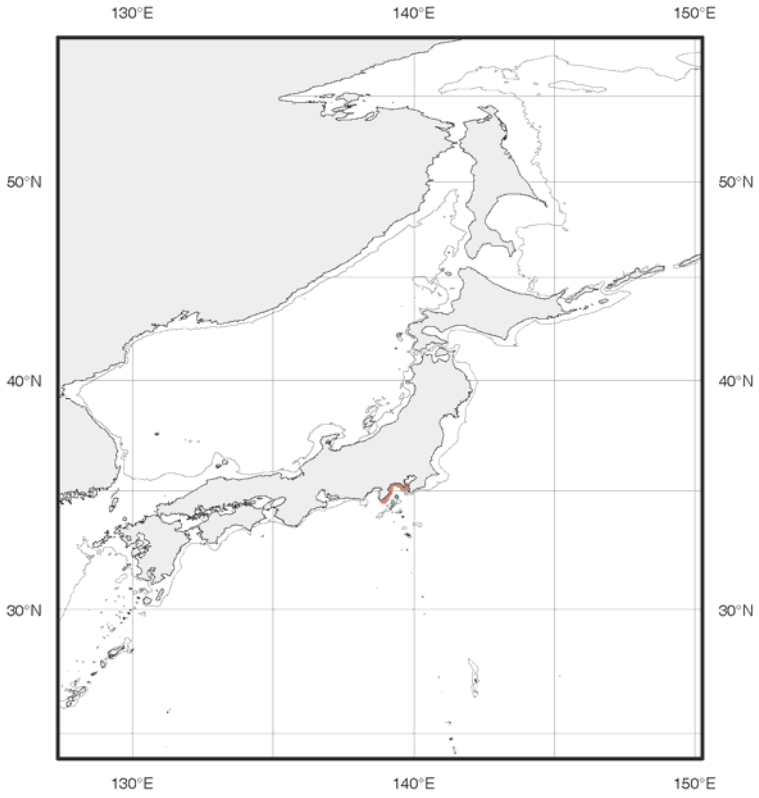


Fig. 50. Distribution of *Paramyxine moki.*

Interest to fishery: Probably sold as ***Paramyxine atami***.

Remarks: For many years some six-gilled Japanese ***Paramyxine*** with 3/2 multicusp pattern were misidentified (at all or in part) as ***P. atami***, which has a 3/3 multicusp pattern. It is probable that some of them must be regarded to ***P. moki***.

Known only from nine specimens, which were not available for examination. The description above was based on data provided by McMillan and Wisner (2004).

Common names: FAO: Mok's hagfish.

Paramyxine nelsoni Kuo, Huang and Mok, 1994

Paramyxine nelsoni Kuo, Huang and Mok, 1994: 131, Figs. 3d, 7j [original description; type locality: southwest coast of Taiwan, 50-200 m; holotype: NSYU 2857]. –Honma, 1998: 50 [identification key; southwest Taiwan]. –Kuo and Mok, 1999: 89, Figs. 2a, 4a, 6a [redescription; southwestern Taiwan]. –Paxton, 2000: 577 [South China Sea]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes].

Eptatretus nelsoni. –Fernholm, 1998: 34 [SW Taiwan].

Quadratus nelsoni. –Mok *et al.*, 2001: 1031 [comparison with ***Quadratus ancon***]. –Soto and Mincarone, 2004: 15 [MOVI catalog of fishes]. –McMillan and Wisner, 2004: 63, Fig. 8, 11a [identification key, redescription; Taiwan].

Material examined: 4 specimens. TAIWAN: MOVI 16711, 1(216 mm), 22°14'08"N, 120°35'38"E, 156 m, H.-K. Mok, 5 Nov. 1996; SIO 00-184, 1(151 mm), 22°24.420'N, 120°15.564'E, 179 m, H.-K. Mok, 12 Mar. 1997; USNM 358163, 2(142-162 mm), 22°23'30"N, 120°16'04"E, 190 m, 25 Sep. 1996.

Diagnostic features: Body elongated, its depth 14-15% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots absent. Three pairs of barbels on head; first two about equal in size (1.1-1.3% TL), third one longer (2.3-2.4% TL). Five (rarely 4) pairs of gill pouches corresponding to 5 (rarely 4) pairs of gill apertures. Gill apertures crowded, closely spaced

in a nonlinear pattern. Last gill aperture on left side usually confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 3-4. Ventral finfold vestigial. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 30.5-32.6; branchial length 1.2-2.8; trunk length 49.5-52.6; tail length 15.0-15.5; body width 8.9-9.2; body depth including VFF 15.0-15.5; body depth excluding VFF 14.7-15.3; body depth over cloaca 6.4-7.1; tail depth 8.9-10.1. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 5-8. Posterior unicusps 5-7. Total cusps 32-38. Prebranchial pores 14-20. No branchial pores. Trunk pores 35-39. Tail pores 6-10. Total pores 57-67.

Color in alcohol: body dark brown dorsally, very light ventrally; tip of barbels pale; gill apertures with pale margins; ventral finfold with narrow pale margin; caudal finfold occasionally with pale margin.

Size: Maximum total length 260 mm (Kuo and Mok, 1999).

Distribution and habitat: Known from southwestern Taiwan, at depths from 50 to 250 m.

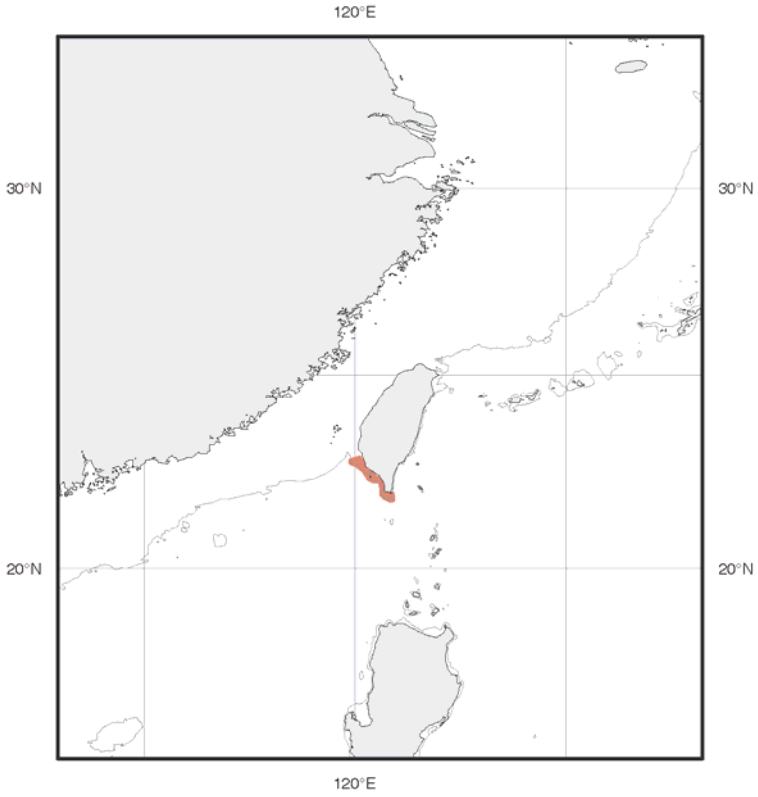


Fig. 51. Distribution of *Paramyxine nelsoni.*

Interest to fishery: None.

Remarks: The number of gill pouches in the original description of ***P. nelsoni*** was reported as four, based on the holotype, a small specimen with only four gill apertures. When latter dissected, it was found to have five gill pouches. Kuo and Mok (1999) redescribed the species based on 309 specimens, of which just nine had four gill apertures and/or pouches.

Paramyxine nelsoni is a dwarf species, with females maturing at about 190 mm. In 277 specimens examined by Kuo and Mok (1999) no hermaphroditism was notes, and the sex ratio (male/female) was 1.36. McMillan and Wisner (2004) examined one 244-mm female with 11 eggs of about 15 mm long with polar caps already forming. Length-weight equations are given by Kuo and Mok (1999) for specimens from southwestern Taiwan: females, $W = 0.0084 \times TL^{2.707}$ ($r^2 = 0.792$); males, $W = 0.0152 \times TL^{2.452}$ ($r^2 = 0.678$).

Common names: FAO: Nelson's hagfish.

***Paramyxine sheni* Kuo, Huang and Mok, 1994**

Paramyxine sheni Kuo, Huang and Mok, 1994: 132, Figs. 5, 7e [original description; type locality: southwest coast of Taiwan, 450 m; type series: holotype, NSYU 2585, paratypes, NSYSU 2865 (11)]. –Honma, 1998: 50 [identification key; east and southwest Taiwan]. –Paxton, 2000: 577 [South China Sea]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes]. –McMillan and Wisner, 2004: 60 [identification key, redescription; Taiwan].

Eptatretus sheni. –Fernholm, 1998: 34 [SW Taiwan].

Material examined: 8 specimens. TAIWAN: SIO 00-34, 2(191-202 mm), and USNM 358164, 2(118-248 mm), 22°22.917'N, 120°09.802'E, 585 m, H.-K. Mok, 3 Aug. 1998; SIO 99-90, 2(390-400 mm), and USNM 361239, 2(106-128 mm), NW of Hsinchu, 25°08.917'N, 121°47.132'E, 427 m, shrimp trap, H.-K. Mok, 25 Sep. 1997.

Diagnostic features: Body elongated, its depth 7-9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots prominent. Three pairs of barbels on head; first two about equal in size (0.9-1.6% TL), third one longer (1.6-2.2% TL). Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture on left side confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 2-4. Ventral aorta branches at gill pouches 4-5. Ventral finfold low, 1-4 mm high, beginning within anterior 23-37% of trunk, extending backward to the cloaca. Caudal finfold wide, rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 24.5-30.7; branchial length 2.4-4.2; trunk length 53.2-56.2; tail length 14.4-16.7; body width 5.6-6.6; body depth including VFF 7.3-10.0; body depth excluding VFF 6.9-9.2; body depth over cloaca 7.9-9.2; tail depth 8.3-10.0. Three-cusp multicusps on the anterior and posterior rows of

cusps. Anterior unicusps 9-12. Posterior unicusps 8-11. Total cusps 48-53. Prebranchial pores 12-18. Branchial pores 0-2. Trunk pores 39-47. Tail pores 8-12. Total pores 62-74.

Color in alcohol: body dark brown, slightly lighter ventrally; occasional pale area around mouth; tip of barbels whitish; gill apertures with narrow whitish margins; slime pores, ventral finfold and caudal finfold without pale margin.

Size: Maximum total length 436 mm (Mok and Chen, 2001).

Distribution and habitat: Northern, northeastern, and southwestern Taiwan, on the slopes at depths from 200 to 800 m. It probably occurs also off east coast.

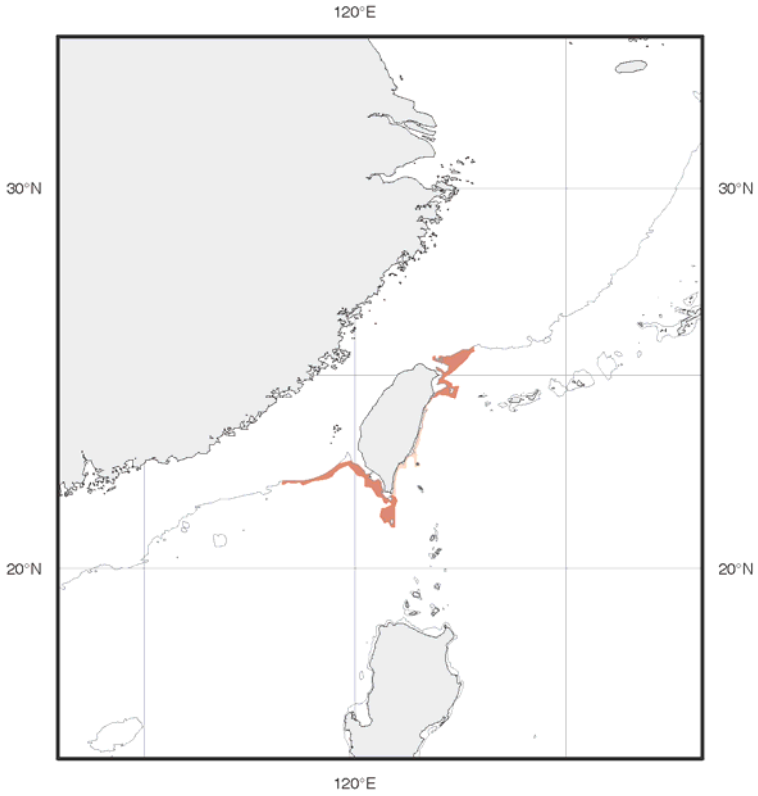


Fig. 52. Distribution of *Paramyxine sheni.*

Interest to fishery: None.

Remarks: According to Kuo *et al*. (1994), the reproductive season of ***P. sheni*** in Taiwanese waters ranges from January to March. In February, 12.5% of the specimens

collected from the southwest region carried eggs. The largest egg was 38.8 mm. The smallest female with eggs, most in round or slightly ovoid stages was 355 mm TL. Stomach contents of ***P. sheni*** contained shrimp, crab, mollusk, and fish.

Common names: FAO: Shen's hagfish.

Paramyxine springeri Bigelow and Schroeder, 1952

Paramyxine springeri Bigelow and Schroeder, 1952: 5, Figs. 1-6 [original description; type locality: Gulf of Mexico, 27°44'N, 85°09'W, 254 fm (464 m), Oregon sta. 489; type series: holotype, USNM 161512, paratypes (listed as additional material), MCZ 37399 (1), USNM 161513 (1)]. –Springer and Bullis, 1956: 40 [survey records]. –Teng, 1958: 6 [identification key]. –Lindberg and Legeza, 1959: 24 [comparison with ***Paramyxine atami***]. –Strahan and Honma, 1961: 339, Fig. 4(11) [identification key, further description; Gulf of Mexico]. –Adam and Strahan, 1963: 7 [Gulf of Mexico]. –Fowler, 1964: 49 [catalog of world fishes]. –Bullis and Thompson, 1965: 17 [survey records]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok *et al*., 2001: 1028 [comparison with ***Eptatretus wayuu***]. –Soto and Mincarone, 2004: 15 [MOVI catalog of fishes].

Eptatretus springeri. –Strahan, 1975: 142, Fig. 2e [identification key]. –Hardisty, 1979: 19 [Gulf of Mexico]. –Fernholm and Hubbs, 1981: 74, Figs. 2a-b, 3 [identification key, redescription; northeastern part of Gulf of Mexico]. –Fernholm, 1982: 434 [identification key]. –Hensley, 1985: 866 [identification key]. –Haedrich and Merrett, 1988: 1329 [Bahamas]. –Fernholm, 1998: 34 [Gulf of Mexico]. –McEachran and Fechhelm, 1998: 33 [identification key, short description; Gulf of Mexico]. –Wisner, 1999: 311, Fig. 8 [description of subfamilies]. –Mincarone, 2000: 815 [identification key]. –Fernholm, 2003: 355 [W of Florida].

Material examined: 12 specimens. UNITED STATES OF AMERICA: USNM 161512, holotype, 565 mm, Gulf of Mexico, off Florida, 27°44'N, 85°09'W, 254 fm (464 m), RV *Oregon*, 29 Sep. 1951; MOVI 36930 (ex USNM 218396), 1(512 mm), Gulf of Mexico, off

Florida, 29°10'30"N, 86°46'00"W, 550 m, RV *Oregon II*, sta. 10899, 4 Feb. 1970, J. T. Williams; SIO 76-248 (ex UMML 4405), 1(520 mm), Gulf of Mexico, 29°17'N, 87°41'W, 240 fm (439 m), 18 Feb. 1956; TCWC 6382.09, 2(410-510 mm), Gulf of Mexico, 27°47'00"N, 90°16'54"W, 687 m, C. Kennicutt, 28 Feb. 1986; TCWC 7021.01, 1(573 mm), Northern Gulf of Mexico, continental slope, 28°01'00"N, 90°05'06"W, 448-501 m, 12 Nov. 1984; TCWC 7045.13, 1(370 mm), Northern Gulf of Mexico, continental slope, 27°40'10"N, 92°09'14"W, 516-527 m, 10 Jun. 1985; TCWC 7049.25, 2(154-173 mm), Northern Gulf of Mexico, continental slope, 27°51'43"N, 90°45'47"W, 472-486 m, 23 May 1985; TCWC 8438.02, 1(416 mm), Gulf of Mexico, 29°09'17"N, 88°03'16"W, 518-655 m, M. Wicksten, 26 Oct. 1989; UF 27898, 2(500-550 mm), Gulf of Mexico, off Florida, SSE of Santa Rosa Sound, 29°03'N, 86°38'W, 225 fm (411 m), RV *Oregon II*, US Bureau of Commercial Fisheries, 18 Sep. 1973.

Fig. 53. *Paramyxine springeri* (after Bigelow and Schroeder, 1952).

Diagnostic features: Body elongated, its depth 6-9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots usually conspicuous. Three pairs of barbels on head; first two about equal in size (0.7-1.8% TL), third one longer (1.5-2.5% TL). Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a straight line. Last gill aperture on left side confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 3-4. Ventral aorta branches at gill pouches 3-6. Ventral finfold vestigial to well developed, 1-7 mm high, beginning within anterior 21-41% of trunk, extending backward to the cloaca. Caudal finfold well developed, rounded, the ventral

outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 22.4-26.0; branchial length 2.5-4.7; trunk length 55.3-60.7; tail length 15.0-17.8; body width 4.4-6.7; body depth including VFF 6.3-9.9; body depth excluding VFF 6.2-9.2; body depth over cloaca 5.3-7.1; tail depth 7.2-9.5. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 10-11. Posterior unicusps 9-10. Total cusps 49-52. Prebranchial pores 16-19. Branchial pores 1-4. Trunk pores 53-57. Tail pores 10-13. Total pores 83-90.

Color in alcohol: body light to dark brown; tip of barbels, mouth area, and margins of gill apertures whitish; ventral and caudal finfolds the same color as body.

Size: Maximum total length 590 mm (Bigelow and Schroeder, 1952).

Distribution and habitat: Northern Gulf of Mexico, on the continental slope at depths from 400 to 730 m depth.

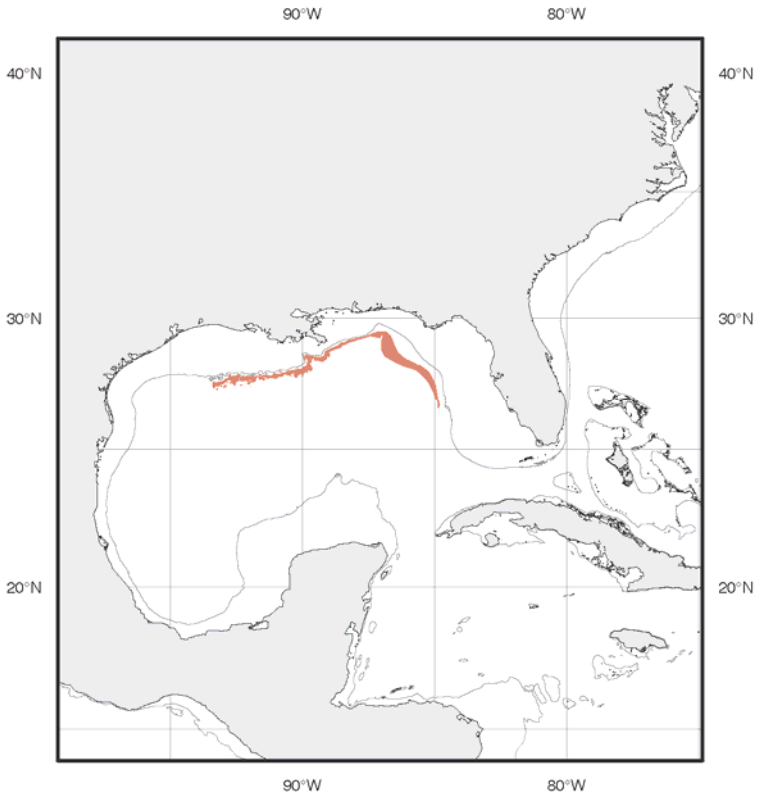


Fig. 54. Distribution of *Paramyxine springeri.*

Interest to fishery: None.

Remarks: Mok *et al*. (2001) stated that ***P. springeri*** belongs to the genus ***Eptatretus*** because the 338-mm female USNM 161513 (paratype of ***P. springeri***) has one slime pore next to each gill aperture (slime pores absent from this area was used as a diagnostic character for ***Paramyxine*** by Kuo *et al*., 1994). However, this paratype is in fact an ***E. minor***, as previously reported by Fernholm and Hubbs (1981) and confirmed on recent examination.

Common names: USA, FAO: Gulf hagfish.

Paramyxine taiwanae Shen and Tao, 1975

Paramyxine taiwanae Shen and Tao, 1975: 73, Figs. 4-5 [original description; type locality: Ta-chi, northeast coast of Taiwan, 24°56.5'N, 121°53.0'E, 100 fm (183 m); type series: holotype, NTUM 7202715, paratypes, NTUM 7200304 (22), NTUM 7200315 (10), NTUM 7200918 (5), NTUM 7201103 (18), NTUM 7300710 (4), NTUM 7500412 (58)]. –Shen, 1984a: 1, Pl. 1, Fig. 1-3a, b [Taiwan]. –Shen, 1984b: 45 [identification key; Taiwan]. –Kuo *et al*., 1994: 134, Figs. 6, 7h [identification key, redescription]. –Honma, 1998: 50 [identification key; northeast and southwest Taiwan]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes].

Eptatretus taiwanae. –Fernholm, 1998: 34 [NE Taiwan].

Quadratus taiwanae. –Wisner, 1999: 309 [designation of type species]. –Mok *et al.*, 2001: 1031 [comparison with ***Quadratus ancon***]. –McMillan and Wisner, 2004: 64, Figs. 9, 11c [identification key; further description; Taiwan].

Material examined: 10 specimens. TAIWAN: SIO 80-212, 6(215-285 mm), Ta-chi, I-lan, 24°57'N, 121°53'E otter trawl, L. Chen, 12 Feb. 1977; USNM 206826, 2(202-220 mm), Tachi, S. C. Shen, no date; USNM 361240, 2(166-171 mm), northeastern Taiwan (fish

market), H.-K. Mok, Aug. 1998.

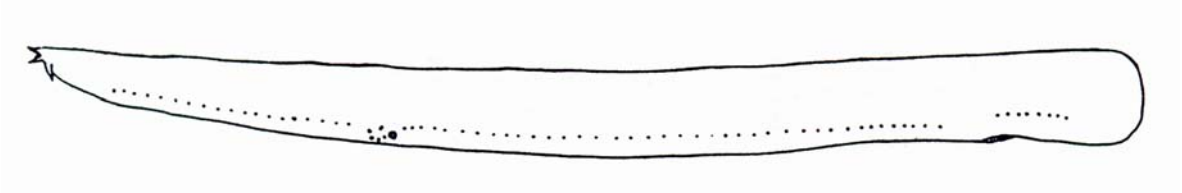


Fig. 55. *Paramyxine taiwanae* (after Shen and Tao, 1975).

Diagnostic features: Body elongated, its depth 6-11% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots absent. Three pairs of barbels on head; first two about equal in size (0.9-1.5% TL), third one longer (1.3-2.3% TL). Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures crowded, closely spaced in a nonlinear pattern. Last gill aperture on left side usually confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 4-5. Ventral finfold vestigial to low, about 1 mm high. Caudal finfold rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 28.1-35.0; branchial length 1.3-2.7; trunk length 51.8-56.0; tail length 12.1-14.6; body depth including VFF 6.4-10.8; body depth excluding VFF 6.3-10.6; body depth over cloaca 8.1-10.0; tail depth 8.1-11.8. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-8. Posterior unicusps 5-9. Total cusps 32-37. Prebranchial pores 16-19. No branchial pores. Trunk pores 36-42. Tail pores 6-9. Total pores 60-68.

Color in alcohol: body dark brown dorsally, gray ventrally; pale area around month; gill apertures with pale margins; ventral and caudal finfolds with pale margins.

Size: Maximum total length 334 mm (McMillan and Wisner, 2004).

Distribution and habitat: Northeastern Taiwan, at depths from 120 to 427 m.

Fig. 56. Distribution of *Paramyxine taiwanae.*

Interest to fishery: None.

Remarks: ***Paramyxine taiwanae*** is a dwarf species maturing at less than 300 mm TL (McMillan and Wisner, 2004). About 12% of specimens from the southwestern Taiwan examined by Kuo *et al*. (1994) had eggs in February, the largest one found in a 295-mm female measured 20.6 mm long.

Common names: FAO: Taiwanese hagfish.

***Paramyxine walkeri* McMillan and Wisner, 2004**

Paramyxine walkeri McMillan and Wisner, 2004: 61, Fig. 7 [original description; type locality: off Choshi, E coast of Honshu Island, Japan, 75 m; type series: holotype, SIO 76-257, paratypes, SIO 76-257 (9)].

Material examined: None.

Diagnostic features: Body elongated, its depth 5-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Eyespots faint or absent. Three pairs of barbels on head; first two about equal in size, third one longer. Six (rarely 5) pairs of gill pouches corresponding to 6 (rarely 5) pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture on left side usually confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 3-4. Ventral finfold low to vestigial. Caudal finfold rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26.5-32.0; branchial length 2.0-3.1; trunk length 52.6-57.7; tail length 13.0-15.6; body width 4.1-5.8; body depth including VFF 6.4-8.4; body depth excluding VFF 6.2-8.2; body depth over cloaca 5.6-6.8; tail depth 7.1-8.3. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-9. Posterior unicusps 7-9. Total cusps 38-44. Prebranchial pores 16-23. No branchial pores. Trunk pores 40-48. Tail pores 9-14. Total pores 69-79.

Color in alcohol: body light to dark brown, slightly lighter ventrally; gill apertures with narrow whitish margins; ventral finfold (when present) with a very narrow pale margin; caudal finfold occasionally with a narrow pale margin.

Size: Maximum total length 518 mm (McMillan and Wisner, 2004).

Distribution and habitat: Known from Choshi Point, eastern Honshu Island, and from Izumosaki to Niigata, on the west coast of Honshu Island, Japan, on shallow waters from 75 to 120 m depth.

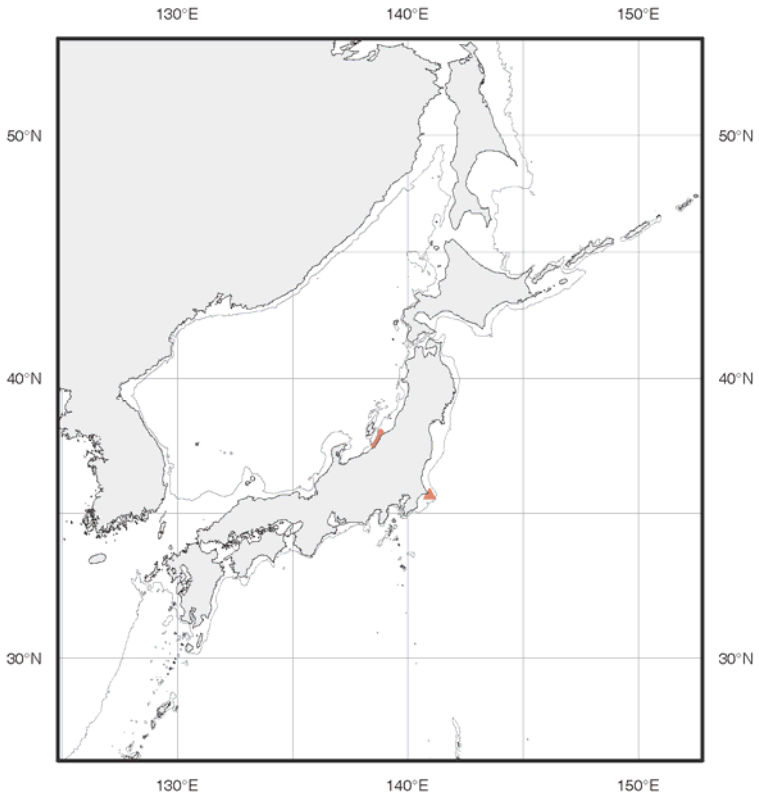


Fig. 57. Distribution of *Paramyxine walkeri.*

Interest to fishery: Probably sold as ***Paramyxine atami***.

Remarks: For many years some six-gilled Japanese ***Paramyxine*** with 3/2 multicusp pattern were misidentified (at all or in part) as ***P. atami***, which has a 3/3 multicusp pattern. It is probable that some of them must be regarded to ***P. walkeri***.

The description above was based on data provided by McMillan and Wisner (2004).

Common names: FAO: Walker's hagfish.

Paramyxine wayuu (Mok, Saavedra-Diaz and Acero-P., 2001)

Eptatretus wayuu Mok, Saavedra-Diaz and Acero-P., 2001: 1026, Figs. 1-3 [original description; type locality: Caribbean coast of Colombia, off the Guajira Peninsula, between 12°24'1.8"N, 72°15'0.6"W and 12°24'22.2"N, 72°14'0.4"W, 300-306 m; type

series: holotype, INVEMAR-PEC 2410, paratype, INVEMAR-PEC 2411 (1)]. – Saavedra-Diaz *et al*., 2003: 967 [endemic species].

Material examined: None.

Diagnostic features: Body elongated, its depth 7-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Eyespots faint. Three pairs of barbels on head; first two about equal in size, third one longer. Five pairs of gill pouches corresponding to 5 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture on left side usually confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 1-2. Ventral finfold well developed. Caudal finfold nearly rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 33.0-33.1; branchial length 3.0-3.5; trunk length 47.8-50.2; tail length 10.9-14.9; body width 6.0-9.5; body depth including VFF 8.6-9.4; body depth excluding VFF 7.0-7.7; body depth over cloaca 7.8-8.8; tail depth 10.1-11.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-8. Posterior unicusps 8-9. Total cusps 41-43. Prebranchial pores 24. Branchial pores 2. Trunk pores 38-40. Tail pores 9. Total pores 73-75.

Color in alcohol: body dark violet, branchial region lighter than other parts of the body; gill aperture with pale margins. In life, the head, body, tail and finfolds are pink.

Size: Known only from two type specimens measuring 194 and 216 mm TL (Mok e*t al*., 2001).

Distribution and habitat: Caribbean Sea, coast of Colombia, on the upper continental slope at depths from 300 to 306 m.

Fig. 58. Distribution of *Paramyxine wayuu.*

Interest to fishery: None.

Remarks: Originally described in the genus ***Eptatretus***, the species is herein replaced in ***Paramyxine*** due to its closely spaced gill apertures and reduced number of branchial pores.

Common names: FAO: Wayuu hagfish.

Paramyxine wisneri Kuo, Huang and Mok, 1994

Paramyxine wisneri Kuo, Huang and Mok, 1994: 137, Figs. 8, 9b [original description; type locality: coastal waters of Fukang, Taiwan, 200 m; type series: holotype, NSYU 2868, paratypes, NSYSU 2869 (3), NSYSU 2870 (2)]. –Honma, 1998: 50 [identification key; southwest Taiwan]. –Mok, 2001: 358 [nasal-sinus papillae]. –McMillan and Wisner, 2004: 62 [identification key, redescription; SE Taiwan].

Eptatretus wisneri. –Fernholm, 1998: 34 [SE Taiwan].

Material examined: 1 specimen. TAIWAN: SIO 02-76 (ex NSYSU 2870), paratype, 1(198 mm), Fukang, H.-K. Mok, 28 Sep. 1990.

Diagnostic features: Body elongated, its depth 8-9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots inconspicuous. Three pairs of barbels on head; first two about equal in size, third one longer. Six pairs of gill pouches corresponding to 6 pairs of gill apertures. Gill apertures closely spaced (but not crowded) in a nearly straight line. Last gill aperture on left side usually confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 2-4. Ventral aorta branches at gill pouches 3-4. Ventral finfold vestigial, 1 mm high. Caudal finfold rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 28.0; branchial length 4.6; trunk length 49.4; tail length 13.6; body width 5.1; body depth including VFF 9.6; body depth excluding VFF 9.3; body depth over cloaca 8.1; tail depth 10.5. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-10. Posterior unicusps 7-9. Total cusps 36-48. Prebranchial pores 15-20. Branchial pores 0-1. Trunk pores 36-44. Tail pores 6-11. Total pores 63-72.

Color in alcohol: body light brown, lighter ventrally; barbels and slime pores the same color as body; gill apertures and ventral finfold with narrow whitish margins; tail darker than body.

Size: Maximum total length 335 mm (Kuo *et al*., 1994).

Distribution and habitat: Southeastern Taiwan, at depths from 330 to 412 m.

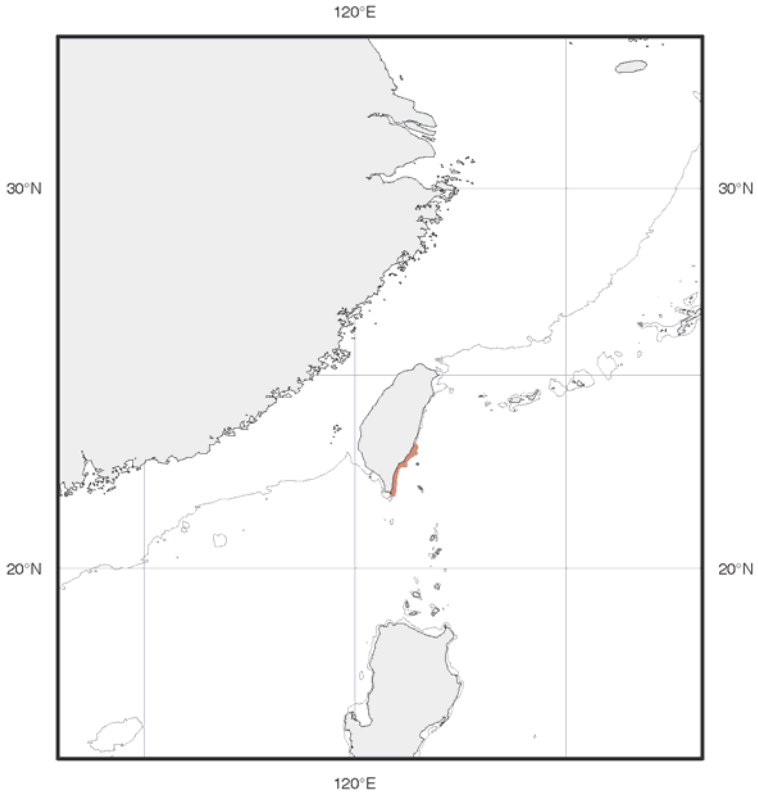


Fig. 59. Distribution of *Paramyxine wisneri.*

Interest to fishery: None.

Remarks: Known only from the type material, six specimens measuring from 159 to 335 mm TL.

Common names: FAO: Wisner's hagfish.

***Paramyxine yangi* Teng, 1958**

Paramyxine yangi Teng, 1958: 3, Figs. 1-2 [original description; type locality: southwest Taiwan (obtained from fish market in Kao-Hsiung); syntypes: Taiwan Fish. Lab. 103423 (1, drawing), 103529 (1)]. –Strahan and Honma, 1961: 339 [identification key; selected characters; southwestern Taiwan]. –Adam and Strahan, 1963: 7 [Formosa]. –Shen and Tao, 1975: 69, Fig. 2 [identification key; redescription; northeastern and southwestern Taiwan]. –Shen, 1984a: 1, Pl. 1, Fig. 1-2a, b, c

[southern Japan to Taiwan]. –Shen, 1984b: 45 [identification key; Taiwan]. –Kuo *et al*., 1994: 132, Figs. 4, 7i [identification key; redescription]. –Honma, 1998: 50 [identification key; northeast and southwest Taiwan]. –Kuo and Mok, 1999: 89, Figs. 2b, 4b, 6b [further description]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes].

Eptatretus yangi. –Strahan, 1975: 141, Fig. 2h [identification key; southwestern cost of Taiwan]. –Hardisty, 1979: 19 [Formosa]. –Fernholm, 1998: 34 [NE and SW Taiwan].

Quadratus yangi. –Wisner, 1999: 310, Figs. 6-7 [description of ***Quadratus***]. –Mok *et al.*, 2001: 1031 [comparison with ***Quadratus ancon***]. –McMillan and Wisner, 2004: 65, Figs. 10, 11b [identification key; redescription; Taiwan, South China Sea]. –Soto and Mincarone, 2004: 15 [MOVI catalog of fishes].

Material examined: 19 specimens. TAIWAN: BMNH 1998.2.2.20-29, 10(185-246 mm), Taiwan Strait, south Formosa, 22°14'N, 120°24'E, no date; MOVI 16710, 1(185 mm), 24°40'54"N, 121°54'06"E, 120 m, H.-K. Mok, 24 Sep. 1997; SIO 76-256, 4(161-275 mm), NE of Taiwan, Ta-chi, 100-150 ft (30-45 m), trawl, local fishermen, 26 May 1972; SIO 00-32, 2(190-212 mm), 24°46.897'N, 121°54.095'E, 120 m, 25 Sep. 1997; USNM 361241, 2(168-199 mm), 22°14'25"N, 120°24'44"E, 226-258 m, H.-K. Mok, 14 Apr. 1997.

Diagnostic features: Body elongated, its depth 6-10% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. No nasal-sinus papillae. Eyespots absent. Three pairs of barbels on head; first two about equal in size (0.8-1.9% TL), third one longer (1.8-2.4% TL). Five pairs of gill pouches corresponding to 5 pairs of gill apertures. Gill apertures crowded, closely spaced in a nonlinear pattern. Last gill aperture on left side confluent with pharyngocutaneous duct. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at gill pouches 4-5. Ventral finfold vestigial to about 3 mm high, beginning within anterior 10-29% of trunk, extending backward to the cloaca. Caudal finfold nearly rounded, the ventral outline nearly straight, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 29.2-32.0; branchial length 1.1-1.7; trunk length 53.2-54.9; tail length 12.2-15.6; body width 3.6-5.9; body depth including VFF 6.9-10.4; body depth excluding VFF 6.3-9.6; body depth over cloaca 6.3-8.8; tail depth 6.5-10.0. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-8. Posterior unicusps 6-9. Total cusps 32-40. Prebranchial pores 16-23. No branchial pores. Trunk pores 39-47. Tail pores 7-12. Total pores 68-79.

Color in alcohol: body brownish-gray dorsally and lighter gray in lateral and ventral surface; tip of barbels pale; month, gill apertures, and ventral finfold with pale margins; caudal finfold occasionally with pale margins.

Size: Maximum total length 296 mm (McMillan and Wisner, 2004).

Distribution and habitat: From northeastern to southwestern Taiwan, from 120 to 261 m, and northern South China Sea, at 547 m depth. It is the most abundant hagfish species in shallower Taiwanese waters (Mok and Chen, 2001). It is sometimes taken with ***P. taiwanae***, ***P. nelsoni***, and ***E. burgeri*** (McMillan and Wisner, 2004).

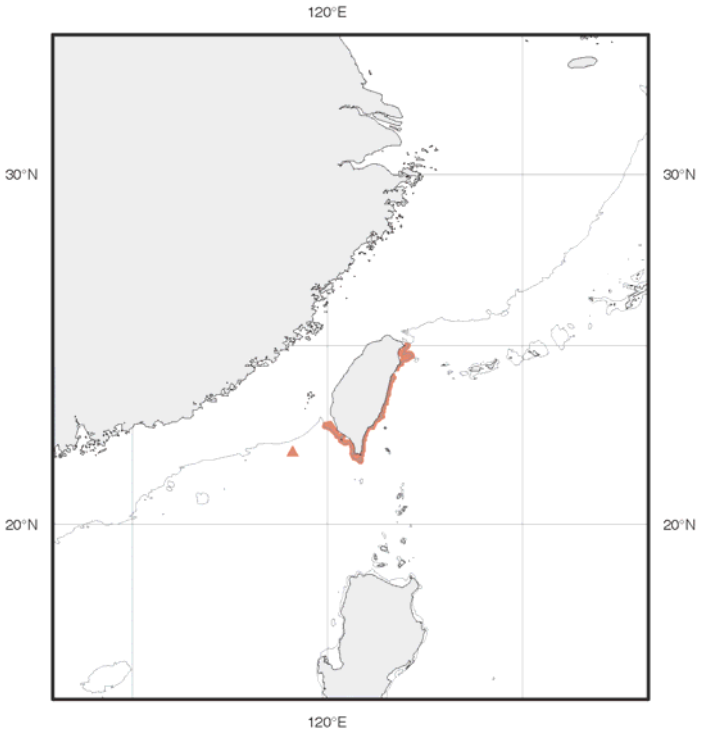


Fig. 60. Distribution of *Paramyxine yangi*.

Interest to fishery: None.

Remarks: ***Paramyxine yangi*** is a dwarf species, with females maturing at about 210 mm. In 256 specimens examined by Kuo and Mok (1999) no hermaphroditism was notes, and the sex ratio (male/female) was 0.68. Length-weight equations are given by Kuo and Mok (1999) for 256 specimens from southwestern Taiwan: females, $W = 0.0084 \times TL^{2.542}$ ($r^2 = 0.832$); males, $W = 0.1118 \times TL^{1.644}$ ($r^2 = 0.687$).

Common names: FAO: Yang's hagfish.

Myxine **Linnaeus, 1758**

Myxine Linnaeus, 1758: 650 [type-species ***Myxine glutinosa*** Linnaeus, 1758; type by monotypy.

Petromyzon (not Linnaeus, 1758). –Walbaum, 1792: 500 [in part; type-species ***Myxine glutinosa*** Linnaeus, 1758].

Gastrobranchus Bloch, 1791: 26 [type-species ***Gastrobranchus coecus*** Bloch, 1791; type by monotypy].

Muraenoblenna La Cepède (ex Commerson), 1803: 652 [type-species ***Muraenoblenna olivacea*** La Cepède, 1803; type by monotypy].

Anopsus Rafinesque, 1815: 93 [type-species ***Muraenoblenna olivacea*** La Cepède, 1803; type by being a replacement name].

Gasterobranchus. –Voigt, 1832: 529 [misspelling for ***Gastrobranchus*** Bloch, 1791; subgenus of ***Myxine***].

Diagnostic features: Efferent branchial ducts open by a common gill aperture on each side, i.e. only one pair of branchial apertures; 5-7 pairs of gill pouches; ventral finfold beginning posterior the pharyngocutaneous duct; gill aperture on the left side confluent with the pharyngocutaneous duct; no paired finfolds.

Distribution: Circunglobal, except Indian Ocean and western South Pacific (Fig. 61).

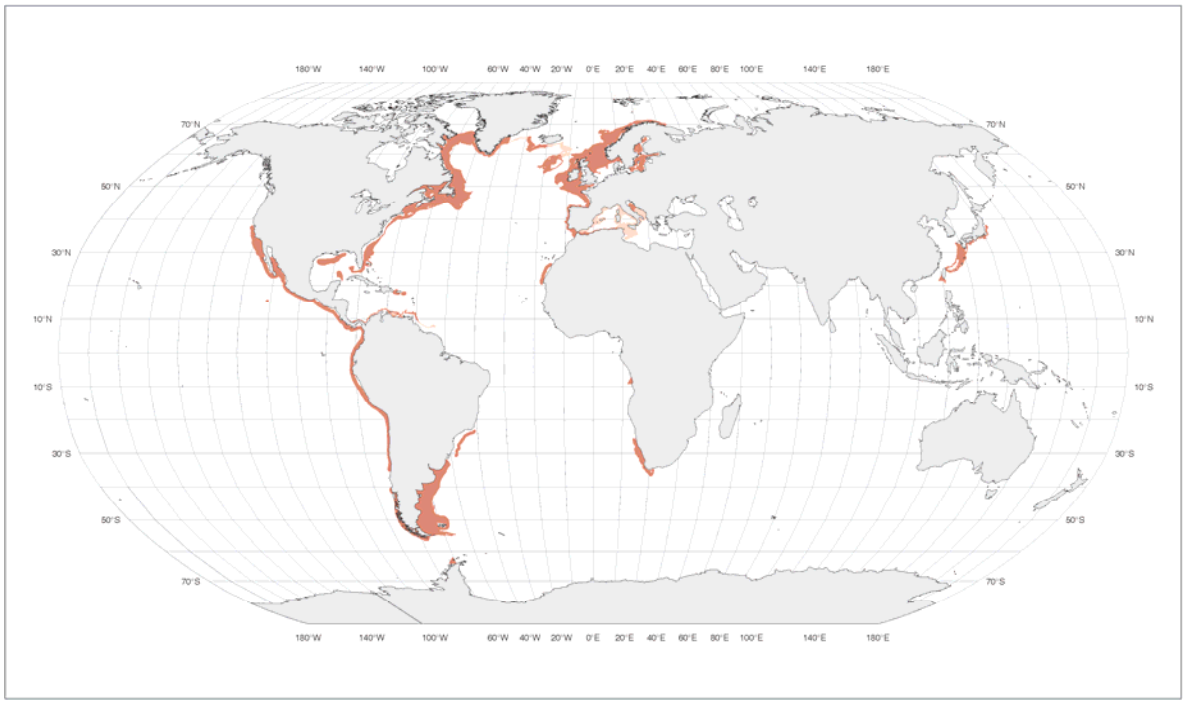


Fig. 61. Global distribution of the genus *Myxine*.

Species: The genus comprises 21 species.

Myxine affinis: Chile to Argentina (South America)

Myxine australis: Chile to southern Brazil (South America)

Myxine capensis: Namibia to South Africa (eastern South Atlantic)

Myxine circifrons: California to Chile (eastern Pacific)

Myxine debueni: Strait of Magellan (South America)

Myxine fernholmi: Falkland Islands (South Atlantic) and Chile (South Pacific)

Myxine formosana: Taiwan (western North Pacific)

Myxine garmani: Japan (western North Pacific)

Myxine glutinosa: North Atlantic and Mediterranean Sea

Myxine hubbsi: USA to Chile (eastern Pacific)

Myxine hubbsoides: Chile (eastern South Pacific)

Myxine ios: Ireland to Angola (eastern Atlantic)

Myxine jespersenae: Greenland and Iceland (North Atlantic)

Myxine knappi: southern Argentina (western South Atlantic)

Myxine kuoi: Taiwan (western North Pacific)

Myxine mccoskeri: Panama to Venezuela (Caribbean Sea)

Myxine mcmillanae: Gulf of Mexico and Caribbean Sea (western Central Atlantic)

Myxine paucidens: Japan (western North Pacific)

Myxine pequenoi: Chile (eastern South Pacific)

Myxine robinsorum: Colombia to Trinidad and Tobago (Caribbean Sea)

Myxine sotoi: Brazil (western South Atlantic)

Key to Species of *Myxine* from the Atlantic Ocean

1a. Seven pairs of gill pouches 2
1b. Five to six pairs of gill pouches 3

2a. Total cusps 36-43 ..... ***Myxine capensis***
2b. Total cusps 44-51 ..... ***Myxine ios***

3a. Six pairs of gill pouches 4
3b. Five pairs of gill pouches 12

4a. Three fused cusps on anterior and two on posterior multicusps (3/2) 5
4b. Two fused cusps on both anterior and posterior multicusps (2/2) 6

5a. Trunk pores 76; total pores 104 ..... ***Myxine fernholmi***
5b. Trunk pores 80-83; total pores 113-121 ..... ***Myxine debueni***

6a. Single nasal sinus papillae 7
6b. Paired nasal sinus papillae ..... ***Myxine jespersenae***

7a. Head white 8
7b. Head the same color as body (except some NW Atlantic specimens of ***M. glutinosa***) .. 9

8a. Total cusps 42-48, mean 44.4; body color of living specimens bluish gray (Gulf of Mexico and Caribbean Sea).....***Myxine mcmillanae***
8b. Total cusps 38-44, mean 41.6; body color of living specimens pinkish red (Brazil)..... .....***Myxine sotoi***

9a. Prominent whitish band on ventral surface..... 10
9b. No prominent whitish band 11

10a. Anterior unicusps 7-10; total cusps 38-46 ..... ***Myxine affinis***
10b. Anterior unicusps 5-7; Total cusps 30-38 .....***Myxine australis***

11a. Tail length 13-17% TL (North Atlantic and Mediterranean Sea).....***Myxine glutinosa***
11b. Tail length 12-13% TL (southern Argentina).....***Myxine knappi***

12a. Anterior unicusps 6-9; total cusps 36-48 ..... ***Myxine mccoskeri***
12b. Anterior unicusps 11-13; total cusps 56-58 .....***Myxine robinsorum***

Key to Species of *Myxine* from the Pacific Ocean

1a. Seven pairs of gill pouches .....***Myxine pequenoi***
1b. Five to six pairs of gill pouches..... 2

2a. Six pairs of gill pouches 3
2b. Five pairs of gill pouches..... 7

3a. Three fused cusps on anterior and two on posterior multicusps (3/2)....***Myxine garmani***
3b. Two fused cusps on both anterior and posterior multicusps (2/2)..... 4

4a. Total cusp 26..... ***Myxine paucidens***
4b. More than 30 total cusps..... 5

5a. Total cusps 30-32 (Taiwan) ..... ***Myxine kuoi***

5b. Total cusps 32-42 (eastern Pacific) 6

6a. Prebranchial pores 18-28; total pores 90-111 ..... ***Myxine hubbsi***

6b. Prebranchial pores 30-31; total pores 111-116..... ***Myxine hubbsoides***

7a. Single nasal sinus papillae (California to Chile) ..... ***Myxine circifrons***

7b. Paired nasal sinus papillae (Taiwan) ..... ***Myxine formosana***

***Myxine affinis* Günther, 1870**

Myxine affinis Günther, 1870: 511 [original description; type locality: unknown; holotype: BMNH 1951.10.4.3 (poor condition)]. –Norman, 1937: 6 [Patagonia]. –Oliver Schneider, 1943: 77 [Bahía de Coronel, Golfo de Arauco]. –Fowler, 1944: 476 [Magellan Strait, Tierra del Fuego, Punta Arenas]. –Fowler, 1951: 267 [identification key]. –Bigelow and Schroeder, 1948: 33 [identification key]. –de Buen, 1953: 90 [citation]. –de Buen, 1961: 109 [citation]. –Adam and Strahan, 1963: 4 [southern Chile to southern Argentina]. –Bahamonde and Pequeño, 1975: 5 [list of Argentinean fishes]. –Hardisty, 1979: 19 [list]. –Pequeño, 1989: 5 [list of Chilean fishes]. –Wisner and McMillan, 1995: 539 [identification key; review of the New World *Myxine*]. –Fernholm, 1998: 35 [Straits of Magellan]. –Mincarone and Soto, 2001: 126 [distribution]. –Mok, 2001: 358 [nasal sinus papillae]. –Soto and Mincarone, 2004: 13 [catalog]. –Møller *et al*., 2005: 382 [selected characters].

Myxine australis (not Jenyns, 1842). –Günther, 1870: 511 [in part, specimens "*b-d*" from Sandy Point]. –Vaillant, 1888b: 32 [Punta Arenas]. –Garman, 1899: 345 [synonymy; Port Famine, Sandy Point, Straits of Magellan]. –Regan, 1913a: 397 [in part, specimens 1 to 11]. –Thompson, 1916: 419 [Port Churruca, Borja Bay, Sandy Point]. –Holly, 1933: 48 [in part]. –Tortonese, 1939: 192 [Stretto di Magellano].

Myxine glutinosa var. ***australis***. –Putnam, 1874a: 135 [in part, specimens from Sandy Point and Port Famine, Straits of Magellan].

Myxine glutinosa forma ***australis***. –Smitt, 1898: 75 [Terre de Feu].

Myxine tridentiger Garman, 1899: 345 [in part, specimens from Sandy Point, paralectotypes BMNH 1868.6.15.5-6].

Myxine glutinosa (not Linnaeus, 1758). –Lahille, 1915: 363, Fig. 1 [Ushuaia]. –Fowler, 1964: 48 [synonymy]. –Lloris and Rucabado, 1991: 22 [five specimens from the Beagle Channel]. –Allué *et al*., 2000: 15 [catalog; Beagle Channel].

Myxine glutinosa var. ***olivacea***. –Lahille, 1921: 8, Fig. 1 [list of Argentinean fishes].

[***Myxine***] ***affinis-australis*** group. –Nani and Gneri, 1951: 207 [in part, MACN 1883].

Material examined: 47 specimens. BMNH 1951.10.4.3, holotype (~250 mm), no locality, A. Gunther (poor condition). ARGENTINA: IIPB 35-36/1987, 2(453-480 mm), Beagle Channel, Isla Estorbo, 54º52.4'S, 68º28'W, 110 m, 11 Feb. 1987; IIPB 59/1987, 1(damaged), Beagle Channel, Bahia Lapataia, 6 m, D. Lloris, 1985; MACN 1318, 1(470 mm), Tierra del Fuego, Ushuaia, San Sebastian Bay, RV *San Juan*, A. Feilberg, Dec. 1933; MACN 1440, 4(252-435 mm), Tierra del Fuego, Ushuaia, HV *San Luis*, A. Carcelles, 16 May 1934; MACN 1883, 5(360-456 mm), Tierra del Fuego, Dalbene, 25 Apr. 1902; MACN 1884, 1(403 mm), Tierra del Fuego, Ushuaia, R. Lechmann, Nov. 1900; MACN 4676, 2(150-230 mm), Tierra del Fuego, Beagle Channel, Yunque y Martillo Island, A. Carcelles, Mar. 1923; MACN 5889, 1(385 mm), Tierra del Fuego, Ushuaia, Bahia Buen Suceso, A. Nani, 24 Dec. 1951; MLP 1099, 1(370 mm), Tierra del Fuego Ushuaia [catalogued in 1932]; MLP 8251, 1(273 mm), Tierra del Fuego, Isla de los Estados, R. Ronderos, Nov. 1971; MOVI 08570, 1(406 mm), Bahia Ensenada, Ushuaia, 3 m, J. Calvo, Dec. 1996. CHILE: BMNH 1868.6.15.5-6 [paralectotypes of ***Myxine tridentiger***], 3(326-376 mm), Sandy Point [=Punta Arenas], Dr. Cunningham; MNHN 1884-0883, 1(556 mm), Cape Horn, Orange, NO *Romanche*, Miss. Scient. Du Cap Horn, 1884; SIO 78-43, 21(335-616 mm), Isla Navarino, Caleta Wulaia, 55°03'S, 68°10.0'W, 30 m, RV *Hero*, trap, K. Norris, 1 Dec. 1968, 18:00 h; SU 22678, 1(325 mm), Strait of Magellan, Port Churruca, *Albatross*, 2 Feb. 1888.

Diagnostic features: Body elongated, its depth 3-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular, tip rounded.

One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.6-1.2% TL), third one longer (1.2-2.3% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at second gill pouch. Ventral finfold ranging from 1 to 13 mm, averaging 3 mm high, beginning within anterior 8% of trunk, extending backward to the cloaca. Caudal finfold thin, rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26-31; trunk length 56-62; tail length 11-15; body width 3-5; body depth including VFF 4-7; body depth excluding VFF 3-7; body depth over cloaca 4-5; tail depth 4-6. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 7-10. Posterior unicusps 7-10. Total cusps 38-46. Prebranchial pores 26-42. No branchial pores. Trunk pores 57-79. Tail pores 9-14. Total pores 99-124.

Color in alcohol: body reddish brown; barbels dark at base, pale distally; narrow yellow band ventrally limited to below the lines of pores, often extending as intermittent patches to the yellowish face; gill apertures and slime pores with narrow pale margins; ventral finfold yellowish; caudal finfold rarely with pale margin.

Size: Maximum total length 659 mm (Wisner and McMillan, 1995).

Distribution and habitat: Southern coasts of Chile and Argentina; within and closely adjacent to the Straits of Magellan, Beagle Channel, and other channel systems around Tierra del Fuego, including Isla de los Estados and Cape Horn. Usually taken on muddy and sandy bottoms in shallow coastal waters, at depths from 3 to 146 m.

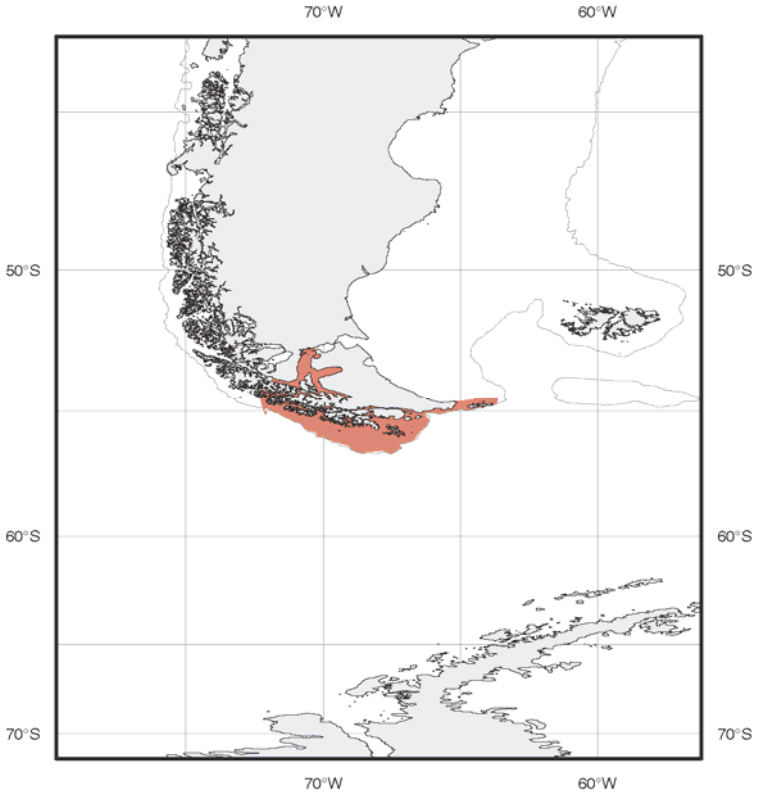


Fig. 62. Distribution of *Myxine affinis.*

Interest to fishery: None.

Remarks: The holotype of ***Myxine affinis*** (BMNH 1951.10.4.3) was examined but it was not possible to take any measurement or count (except teeth), as the specimen was totally dried. Three paralectotypes of ***Myxine tridentiger*** (BMNH 1868.6.15.5-6) were recently examined and re-identified as ***Myxine affinis***. They were formerly misidentified as ***Myxine australis*** by Günther (1870: 511, specimens "*b – d*" from Sandy Point [Punta Arenas]).

Muraenoblenna olivacea La Cepède, 1803 from Strait of Magellan was placed in the synonymy of the younger ***Myxine affinis*** as *nomen dubium* by Wisner and McMillan (1995). It is an undoubted ***Myxine***, but can't be referred with certainty to any species once La Cepède's description was very short and no type material is available for examination.

Myxine affinis has been frequently taken and confused with ***Myxine australis*** but they can be distinguished by number of unicusps (7-10 *vs*. 4-7, respectively). Nani and Gneri (1951) did not distinguish these species, which were treated as "***affinis-australis*** group". Of the 15 specimens listed by Nani and Gneri (1951: 207), six (MACN 1883) are

M. affinis, and seven (MACN 123) are actually representatives of ***M. australis***; MACN 1886 and 4146 were not found in the MACN collection.

Of 256 specimens examined by Wisner and McMillan (1995), 171 (67%) were female, 48 (19%) male and 37 (14%) hermaphroditic. Numbers and sizes of large eggs range from 36 (20x6 mm) in a female of 550 mm to 17 (26x9 mm) in one of 475 mm.

Common name: ARGENTINA: Anguila babosa, Babosa, Babosa de mar, Chkoutaouélik (Fuegian); CHILE: Anguila; FAO: Patagonian hagfish.

Myxine australis Jenyns, 1842

Myxine australis Jenyns, 1842: 159 [original description; type locality: Goree Sound [in Lennox Island] and elsewhere in Tierra del Fuego; lectotype: UMZC AG.164 (ex Darwin no. 515) [by present designation]. –Steindachner, 1898: 334 [Feuerland]. –Regan, 1913a: 397 [in part, specimens 12 and 15]. –Hussakof, 1914: 85 [north of the mouth of Rio Coyle, Patagonia]. –Lahille, 1915: 366 [in part, meristic data]. –Holly, 1933: 48 [in part; identification key]. –Norman, 1937: 6 [Patagonia]. –Fowler, 1944: 476 [Magellan Strait, Tierra del Fuego, Punta Arenas]. –Fowler, 1951: 267 [identification key]. –Fernholm, 1990b: 77, Fig. 2 [South Shetland Islands]. –Wisner and McMillan, 1995: 538 [identification key; review of the New World *Myxine*]. –Fernholm, 1998: 35 [Straits of Magellan]. –Pequeño, 2000: 84, Fig. 2 [Cabo de Hornos]. –Mincarone and Soto, 2001: 125, Fig. 1 [southern Brazil]. –Mok, 2001: 358 [nasal sinus papillae]. –Mincarone, 2003: 21 [catalog of Brazilian fishes]. –Mincarone and Sampaio, 2004: 35 [citation]. –Soto and Mincarone, 2004: 13 [catalog]. –Møller *et al*., 2005: 382 [selected characters].

Myxine glutinosa var. ***australis***. –Putnam, 1874a: 135 [in part, specimens from Puerto Bueno, Straits of Magellan].

Myxine acutifrons Garman, 1899: 347, Pl. 68 (fig. 6) [original description; Sandy Point, Strait of Magellan; Puerto Bueno, south Chile; syntypes: MCZ 8836-37 (12, 1), 8838 (75, missing), 8839 (31), 89528-32 (2, 3, 15, 22, 1); USNM 153595 (ex MCZ 8836) (1)].

Myxine australis var. ***acutifrons***. –Dean, 1904: 23 [citation].

Myxine glutinosa (not Linnaeus, 1758). –Pozzi and Bordale, 1935: 149 [citation]. –de Buen, 1961: 108 [synonymy]. –Adam and Strahan, 1963: 3 [in part]. –Fowler, 1964: 48 [synonymy]. –Pequeño, 1989: 5 [list of Chilean fishes]. –Hureau and Fischer, 1985: 208 [South Shetland Islands].

[***Myxine***] ***affinis-australis*** group. –Nani and Gneri, 1951: 207 [in part, MACN 123].

Myxine glutinosa australis. –Bahamonde and Pequeño, 1975: 5 [list of Argentinean fishes].

Material examined: 48 specimens. BRAZIL: MOVI 06237-06238, 2 (250-292 mm), off southern Brazil, 33º00'-33º20'S, 52º00'-52º15'W, 30-45 m, bottom trawl, J. M. R. Soto, 18 Jul. 1986. ARGENTINA: MACN 123, 11(209-287 mm), Tierra del Fuego, Bahia San Sebastian, M. Doello Jurado, 1921; MACN 453, 2(330-340 mm), Provincia de Santa Cruz, off Buen Tiempo Cape, Mouth of Rio Gallegos, 51º34'S, 68º50'W, 6 fm (11 m), L. H. Valentte, water temperature 10ºC, bottom fine sand; MACN 2227, 1(250 mm), off Provincia de Buenos Aires, *Comodoro Rivadavia*, A. J. Pozzi and J. J. Parodiz, 12-23 Sep. 1938; MACN 2677, 1(194 mm), off Tierra del Fuego, 54º23'S, 65º42'W, RV *Bahia Blanca*, A. J. Pozzi, Apr. 1941; MACN 3047, 2(241-256 mm), 37º30'S, 57º30'W, A. Nani, 1941; MACN 3050, 1(~260 mm), 36º40'S, 57º20'W, A. Nani, 1941; MACN 3295, 1(230 mm), Rio Santa Cruz, RV *Bahia Blanca*, E. Piñeyro; MACN 5204, 3(237-420 mm), Atlantic Ocean, *Chiriguano*, R. Lopez; MACN 8148, 1(237 mm), Provincia de Santa Cruz, Ria Deseado, 47º45'S, 65º55'W, A. Pettovello; MLP 7609, 1(325 mm), 40 miles to north of Puerto Deseado, Santa Cruz, A. Amor, 1962; SIO 78-51, 18(129-352 mm), Bahia Basil Hall, 54°45.4'S, 64°09.0'W, 14 m, RV *Hero*, crab net, 20 Oct. 1971. CHILE: MACN 3346, 1(338 mm), Londonderry Island, Puerto Engaño, 54º47'S, 70º50'W, *Robinson*, A. L. Medrano; MNHN 1883-1117, 1(225 mm), Punta Arenas, Lebrun; MNHN 1995-0471, 1(264 mm), Isla Navarino, NO *Alcyone Cousteau*, Sarano, 4 Feb. 1986; MOVI 16484-16485 (ex USNM 176460), 2(306-312 mm), Castro, 42°29´S, 72°46´W, M. J. Lobell, no date.

Diagnostic features: Body elongated, its depth 5-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum variably acute to rounded. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.5-1.2% TL), third one longer (1.0-1.9% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill pouches 1 to 2. Ventral aorta branches at the second gill pouch. Ventral finfold ranging from 1 to 6 mm, averaging 1.6 mm high, beginning within anterior 8% of trunk, extending backward to the cloaca. Caudal finfold thin, rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26-32; trunk length 53-60; tail length 11-19; body width 2-5; body depth including VFF 4-8; body depth excluding VFF 5-7; body depth over cloaca 4-6; tail depth 4-7. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 5-7. Posterior unicusps 6-8. Total cusps 30-38. Prebranchial pores 22-42. No branchial pores. Trunk pores 51-68. Tail pores 8-14. Total pores 86-118.

Color in alcohol: body reddish to dark brown; barbels and top of head dark; prominent yellow band ventrally extending slightly above rows of slime pores, continuing forward and widening into a large blotches anterior to gill apertures and to yellowish face; ventral finfold yellowish; gill apertures and slime pores with narrow pale margins, caudal finfold without pale margin.

Size: Maximum total length 420 mm (present study).

Distribution and habitat: Southern coast of South America, from southern Brazil (Rio Grande do Sul) to southern Chile (Golfo de Corcovado, Chiloé Island), including Tierra del Fuego and Strait of Magellan. Also reported from the South Shetland Islands based on a single 230 mm specimen (Norman, 1937; Hureau and Fischer, 1985; Fernholm, 1990b). Usually taken on muddy bottoms in shallow coastal waters at depths from 4 to 146 m. The

Brazilian record is based on only two females 250-292 mm, taken on the continental shelf at 30-45 m depth (Mincarone and Soto, 2001; Mincarone, 2003).

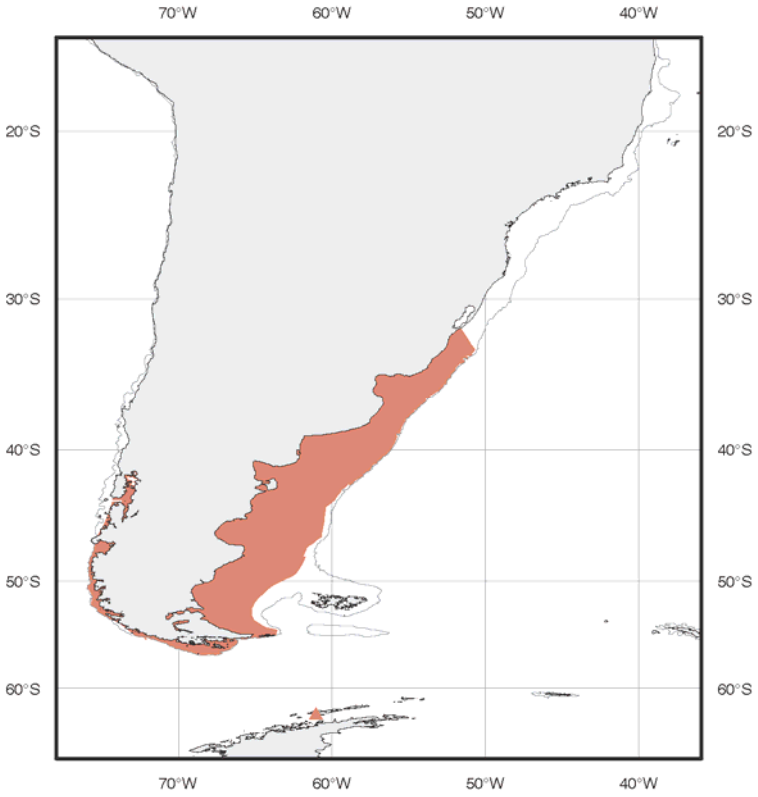


Fig. 63. Distribution of *Myxine australis.*

Interest to fishery: None.

Remarks: The type locality of ***M. australis*** is given by Jenyns (1842) as "Goree Sound and elsewhere in Tierra del Fuego". With multiple localities, we don't know how other specimens might have contributed to his understanding of the species. Multiple localities imply syntypes, but only one specimen deposited in the University Museum of Zoology, Cambridge is known (Norman, 1937; Ray Symonds, pers. comm.), which could be probably the surviving syntype. As Jenyns mentioned other localities in the original description, that in itself is evidence that other specimens were seen or somehow contributed to his assumption that this was a new species. Based on these evidences, the specimen UMZC AG.164 (285 mm TL) from Goree Sound, is herein designated as lectotype.

The fusion of three cusps is given by Günther (1870) as a character of ***Myxine australis*** but occurs in only one specimen from Punta Arenas, Strait of Magellan. That 460-mm specimen was later selected as the type for ***Myxine tridentiger*** by Regan (1913a).

Most of syntypes of ***Myxine acutifrons*** (MCZ 8836-37, 8839, and 89528-32) were not found in the MCZ fish collection and they are probably on loan to SIO. The syntypes MCZ 8838 have apparently been missing since sometime in the 1940's and have not been found on more recent searches (Karsten E. Hartel, pers. comm. on April 4, 2005).

Of 86 specimens examined by Wisner and McMillan (1995), 71 (82%) were female, 12 (14%) male and 3 (4%) hermaphroditic. Numbers and sizes of large eggs range from 9 (24x8 mm) in a female of 330 mm to 16 (21x7 mm) in one of 345 mm.

In their study on the food habits of the Peale's dolphin (***Lagenorhynchus australis***) stranded and incidentally-captured in Tierra del Fuego, Schiavini *et al*. (1997) stated that ***Myxine australis*** was the most numerous prey species. The authors said that remains of hagfish were identified by the neurocranial cartilage, branchial skeleton, and by the presence of dental plates. However, based on this material is almost impossible to confirm the identity of a hagfish (except maybe if the cusps on dental plates were counted). It is also possible that this sample comprises more than one species, once 97 specimens were found in the stomachs of five Peale's dolphins.

Many authors have just cited ***M. australis*** in their checklists and reports but such citations pertain to unrecognizable species in that no useful character was provided, e.g. Günther (1880), Perugia (1891), Reed (1897), Delfin (1900, 1901), Lönnberg (1905, 1907), Jordan (1905, 1925), Fowler (1944), Bahamonde and Pequeño (1975).

Common names: BRAZIL: Peixe-bruxa, Feiticeira; ARGENTINA: Babosa de mar; FAO: Southern hagfish.

Myxine capensis Regan, 1913

Myxine capensis Regan, 1913a: 398 [original description; type locality: South Africa, Cape of Good Hope, 110 fm (201 m); holotype: BMNH 1898.12.17.35]. –Regan, 1913b: 229 [Cape Point]. –Holly, 1933: 48 [citation]. –Barnard, 1947: 2 [Cape Point and the

west coast]. –Bigelow and Schroeder, 1948: 38 [comparison]. –Smith, 1975: 9 [common name]. –Fernholm, 1981: 75 [redescription, comparison]. –Fernholm, 1986: 36 [identification key; diagnosis; off Cape of Good Hope and west coast]. –Lloris, 1986: 84, Fig. 16 [Namibia]. –Villanueva, 1993: 122 [gut content of ***Octopus magnificus***]. –Fernholm, 1998: 35 [Cape of Good Hope, S. Africa]. –Bianchi *et al*., 1999: 69 [catalog of Namibian fishes]. –Allué *et al*., 2000: 15 [catalog; Namibia]. –Mok, 2001: 358 [nasal sinus papillae]. –Soto and Mincarone, 2004: 13 [catalog]. –Møller *et al*., 2005: 382 [selected characters].

Myxine glutinosa (not Linnaeus, 1758). –Adam and Strahan, 1963: 3 [in part, Cape of Good Hope]. –Fowler, 1964: 48 [synonymy]. –Hardisty, 1979: 19 [in part, Cape of Good Hope].

Material examined: 15 specimens. NAMIBIA: IIPB 425-426/1981, 2(405-417 mm), 26°06'S, 13°45'E, 405-406 m, D. Lloris, 29 May 1980. SOUTH AFRICA: BMNH 1898.12.17.35, holotype, 310 mm, off Cape of Good Hope, 34°38'30"S, 18°33'00"E, 110 fm (201 m), J. D. F. Gilchrist; AMS IA.2529, 1(330 mm), off Cape Point, 366 m, 1925; MOVI 27537 (ex RUSI 48483), 1(439 mm), and RUSI 48483, 3(365-430 mm), west coast, 33°36'S, 17°37'E, 230 m, RV *Africana*, trawl, L. J. V. Compagno, 9 Jul. 1986; MOVI 27538 (ex RUSI 48492), 1(532 mm), west coast, 33°37'S, 17°39'E, 230 m, RV *Africana*, trawl, L. J. V. Compagno, 9 Jul. 1986; MOVI 27539 (ex RUSI 64245), 1(350 mm), and RUSI 64245, 1(335 mm), NW of Childs Bank, 30°38'S, 15°15'E, 612-675 m, 47m bottom trawl, *Fridtjof Nansen*, M. E. Anderson, 21 Feb. 2001; RUSI 48492, 2(460-480 mm), west coast, 33°37'S, 17°39'E, 230 m, RV *Africana*, trawl, L. J. V. Compagno, 9 Jul. 1986; SIO 92-107 (formerly SU 31453), 1(261 mm), and SU 31453, 1(288 mm), Cape Collony, off Cape Point, SS *Pickle*, C. von Bonde, 1934.

Diagnostic features: Body elongated, its depth 4-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum variably triangular to bluntly rounded. Two nasal-sinus papillae aligned in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.8-1.0% TL), third one longer (1.2-1.7% TL). Seven pairs of gill pouches. Each gill pouch with efferent branchial

ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side usually confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at the second or third gill pouch. Ventral finfold progressively reducing from 2-4 mm (origin) to 1 mm high (cloaca), beginning within anterior 9% of trunk, extending backward to the cloaca. Caudal finfold thin, rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26-31; trunk length 57-61; tail length 10-15; body width 3-5; body depth including VFF 4-7; body depth excluding VFF 4-6; body depth over cloaca 3-5; tail depth 3-5. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 7-9. Posterior unicusps 7-10. Total cusps 36-43. Prebranchial pores 26-35. No branchial pores. Trunk pores 58-66. Tail pores 9-13. Total pores 92-111.

Color in alcohol: Body medium brown; barbels, face, and ventral surface of prebranchial region occasionally pale; ventral finfold pale; caudal finfold lighter than body; all other parts the same color as body.

Size: Maximum total length 532 mm (Soto and Mincarone, 2004).

Distribution and habitat: Known only off southern Africa, from Walvis Bay (Namibia) to Cape Infanta (South Africa). Usually taken on muddy bottoms on the continental shelves and slopes at depths from 88 to 480 m. Two specimens (MOVI 27359 and RUSI 64245) were recently collected NW of Childs Bank, 30°38'S, 15°15'E, at 612-675 m depth.

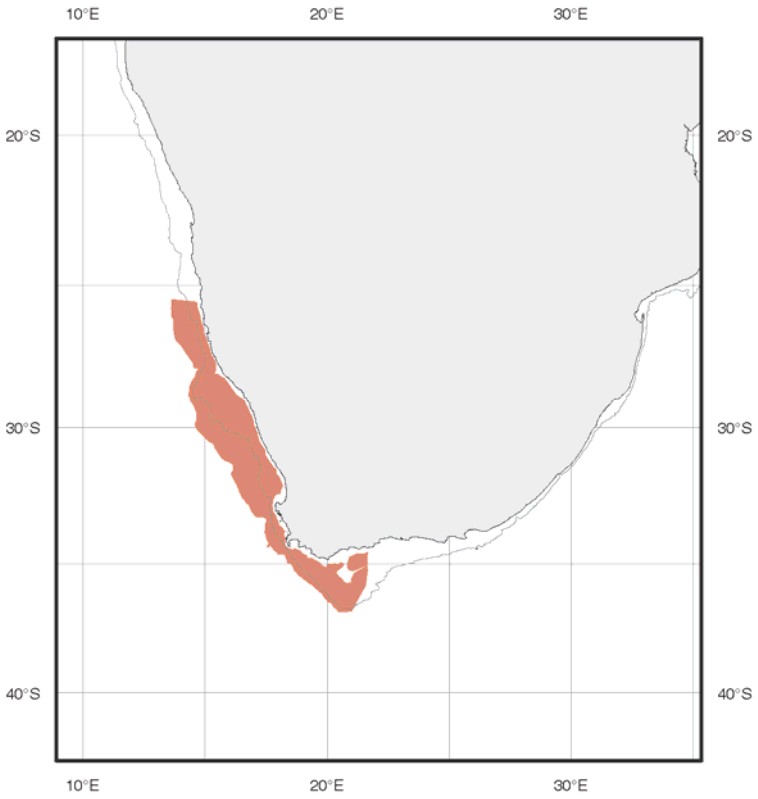


Fig. 64. Distribution of *Myxine capensis.*

Interest to fishery: None.

Remarks: The gill aperture and pharyngocutaneous duct have not a common aperture on the left side in about 30% of the specimens examined. In this case, such apertures are close together, just separated by a very short distance, therefore different of ***Notomyxine tridentiger***, which has the left gill aperture widely separated from the pharyngocutaneous duct.

According to Villanueva (1993), ***Myxine capensis*** accounted for 14.4% of the diet of 90 specimens of ***Octopus magnificus*** (Cephalopoda) caught off Namibia and South Africa; prey ranging in size from 21 to 31.5 cm TL.

Females maturing at 320-330 mm (Fernholm, 1981).

Commom names: SOUTH AFRICA: Kaapse slymslang; FAO: Cape hagfish.

Myxine circifrons Garman, 1899

Myxine circifrons Garman, 1899: 344, Pl. 68 (Figs. 1-4) [original description; type locality: Gulf of Panama, 7°30'36"N, 78°39'W, 730 fm (1334 m), Albatross sta. 3395; syntypes: MCZ 28419 (2), MCZ 91374 (1)]. –Dean, 1904: 23 [citation]. –Brauer, 1906: 365 [list]. –Regan, 1913a: 396 [citation]. –Holly, 1933: 48 [identification key]. –Fowler, 1944: 476 [Panama]. –Bigelow and Schroeder, 1948: 33 [identification key]. –de Buen, 1953: 90 [citation]. –Adam and Strahan, 1963: 4 [Gulf of Panama]. –Fowler, 1964: 48 [catalog of world fishes]. –Miller and Lea, 1972: 32 [list of fishes from California]. –Hardisty, 1979: 19 [list]. –Hubbs *et al*., 1979: 3 [list of fishes from California]. –Eschmeyer *et al*., 1983: 10 [field guide]. –Wisner and McMillan, 1995: 539 [identification key; review of the New World ***Myxine***]. –Chirichigno and Vélez, 1998: 28, Fig. 1 [identification key]. –Fernholm, 1998: 35 [E. Pacific]. –Mok, 2001: 358 [nasal sinus papillae]. –Soto and Mincarone, 2004: 13 [catalog]. –Vilchez-Chumacero, 2004: 2 [identification key]. –Møller *et al*., 2005: 382 [selected characters]. –Love *et al*., 2005: 1 [calalog; San Franciso, northern California to northcentral Chile].

Material examined: 13 specimens. MEXICO: MOVI 27510-27512, 3(200-440 mm), and SIO 59-52-4A, 3(197-435 mm), Baja California North, 11 miles WSW of Punta Descanso, 32°14.4´N, 117°13.5´W, 746 fm (1364 m), 11:00-15:45 h, RV *T-441*, trap, G. B. Schick, 19 May 1959. ECUADOR: CAS 24425, 4(140-430 mm), and MOVI 30903-30905 (ex CAS 24425) 3(140-416 mm), off Gulf of Guayaquil, 02°25'S, 81°10'W, 700-1000 m, 16' otter trawl, M. G. Bradbury, 1 Sep. 1968, 08:50-12:10 h.

Fig. 65 ***Myxine circifrons*** **(after Garman, 1899).**

Diagnostic features: Body elongated, its depth 4-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum variably triangular to bluntly rounded. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.8-1.1% TL), third one longer (1.5-1.8% TL). Five pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the second gill pouch. Ventral finfold usually well developed (to 12 mm), but may be vestigial (1 mm), beginning within anterior 9% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 29-31; trunk length 55-58; tail length 10-15; body width 4-6; body depth including VFF 6-8; body depth excluding VFF 4-7; body depth over cloaca 3-5; tail depth 5-6. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-13. Posterior unicusps 8-12. Total cusps 43-56. Prebranchial pores 18-33. No branchial pores. Trunk pores 48-62. Tail pores 7-13. Total pores 80-102.

Color in alcohol: body grayish black to reddish brown; anterior portion of head paler, often whitish; barbels same color as head; gill apertures often with narrow pale margins; ventral and caudal finfolds the same color as body, without pale margins.

Size: Maximum total length 650 mm (Wisner and McMillan, 1995).

Distribution and habitat: Eastern Pacific, from San Francisco (California, USA) to San Antonio (central Chile). Usually taken on the continental slopes at depths from 700 to 1860 m (Wisner and McMillan, 1995). The syntypes were collected in the Gulf of Panama at 1334 m depth in water of 3.6°C on rocky bottom (Garman, 1899).

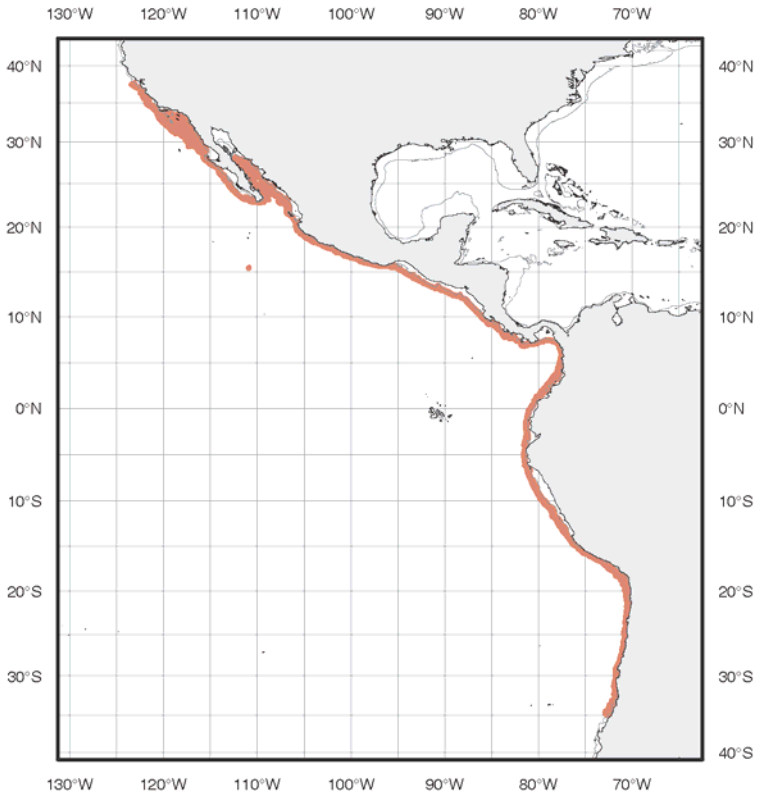


Fig. 66. Distribution of *Myxine circifrons*.

Interest to fishery: None.

Remarks: The sex ration in the material analyzed by Wisner and McMillan (1995) was equal off southern California (n=220) but unequal near the mouth of the Gulf of California (*n*=136), 66% females and 34% males, and Costa Rica to northern Chile (*n*=54), 59% female to 41% male; no hermaphroditism was found in 320 specimens examined.

Common names: USA: Whiteface hagfish; PERU: Lamprea de mar, Lamprea babosa; FAO: Pacific whitehead hagfish.

Myxine debueni Wisner and McMillan, 1995

Myxine debueni Wisner and McMillan, 1995: 535 [original description; type locality: Strait of Magellan, 53°39'S, 70°14'W, 300 m; type series: holotype, SIO 90-140, paratype, SIO 90-140 (1)]. –Fernholm, 1998: 35 [Straits of Magellan]. –Mincarone and Soto, 2001: 126 [distribution]. –Mok, 2001: 358 [nasal sinus papillae]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: 1 specimen. CHILE: SIO 90-140, paratype, 1(527 mm), Strait of Magellan, 53°39.0'S, 70°14.4'W, 300-302 m, try net, *Hero*, B. C. Fehlmann, 28 Apr. 1970.

Diagnostic features: Body elongated, its depth 5-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with pointed tip. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (1.1% TL), third one longer (1.9% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies the first gill pouch. Ventral aorta branches at the second gill pouch. Ventral finfold absent. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 24-25; trunk length 66-69; tail length 8-10; body width 4-5; body depth including VFF 5-6; body depth excluding VFF 5-6; body depth over cloaca 4-4; tail depth 4-4. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-7. Posterior unicusps 7. Total cusps 37-38. Prebranchial pores 21. No branchial pores. Trunk pores 76. Tail pores 7. Total pores 104.

Color in alcohol: body light brown; head and barbels paler; gill apertures with narrow pale margins; ventral finfold the same color as body; caudal finfold with narrow pale margin.

Size: Known only from two specimens, 545 and 570 mm TL (Wisner and McMillan, 1995).

Distribution and habitat: Known only from the type locality, northeast of Dawson Island, Strait of Magellan. The only two specimens known were taken at mid-channel waters, from 300 to 302 m depth.

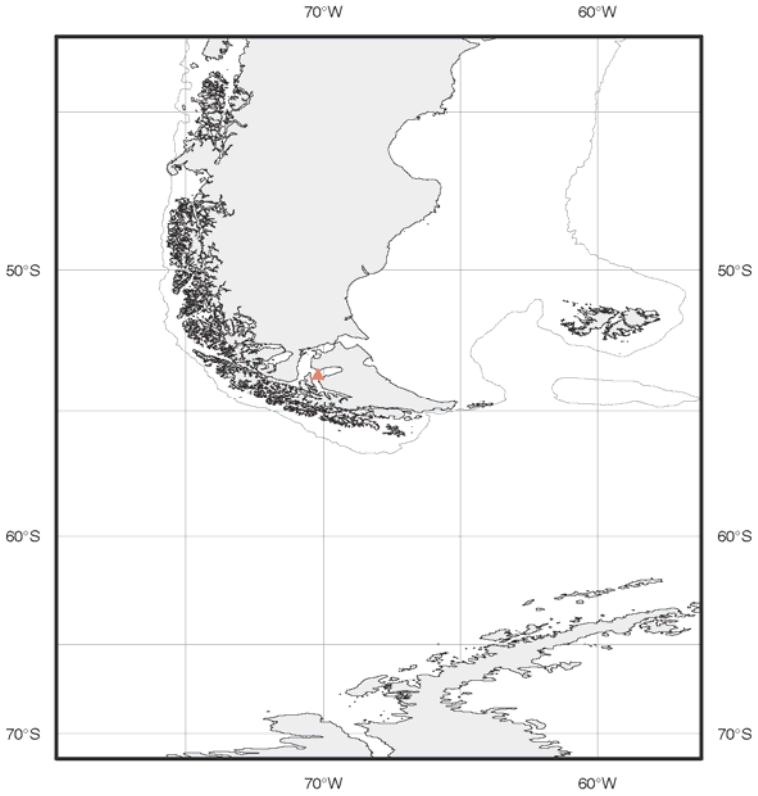


Fig. 68. Distribution of *Myxine debueni.*

Interest to fishery: None.

Commom names: FAO: de Buen's hagfish.

Myxine fernholmi Wisner and McMillan, 1995

Myxine fernholmi Wisner and McMillan, 1995: 535 [original description; type locality: off northern Falkland Islands, 49°29'S, 58°56'W, 400 m; type series: holotype, ISH 257-1978, paratypes, SIO 90-138 (1), SIO 90-139 (1), ZIL 791-966 (1)]. –Fernholm, 1998: 35 [Central Chile and Falkland Is.]. –Mincarone and Soto, 2001: 126 [distribution]. –Mok, 2001: 358 [nasal sinus papillae]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: 4 specimens. ARGENTINA: SIO 90-138 (ex ISH 108/71), paratype, 1(780 mm), 53°00'S, 64°00´W, 295-300 m, 140' bottom trawl, 2 Aug. 1971. FALKLAND ISLANDS (UK): MNHN 1990-0886, 2(670-725 mm), Malouines Islands, NO *Commandant Gue*, Le Morran, May 1987. CHILE: SIO 90-139, paratype, 1(570 mm), 33°39'S, 72°09.5´W, 1170-1480 m, 72'shrimp trawl, *Anton Bruun*, 10 Aug. 1966, 12:08-17:15 h.

Diagnostic features: Body elongated, its depth 4-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with rounded tip. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.7-1.2% TL), third one longer (1.2-1.6% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies the first gill pouch. Ventral aorta branches at the second or third gill pouch. Ventral finfold ranging from 3 to 7 mm high, beginning within anterior 5% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 20-25; trunk length 67-72; tail length 8-10; body width 3-5; body depth including VFF 4-7; body depth excluding VFF 4-7; body depth over cloaca 3-5; tail depth 4-6. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-7. Posterior

unicusps 6-7. Total cusps 34-37. Prebranchial pores 23-26. No branchial pores. Trunk pores 80-83. Tail pores 7-9. Total pores 113-121.

Color in alcohol: body uniformly light brown; gill apertures with prominent pale margins; ventral finfold pale; caudal finfold the same color as body.

Size: Maximum total length 846 mm (Wisner and McMillan, 1995).

Distribution and habitat: Around Falkland Islands and Burdwood Bank, at depths from 135 to 400 m. One specimen (SIO 90-139) collected off San Antonio (central Chile), 33°39'S, 72°09.5´W, at 1170-1480 m depth.

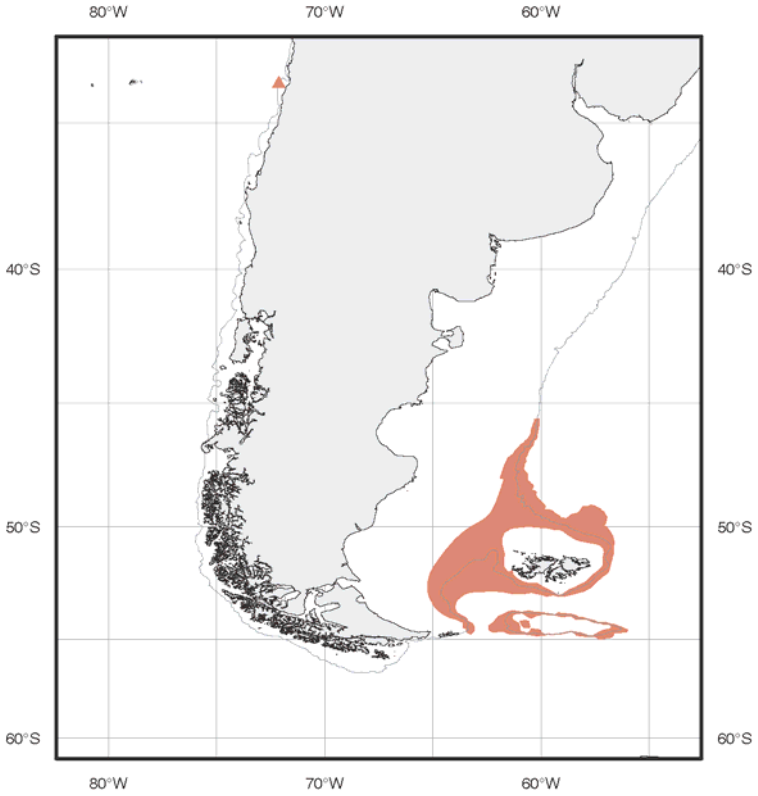


Fig. 69. Distribution of *Myxine fernholmi.*

Interest to fishery: None.

Remarks: During a deep-sea investigation on the scavenging fauna of the Patagonian slope (900-1750 m), east of Falkland Islands, high density of hagfishes were recorded by Collins

et al. (1999). Using a deep-sea camera, hagfish were seen during six of the 10 experiments, between depths from 900 to 1212 m. The absolute number of specimens was hard to determine, but over 200 were visible in single frames (45 m^2). According to Collins *et al*. (1999), species identification was not possible, though it is likely that they were ***Myxine fernholmi***, distinguished by a prominent ventral finfold that was clearly visible in the photographs; ***Myxine knappi***, also reported from Falkland Islands, has a very small ventral finfold. However, it is possible that more than one species has been sampled.

Common names: FAO: Falkland hagfish.

Myxine formosana Mok and Kuo, 2001

Myxine formosana Mok and Kuo, 2001: 295, Fig. 2 [original description; type locality: southwest of Taiwan, 22°15'34"N, 120°06'05"E, 753 m; type series: holotype, NSYSU 3038, paratypes, NSYSU 3036 (1), NSYSU 3037 (119), NSYSU 3039 (44)]. –Mok, 2001: 358 [nasal sinus papillae]. –McMillan and Wisner, 2004: 66 [identification key; review of Asian hagfishes]. –Soto and Mincarone, 2004: 13 [catalog]. –Møller *et al*., 2005: 382 [selected characters].

Myxine sp. 2. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes].

Material examined: 3 specimens. TAIWAN: SIO 01-191 (ex NSYSU 3037), paratypes, 2(282-315 mm), southwestern Taiwan, 22°11'20"N, 120°13'42"E, 843 m, H. K. Mok, 18 Dec. 1997; MOVI 16712, 1(395 mm), southwestern Taiwan, 22°11'20"N, 120°13'42"E, 843 m, H. K. Mok, 18 Dec. 1997.

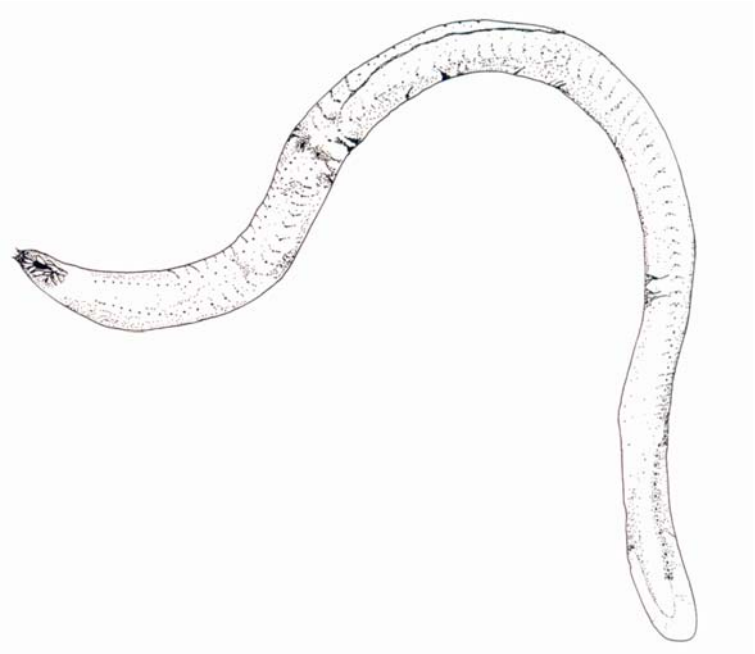


Fig. 70 ***Myxine formosana*** **(after Mok and Kuo, 2001).**

Diagnostic features: Body elongated, its depth 3-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.8-0.9% TL), third one longer (1.0-1.1% TL). Five pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta not branched. Ventral finfold beginning within anterior 9% of trunk, extending backward to the cloaca, progressively reducing from 2-3 mm (origin) to 1 mm high (cloaca). Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 27-42; trunk length 46-67; tail length 13-24; body depth including VFF 4-8; body depth excluding VFF 3-8; body depth over cloaca 3-7; tail depth 4-7. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 8-12. Posterior unicusps 8-12;

total cusps 42-58. Prebranchial pores 20-44. No branchial pores. Trunk pores 42-66. Tail pores 10-20. Total pores 80-117.

Color in alcohol: grayish black to dark purple; head anterior to first slime pore white; gill apertures usually with narrow pale margins; ventral finfold usually without pale margin.

Size: Maximum total length 768 mm (Mok and Kuo, 2001). The size range appears to be stratified by depth. According to Mok and Kuo (2001), 120 specimens ranging in length from 102 to 380 mm were collected in 3 different sites off southwestern Taiwan at depths of 588, 753, and 843 m, whereas 271 specimens ranging from 131 to 768 mm were also collected off southwestern Taiwan at deeper waters (1000 to 1500 m).

Distribution and habitat: Southwestern Taiwan. Usually taken on the continental slope at depths from 588 to 1500 m (Mok and Kuo, 2001).

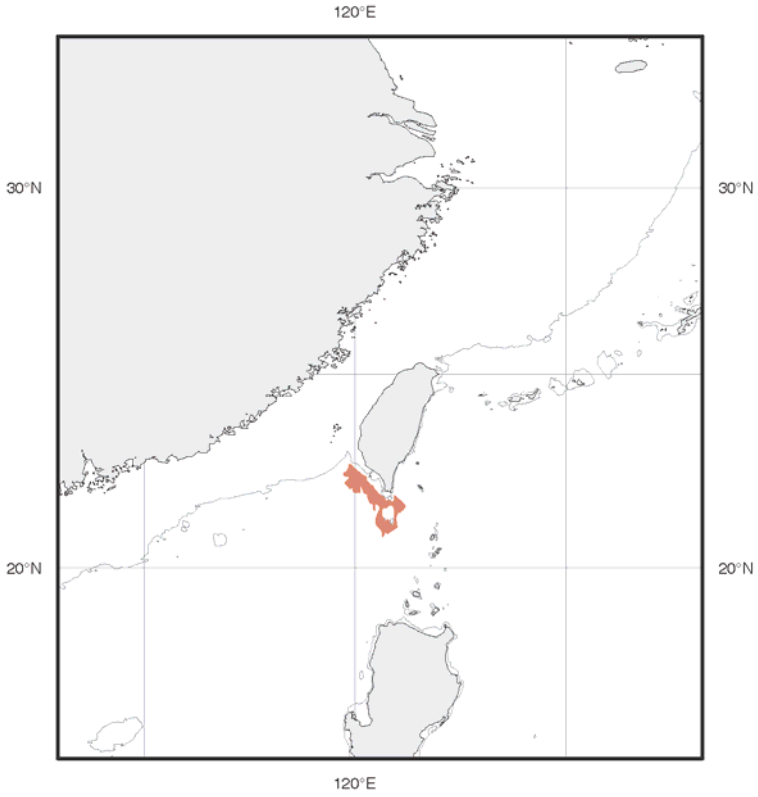


Fig. 71. Distribution of *Myxine formosana.*

Interest to fishery: ***Myxine formosana*** has been captured with white plastic shrimp traps (365 cm length, 16 cm diameter) off southwestern Taiwan by the fishermen from Tong-Kung (Mok and Kuo, 2001).

Remarks: After the publication of the original description (Mok and Kuo, 2001) two paratypes (NSYSU 3037) were donated to SIO (SIO 01-191).

The description above was based on data provided by Mok and Kuo (2001) combined with those listed in "material examined".

Common names: FAO: Taiwanese whitehead hagfish.

Myxine garmani Jordan and Snyder, 1901

Myxine garmani Jordan and Snyder, 1901: 731, Pl. 30 (upper fig. of head) [original description; type locality: off Misaki, Japan; type series: lectotype, SU 6665, paralectotypes, USNM 49981 (2)]. –Dean, 1904: 15, Fig. 2e, Pl. 1 (fig. 6). [notes on Japanese hagfishes]. –Jordan and Starks, 1904: 577 [further data on type locality: Albatross sta. 3757, off Suno Point (=Suno-saki), Sagamy Bay, 41-50 fm (75-91 m)]. –Jordan, 1905: 490 [Japan]. –Jordan *et al*., 1913: 5, Fig. 2 [catalog; Sagami Sea]. –Regan, 1913a: 395 [*Hyalonema* Ground]. –Jordan, 1925: 170 [Japan]. –Holly, 1933: 48 [identification key]. –Bigelow and Schroeder, 1948: 33 [identification key]. –Böhlke, 1953: 8 [designation of lectotype]. –de Buen, 1953: 90 [citation]. –Matsubara, 1955: 92 [identification key]. –Lindberg and Legeza, 1959: 22 [list of Japanese fishes]. –Abe, 1963: 1, Fig. 2 [identification key; list of Japanese fishes]. –Adam and Strahan, 1963: 3 [east coast of Japan]. –Fowler, 1964: 48 [catalog of world fishes]. –Fernholm and Holmberg, 1975: 253 [eye morphology]. –Hardisty, 1979: 19 [list]. –Sato, 1984: 1 [list of Japanese fishes]. –Yamakawa, 1984: 34, Fig. 2 [list of fishes from Okinawa]. –Yamada *et al*., 1986: 2 [citation]. –Iwata, 1993: 83 [identification key; catalog of fishes from Japan]. –Iwata, 1997: 32, Fig. 3 [catalog of fishes from Japan]. –Fernholm, 1998: 35 [Japan]. –Honma, 1998: 49 [identification key; fishery]. –Iwata, 2000: 108 [identification key; catalog of fishes from Japan]. –

Mok, 2001: 358 [nasal sinus papillae]. –Nakabo, 2002: 108 [identification key; southern Japan and Okinawa Trough]. –Froese and Sampang, 2004: 1 [list of seamount fishes; southern Japan]. –McMillan and Wisner, 2004: 67, Fig. 12 [identification key; review of Asian hagfishes]. –Møller *et al*., 2005: 382 [selected characters].

Myxine australis (not Jenyns, 1842). –Günther, 1887: 267 [in part, longer specimens from *Hyalonema* Ground, off Eno-shima, Japan, 345 fm, *Challenger* sta. 232]. –Goode and Bean, 1896: 3 [in part, longer specimens from *Hyalonema* Ground, off Eno-shima, Japan, 345 fm, *Challenger* sta. 232].

Material examined: 9 specimens. JAPAN: SU 6665, lectotype, 500 mm, Chiba, Honshu Island, Sagami Nada, D. S. Jordan and J. O. Snyder, 1900; USNM 49981 (ex Imperial University Collection), paralectotypes, 2(400 mm), Misaki; BMNH 1879.5.14.443, 1(530 mm), Sagami-wan, 35°11'N, 139°28'E, 345 fm (631 m), HMS *Challenger*; BMNH 1912.11.28.4-5, 2(311-348 mm), *Hyalonema* ground, HMS *Challenger*; BSKU 19473, 1(111 mm), 33°06.5'N, 140°04.8'E, 490-495 m, RV *Sōyō-Maru*, 12 Dec. 1963; SIO 90-133, 2(512-515 mm), Misaki, 35°08'N, 139°37'E, 2 Nov. 1973.

Diagnostic features: Body elongated, its depth 5-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with rounded tip. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.7-1.0% TL), third one longer (1.0-1.3% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the first gill pouch. Ventral finfold beginning within anterior 9% of trunk, extending backward to the cloaca, progressively reducing from 5-7 mm (origin) to 1 mm high (cloaca). Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26-30; trunk length 54-60; tail length 12-15; body width 3-5; body depth including VFF 5-8; body depth excluding VFF 5-7; body depth over cloaca 4-6; tail depth 4-6. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 8-9. Posterior unicusps 8-9. Total cusps 42-46. Prebranchial pores 27-29. No branchial pores. Trunk pores 52-61. Tail pores 12-13. Total pores 95-101.

Color in alcohol: body dark brown; head variably white or slightly lighter than body; gill apertures and ventral finfold variably with a narrow pale margin; caudal finfold usually without pale margin. According to Sato (1984) some specimens have a white head, which was not observed in our material.

Size: Maximum total length 610 mm (McMillan and Wisner, 2004).

Distribution and habitat: East, southeast, and south coasts of Japan, including Okinawa Trough. On the continental slope at depths from 200 to 1100 m (Nakabo, 2002).

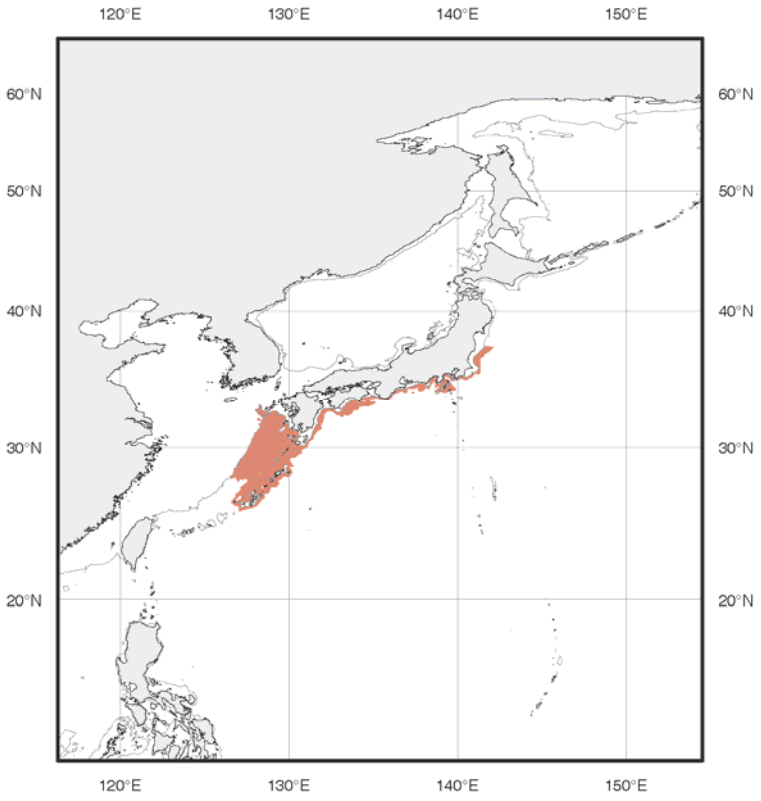


Fig. 72. Distribution of *Myxine garmani.*

Interest to fishery: Because of the paucity of the local source of roast hagfish, ***Paramyxine atami*** (= ***Paramyxine*** spp.), sold in Teradomari near Niigata, a large amount of ***M. garmani*** were imported from Onahama to Teradomari until 1994 in order to supplement the ***Paramyxine*** catch. However, the hagfish catch off Onahama has declined rapidly, perhaps due to overfishing by Japanese and Korean boats off the coast of Fukushima Prefecture (Honma, 1998).

Common names: JAPAN: Mekura-unagi; FAO: Garman's hagfish.

Myxine glutinosa Linnaeus, 1758

Myxine glutinosa Linnaeus, 1758: 650 [original description; type locality: Atlantic; syntypes: NRM LP 89 (4)]. –Fabricius, 1780: 344 [Greenland]. –Latreille, 1804: 75 [citation]. –Shaw, 1804: 133, 134 [Europe]. –Fleming, 1822: 375 [citation]. –Nilsson, 1832: 123 [citation]. –Müller, 1836: 79, several figures [anatomy; Europe and Greenland]. –Valenciennes, 1837: 583 [mer du Nord]. –Müller, 1838: 246, Pl. 3(figs. 4-6) [anatomy]. –Swainson, 1839: 338 [citation]. –Girard, 1859: 223 [citation]. –Günther, 1870: 510 [museum catalog; coast of Europe and North America]. –Jordan and Gilbert, 1883: 5 [coast of Europe and America]. –Günther, 1887: 267 [North Atlantic]. –Vaillant, 1888a: 81 [Portugal]. –Vaillant, 1888b: 32 [comparison]. –Goode and Bean, 1896: 2, Pl. 1 (fig. 1) [both coasts of North Atlantic]. –Jordan and Evermann, 1896a: 211 [checklist, North Atlantic on both coasts]. –Jordan and Evermann, 1896b: 7 [catalog, North Atlantic on both coasts, south to Cape Cod]. –Lönnberg, 1896: 45 [Linnean type-specimens]. –Garman, 1899: 346 [Denmark, Norway, Great Britain, Liverpool, Triest]. –Dean ,1900: 33 [description of eggs]. –Dean, 1904: 23 [citation]. –Jordan, 1905: 490 [north of Europe]. –Brauer, 1906: 365 [Norway, Greenland, Portugal]. –Fowler, 1908: 461 [citation]. –Berg, 1911: 9 [list of synonyms]. –Otterstrøm, 1917: 129, Figs. 71-72 [biology, North Atlantic]. –Regan, 1913a: 397 [from several localities of northeastern Atlantic]. –Jordan, 1925: 170 [north of Europe]. –Soldatov, 1928: 7, Fig. 2(3) [biology]. –Lahille, 1930: 3 [in part,

both coasts of North Atlantic]. –Holly, 1933: 47, Fig. 54 [identification key, list of synonyms; Europe]. –de Buen, 1935: 22 [Atlantic]. –Schnakenbeck, 1931 [short description, biology, eggs; North Atlantic]. –Jensen, 1941: 55 [Greenland]. –Bigelow and Schroeder, 1948: 33, Fig. 4 [identification key, description, habits; western North Atlantic]. –Nani and Gneri, 1951: 215, Fig. 4 [comparison with congeners]. –Bigelow and Schroeder, 1953: 10, Fig. 2 [description, habits; Artic seas and both coasts of North Atlantic]. –de Buen, 1953: 90, Fig. 49 [catalog, North Atlantic]. –Konstantinov and Shchegelov, 1958: 1745 [Iceland]. –Tortonese, 1958: 312 [list of Mediterranean fishes]. –Strahan, 1959: 165 [slime production]. –Adam, 1960: 595, Figs. 1-3 [body movements]. –McAllister, 1960: 4 [checklist of Canadian fishes]. –Tortonese, 1960: 44 [Marroco and Algeria]. –de Buen, 1961: 90, Fig. 49 [citation]. –Adam and Strahan, 1963: 3 [in part, North Atlantic and Mediterranean]. –Strahan, 1963: 76 [behavior]. –Tortonese, 1963: 157 [list of Mediterranean fishes]. –Fowler, 1964: 48 [catalog of world fishes]. –Bullis and Thompson, 1965: 17 [fishery report]. –Leim and Scott, 1966: 20 [description, biology; North Atlantic]. –Tambs-Lyche, 1969: 279 [distribution, ecology]. –Wheeler, 1969: 24, 26, Fig. 1 [identification key, short description, biology; European coast]. –Vladikov, 1973: 6 [list of synonyms, biology; western Mediterranean Sea and North Atlantic]. –Patzner, 1974: 81 [early stages of the oogenesis]. –Patzner, 1975: 111 [egg development and maturation]. –Shelton, 1978: 81 [feeding]. –Hardisty, 1979: 19 [in part, North Atlantic and Mediterranean]. –Tortonese and Hureau, 1979: 339 [catalog; Marocco and Algeria]. –Bauchot and Pras, 1980: 28, Fig. 13 [catalog; Atlantic and Mediterranean Sea]. –Fernholm, 1981: 75 [comparison]. –Fernholm and Wheeler, 1983: 207-208 [type catalog]. –Möller-Buchner *et al*., 1983: 128 [feeding habits]. –Fernholm and Vladykov, 1984: 68 [diagnosis, coast of Europe and Mediterranean Sea]. –Bauchot, 1987: 763 [catalog, European and Mediterranean coasts]. –Elger, 1987: 489 [branchial circulation and histology]. –Haedrich and Merrett, 1988: 1329 [southern New England and Iceland]. –Scott and Scott, 1988: 3 [short description, biological and ecological notes; Artic seas southward along both coasts of the North Atlantic]. –McAllister, 1990: 24-25, Fig. 2 [catalog, Arctic and Atlantic coasts]. –Lythgoe and Lythgoe, 1992: 10 [catalog, biology; North Atlantic and Mediterranean]. –Wheeler, 1992: 5 [list of common

names; British Isles]. –Nakaya, 1995: 45 [catalog, short description; western Mediterranean Sea along Africa, Portugal to Norway, the North Sea and Greenland]. –Wisner and McMillan, 1995: 541 [comparison, measurements and counts]. –Lesser *et al.*, 1996: 215 [ecology, Gulf of Maine]. –Martini *et al*., 1997: 311 [morphometrics, ecology, reproduction; Gulf of Maine]. –Martini *et al*., 1997: 97 [ecology; Gulf of Maine]. –Casey and Myers, 1998: 2332 [southern Newfoundland, Canada]. –Fernholm, 1998: 35 [Europe, Mediterranean to Murmansk]. –Martini *et al*., 1998: 516 [morphological variation; North Atlantic]. –Robson *et al*., 2000: 281 [description of skeleton]. –Delarbre *et al*., 2001: 634 [complete mitochondrial genome]. –Mok, 2001: 358 [nasal sinus papillae]. –Martini and Flescher, 2002: 10, Figs. 13-15 [in part, records from North Atlantic]. –Moore *et al*., 2003: 166 [checklist; off New England]. –Shackell and Frank, 2003: 310 [diversity; Scotian Shelf, Canada]. –Coad and Reist, 2004: 7 [catalog; Labrador Sea]. –Soto and Mincarone, 2004: 13 [catalog]. –Møller *et al*., 2005: 378 [comparison with ***Myxine jespersenae***].

Gastrobranchus coecus Bloch, 1791: 45 [original description; type locality: European seas; syntypes: ZMB 4699 (1, poor condition), ZMB 4703 (1); based in part on ***Myxine glutinosa***, Linnaeus 1758]. –Bloch, 1795: 67, Pl. 413 (figs. 1-4) [further description]. –Shaw, 1804: 133, 134 [synonym of ***Myxine glutinosa***]. –La Cepède, 1830: 175 [vernacular name: Gastrobranche aveugle; short description]. –Minding, 1832: 41 [Nordsee]. –Valenciennes, 1837: 583 [mer du Nord]. –Günther, 1870: 511 [synonym of ***Myxine glutinosa***]. –Paepke and Schmidt, 1988: 158 [type catalog]. –Paepke, 1999: 104 [Bloch's fish collection, type information].

Petromyzon myxine. –Walbaum, 1792: 500 [citation].

Myxine* (*Gastrobranchus*) *glutinosa. –Voigt, 1832: 529 [new combination].

Myxine limosa Girard, 1859: 224 [original description; type locality: off Grand Manan Island, Bay of Fundy, New Brunswick, Canada, 50 fm (91 m); holotype: USNM 1139 (poor condition)]. –Garman, 1899: 346 [North Carolina and Maine]. –Dean, 1904: 23 [citation]. –Jordan, 1905: 490 [West Atlantic]. –Brauer, 1906: 365 [list]. –Berg, 1911: 10 [identification key]. –Halkett, 1913: 38 [checklist; Canada]. –Regan, 1913a: 398 [Bay of Fundy]. –Jordan, 1925: 170 [West Atlantic]. –Jordan *et al*., 1930: 8 [Newfounland, south to Cape Cod, Grand Manan Island, New Brunswick]. –Holly,

1933: 47 [identification key, list of synonyms; northwest Atlantic]. –Wisner and McMillan, 1995: 539 [identification key, review of the New World ***Myxine***]. –Fernholm, 1998: 35 [western North Atlantic]. –Mok, 2001: 358 [nasal sinus papillae]. –Fernholm, 2003: 355 [catalog; around Florida north to Davis Strait]. –Soto and Mincarone, 2004: 13 [catalog].

Myxine glutinosa var. ***septentrionalis***. –Putnam, 1874a: 133, 135 [in part, specimens from coast of England].

Myxine glutinosa var. ***limosa***. –Putnam, 1874a: 133, 135 [in part, specimens from Grand Menan and eastern coast of United States].

Myxine atlantica Regan, 1913a: 398 [original description; type locality: western North Atlantic, off Nova Scotia, 44°17'N, 58°10'W, 120 fm (219 m); holotype: BMNH 1880.9.14.68].

Material examined: 190 specimens. CANADA: BMNH 1880.9.14.68 (holotype of ***Myxine atlantica***), 1(308 mm), 44°17'N, 58°10'W, 120 fms [219 m] (poor condition, without skin); MNHN A-2430, 1(380 mm), Terre-Nueve, Grand Banks, M. Washington, 1880 (poor condition); VIMS 03536, 1(510 mm), Grand Banks, *Albatross IV*, D. Cargo, Oct.-Nov. 1964; VIMS 04187, 2(440-472 mm), slope off Scotian shelf, 44°19'N, 59°20'W, 110 fms [201 m], *A. T. Cameron*, 36 yankee, 24 Jul. 1970. UNITED STATES OF AMERICA: CAS 31999, 1(326 mm), 36°37'36"N, 74°41'15"W, 255 m, *Iselin*, 45' otter trawl, J.A. Musick *et al*., 8 Jun. 1973, 12:17 h; CAS 32003 (ex VIMS 2255), 3(275-340 mm), 38°17'N, 73°38'W, 100 fms [183 m], *See Breeze*, 45' semi-ballon trawl, Dawis, 19 Aug. 1966; MOVI 27513-27516 (ex SIO 75-686), 4(380-480 mm), 42°33'N, 69°48'W, 150 fms [274 m], *Albatross*, 28 Apr. 1974, 15:00 h; MOVI 30900-30902 (ex CAS 31999), 3(158-231 mm), 36°37'36"N, 74°41'15"W, 255 m, *Iselin,* 45' otter trawl, J. A. Musick, 8 Jun. 1973; SU 9533, 1(352 mm), Nantucket to Cape Sable, N.S., 39°58'50"N, 70°39'40"W, 168 fms [307 m], *Albatross*, beam trawl, U.S. Fish Commission, 20 Sep. 1883; VIMS 05677, 1(355 mm), 36°41.1'N, 74°40.0'W, 284 m (518 m), *Gilliss*, 45' otter trawl, J.A. Musick *et al*., 17 Sep. 1975; VIMS 07469, 2(510-555 mm), Massachusetts, NE Cape Cod, 40-50 m, *Delaware II*, otter trawl, W.G. Raschi, May 1980. GREENLAND (DENMARK): ZMUB 9806, 83(250-420 mm), West Greenland, 63°28’N, 51°56’W, 200 m, *G.O. Sars*, B. Berland, 29-30 Apr. 1962; ZMUB

9807, 43(272-423 mm), West Greenland, 63°28'N, 51°50'W, 270 m, G. Foss, 1964; ZMUB 6427, 1(314 mm), 69°42'N, 19°43'W, 115 m, *Asterias*, 2 Oct. 1969; ZMUB 9198, 1(290 mm), 66°20'N, 56°25'W, 350-390 m, 7-8 Aug. 1983. NORWAY: ZMUB 9811, 41(190-315 mm), Samlafjord, Hardanger, Hordaland, 864 m, H. Tambs-Lywke, 21-22 Jul. 1959. DENMARK: AMS I.2891, 1(215 mm), Denmark, 1891.

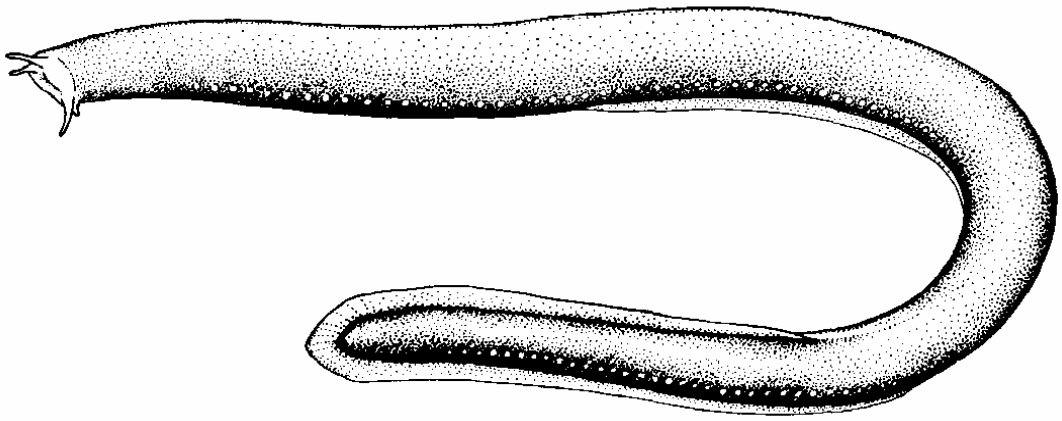


Fig. 73. *Myxine glutinosa* (after Bigelow and Schroeder, 1948).

Diagnostic features: Body elongated, its depth 3-8% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular, bluntly pointed. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.6-1.2% TL), third one longer (1.2-2.3% TL). Six (rarely 7) pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at second gill pouch. Ventral finfold ranging from 1 to 13 mm, averaging 3 mm high, beginning within anterior 8% of trunk, extending backward to the cloaca. Caudal finfold thin, rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL; ranges of the eastern North Atlantic population given first, followed by those of the western North Atlantic in parentheses):

prebranchial length 24-30 (23-30); trunk length 55-60 (55-62); tail length 13-17 (12-17); body width 3-6 (2-5); body depth including VFF 5-9 (4-7); body depth excluding VFF 5-8 (3-7); body depth over cloaca 4-6 (3-5); tail depth 4-6 (3-6). Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 4-7 (5-8). Posterior unicusps 5-8 (5-8). Total cusps 29-38 (30-42). Prebranchial pores 20-36 (22-40). No branchial pores. Trunk pores 50-63 (52-69). Tail pores 8-15 (8-16). Total pores 85-108 (89-118).

Color in alcohol: WNA: body reddish brown to dark purple; head only slightly pale; occasional pale blotches ventrally; gill apertures, slime pores, ventral fanfold, and caudal finfold usually with pale margins; a narrow pale streak of variable length usually present on dorsal midline. ENA: body grayish (light to dark brown on live specimens); head the same color as body; ventral area of prebranchial region lighter then body; ventral finfold pale; caudal finfold without pale margim; gill apertures and slime pores usually with pale margins; no pale streak on dorsal midline.

Size: Maximum total length is 950 mm for the western North Atlantic population (Kuenstner, 1996), and 420 mm for the eastern North Atlantic population (Bigelow and Schroeder, 1948).

Distribution and habitat: Two populations from the North Atlantic Ocean. In the eastern North Atlantic, it has been reported from Murmansk (Russia) to northern Marocco, including the Baltic Sea and western Mediterranean Sea (north Marocco, Algeria, and northern Adriatic Sea, but probably occurs along all coastal regions of western Mediterranean), at depths from 40 to 1200 m. In the western North Atlantic, it is found from Greenland to Florida, including few records in the Gulf of Mexico (off Yucatán and Florida), from 75 to 742 m depth.

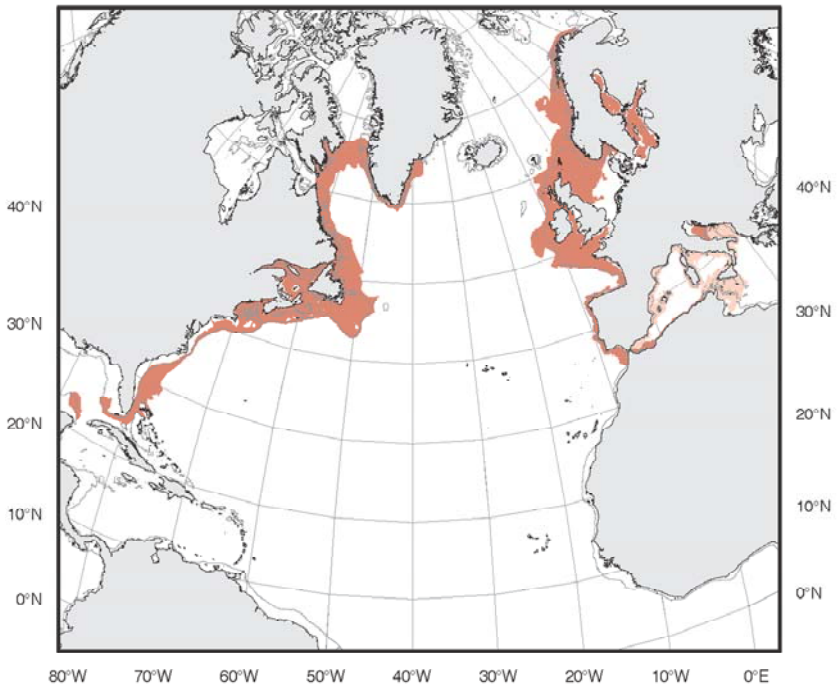


Fig. 74. Distribution of *Myxine glutinosa.*

Interest to Fisheries: Data on the developing fishery on the eastern Atlantic population of ***M. glutinosa*** have been collected by the National Marine Fisheries Service (NMFS) and by the New England Fisheries Development Association (NEFDA) (Martini and Flescher, 2002). In 1991, two boats made 32 trips over an 8-month period. During 1993, some 890,000 lb of hagfish were landed at Gloucester, Sandwich, Hampton, and Stonington. During 1994, five boats were involved in full-time hagfishing and made a total of 796 trips. Catches rose during 1997-1999, totaling 11.5 million lb and generating approximately US$ 3.3 million. Over the period 1991-1996, roughly 50 million hagfish were processed and shipped overseas; during 1997-1999, that number grew to roughly 212 million. Hagfish shorter than 500 mm, the minimum length suitable for leather, are discarded into the surface waters, where they quickly become moribund. On some trips, over 50% of the catch was discarded as unmarketable. Under these conditions the number of individuals removed from the environment would be more than twice the number landed ashore. It is not known what effects such a decline will have on the benthic ecology. However, from a regulatory perspective it is obviously difficult to set defensible quotasor guidelines for a fishery when

virtually nothing definitive is known about the size of the population, their reproductive potencial, their individual growth rates, or their longevity.

Remarks: According to Fernholm and Wheeler (1983), four specimens in the Naturhistoriska Riksmuseet (Swedish Museum of Natural History) are probably the original material examined by Linnaeus (1758) to describe the species and they should be accorded type status.

The western North Atlantic population was at one time assigned to a separate species, ***Myxine limosa*** Girard, 1859, and Wisner and McMillan (1995) suggested a return to this practice based on differences in size at maturity (eastern North Atlantic are smaller) and color differences in preserved specimens. In the absence of other supporting morphological data, these features seem insufficient to justify dividing the eastern and western Atlantic populations into separate species (Martini *et al*., 1998; Martini and Flescher, 2002). More conclusive studies involving morphological and molecular data are necessary to solve this taxonomic complex. For descriptive purpose, morphometrical and meristic data were given here for both populations, according to Wisner and McMillan (1995).

Konstantinov and Shchegelov (1958) reported the occurrence of one 285-mm specimen of ***M. glutinosa*** off eastern coast of Iceland, but unfortunately they do not provide any descriptive information. The depth of capture (940 m) suggest that it could be ***M. jespersenae***, which occurs off southeast Iceland from 752 to 1556 m depth (Møller *et al*., 2005). In addition, ***M. glutinosa*** was not included in a recent check-list of Iceland fishes (Jónsson, 1992). Although its presence in Iceland waters is uncertain, it is caught in the Denmark Strait on the Greenland site, which is very close to Iceland.

The maximum depth (1006 m) given by Wisner and McMillan (1995) for western North Atlantic population was based on a single specimen (ISH 431-1986) recently reidentified as ***Myxine jespersenae***, which was in fact collected off southeastern Iceland (Møller *et al*., 2005).

The sex ratio of females and males in the samples analyzed by Martini *et al*. (1997) was highly skewed, at 9.8:1, which is typical for the species as a whole. The paucity of males in population on both sides of the Atlantic has long been recognized, but it remains unexplained.

Common names: EUA, UK, FAO: Atlantic hagfish; CANADA: Atlantic hagfish, Northern hagfish, Myxine du nord; FRANCE: Myxine; SPAIN: Pez moco; SWEDEN: Pirål.

Myxine hubbsi Wisner and McMillan, 1995

Myxine hubbsi Wisner and McMillan, 1995: 536 [original description; type locality: Eastern North Pacific, 32°38'N, 118°08°4'(sic)W, 2009 m (according to SIO database, the correct type locality is: Clemente Basin, SE of Clemente Island, 32°38.7'N, 118°08.4'W); type series: holotype, SIO 65-452, paratypes, CAS 79536 (10), CAS 77360 (10), LACM 45786-1 (18), MCZ 101240 (6), SIO 65-452 (82), SIO 68-60 (36), SIO 68-61 (2), SIO 72-176 (8), SIO 73-293 (16), SIO 92-114 (7), SIO 92-115 (7), USNM 325214 (16)]. –Fernholm, 1998: 35 [W. coast of North and South America]. –Mok, 2001: 358 [nasal sinus papillae]. –Soto and Mincarone, 2004: 13 [catalog]. –Love *et al*., 2005: 1 [calalog; southern California to Chile]. –Møller *et al*., 2005: 382 [selected characters].

Myxine sp. –Hubbs *et al*., 1979: 3 [list of fishes from California]. –Eschmeyer *et al*., 1983: 10 [field guide].

Material examined: 17 specimens. UNITED STATES OF AMERICA: CAS 79536 (ex SIO 65-452) paratypes, 10(350-418 mm), Clemente Basin, SE of San Clemente Island, 32°38'42"N, 118°08'24"W, 1098 fm (2008 m), RV *Alexander Agassiz*, setline, C. L. Hubbs, 25 Sep. 1965, 03:10-10:56 h. MEXICO: CAS 77360 (ex SIO 59-363) paratypes, 3(315-395 mm), Baja California Norte, 31°00'N, 118°06'W, 950 fm (1737 m), trap, G. B. Schick, 27 Oct. 1959, 02:10-14:15 h; MOVI 27508-27509 (ex SIO 59-366), 2(215-410 mm), 31°02.7'N, 116°59.25'W, 1170 fm (2139 m), trap, G. B. Schick, 27-28 Oct. 1959, 21:15-20:36 h; USNM 325214 (ex SIO 68-676), paratypes, 2(440-450 mm), 32°39'N, 118°11'W, 1829 m, RV *Velero IV*, hook & line, R. McConnaughey, 9-10 Dec. 1968, 16:00-09:40 h.

Diagnostic features: Body elongated, its depth 4-5% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum short and rounded.

One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.5-0.9% TL), third one longer (0.6-1.4% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the first or second gill pouch. Ventral finfold 3-8 mm high, beginning within anterior 13% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 25-28; trunk length 58-65; tail length 10-12; body width 3-5; body depth including VFF 4-6; body depth excluding VFF 4-5; body depth over cloaca 3-5; tail depth 3-5. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 5-9. Posterior unicusps 5-8. Total cusps 32-42. Prebranchial pores 18-28. No branchial pores. Trunk pores 57-73. Tail pores 8-14. Total pores 90-111.

Color in alcohol: body light to dark purplish black, rarely with pale blotches; head usually pale anteriorly; barbels pale; gill apertures and ventral finfold with narrow pale margins; caudal finfold the same color as body.

Size: Maximum total length 522 mm (Wisner and McMillan, 1995).

Distribution and habitat: Eastern Pacific Ocean, from 33°N to 22°S. Off North America, from San Diego (USA) to Baja California Sur (Mexico); off Central America, south of Nicoya Peninsula (Costa Rica); and off South America, from Talara (Peru) to about Tocopilla (Chile). A deep-water species living on the lower slope and sea floor at depths from 1100 to 2440 m (Wisner and McMillan, 1995).

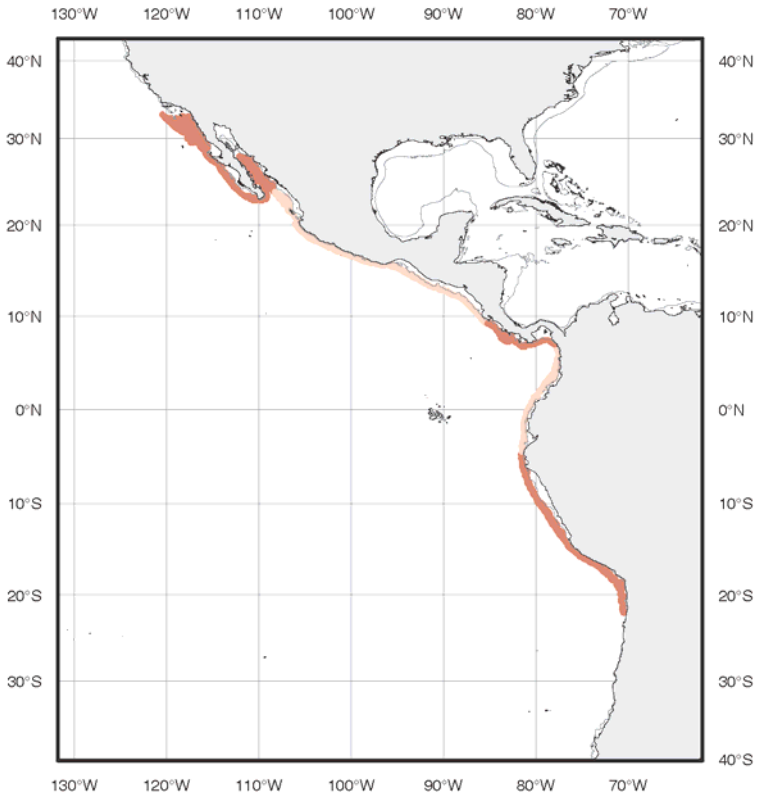


Fig. 75. Distribution of *Myxine hubbsi.*

Interest to fishery: None.

Remarks: Wisner and McMillan (1995) stated that bichromatism on ***Myxine hubbsi*** is rare; only five of 36 specimens from near Cape San Lucas, Baja California, Mexico (SIO 68-60), were notably bichromatic with colors generally bluish-purple ventrally and pinkish dorsally.

The sex ratio of the specimens examined by Wisner and McMillan (1995) was extremely unbalanced. Of 150 specimens sexed 114 (76%) were females, 35 (23%) hermaphroditic, and 6 (0.4%) males. From 7 to 15 large eggs, ranging between 17x6 mm and 24x8 mm, occur in eight females (415-450 mm); all other females have small eggs. The largest number of eggs (15) occurs in a female of 440 mm.

Common names: USA, FAO: Bathybial hagfish.

Myxine hubbsoides Wisner and McMillan, 1995

Myxine hubbsoides Wisner and McMillan, 1995: 536 [original description; type locality: off central Chile, 34°00'S, 72°14'W, 880 m (735 m, according to SIO database); type series: holotype, SIO 90-143 (ex MNHMC 80047), paratypes, SIO 90-141 (1), SIO 90-142 (1)]. –Fernholm, 1998: 35 [Central Chile]. –Mok, 2001: 358 [nasal sinus papillae]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: 3 specimens. CHILE: SIO 90-143 (ex MNHNC 80047) holotype, 800 mm, 34°00'S, 72°14'W, 735 m, *Izumi*, Kong-Zavala, 31 Aug. 1980; SIO 90-141 (ex MNHNC 80043), paratype, 1(680 mm), 34°21'S, 72°18'W, 820 m, *Izumi*, Kong-Zavala, 31 Aug. 1980; SIO 90-142 (ex MNHNC 80044) paratype, 1(651 mm), 34°14'S, 72°21'W, 735 m, trawl, *Izumi*, Kong-Zavala, 31 Aug. 1980.

Diagnostic features: Body elongated, its depth 4-5% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with rounded tip. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.8-1.3% TL), third one longer (1.6-2.1% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the second gill pouch. Ventral finfold low, 1 mm high (with portions intermittently absent), beginning within anterior 6% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 27-28; trunk length 61-62; tail length 12; body width 2-4; body depth including VFF 4; body depth excluding VFF 4-5; body depth over cloaca 3-4; tail depth 4. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 6-7. Posterior unicusps 7. Total cusps 34-36.

Prebranchial pores 30-31. No branchial pores. Trunk pores 68-71. Tail pores 12-13. Total pores 111-116.

Color in alcohol: body dark brown; head and barbels slightly paler; gill apertures and slime pores with very narrow pale margins; ventral and caudal finfolds the same color as body.

Size: Known only from three specimens, 655 to 820 mm TL (Wisner and McMillan, 1995).

Distribution and habitat: Known only off central Chile, between Navidad and Punta Topocalma. On the lower continental slope at depths from 735 to 820 m.

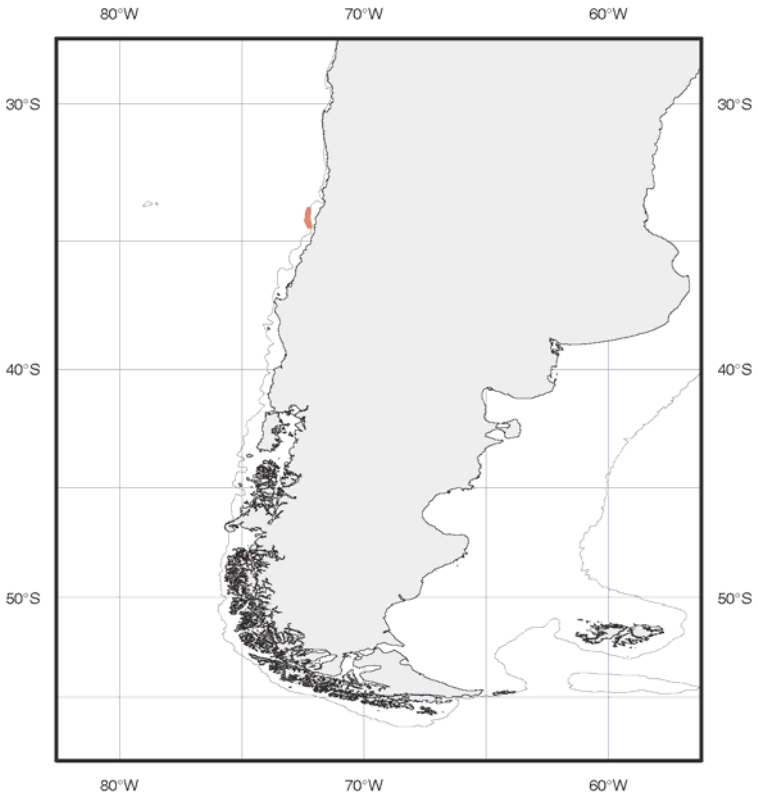


Fig. 76. Distribution of *Myxine hubbsoides.*

Interest to fishery: None.

Common names: FAO: Hubbsoides hagfish.

Myxine ios Fernholm, 1981

Myxine ios Fernholm, 1981: 74, Figs. 1-4 [original description; type locality: Northeastern Atlantic off west Africa, 23°41.4'N, 17°04.1'W, 623 m; type series: holotype, BMNH 1980.6.4.1, paratypes, BMHN 1980.6.4.2-14 (13), ZMUC P 02125 (1), SIO 80-50 (1), SIO 80-51 (1)]. –Fernholm and Vladykov, 1984: 69 [west of Ireland and Iceland]. –Haedrich and Merrett, 1988: 1329 [Porcupine Seabight and northwest Africa]. –Fernholm, 1990a: 1 [western Sahara]. –Merrett *et al*., 1991: 336 [Porcupine Seabight]. –Jónsson, 1992: 53 [West Africa and Iceland]. –Fernholm, 1998: 35 [West Africa and Ireland]. –Mok, 2001: 358 [nasal sinus papillae]. –Massutí *et al*., 2004: 114 [Porcupine Seabight]. –Møller *et al*., 2005: 378 [comparison with *Myxine jespersenae*].

Myxine sp. nov. –Merrett and Marshall, 1981: 235 [northwest Africa].

Material examined: 17 specimens. IRELAND: SIO 80-52, 1(421 mm), 51°04.4'N, 11°59.3'W, 1494-1572 m, RV *Discovery*, semi balloon otter trawl, 21 Apr. 1978. MOROCCO: BMNH 1980.6.4.1, holotype, 371 mm, 23°41'36"N, 17°03'42"W, 614 m, RV *Discovery*, baited trap, 23 Mar. 1972; BMNH 1980.6.4.2-14, paratypes, 12(247-475 mm), taken with the holotype; SIO 80-50, paratype, 1(430 mm), 25°46.42'N, 15°57.09'W, 929 m, RV *Discovery*, baited trap, 25 Mar. 1972. ANGOLA: CAS 223405, 1(320 mm), 10°03'S; 12°47'E, 165° from start of trawl at given coordinates, 725-734 m, RV *Dr. Fridtjof Nansen*, large otter trawl, T. Iwamoto, 8 Apr. 2005, 18:58-19:28 h; RUSI 66087, 1(298 mm), 08°16'S, 12°41'E, 703-705 m, RV *Dr. Fridtjof Nansen*, 47’ bottom trawl, D. Tweddle, 16 Mar. 2002.

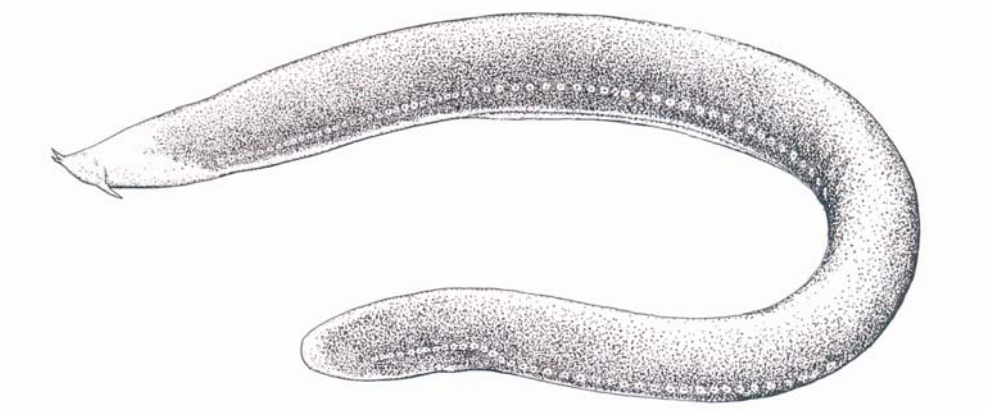


Fig. 77 ***Myxine ios*** **(after Jónsson, 1992).**

Diagnostic features: Body elongated, its depth 4-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.7-1.0% TL), third one longer (1.0-1.6% TL). Seven pairs of gill pouches (specimens with six gill pouches are rare). Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill pouches 1-2. Ventral aorta branches at the second gill pouch. Ventral finfold developed, 3-5 mm high, beginning within anterior 9% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL; ranges of the W. African population given first, followed by those of the Irish population in parentheses): prebranchial length 25-29 (28-30); trunk length 59-64 (58-60); tail length 12-14 (12-13); body width 3-5 (3-4); body depth including VFF 5-7 (4-5); body depth excluding VFF 4-6 (4-5); body depth over cloaca 3-5 (3-4); tail depth 4-5 (3-4). Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 9-11 (8-11). Posterior unicusps 9-11 (8-10). Total cusps 45-51 (44-50). Prebranchial pores 28-35 (30-36). No branchial pores. Trunk pores 63-73 (64-68). Tail pores 9-12 (11-13). Total pores 103-116 (107-116).

Color in alcohol: body uniformly grey, occasionally with a whitish ventral finfold (West African population), or more variable in shade being lighter grey or reddish grey

(Irish population). Also the Irish population is distinguished by having a whitish head, gill apertures and slime pores with a whitish margin and usually a lighter middorsal and/or midventral stripe.

Size: Maximum total length 522 mm (W. African population) and 468 mm (Irish population) (Fernholm, 1981).

Distribution and habitat: Known from two populations, as defined by Fernholm (1981). The Irish population is mainly known from Porcupine Seabight, southwestern Ireland. The West African population is known off Western Sahara, from Cap Boujdour to Cap Blanc. Two specimens (CAS 223405 and RUSI 66087) were recently trawled off Angolan waters and they are first reported herein. The Irish specimens were caught in semi-balloon other trawls on the Porcupine Seabight, an amphitheatre-shaped embayment in the continental margin to the southwest of Ireland, at depths from 985 to 1650 m (Merrett *et al*., 1991; Massutí *et al*., 2004). The bottom water temperatures from two Irish capture localities were 4.7°C and 6.2-6.4°C, and the associated fauna and collection data suggest that the bottom substrate was soft mud. A list of 118 species of fishes taken from Porcupine Seabight (including *M. ios*) was provided by Merrett *et al*. (1991). The West African specimens were collected in baited traps on the lower slope at depths from 614 to 976 m (Fernholm, 1981). Angolan specimens were trawled on the lower slope at depths from 703 to 734 m.

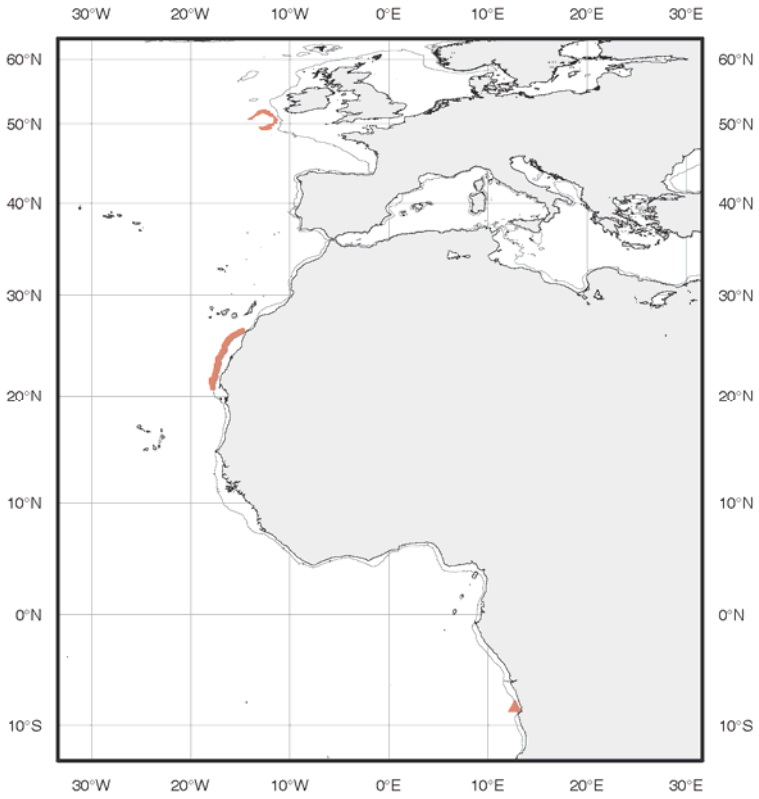


Fig. 78. Distribution of *Myxine ios.*

Interest to fishery: None.

Remarks: According to Møller *et al*. (2005), some records of *M. ios* from the Denmark Strait (Fernholm and Vladykov, 1984; Jónsson, 1992) and West Greenland (Jørgensen, 2003) might belong to ***M. jespersenae***. Due to some mistakes in the Fernholm's (1981) original description, the counts given here for the Irish population are those given by Møller *et al*. (2005), which were based on Fernholm's original data sheets. Data from the West African population include those taken from Angolan specimens.

All the West African material was caught in March and contains no ripe individuals (largest maturing eggs found are 5-9 mm). The Irish material contains a recently spawned female captured in July and males appearing ripe in June and July (Fernholm, 1981).

Common names: ENGLAND: White-headed hagfish; ICELAND: Slímáll; FAO: Atlantic whitehead hagfish, Myxine à tête blanche.

Myxine jespersenae Møller, Feld, Poulsen, Thomsen and Thormar, 2005

Myxine jespersenae Møller, Feld, Poulsen, Thomsen and Thormar, 2005: 375, Figs. 1, 2, 3A, 4 [original description; type locality: off West Greenland, Davis Strait, 64°46'N, 55°38'W, 905 m; type series: holotype, ZMUC P02166, paratypes, BMNH 2004.9.6.1 (1), HAF-96-13 (1), HAF-2000-023 (1), HAF-2003-002 (1), ISH 431-1986 (1), USNM 378951 (1), ZMUC P02127-28 (2), ZMUC P02129 (1), ZMUC P02143 (1), ZMUC P02145 (1), ZMUC P02146-47 (2), ZMUC P02148 (1), ZMUC P02159-60 (2), ZMUC 902161 (1), ZMUC P02162 (1), ZMUC P02163-64 (1), ZMUC P02165 (1), ZMUC P02182 (1)].

Myxine glutinosa (not Linnaeus, 1758). –Nielsen and Bertelsen, 1992: 6 [in part].

Myxine limosa (not Girard, 1859). –Wisner and McMillan, 1995: 539 [in part, ISH 431-1986].

Myxine ios (not Fernholm, 1981). –Møller, 2001: 37 [Greenland]. –Jørgensen, 2003: 24 [west Greenland].

Material examined: 1 specimen. GREENLAND (DENMARK): MOVI 37937 (ex ZMUC P02142) 1(365 mm), Davis Strait, off Nuuk, 64°05'N, 54°57'W, 1158-1167 m, RV *Shinkai Maru*, bottom trawl, P. R. Møller, 15 Aug. 1992.

Diagnostic features: Body elongated, its depth 3-4% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum bluntly rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.8-1.3% TL), third one longer (1.1-1.6% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill pouches 1 to 2. Ventral aorta branches at the first or second gill pouch. Ventral finfold low (1 mm) to well developed (4 mm high), beginning within anterior 10% of trunk, extending backward to the cloaca.

Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 21-30; trunk length 57-66; tail length 11-14; body width 2-4; body depth excluding VFF 3-4; body depth over cloaca 3-4; tail depth 3-4. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 7-9. Posterior unicusps 8-10. Total cusps 38-44. Prebranchial pores 28-37. No branchial pores. Trunk pores 65-74. Tail pores 11-15. Total pores 107-121.

Color in alcohol: body dark grayish brown; head anterior to first slime pore always white; whitish color of ventral surface often limited by the lines of prebranchial slime pores, occasionally extending to the white ventral finfold; margins of slime pores, gill apertures, cloaca, and caudal finfold white. Color pattern of live and preserved specimens similar.

Size: Maximum total length 498 mm (Møller *et al*., 2005).

Distribution and habitat: Known from the North Atlantic, eastern Davis Strait, Denmark Strait, Reykjanes Ridge, and southeast of Iceland. Usually taken from muddy bottoms and cold waters (3.7-4.7°C) on the lower slope at depths from 752 to 1556 m. According to Møller *et al*. (2005) the disjunct distribution is a result of a very limited sampling effort in the waters around southern Greenland.

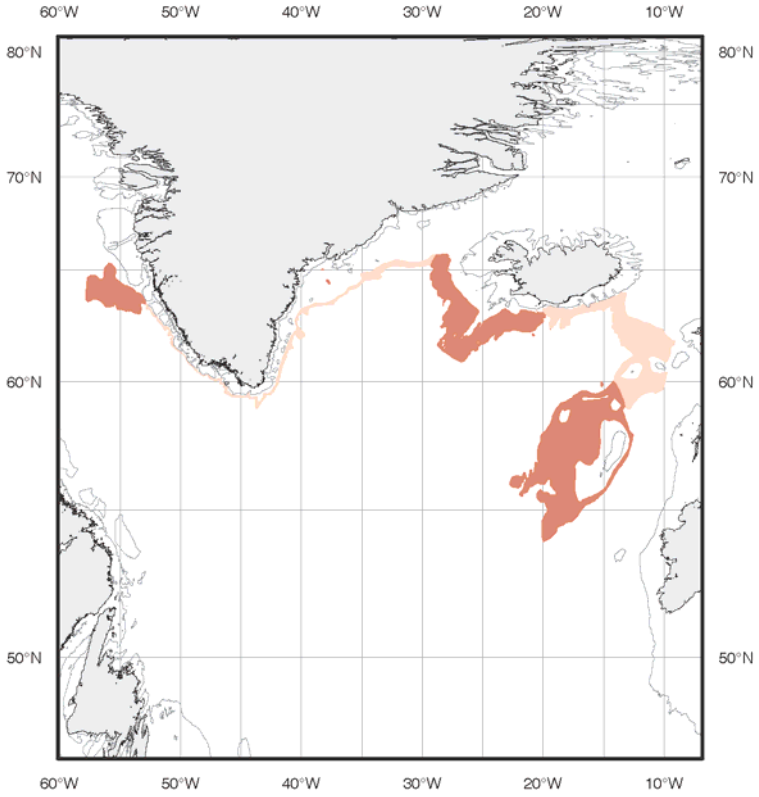


Fig. 79. Distribution of *Myxine jespersenae.*

Interest to fishery: None.

Remarks: Only a single specimen was available for examination, thus the description above was based on data provided by Møller *et al*. (2005).

According to Møller *et al*. (2005), the eggs of a single damaged female were in various stages of maturation, elliptical, up to 23.6 x 8.5 mm. All eggs were in mesenteries and no anchor filaments were found.

Common names: FAO: Jespersen's hagfish.

Myxine knappi Wisner and McMillan, 1995

Myxine knappi Wisner and McMillan, 1995: 538 [original description; type locality: off northeastern Falkland Islands, 49°16'S, 57°02'W, 630-650 m; type series: holotype, SIO 90-144 (formerly ZIN 721-966), paratypes, SIO 90-144 (2)]. –Fernholm, 1998:

35 [Falkland Islands]. –Mincarone and Soto, 2001: 126 [distribution]. –Mok, 2001: 358 [nasal sinus papillae]. –Møller *et al*., 2005: 382 [selected characters].

Myxine australis (not Jenyns, 1842). –Günther, 1870: 511 [in part, specimens *e* and *f* from Tyssen Islands]. –Vaillant, 1888b: 32 [in part, specimens from baie Orange]. –Regan, 1913a: 397 [in part, specimens 13-14 from Tyssar (=Tyssen) Islands].

Myxine tridentiger Garman, 1899 [in part, specimens from Tyssen Islands; paralectotypes BMNH 1868.9.16.12-13]. –Holly, 1933: 48 [in part, Tysseninseln (=Tyssen Islands)].

Myxine dorsum Wisner and McMillan, 1995: 537 [original description; type locality: off southern Falkland Islands, 54°25'S, 59°42'W, 112 m; type series: holotype, ISH 99-1971, paratype, SIO 92-21 (formerly ZIN 721-966)]. –Fernholm, 1998: 35 [SW Atlantic Ocean]. –Mincarone and Soto, 2001: 126 [distribution]. –Mok, 2001: 358 [nasal sinus papillae]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: 11 specimens. FALKLAND ISLANDS: SIO 90-144 (ex ZIN 721-966), holotype, 546 mm, 49°16'S, 57°02'W, 630-650 m, trawl, *Academican Knopowich*, Y. E. Permitin, 24 Mar. 1965; SIO 90-144 (ex ZIN 721-966), paratype, 1(496 mm), taken with holotype; SIO 92-21 (ex ZIN 721-966) paratype of ***Myxine dorsum***, 1(484 mm), 49°16'S, 57°02'W, 630-650 m, trawl, *Academican Knopowich*, Y. E. Permitin, 24 Mar. 1965; BMNH 1868.9.16.12-13, paralectotypes of ***Myxine tridentiger***, 2(247-280 mm), Tyssen Island, Dr. Cunningham, Lords of the Admiralty; MNHN 1990-0887, 2(370-505 mm), Malouines, NO *Commandant Gue*, Le Morvan, Jun. 1987. CHILE: MNHN 1884-0885, 1(384 mm), MNHN 1884-0886, 1(350 mm), MNHN 1884-0887, 3(293-320 mm), Chile, Orange, 55°10'S, 68°40'W, NO *Romanche*, Mission scientifique du cap Horn, 1884.

Diagnostic features: Body elongated, its depth 4-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with rounded tip. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.6-1.2% TL), third one longer (1.0-1.9% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct,

forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the first or second gill pouch. Ventral finfold vestigial (0.4 mm) to well developed (7 mm high), beginning within anterior 12% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending forward dorsally as a ridge beyond a vertical from cloacal origin one to four times the tail length.

Body proportions (in percentage of TL): prebranchial length 27-30; trunk length 56-62; tail length 12-13; body width 3-5; body depth including VFF 4-6; body depth excluding VFF 4-6; body depth over cloaca 3-5; tail depth 4-6. Two-cusp multicusps on the anterior and posterior rows of cusps Anterior unicusps 6-8. Posterior unicusps 7-9. Total cusps 34-40. Prebranchial pores 30-38. No branchial pores. Trunk pores 54-74. Tail pores 7-14. Total pores 98-126.

Color in alcohol: body purple to reddish brown, dorsal region usually darker than ventral; barbels with pale tip; head usually pale anteriorly; occasional whitish ventral band or blotches between the rows of prebranchial slime pores; gill apertures with narrow whitish margin; ventral finfold pale; caudal finfold the same color as body or with a narrow pale margin.

Size: Maximum total length 565 mm (Wisner and McMillan, 1995).

Distribution and habitat: Known from southern Argentina, from Falkland Islands to Cape Horn, including the Burdwood Bank. Usually taken from shallow waters of Falkland Sound to upper slopes (to 650 m).

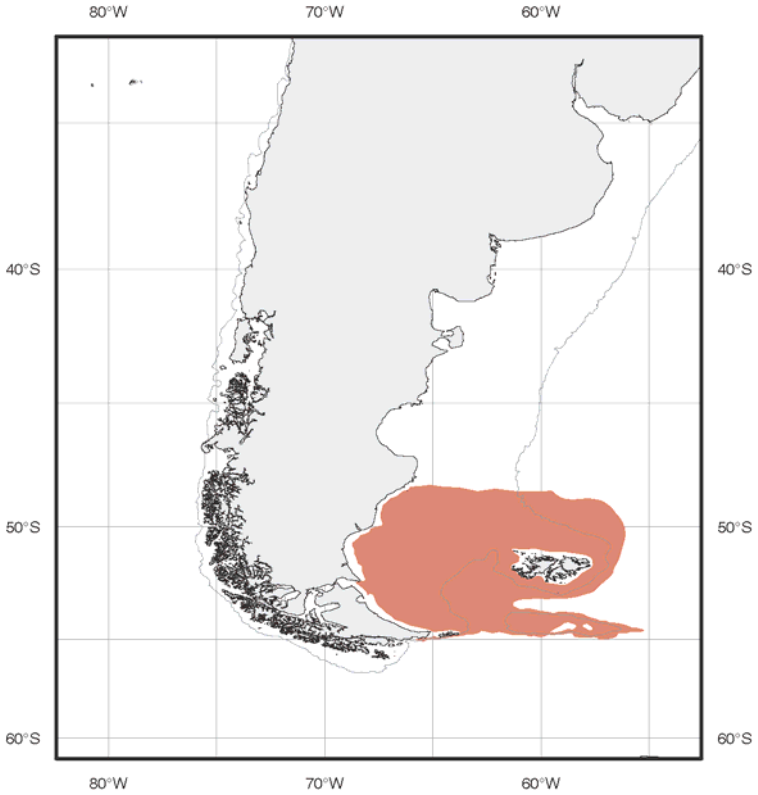


Fig. 80. Distribution of *Myxine knappi.*

Interest to fishery: None.

Remarks: ***Myxine dorsum*** Wisner and McMillan, 1995 is placed here as a junior synonym of ***M. knappi*** Wisner and McMillan, 1995. Both species were described based on few specimens available (3 of ***M. knappi*** and 2 of ***M. dorsum***). Some types of ***M. knappi*** (SIO 90-144) and ***M. dorsum*** (SIO 92-21) belonged to the same former lot (ZIN 721-966). They were donated separately to SIO and unjustifiably described by Wisner and McMillan (1995) as different species. Recent analysis of type material and nine additional specimens revealed that there are no morphological differences between these species.

Two paralectotypes of ***Myxine tridentiger*** (BMNH 1868.9.16.12-13) were recently examined and re-identified as ***Myxine knappi***. They were previously misidentified as ***Myxine australis*** by Günther (1870: 511).

Common names: FAO: Knapp's hagfish.

Myxine kuoi Mok, 2002

Myxine sp. 3. –Mok and Chen, 2001: 235 [distribution of Taiwanese hagfishes].

Myxine kuoi Mok, 2002: 60, Figs. 1-2 [original description; type locality: southwestern Taiwan, 22°29'35"N, 120°03'34"E, 595 m; type series: holotype, NSYSU 3176, paratypes, NSYSU 3177 (4), NSYSU 3178 (1)]. –McMillan and Wisner, 2004: 68 [identification key; review of Asian hagfishes]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: None; the description below was based on original description.

Diagnostic features: Body elongated, its depth 4.4-5.3% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head. Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta not branched. Ventral finfold well developed in young but vestigial in mature specimens. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 25.9-28.7; trunk length 56.9-63.2; tail length 11.0-16.2; body depth including VFF 4.4-6.3; body depth excluding VFF 4.4-5.3; body depth over cloaca 4.1-4.7; tail depth 3.1-6.6. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 5-6. Posterior unicusps 6-7. Total cusps 30-32. Prebranchial pores 24-30. No branchial pores. Trunk pores 57-68. Tail pores 11-13. Total pores 95-100.

Color in alcohol: body dark brow; middorsal region and abdomen behind gill apertures light brown; ventral finfold with pale margin.

Size: Maximum total length 410 mm (Mok, 2002).

Distribution and habitat: Known only from the type locality, off southwestern Taiwan, on the continental slope at 595 m depth.

Fig. 81. Distribution of *Myxine kuoi.*

Interest to fishery: None.

Remarks: ***Myxine kuoi*** is known from only six specimens ranging from 123 to 410 mm TL. The biggest one is a mature female with eggs reaching 12 mm. The sex of remain specimens (123-187 mm) was not determined (Mok, 2002).

Common names: FAO: Kuo's hagfish.

Myxine mccoskeri Wisner and McMillan, 1995

Myxine mccoskeri Wisner and McMillan, 1995: 534 [original description; type locality: off

San Blas Archipelago, Caribbean Sea, 09°39'N, 78°60'W (sic), 530-560 m (according to SIO database, the correct type locality is: 09°39.7'N, 78°39.1'W); type series: holotype, SIO 70-363, paratypes, CAS 79537 (2, not at CAS), MCZ 41634 (1), MCZ 48809 (2), SIO 70-363 (2, correct collection number SIO 72-363), SIO 92-117 (1), USNM 325212 (2)]. –Fernholm, 1998: 35 [southern Caribbean Sea]. –Mok, 2001: 358 [nasal sinus papillae]. –Fernholm, 2003: 355 [southern Caribbean Sea]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: 1 specimen. VENEZUELA: SIO 92-117 (ex UMML 29269), paratype, 1(228 mm), Caribbean Sea, 11°46'N, 67°05.7'W - 11°54.7'N, 67°05'W, 600-642 fm (1097-1174 m), otter trawl, RV *Pillsbury*, 24 Jul. 1968.

Diagnostic features: Body elongated, its depth 4-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum elongated, bluntly pointed. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Three pairs of barbels on head. Five pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the first gill pouch. Ventral finfold vestigial to well developed (0.2-5 mm high), beginning within anterior 4% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 27-34; trunk length 52-56; tail length 13-17; body width 3-5; body depth including VFF 5-9; body depth excluding VFF 4-7; body depth over cloaca 4-7; tail depth 4-7. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 6-9. Posterior unicusps 7-10. Total cusps 36-48. Prebranchial pores 22-27. No branchial pores. Trunk pores 43-53. Tail pores 9-14. Total pores 77-92.

Color in alcohol: body variably light to dark brown; head, barbels, and ventral aspects anterior to gill apertures white or lighter than body; a pale band extends dorsally to

over the cloaca; gill apertures with narrow pale margin; ventral and caudal finfolds the same color as body, usually without pale margins.

Size: Maximum total length 286 mm (Wisner and McMillan, 1995).

Distribution and habitat: Known only from the type specimens from the southern Caribbean Sea, off Panama, Colombia, and Venezuela, on the continental slopes at depths from 439 to 1174 m. A probable record off Suriname reported by Shimizu (1983).

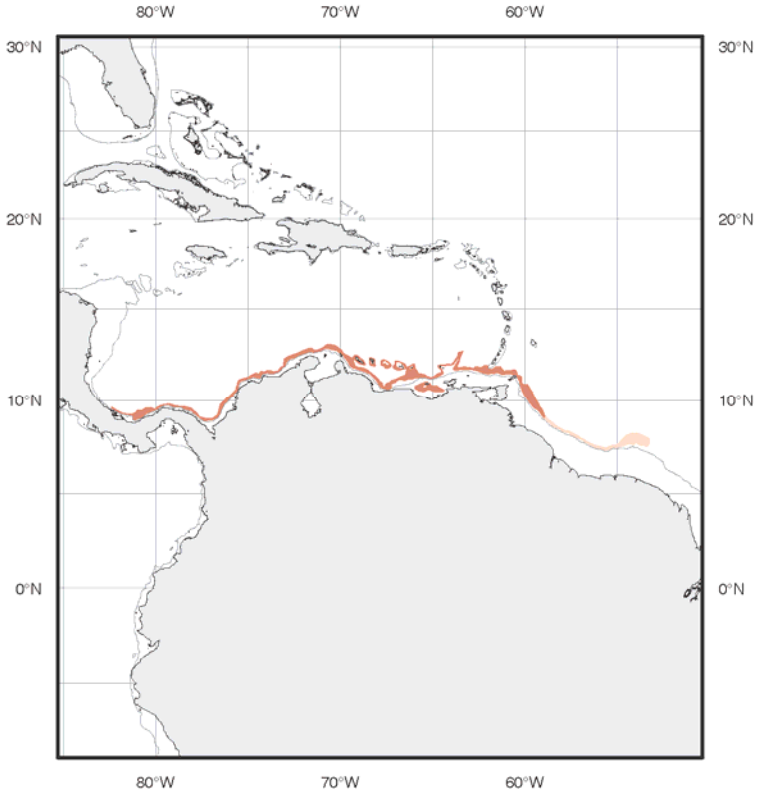


Fig. 82. Distribution of *Myxine mccoskeri.*

Interest to fishery: None.

Remarks: Data from description were those provided by Wisner and McMillan (1995). The paratypes CAS 79537 (2), MCZ 41634 (1), and MCZ 48809 (2) were not found in their respective fish collections.

Shimizu (1983) reported three specimens of an undescribed *Myxine* off Suriname at 310 m depth. According to Wisner and McMillan (1995), the short description given by Shimizu (1983) is very similar to that of ***M. mccoskeri***, except by the color pattern. However, the color described by Shimizu was based on fresh specimens, different therefore from those preserved specimens described by Wisner and McMillan (1995).

According to Wisner and McMillan (1995), a 264-mm female contained only four large eggs, each about 18x7 mm; two other females, 218 and 222 mm, contained four and five eggs, about 15x5 mm. It is considered a dwarf species because of the short length of females with such large eggs.

Common names: FAO: McCosker's Caribbean hagfish.

Myxine mcmillanae Hensley, 1991

Myxine mcmillanae Hensley, 1991: 1040, Fig. 1 [original description; type locality: off southern Puerto Rico, 17°51.8'N, 66°58.9'W, 925 m; type series: holotype, USNM 308405, paratypes, SIO 90-21 (11), SIO 90-22 (2), UF 81724 (4), UPRM 3756 (2), UPRM 3757 (2), USNM 308406 (20), 308407 (1)]. –Wisner and McMillan, 1995: 539 [identification key; review of the New World ***Myxine***]. –Smith, 1997: 244 [Puerto Rico and Virgin Islands]. –Fernholm, 1998: 35 [Caribbean Sea]. –McEachran and Fechhelm, 1998: 34 [identification key; northeastern Gulf of Mexico]. –Mincarone, 2001b: 480 [comparison with *Myxine sotoi*]. –Mok, 2001: 358 [nasal sinus papillae]. –Fernholm, 2003: 355 [W and SW Puerto Rico, St. Croix, Virgin Islands]. –Møller *et al*., 2005: 376 [comparison with ***Myxine jespersenae***].

Material examined: 6 specimens. PUERTO RICO (USA): USNM 308405, holotype, 390 mm, Caribbean Sea, 17°51'48"N, 66°58'54"W, 925 m, D. A. Hensley, 4-5 Oct. 1984; USNM 308406, paratype, 1(455 mm), Caribbean Sea, 18°26'54"N, 67°19'30"W, 1500 m, D. A. Hensley, 12-13 Feb. 1986; USNM 308407, paratype, 1(270 mm), Caribbean Sea, 18°25'42"N, 67°18'54"W, 700 m, D. A. Hensley, 13-14 Feb. 1986. UNITED STATES OF AMERICA: UF 30308, 2(258-276 mm), Gulf of Mexico, south of Mississippi River Delta,

28°25'N, 89°10'W, 330 fm (603 m), RV *Oregon* II, 27 Sep. 1971. VENEZUELA: SIO 92-117 (ex UMML 29269), paratype, 1(228 mm), Caribbean Sea, 11°4'N, 67°05.7'W - 11°54.7'N, 67°05'W, 600-642 fm [1097-1174 m], otter trawl, RV *Pillsbury*, 24 Jul. 1968.

Diagnostic features: Body elongated, its depth 4-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with slightly rounded tip. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.7-1.0% TL), third one longer (1.2-1.5% TL). Six pairs of gill pouches (rarely seven). Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill pouches 1-3. Ventral aorta branches at the second gill pouch. Ventral finfold prominent, ranging from 3 to 6 mm high, beginning within anterior 15% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 26-31; trunk length 56-61; tail length 11-14; body width 4-6; body depth including VFF 4-8; body depth excluding VFF 4-7; body depth over cloaca 4-6; tail depth 4-6. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 8-10. Posterior unicusps 8-10. Total cusps 42-48. Prebranchial pores 26-35. No branchial pores. Trunk pores 60-76. Tail pores 9-12. Total pores 101-113.

Color in alcohol: body bluish gray to brown; head anterior to first slime pore white; occasionally whitish area of ventral head surface continuing to origin of ventral finfold; ventral finfold whitish; gill apertures, slime pores, and caudal finfold with whitish margins; whitish color of dorsal section of caudal fin extending anteriorly to form a whitish middorsal stripe of variable length. In life, the body is bluish gray.

Size: Maximum total length 473 mm (Hensley, 1991).

Distribution and habitat: Known from the west (off Mona Island and Aguadilla) and southwest coast of Puerto Rico, and St. Croix, U.S. Virgin Islands (Hensley, 1991). Further reported in the northeastern Gulf of Mexico (McEachran and Fechhelm, 1998) and from south of Mississippi River Delta (present study). It is probable that it also occurs off other Antillean islands. All known specimens were collected on mud bottoms at depths from 603 to approx. 1500 m.

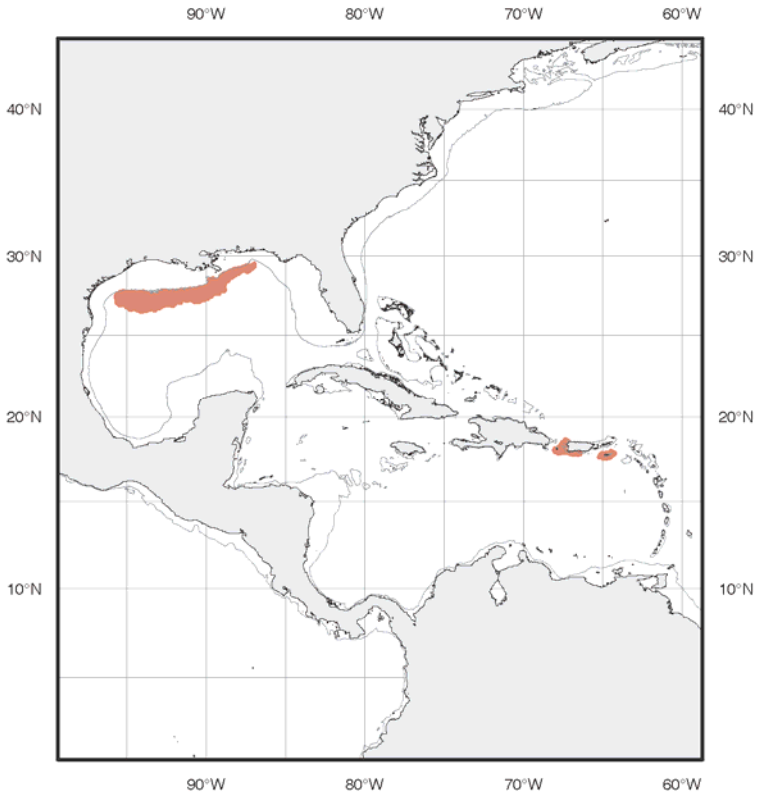


Fig. 83. Distribution of *Myxine mcmillanae.*

Interest to fishery: None.

Remarks: According to Hensley (1991), one 455-mm female had eggs in various stages of maturation. Many eggs were large and elliptical measuring from 15.7x5.4 to 17.0x5.1 mm, and no anchor filaments were visible.

Common names: FAO: Caribbean hagfish.

***Myxine paucidens* Regan, 1913**

Myxine paucidens Regan, 1913a: 396 [original description; type locality: Japan, *Hyalonema* ground, 345 fm (631 m); syntypes: BMNH 1879.5.14.444 (1), 1912.11.28.6 (1)]. –Holly, 1933: 48 [identification key; Japan]. –Bigelow and Schroeder, 1948: 33 [identification key]. –de Buen, 1953: 90 [citation]. –Matsubara, 1955: 92 [identification key]. –Adam and Strahan, 1963: 3 [east coast of Japan]. –Fowler, 1964: 48 [catalog of world fishes]. –Hardisty, 1979: 19 [list]. –Sato, 1984: 1 [list of Japanese fishes]. –Yamakawa, 1984: 35: [citation]. –Fernholm, 1998: 35 [Japan]. –Honma, 1998: 49 [identification key]. –Iwata, 2000: 108 [identification key; catalog of Japanese fishes]. –Kuo *et al*., 1994: 136, Fig. 7k [illustration]. –Nakabo, 2002: 108 [identification key; Sagami Nada]. –McMillan and Wisner, 2004: 68, Fig. 13 [identification key; review of Asian hagfishes]. –Møller *et al*., 2005: 382 [selected characters].

Myxine australis (not Jenyns, 1842). –Günther, 1887: 267 [in part, small specimens from *Hyalonema* ground, off Eno-shima, Japan, 345 fm, *Challenger* sta. 232]. –Goode and Bean, 1896: 3 [in part, small specimens from *Hyalonema* ground, off Eno-shima, Japan, 345 fm, *Challenger* sta. 232].

Material examined: 4 specimens. JAPAN: BMNH 1879.5.14.444, 1(236 mm) and BMNH 1912.11.28.6, 1(297 mm), syntypes, *Hyalonema* ground, 345 fm, Challenger Expedition; MNHN 1890-0154, 1(245 mm), *Hyalonema* ground, Challenger Expedition; BSKU 20243, 1(253 mm), 35°07.7'N, 139°29.9'E, 450 m, RV *Sōyō Maru*, 30 Jun. 1972.

Diagnostic features: Body elongated, its depth 4-5% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with slightly rounded tip. One single nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.8-1.1% TL), third one longer (1.2-1.6% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side not confluent with the pharyngocutaneous duct, but

separated by a very short distance. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta not branched. Ventral finfold beginning within anterior 8% of trunk, extending backward to the cloaca, progressively reducing from 5 mm (origin) to 1 mm high (cloaca). Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending slightly anterior to cloaca.

Body proportions (in percentage of TL): prebranchial length 27-29; trunk length 58-60; tail length 13-14; body width 3-4; body depth including VFF 5-6; body depth excluding VFF 4-5; body depth over cloaca 4-5; tail depth 4-6. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 4. Posterior unicusps 5. Total cusps 26. Prebranchial pores 24-28. No branchial pores. Trunk pores 52-59. Tail pores 10-11. Total pores 88-97.

Color in alcohol: body light brown; barbels, face, and ventral finfold pale; slime pores and gill apertures with narrow whitish margins.

Size: Maximum total length 305 mm (Regan, 1913a).

Distribution and habitat: Known from the type locality, *Hyalonema* ground, and from Sagami Nada, Honshu, Japan. It lives on the continental slope at depths from 450 to 631 m.

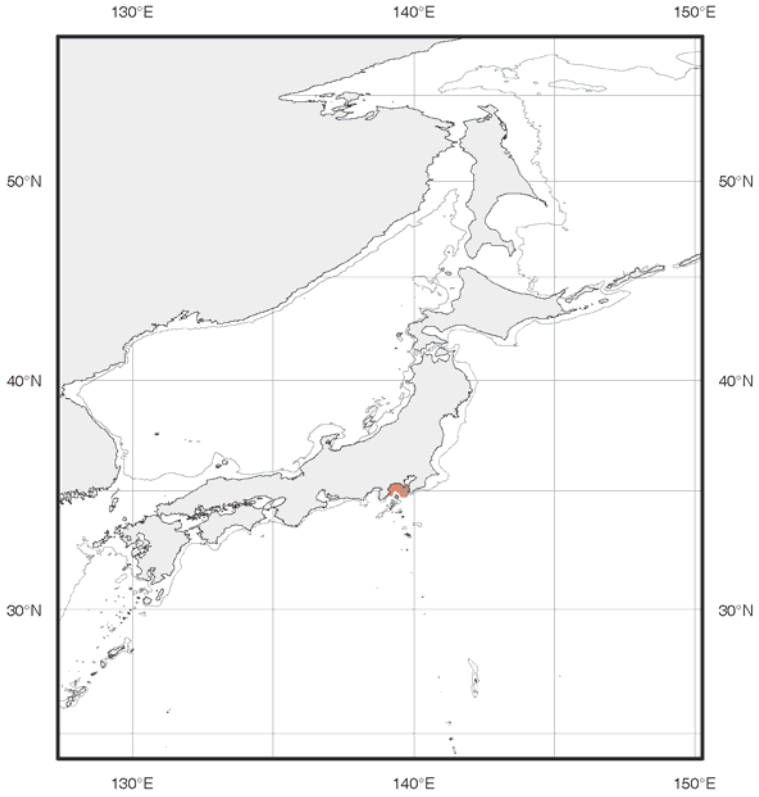


Fig. 84. Distribution of *Myxine paucidens.*

Interest to fishery: None.

Remarks: Although the gill ducts and pharyngocutaneous duct have not a common aperture on left side, they are close together, just separated by a very short distance, therefore different from ***Notomyxine tridentiger***, in which such apertures are widely and conspicuously separated.

Common names: JAPAN: Okina-mekura; FAO: Sagamy's hagfish.

Myxine pequenoi Wisner and McMillan, 1995

Myxine pequenoi Wisner and McMillan, 1995: 537 [original description; type locality: Chile, 41°29'S, 74°09'W, 185 m; type series: holotype, SIO 90-145, paratype, SIO 90-146 (1)]. –Fernholm, 1998: 35 [Valdivia, Chile]. –Mok, 2001: 358 [nasal sinus papillae]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: 2 specimens. CHILE: SIO 90-145, holotype, 178 mm, Pacific, Chile, 41°29'S, 74°09'W, 185 m, 1 Mar. 1973; SIO 90-146, paratype, 1(170 mm), Pacific, Chile, 40°44'-40°41'S, 74°15'-74°14'W, 251 m, RV *Akebono Maru 72*, crab-trap, S. Aviles & P. Ojeda, 5 Oct. 1978.

Diagnostic features: Body elongated, its depth 3-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum short, triangular with pointed tip. One single nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (1.0-1.2% TL), third one longer (1.4-1.8% TL). Seven pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill pouch 1. Ventral aorta branches at the second gill pouch. Ventral finfold very low (1 mm), beginning immediately behind gill apertures, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 31-32; trunk length 55-56; tail length 12-13; body width 4; body depth including VFF 4-6; body depth excluding VFF 3-6; body depth over cloaca 4; tail depth 4-5. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 4. Posterior unicusps 5-6. Total cusps 26-28. Prebranchial pores 22-23. No branchial pores. Trunk pores 52-55. Tail pores 8-9. Total pores 82-86.

Color in alcohol: body medium brown, head and body lighter ventrally; barbels the same color as body; gill apertures and slimes pores with narrow pale margins; ventral finfold and caudal finfold with pale margins.

Size: Known only from two specimens, 175 and 183 mm TL (Wisner and McMillan, 1995).

Distribution and habitat: Off Région de Los Lagos, Chile. On the upper slope at depths from 185 to 251 m.

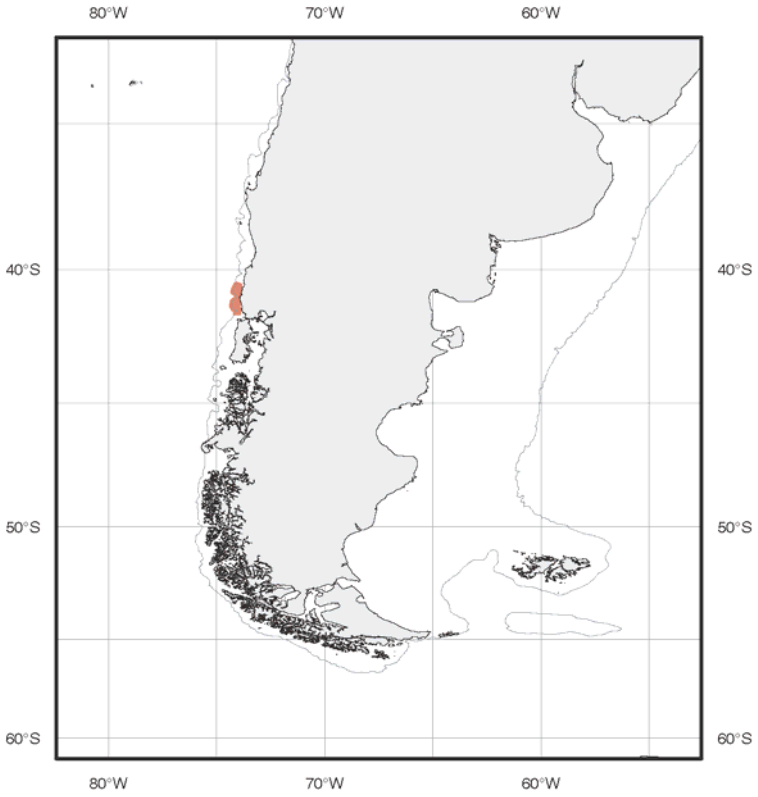


Fig. 85. Distribution of *Myxine pequenoi.*

Interest to fishery: None.

Remarks: Wisner and McMillan (1995) regard this species as a dwarfed hagfish because of the advanced sexual development of the two known small specimens. The holotype is a 183 mm female with 10 maturing eggs with 10x4 mm, and the paratype is a 175 mm male with well-developed testes.

Common names: FAO: Dwarf hagfish.

Myxine robinsorum Wisner and McMillan, 1995

Myxine robinsi Wisner and McMillan, 1995: 534 [original description; type locality: North

of Trinidad and Tobago, 11°37'N, 60°50'W (different coordinates on label: 11°37.3'-11°41'N, 60°59.4'-61°01.3'W), 783-1281 m; type series: holotype, SIO 90-149 (formerly UMML 29270), paratypes, SIO 90-149 (1), USNM 325213 (1), MCZ 101239 (1, missing)]. –Mok, 2001: 358 [nasal sinus papillae].

Myxine robinsorum. –Fernholm, 1998: 35 [S. Caribbean Sea]. –Fernholm, 2003: 355 [S. Caribbean Sea]. –Møller *et al*., 2005: 382 [selected characters].

Material examined: 1 specimen. TRINIDAD AND TOBAGO: SIO 90-149 (ex UMML 29270), paratype, 1(490 mm), off Tobago, 11°37.3'-11°41'N, 60°59.4'-61°01.3'W, 783-1281 m, 41 ft otter trawl, 2 Jun. 1969.

Diagnostic features: Body elongated, its depth 4-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum variably rounded to bluntly conical. Two nasal-sinus papillae aligned in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.7-0.9% TL), third one longer (1.3% TL). Five pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side usually confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill pouch 1. Ventral aorta branches at the first or second gill pouch. Ventral finfold well developed (3-6 mm high), beginning within anterior 10% of trunk, extending backward to the cloaca. Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 29-32; trunk length 57-60; tail length 11-14; body width 3-5; body depth including VFF 5-7; body depth excluding VFF 4-6; body depth over cloaca 4-5; tail depth 4-5. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 11-13. Posterior unicusps 11-12. Total cusps 56-58. Prebranchial pores 25-32. No branchial pores. Trunk pores 59-61. Tail pores 7-11. Total pores 94-104.

Color in alcohol: body light to medium brown; head whitish continuing to first few slime pores; a decreasingly paler area, often blotchy, extends posteriorly along dorsal

surface and often laterally to near gill apertures; slime pores and gill apertures variably with pale margins; ventral finfold and caudal finfold the same color as body, without pale margins.

Size: Maximum total length 540 mm (Wisner and McMillan, 1995).

Distribution and habitat: Known only from the type specimens collected off Golfo de Morrosquillo (Colombia) and northern Trinidad and Tobago. It probably occurs along the southern Caribbean Sea. A deep-water species living on the lower slope at depths from 783 to 1768 m.

Fig. 86. Distribution of *Myxine robinsorum*.

Interest to fishery: None.

Remarks: The species name ***robinsi*** was corrected to ***robinsorum*** by Fernholm (1998) according to ICZN (1985), Article 32c(ii). The description above was based on data provided by Wisner and McMillan (1995).

Common names: FAO: Robins' hagfish.

Myxine sotoi Mincarone, 2001

Myxine sotoi Mincarone, 2001b: 480, Fig. 1 [original description; type locality: off southern Brazil, 27°28'08"S, 46°53'02"W, 810 m; type series: holotype, MOVI 14961, paratypes, MCP 26199 (2), MOVI 14936-14941 (6), MOVI 14950-14960 (11), MZUSP 62879 (3), MZUSP 62880 (6), USNM 364209 (1)]. –Mincarone and Soto, 2001: 126 [distribution]. –Haimovici *et al*., 2004: 31 [listed]. –Mincarone, 2003: 21 [catalog of Brazilian fishes]. –Mincarone and Sampaio, 2004: 35 [citation]. –Soto and Mincarone, 2004: 14 [type catalog]. –Bernardes *et al*., 2005: 55 [catalog; São Paulo to Santa Catarina]. –Møller *et al*., 2005: 376, Fig. 3b [description of nasal sinus papillae; comparison with ***Myxine jespersenae***].

Material examined: 30 specimens. BRAZIL: MOVI 14961, holotype, 506 mm, off Santa Catarina, 27º28'08"S, 46º53'02"W, 810 m, RV *Prof. W. Besnard*, baited trap, 9 Dec. 1997; MOVI 14950-14960, paratypes, 11(410-511 mm), MZUSP 62880, paratypes, 6(399-485 mm), taken with holotype; MCP 26199, paratypes, 2(395-428 mm), MOVI 14936-14941, paratypes, 6(393-522 mm), MZUSP 62879, paratypes, 3(398-495 mm), USNM 364209, paratypes, 1(356 mm), off Rio de Janeiro, 24º13'52"S, 43º11'08"W, 690 m, RV *Prof. W. Besnard*, baited trap, 6 Dec. 1997.

Diagnostic features: Body elongated, its depth 4-7% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum triangular with slightly rounded tip. One single conspicuous nasal-sinus papillae in the middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.7-1.1% TL), third one longer (1.1-1.5% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side usually confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. Dental muscle overlies gill

pouches 1-2. Ventral aorta branches at end of dental muscle. Ventral finfold beginning within anterior 12% of trunk, extending backward to the cloaca, progressively reducing from 4-6 mm (origin) to 1 mm high (cloaca). Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 28.4-31.2; trunk length 56.8-61.3; tail length 8.9-12.8; body width 3.9-5.7; body depth including VFF 5.0-7.5; body depth excluding VFF 4.2-7.0; body depth over cloaca 5.0-6.8; tail depth 4.9-6.5. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 7-9. Posterior unicusps 8-9. Total cusps 38-44. Prebranchial pores 28-38. No branchial pores. Trunk pores 61-73. Tail pores 11-13. Total pores 101-119.

Color in alcohol: body grayish purple; head anterior to first slime pore white; some specimens have a whitish band ventrally limited between the rows of prebranchial pores; distal margin of ventral finfold whitish; gill apertures, prebranchial pores, trunk pores, cloaca, and caudal finfold with whitish margins; whitish middorsal stripe extending from over gill apertures to caudal finfold; occasional white spots on the lateral and dorsal surface of trunk. In life, the body is pinkish red.

Size: Maximum total length 522 mm (Mincarone, 2001b).

Distribution and habitat: Off southeastern and southern Brazil, from Rio de Janeiro to Santa Catarina states, on the continental slope at depths from 690 to 810 m.

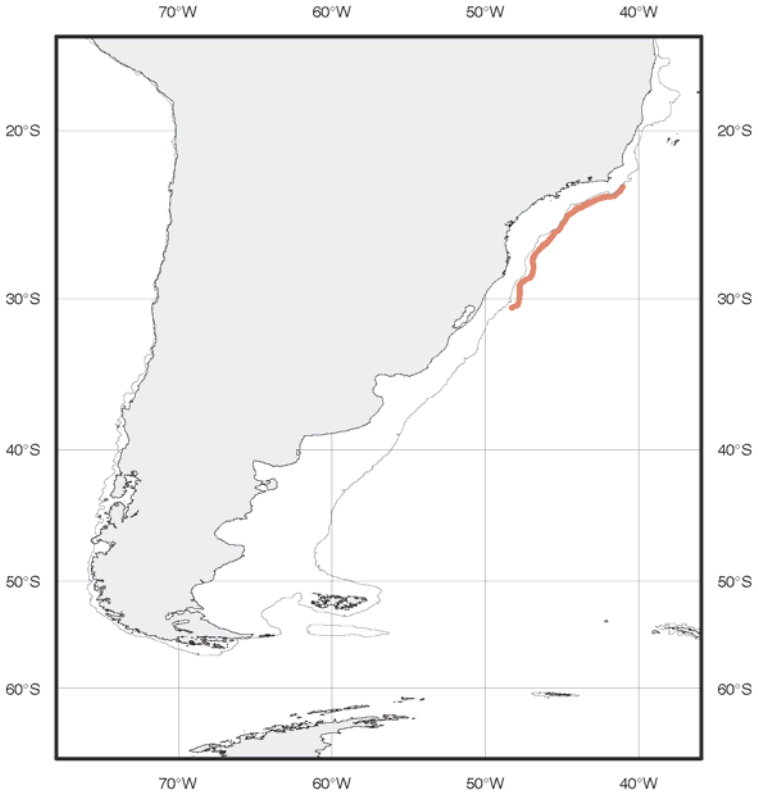


Fig. 87. Distribution of *Myxine sotoi.*

Interest to fishery: None.

Remarks: Of the 30 specimens examined by Mincarone (2001b), 26 were females, 3 males and 1 hermaphrodite. Only four females had large eggs without anchor filaments measuring approximately 20x6 mm.

Common names: BRAZIL: Peixe-bruxa Feiticeira; FAO: Brazilian whitehead hagfish.

Notomyxine Nani and Gneri, 1951

Notomyxine Nani and Gneri, 1951: 195 [type species ***Myxine tridentiger*** Garman, 1899: 345; type by original designation (also monotypic)].

Diagnostic features: One pair of gill apertures; 6 pairs of gill pouches; all efferent gill pouch ducts on one side of the body discharging into a single gill aperture; left gill aperture not confluent with the pharyngocutaneous duct, but separated from it by a distance from 1 to 3 % of total length.

Distribution: Southern South America (Fig. 89).

Species: The genus comprises a single species:

Notomyxine tridentiger: southern Chile to northern Argentina (South America)

Notomyxine tridentiger (Garman, 1899)

Myxine tridentiger Garman, 1899: 345 [original description; type locality: Sandy Point, Tyssen Islands, south coast of South America; type series: lectotype, BMNH 1869.5.3.21, paralectotypes, BMNH 1868.6.15.5-6 (3, 1 in poor condition), BMNH 1868.9.16.12-13 (2)]. –Regan, 1913a: 396 [designation of lectotype]. –Holly, 1933: 48 [key; Sandy Point]. –Norman, 1937: 7 [Sandy Point]. –Fowler, 1944: 476 [Magellan Strait, Sandy point]. –Bigelow and Schroeder, 1948: 33 [key to species of *Myxine*]. –Fowler, 1951: 267 [key to the Chilean hagfishes]. –de Buen, 1953: 90 [citation]. –de Buen, 1961: 109 [citation]. –Fowler, 1964: 48 [catalog; southern coast of South America].

Myxine australis (not Jenyns, 1842). –Günther, 1870: 511 [specimen "*a*" from Sandy Point]. –Günther, 1887: 267 [in part, specimen from Magellan Strait with two branchial apertures on the left side and one on the right]. –Goode and Bean, 1896: 3 [in part, three foremost teeth confluent at the base; Sandy Point].

Myxine australis var. ***tridentiger***. –Dean, 1904: 23 [citation].

Myxine olivacea var. ***tridentiger***. –Lahille, 1915: 369 [Punta Arenas].

Notomyxine tridentiger. –Nani and Gneri, 1951: 195, Plates 1-3, Fig. 1-4 [redescription]. –Adam and Strahan, 1963: 4 [Buenos Aires to Tierra del Fuego]. –Bahamonde and

Pequeño, 1975: 5 [list of Argentinean fishes]. –Hardisty, 1979: 19 [Argentine to Patagonia]. –Pequeño, 1989: 5 [list of Chilean fishes]. –Fernholm, 1998: 35 [S. coast of South America]. –Mok, 2001: 358 [nasal sinus papillae]. –Nelson, 2006: 23 [Buenos Aires to Tierra del Fuego].

Notomyxine sp. –Menni and Lopez, 1984: 75 [Argentina].

Notomyxini tridentiger. –Nelson, 1994: 24 [Buenos Aires to Tierra del Fuego].

Material examined: 16 specimens. ARGENTINA: MACN 2832, 6(462-563 mm), 38º03'S, 55º39'W, 50 fm (91 m), RV *Bahia Blanca*, A. Nani, Jun. 1941; MACN 3092, 6(367-483 mm), Puerto Español, Aguirre Bay, Tierra del Fuego, 54º54'S, 65º58'W, 6 fm (11 m), *1º de Mayo*, A. Nani, F. S. Gneri, F. A. Motti, 18 Feb. 1942; MACN 5731, 1(367 mm), Atlantic Ocean, Patagonian coast, 78 fm (143 m), RV *Bahia Blanca*, A. Nani, Aug. 1955; MCN.AGN 001, 1(394 mm), 38º22´S, 55º37´W, 160 m, L. Buckup, 7 Apr. 1961. CHILE: BMNH 1869.5.3.21, lectotype, 490 mm, Sandy Point, R. O. Cunningham; SIO 78-45, 1(450 mm), Baia Windhound, 55°10'S, 67°30'W, 20 m, trap, W. M. McFarland, E. Shallenberger, 5 Dec. 1968.

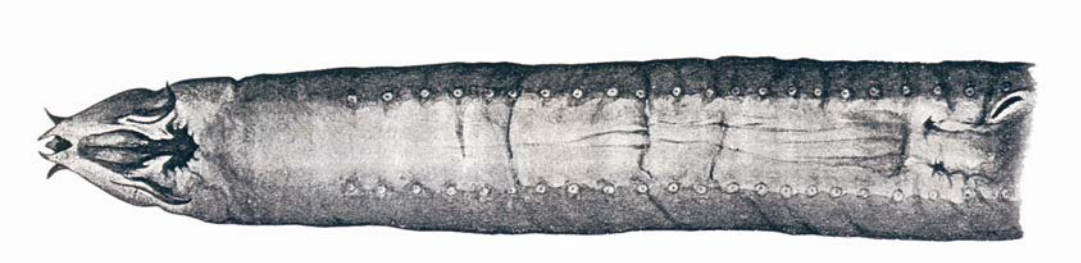


Fig. 88 ***Notomyxine tridentiger*** **(after Nani and Gneri, 1951).**

Diagnostic features: Body elongated, its depth 5-6% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum pointed with slightly rounded tip. One pair of nasal-sinus papillae symmetrically placed on the inner middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.6-1.1% TL), third one longer (1.5-2.1% TL). Six pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side not confluent with the

pharyngocutaneous duct, but separated by a short distance (1-3 % of total length). Dental muscle overlies gill pouches 1-2. Ventral aorta branches at the first or second gill pouch. Ventral finfold usually well developed (absent in just one specimen), beginning within anterior 12% of trunk, extending backward to the cloaca, progressively reducing from 3-7 mm (origin) to 1 mm high (cloaca). Caudal finfold rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prebranchial length 23-25; branchial length 1-3; trunk length 59-66; tail length 10-15; body width 4-6; body depth including VFF 6-8; body depth excluding VFF 5-6; body depth over cloaca 3-6; tail depth 4-6. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 7-8. Posterior unicusps 8-10. Total cusps 40-46. Prebranchial pores 17-21. Branchial pores (those placed between the left gill aperture and pharyngocutaneous duct) 2-5. Trunk pores 57-66. Tail pores 8-11. Total pores 86-98.

Color in alcohol: body reddish brown; distal margin of ventral finfold whitish; mouth, gill apertures, pharyngocutaneous duct opening, and slime pores with whitish margins. In life, the body is bluish gray, with ventral region whitish.

Size: Maximum total length 575 mm (Nani and Gneri, 1951).

Distribution and habitat: South coast of South America, from northern Argentina (off Buenos Aires) to southern Chile, including the Strait of Magellan and Tierra del Fuego. Usually taken on muddy bottoms on the continental shelf at depths from 6 to 143 m.

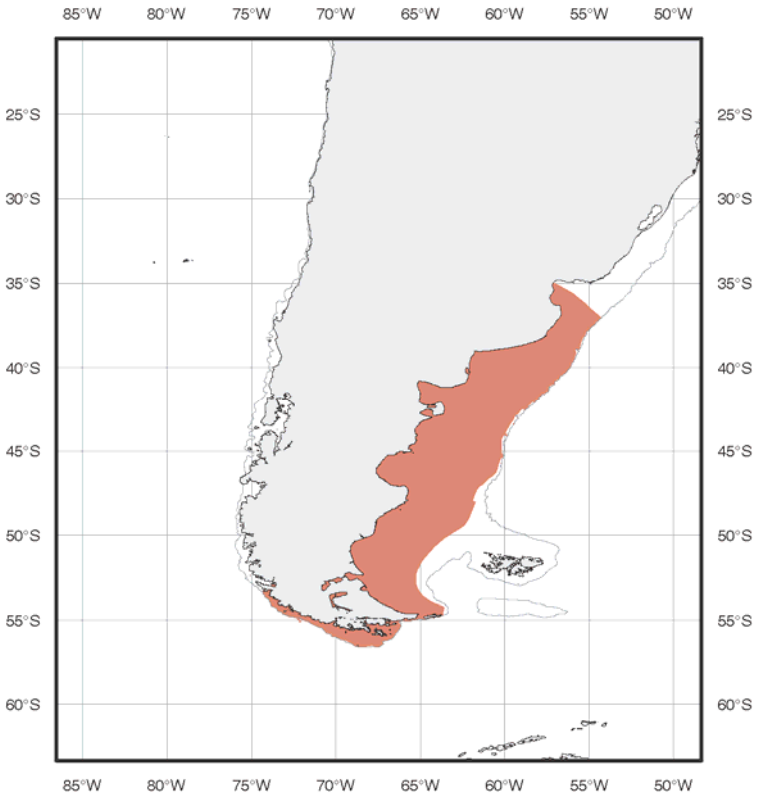


Fig. 89 Distribution of *Notomyxine tridentiger*.

Interest to fishery: None.

Remarks: The three foremost teeth confluent at the base is given by Günther (1870) as a character of ***M. australis***, but occurs in only one 490-mm specimen from Sandy Point, which was selected by Regan (1913a) as the lectotype of ***M. tridentiger***. Based on the recent examination of all type series I re-identified the paralectotypes BMNH 1868.6.15.5-6 from Sandy Point (Punta Arenas) as ***Myxine affinis***, and paralectotypes BMNH 1868.9.16.12-13 from Tyssen Islands as ***Myxine knappi***.

Of the 11 females (405-575 mm TL) examined by Nani and Gneri (1951), those longer than 500 mm were mature. A 507-mm female contained eggs ranging in size from 24.5 x 6.6 to 28 x 8 mm.

Common names: ARGENTINA: Babosa de mar; FAO: Argentine hagfish.

***Nemamyxine* Richardson, 1958**

Nemamyxine Richardson, 1958: 284 [type species ***Nemamyxine elongata*** Richardson, 1958: 284; type by original designation (also monotypic)].

Diagnostic features: Body extremely elongated, its depth ranging from 1.9 to 3% TL; 8 or 10 pairs of gill pouches; each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture; ventral finfold originating well anterior to pharyngocutaneous duct and extending backward to the cloaca.

Distribution: Western South Atlantic and New Zealand (Fig. 90).

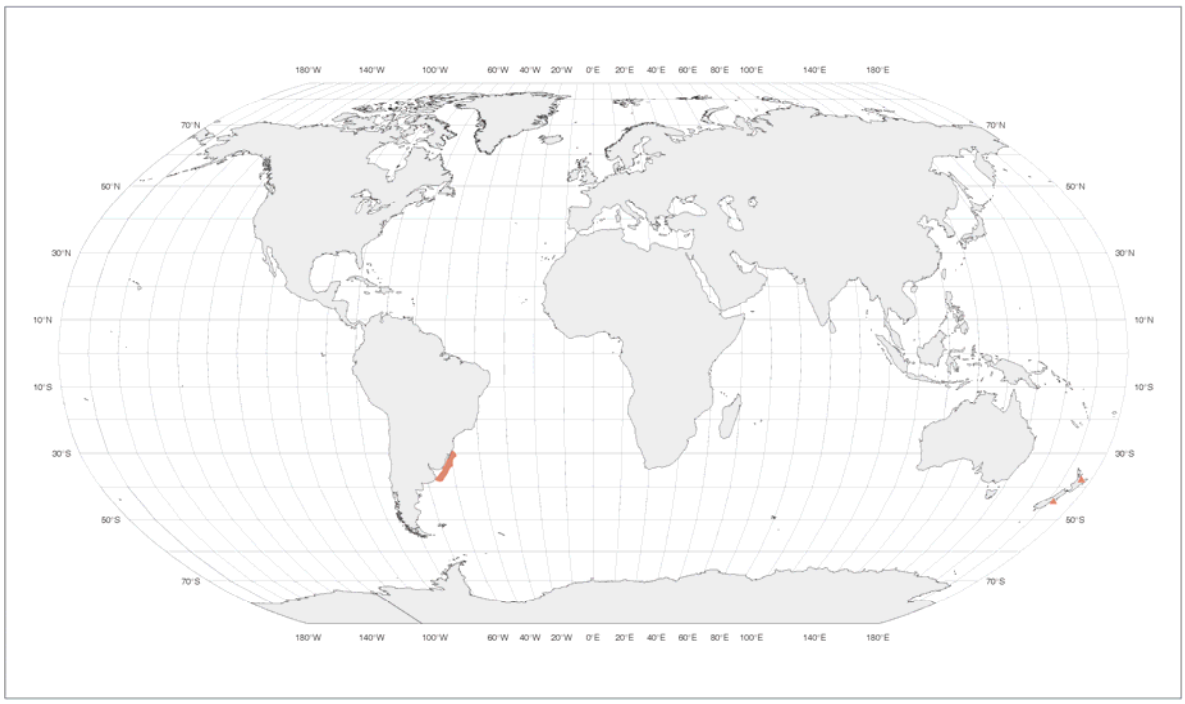


Fig. 90. Global distribution of the genus *Nemamyxine*.

Species: The genus comprises 2 species:

Nemamyxine elongata: New Zealand (western South Pacific)

Nemamyxine kreffti: southern Brazil to northern Argentina (western South Atlantic)

Key to Species of *Nemamyxine*

1a. Ten pairs of gill pouches; two fused cusps on both anterior and posterior multicusps (2/2); total pores 200-201 ..... ***Nemamyxine elongata***

1b. Eight pairs of gill pouches; three fused cusps on anterior and two on posterior multicusps (3/2); total pores 124-148 ..... ***Nemamyxine kreffti***

Nemamyxine elongata Richardson, 1958

Nemamyxine elongata Richardson, 1958: 284, Figs. 1-8 [original description; type locality: 150 yards up Kaituna River, Bay of Plenty, New Zealand; holotype: NMNZ P. 2006]. –Adam and Strahan, 1963: 4 [New Zealand]. –Whitley, 1968: 5 [list of New Zealand fishes]. –Hardisty, 1979: 19 [New Zealand]. –McMillan and Wisner, 1982: 36 [comparison with ***Nemamyxine kreffti***]. –Paulin *et al*., 1989: 9, Fig. 2.3 [key; New Zealand]. –Hardy, 1990: 5 [type catalog]. –Fernholm, 1998: 35 [Bay of Plenty, New Zealand]. –Mincarone, 2001a: 21 [comparison with ***Nemamyxine kreffti***]. –Mok, 2001: 358 [nasal-sinus papillae]. –Mincarone and Stewart, 2006: 227 [10 pairs of gill pouches; northern Canterbury Bight, South Island, New Zealand].

Material examined: 1 specimen. NEW ZEALAND: NMNZ P.37198, 1(790 mm), north Canterbury Bight, South Island, 44°20.3'S, 172°00.5'E, 132 m, FV *Sapun Gora*, trawl, B. Liddle, 21 Mar. 2000.

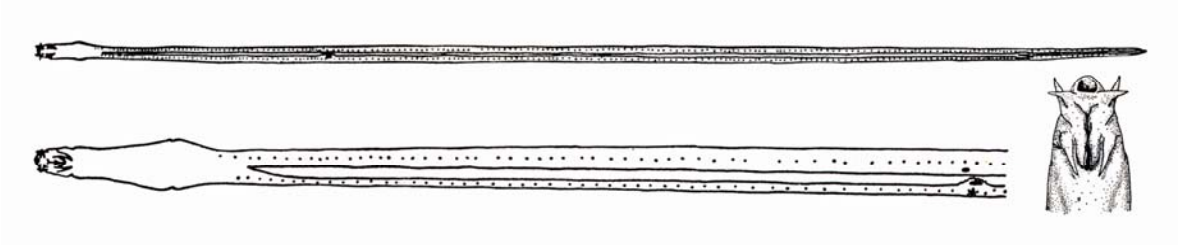


Fig. 91 ***Nemamyxine elongata*** **(after Richardson, 1958).**

Diagnostic features: Body extremely elongated, its depth 1.9% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum rounded. No

nasal-sinus papillae. Three pairs of barbels on head; first two about equal in size (0.3% TL), third one longer (0.5% TL). Ten pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the first gill pouch. Ventral finfold well developed, 2-3 mm high, originating well anterior to pharyngocutaneous duct and extending backward to the cloaca. Caudal finfold prominent, thin and rounded, beginning immediately posterior to edge of cloaca, extending around tail to a short distance on the dorsal surface.

Body proportions (in percentage of TL): prefinfold length 4.4-5.7; prebranchial length 25.3-26.0; trunk length 62.5-65.8; tail length 9.7-11.4; body width 1.1; body depth including VFF 2.3; body depth excluding VFF 1.9; body depth over cloaca 1.6; tail depth 1.7. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 7. Posterior unicusps 7-8. Total cusps 36-38. Prebranchial pores 52-55. Trunk pores 126-130. Tail pores 16-21. Total pores 200-201.

Color in alcohol: body dark, almost black; head slightly lighter than rest of body; barbels of same color as head; gill apertures without whitish margins; ventral finfold with a white distal margin; caudal finfold without whitish margin.

Size: Known only from two specimens, 614 and 790 mm TL (Mincarone and Stewart, 2006).

Distribution and habitat: The two known specimens were collected from very different sites in the New Zealand. The holotype was obtained from a white-baiter fishing 150 yards (137 m) upstream from the mouth of the Kaituna River, Bay of Plenty, North Island. The Kaituna is a small river that widens into an estuary near its mouth and is strongly under tidal influence (Richardson, 1958; McMillan and Wisner, 1982). The second specimen (NMNZ P.37198) was recently trawled by a fishing vessel at 44°20.3’S, 172°00.5’E, 132 m depth, on the outer shelf off north Canterbury Bight, South Island (Mincarone and Stewart, 2006).

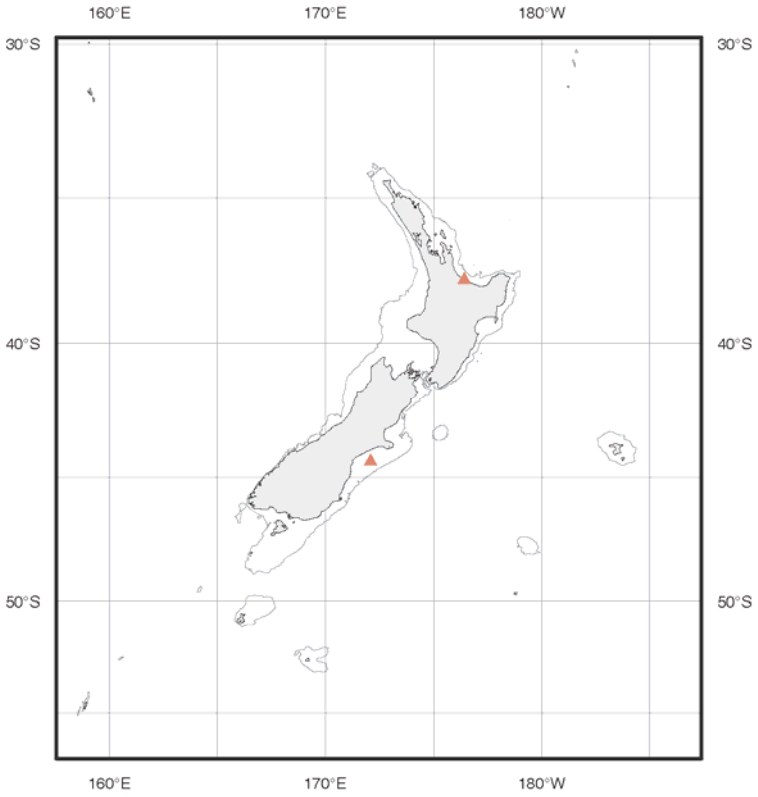


Fig. 92. Distribution of *Nemamyxine elongata.*

Interest to fishery: None.

Remarks: The description above was based on few data from the holotype (Richardson, 1958) combined with those from the specimen NMNZ P.37198. The last one is a mature female measuring 790 mm TL, which has 10 elongated eggs. The holotype was not dissected by Richardson to determine either its sex or number of gill pouches.

Common names: FAO: Pacific worm hagfish.

Nemamyxine kreffti McMillan and Wisner, 1982

Nemamyxine kreffti McMillan and Wisner, 1982: 34 [original description; type locality: Argentina, off Rio de La Plata, 36°51'S, 54°01'W, 800 m, Walther Herwig sta. 244/66; holotype: ISH 1144/66]. –Krefft, 1987: 72 [type catalog]. –Mincarone and

Soto, 1997: 122 [southern Brazil]. –Fernholm, 1998: 35 [off Argentina and southern Brazil]. –Mincarone, 2001a: 19, Figs. 1-3 [redescription; southern Brazil, Uruguay, northern Argentina]. –Mok, 2001: 358 [nasal sinus papillae]. –Mincarone, 2003: 21 [catalog of Brazilian fishes]. –Mincarone and Sampaio, 2004: 35 [citation]. –Soto and Mincarone, 2004: 14 [MOVI catalog of fishes].

[***Myxine***] ***affinis-australis*** group. –Nani and Gneri, 1951: 210 [in part, specimen with eight gill pouches, MACN 2056].

Material examined: 7 specimens. ARGENTINA: ISH 1144/66, holotype, 366 mm, off Rio La Plata, 36º51'S, 54º01'W, 800 m, RV *Walter Herwing*, sta. 244/66, 140' bottom trawl, 14 Jun. 1966, bottom temperature 3.64°C and salinity 34.10 ‰. BRAZIL: MOVI 01253, 1(376 mm), off State of Rio Grande do Sul, between 33º00'S to 33º30'S and 50º20'W to 51º00'W, 140-150 m, bottom trawl, J. M. R. Soto, 10 Sep. 1988, adhered to lateral region of a codling ***Urophycis*** sp. (Gadiformes, Phycidae); MOVI 05591, 1(412 mm), off State of Rio Grande do Sul, 33º47'22"S, 51º14'56"W, 240 m, FV *Iporanga*, baited trap, V. M. Inêz, 13 May 1995. URUGUAY: MACN 439, 1(279 mm), 35º24'S, 53º10'W, 50 fm (91 m), Cia. Argentina de Pesca A. Gardella, Sep. 1927; MACN 2056, 1(350 mm), 35º34'S, 52º48'W, 78 fm (143 m), Steamer *Tito*, A. J. Pozzi, 6-12 Jul. 1937; MZUSP 19135, 1(493 mm), 34º45'S, 52º05'W, 179 m, RV *Prof. W. Besnard*, sta. 1881, bottom trawl, G. Q. Benvegnú, 15 Aug. 1972, bottom temperature 10.49ºC and salinity 34.857 ‰; MZUSP 19136, 1(292 mm), 34º34'S, 52º25'W, 80 m, RV *Prof. W. Besnard*, sta. 1880, bottom trawl, G. Q. Benvegnú, 15 Aug. 1972, bottom temperature 10.65ºC and salinity 34.074 ‰.

Diagnostic features: Body extremely elongated, its depth 2-3% TL. Prebranchial region slightly deeper than wide, increasingly compressed laterally to tail. Rostrum rounded. One single nasal-sinus papillae on the inner middorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.4-1.1% TL), third one longer (0.5-1.2% TL). Eight pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger

than that of right side. First pair of gill pouches lies posterior to end of dental muscle. Ventral aorta branches at the second gill pouch. Ventral finfold well developed, 2-6 mm high, originating well anterior to pharyngocutaneous duct and extending backward to the cloaca. Caudal finfold prominent, thin and rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending about over cloaca.

Body proportions (in percentage of TL): prefinfold length 7.9-11.5; prebranchial length 26.8-30.9; trunk length 59.4-62.8; tail length 9.3-11.7; body width 2.2-2.6; body depth including VFF 2.7-4.6; body depth excluding VFF 2.2-2.9; body depth over cloaca 2.3-2.9; tail depth 2.5-3.4. Three-cusp multicusps on the anterior row and 2-cusp multicusps on the posterior row of cusps. Anterior unicusps 5-6. Posterior unicusps 6-8. Total cusps 32-38. Prebranchial pores 36-44. Trunk pores 73-92. Tail pores 8-16. Total pores 124-148.

Color in alcohol: body light to dark brown; head slightly lighter than rest of body; barbels of same color as body; eyespots absent; gill apertures with narrow whitish margins; ventral finfold white or with white margin; caudal finfold without whitish margin.

Size: Maximum total length 493 mm (Mincarone, 2001a).

Distribution and habitat: Western South Atlantic, from southern Brazil (off Rio Grande do Sul) to northern Argentina (off La Plata river). Usually taken on muddy and sandy bottoms on the continental shelf and slope at depths from 80 to 800 m. All known specimens were caught in winter months, between May and August, a period of lower water temperature in the western South Atlantic, mainly due to Falklands Current influence. Notes on physical and chemical parameters of water taken from research vessels at moment of capture confirm that its vertical distribution is strongly limited by temperature and salinity instead depth. It can be found as on the continental shelf off southern Brazil (RV *Prof. W. Besnard*, sta. 1880: 34°34'S, 52°25'W, 80 m depth, 10.65°C, 34.074‰) as on continental slope off northern Argentina (FRV *Walther Herwig*, sta. 244/66: 36°51'S, 54°01'W, 800 m depth, 3.64°C, 34.1‰).

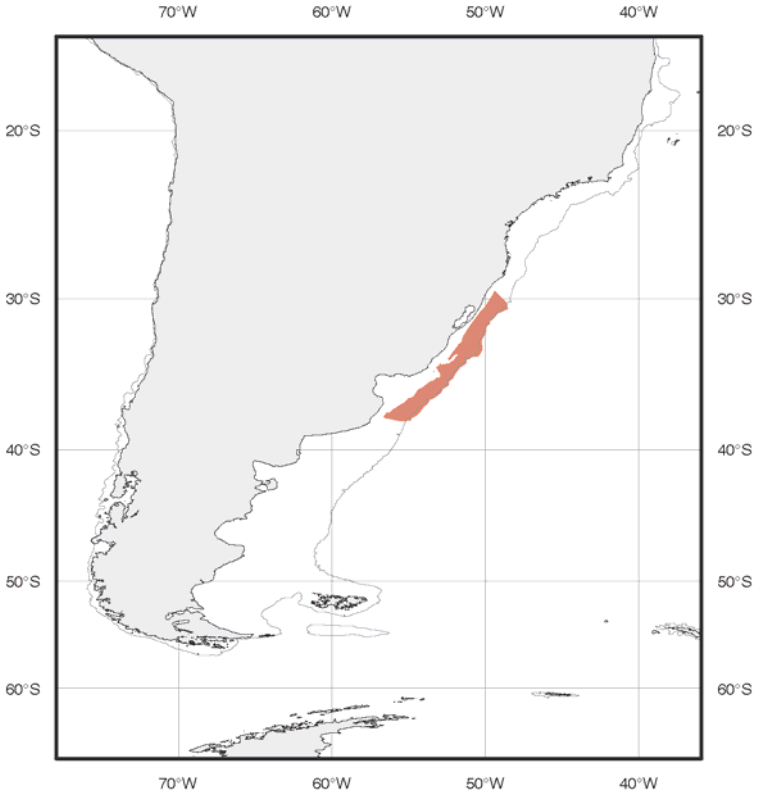


Fig. 93. Distribution of *Nemamyxine kreffti.*

Interest to fishery: None.

Remarks: The species is known only from seven specimens (279-493 mm TL), of which three are immature females, two males, and two were not possible to determine the sex. The holotype is a young female 366 mm with very small eggs ranging in length from 0.1 to 1.5 mm. The other two females measuring 350 and 376 mm have several small eggs in initial stage of development ranging from 0.4 to 2.5 mm in length. Of two males (292-493 mm), only the biggest one is mature.

Due its extremely slender body, ***N. kreffti*** is not easy to capture. Most of specimens preserved in collections until the moment were collected by research vessels using traps and trawls.

Common names: FAO: Atlantic worm hagfish.

Neomyxine Richardson, 1953

Neomyxine Richardson, 1953: 380 [type species ***Myxine biniplicata*** Richardson and Jowett, 1951: 3; type by original designation].

Diagnostic features: One pair of gill apertures; 7 pairs of gill pouches; all efferent gill pouch ducts on one side of the body discharging into a single gill aperture; left gill aperture confluent with the pharyngocutaneous duct; one pair of ventro-lateral finfolds.

Distribution: New Zealand (Fig. 95).

Species: The genus comprises a single species:

Neomyxine biniplicata: New Zealand (western South Atlantic)

Neomyxine biniplicata (Richardson and Jowett, 1951)

Myxine biniplicata Richardson and Jowett, 1951: 3, Figs. 1-3 [original description; type locality: Cook Strait, New Zealand; type series: holotype, NMNZ P.4023, paratype, NMNZ P.1010 (1)]. –Fowler, 1964: 48 [citation]. –Ibarra and Stewart, 1987: 59 [erroneously listed as paratype in the FMNH type catalog of fishes]. –Hardy, 1990: 5 [type catalog].

Neomyxine biniplicata. –Richardson, 1953: 380 [new genus; further description]. –Richardson, 1958: 283 [comparison with ***Nemamyxine elongata***]. –Whitley, 1968: 4 [list of New Zealand fishes]. –Whitley, 1974: 397 [list of New Zealand fishes]. –Paulin *et al*., 1989: 9, Fig. 2.2 [identification key; New Zealand]. –Fernholm, 1998: 35 [Cook Strait, Kaikoura, New Zealand]. –Mok, 2001: 358 [nasal sinus papillae]. –Soto and Mincarone, 2004: 14 [MOVI catalog of fishes]. –Mincarone and Stewart, 2006: 227 [further morphological data]. –Nelson, 2006: 23 [Cook Strait, New Zealand].

Neomyxine biplinicata. –Adam and Strahan, 1963: 4 [Cook Strait, New Zealand]. –Hardisty, 1979: 19 [New Zealand]. –Nelson, 1994: 24 [Cook Strait, New Zealand].

Material examined: 10 specimens. NEW ZEALAND: AMS I.24337001, 1(305 mm), no data (probably New Zealand), L. R. Richardson & J. P. Jowett, 1957; AMS I.24336001, 1(324 mm) no data (probably New Zealand), L. R. Richardson, 1958; AMS IB.3806, 1(314 mm), Cook Strait, 41°15'S, 172°34'E, 73 m, L. R. Richardson, 1957; AMS IB.3807, 1(350 mm), Cook Strait, 41°15'S, 172°34'E, 73 m, L. R. Richardson, 1957; MOVI 27795 (ex NMNZ P. 1171), 1(372 mm), Cape Campbell, South Island, Marlborough, 41°44'S, 174°16'E, 146.3 m, trawl, F. Abernethy, 5 Nov. 1952; MOVI 27796 (ex NMNZ P. 24787), 1(445 mm), Chatham Rise, 42°44.30'-45.00'S, 176°02.40'-00.20'E, 778-798 m, trawl, RV *James Cook*, 8 Jan. 1989; NMNZ P. 24787, 2(410-450 mm), Chatham Rise, 42°44.30'-45.00'S, 176°02.40'-00.20'E, 778-798 m, trawl, RV *James Cook*, 8 Jan. 1989; NMNZ P. 1171, 1(375 mm), Cape Campbell, South Island, Marlborough, 41°44'S, 174°16'E, 146.3 m, trawl, F. Abernethy, 5 Nov. 1952; SIO 94-1 (ex MCZ 39620), 1(333 mm), south of Cape Campbell, 40-50 fm (73-91 m), trawl.

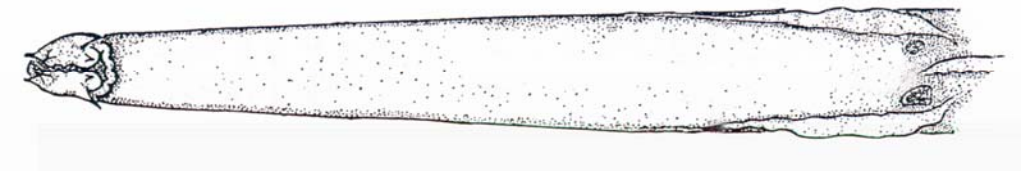


Fig. 94 ***Neomyxine biniplicata*** **(modified from Richardson and Jowett, 1951).**

Diagnostic features: Body elongated, its depth 3-4% TL. Prebranchial region sub-cylindrical, increasingly compressed laterally to tail. Rostrum rounded. Two bilaterally symmetrical nasal-sinus papillae in the dorsal surface of the nasal sinus. Three pairs of barbels on head; first two about equal in size (0.6-1.0% TL), third one longer (1.1-1.4% TL). Seven pairs of gill pouches. Each gill pouch with efferent branchial ducts on either side combined into a single external gill aperture posterior to the gill pouches. Branchial ducts on the left side confluent with the pharyngocutaneous duct, forming a gill aperture larger than that of right side. First pair of gill pouches lies posterior to end of dental muscle.

Ventral aorta branches at the first or second gill pouch. Ventral finfold well developed, 1-3 mm high, originating immediately behind the pharyngocutaneous duct and extending backward to the cloaca. Caudal finfold ventrally prominent, thin and rounded, beginning immediately posterior to edge of cloaca, extending around tail to dorsal surface, ending within second half of the tail length. Paired ventro-lateral finfolds within the last quarter of the prebranchial region, just below the line of slime pores. They commence as indefinite ridges, but posteriorly each fin increases gradually in height to about 2.5 mm at the level of branchial apertures, when the fin diminishes rapidly and terminates posterior to the branchial apertures.

Body proportions (in percentage of TL): prefinfold length 24.0-26.3; prebranchial length 23.6-25.8; trunk length 57.1-63.6; tail length 12.8-18.1; body width 2.3-3.2; body depth including VFF 3.5-5.1; body depth excluding VFF 2.9-4.0; body depth over cloaca 2.8-4.2; tail depth 2.7-3.5. Two-cusp multicusps on the anterior and posterior rows of cusps. Anterior unicusps 5-6. Posterior unicusps 6-7. Total cusps 30-34. Prebranchial pores 32-45. Trunk pores 81-125. Tail pores 17-25. Total pores 138-188.

Color in alcohol: body brown; head slightly lighter than rest of body; barbels of same color as head; gill apertures with narrow whitish margins; lateral, ventral and caudal finfolds white or with white margins.

Size: Maximum total length 450 mm (present study).

Distribution and habitat: Around New Zealand, including the Cook Strait and western Chatham Rise. Known from shallow to deep waters, at depths from 6 to 1095 m (NMNZ database; Andrew L. Stewart, pers. comm.).

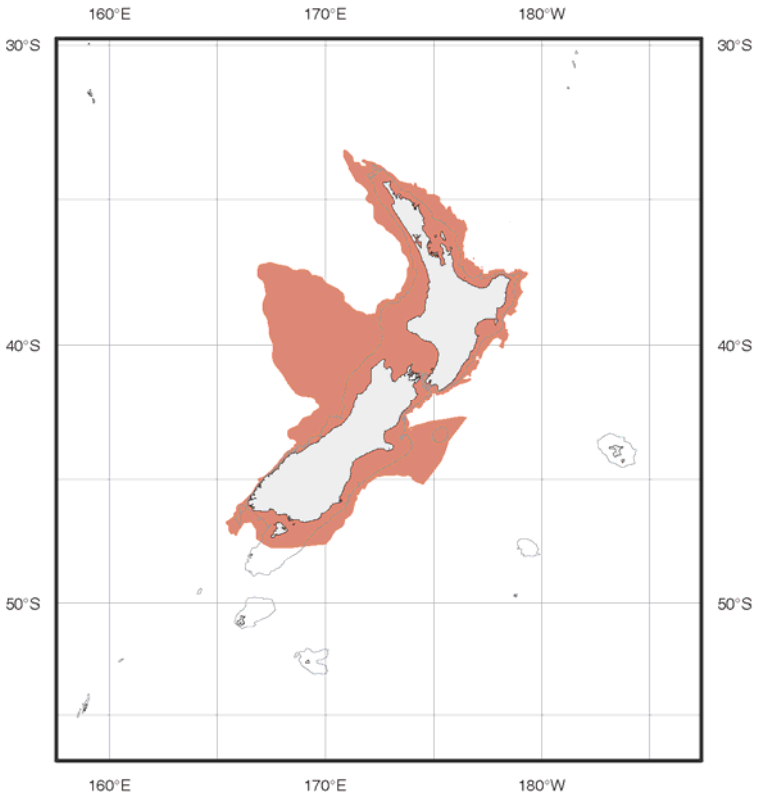


Fig. 95. Distribution of *Neomyxine biniplicata.*

Interest to fishery: None.

Remarks: The species was originally described by Richardson and Jowett (1951) as ***Myxine biniplicata*** based on a 315-mm dissected female and a second small and damaged specimen measuring approximately 163 mm in total length. Richardson (1953) provided further morphological data based on eight additional specimens, replacing ***M. biniplicata*** in the genus ***Neomyxine***.

Proportions and counts given herein were based on the literature (Richardson and Jowett, 1951; Richardson, 1953, 1958) and the examination of 10 additional specimens.

The specimen FMNH 61897 was erroneously listed as paratype by Ibarra and Stewart (1987). In fact, the original description was based on only two specimens, NMNZ P.4023 (holotype) and NMNZ P.1010 (paratype).

Common names: FAO: Paired fin hagfish.

3. LIST OF NOMINAL SPECIES OF MYXINIDAE

NOMINAL SPECIES	PRESENT ALLOCATION
acutifrons, ***Myxine*** Garman, 1899	***Myxine australis***
affinis, ***Myxine*** Günther, 1870	***Myxine affinis***
ancon, ***Quadratus*** Mok, Saavedra-Diaz and Acero P., 2001	***Paramyxine ancon***
atami, ***Paramyxine*** Dean, 1904	***Paramyxine atami***
atlantica, ***Myxine*** Regan, 1913	***Myxine glutinosa***
australis, ***Myxine*** Jenyns, 1842	***Myxine australis***
banksii, ***Homea*** Fleming, 1822	***Eptatretus cirrhatus***
biniplicata, ***Myxine*** Richardson and Jowett, 1951	***Neomyxine biniplicata***
bischoffii, ***Bdellostoma*** Schneider, 1880	***Eptatretus bischoffii***
burgeri, ***Bdellostoma*** Girard, 1855	***Eptatretus burgeri***
capensis, ***Myxine*** Regan, 1913	***Myxine capensis***
caribbeaus, ***Eptatretus*** Fernholm, 1982	***Eptatretus caribbeaus***
carlhubbsi, ***Eptatretus*** McMillan and Wisner, 1984	***Eptatretus carlhubbsi***
cheni, ***Paramyxine*** Shen and Tao, 1975	***Paramyxine cheni***
chinensis, ***Eptatretus*** Kuo and Mok, 1994	***Paramyxine chinensis***
circifrons, ***Myxine*** Garman, 1899	***Myxine circifrons***
cirrhatus, ***Petromyzon*** Forster, 1801	***Eptatretus cirrhatus***
coecus, ***Gastrobranchus*** Bloch, 1791	***Myxine glutinosa***
curtissjamesi, ***Polistotrema*** Townsend and Nichols, 1925	***Eptatretus deani***
deani, ***Polistotrema*** Evermann and Goldsborough, 1907	***Eptatretus deani***
debueni, ***Myxine*** Wisner and McMillan, 1995	***Myxine debueni***
decatrema, ***Heptatretus*** Regan, 1912	***Eptatretus bischoffii***
dorsum, ***Myxine*** Wisner and McMillan, 1995	***Myxine knappi***
elongata, ***Nemamyxine*** Richardson, 1958	***Nemamyxine elongata***
eos, ***Eptatretus*** Fernholm, 1991	***Eptatretus eos***
fernholmi, ***Eptatretus*** McMillan and Wisner, 2004	***Eptatretus fernholmi***
fernholmi, ***Myxine*** Wisner and McMillan, 1995	***Myxine fernholmi***
fernholmi, ***Paramyxine*** Kuo, Huang and Mok, 1994	***Paramyxine fernholmi***
formosana, ***Myxine*** Mok and Kuo, 2001	***Myxine formosana***
forsteri, ***Bdellostoma*** Müller, 1836	***Eptatretus cirrhatus***
fritzi, ***Eptatretus*** Wisner and McMillan, 1990	***Eptatretus fritzi***
garmani, ***Myxine*** Jordan and Snyder, 1901	***Myxine garmani***
glutinosa, ***Myxine*** Linnaeus, 1758	***Myxine glutinosa***
goliath, ***Eptatretus*** Mincarone and Stewart, 2006	***Eptatretus goliath***
grouseri, ***Eptatretus*** McMillan, 1999	***Eptatretus grouseri***
heptatrema, ***Bdellostoma*** Müller, 1836	***Eptatretus cirrhatus***
heterotrema, ***Bdellostoma*** Müller, 1836	***Eptatretus hexatrema***
hexatrema, ***Bdellostoma*** Müller, 1836	***Eptatretus hexatrema***
hubbsi, ***Myxine*** Wisner and McMillan, 1995	***Myxine hubbsi***
hubbsoides, ***Myxine*** Wisner and McMillan, 1995	***Myxine hubbsoides***
indrambaryai, ***Eptatretus*** Wongratana, 1983	***Eptatretus indrambaryai***
ios, ***Myxine*** Fernholm, 1981	***Myxine ios***
jespersenae, ***Myxine*** Møller *et al*., 2005	***Myxine jespersenae***
knappi, ***Myxine*** Wisner and McMillan, 1995	***Myxine knappi***
kreffti, ***Nemamyxine*** McMillan and Wisner, 1982	***Nemamyxine kreffti***

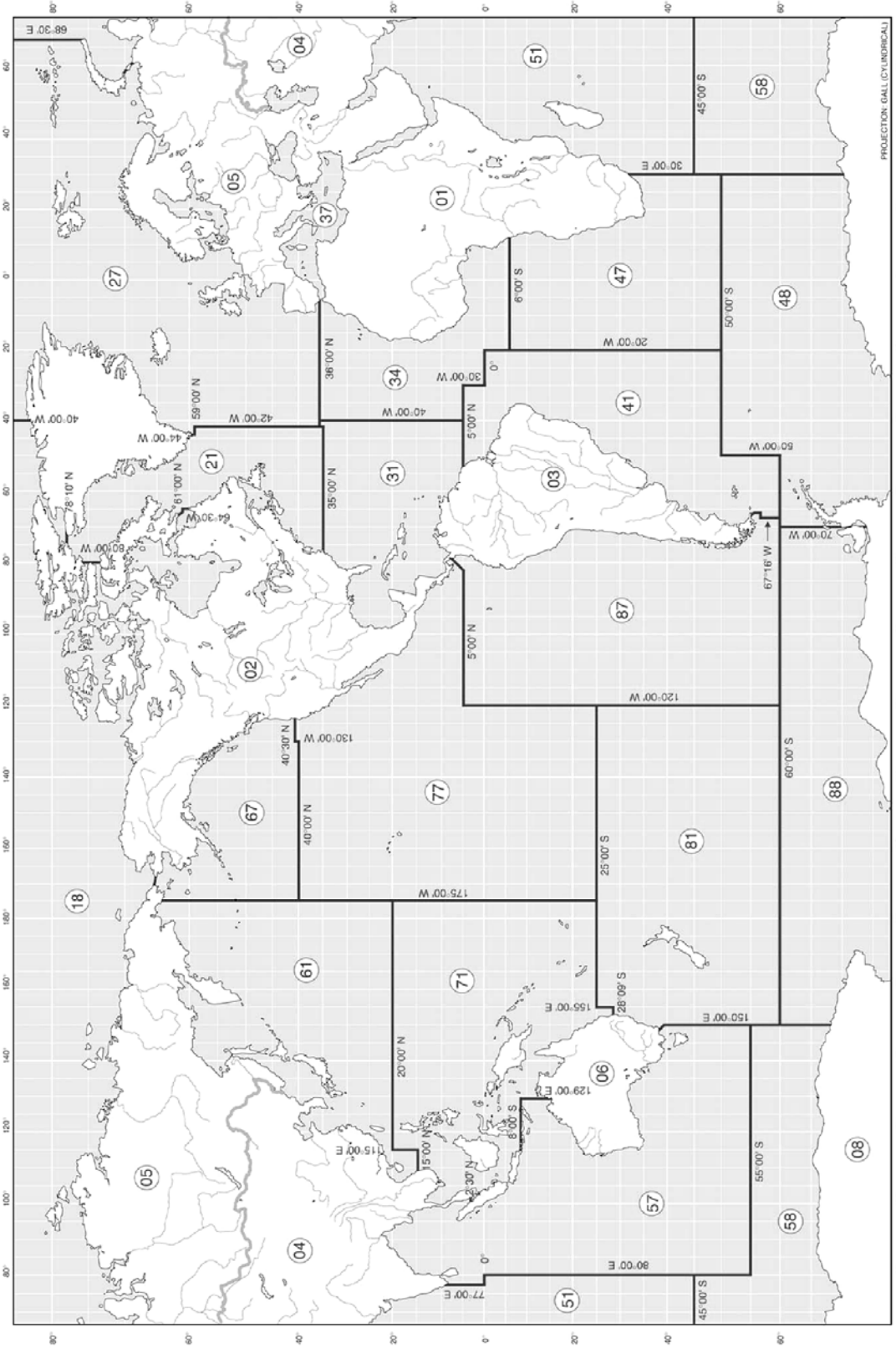
NOMINAL SPECIES	**PRESENT ALLOCATION**
kuoi, ***Myxine*** Mok, 2002	***Myxine kuoi***
lakeside, ***Eptatretus*** Mincarone and McCosker, 2004	***Eptatretus lakeside***
laurahubbsi, ***Eptatretus*** McMillan and Wisner, 1984	***Eptatretus carlhubbsi***
limosa, ***Myxine*** Girard, 1859	***Myxine glutinosa***
longipinnis, ***Eptatretus*** Strahan, 1975	***Eptatretus longipinnis***
mcconnaugheyi, ***Eptatretus*** Wisner and McMillan, 1990	***Eptatretus mcconnaugheyi***
mccoskeri, ***Eptatretus*** McMillan, 1999	***Eptatretus mccoskeri***
mccoskeri, ***Myxine*** Wisner and McMillan, 1995	***Myxine mccoskeri***
mcmillanae, ***Myxine*** Hensley, 1991	***Myxine mcmillanae***
mendozai, ***Eptatretus*** Hensley, 1985	***Eptatretus mendozai***
menezesi, ***Eptatretus*** Mincarone, 2000	***Eptatretus menezesi***
minor, ***Eptatretus*** Fernholm and Hubbs, 1981	***Eptatretus minor***
moki, ***Paramyxine*** McMillan and Wisner, 2004	***Paramyxine moki***
multidens, ***Eptatretus*** Fernholm and Hubbs, 1981	***Eptatretus multidens***
myxine, ***Petromyzon*** Walbaum, 1792	***Myxine glutinosa***
nanii, ***Eptatretus*** Wisner and McMillan, 1988	***Eptatretus nanii***
nelsoni, ***Paramyxine*** Kuo, Huang and Mok, 1994	***Paramyxine nelsoni***
octatrema, ***Heptatretus*** Barnard, 1923	***Eptatretus octatrema***
okinoseana, ***Homea*** Dean, 1904	***Eptatretus okinoseanus***
paucidens, ***Myxine*** Regan, 1913	***Myxine paucidens***
pequenoi, ***Myxine*** Wisner and McMillan, 1995	***Myxine pequenoi***
polytrema, ***Bdellostoma*** Girard, 1855	***Eptatretus polytrema***
profundus, ***Heptatretus*** Barnard, 1923	***Eptatretus profundus***
robinsi, ***Myxine*** Wisner and McMillan, 1995	***Myxine robinsorum***
sheni, ***Paramyxine*** Kuo, Huang and Mok, 1994	***Paramyxine sheni***
sinus, ***Eptatretus*** Wisner and McMillan, 1990	***Eptatretus sinus***
sotoi, ***Myxine*** Mincarone, 2001	***Myxine sotoi***
springeri, ***Paramyxine*** Bigelow and Schroeder, 1952	***Paramyxine springeri***
stoutii, ***Bdellostoma*** Lockington, 1878	***Eptatretus stoutii***
strahani, ***Eptatretus*** McMillan and Wisner, 1984	***Eptatretus strahani***
taiwanae, ***Paramyxine*** Shen and Tao, 1975	***Paramyxine taiwanae***
tridentiger, ***Myxine*** Garman, 1899	***Notomyxine tridentiger***
walkeri, ***Paramyxine*** McMillan and Wisner, 2004	***Paramyxine walkeri***
wayuu, ***Eptatretus*** Mok, Saavedra-Diaz and Acero P., 2001	***Paramyxine wayuu***
wisneri, ***Eptatretus*** McMillan, 1999	***Eptatretus wisneri***
wisneri, ***Paramyxine*** Kuo, Huang and Mok, 1994	***Paramyxine wisneri***
yangi, ***Paramyxine*** Teng, 1958	***Paramyxine yangi***

4. LIST OF SPECIES BY MAJOR FISHING AREAS

SPECIES	GEOGRAPHICAL DISTRIBUTION Major Fishing Areas for Statistical Purposes																		
	18	21	27	31	34	37	41	47	48	51	57	58	61	67	71	77	81	87	88
Eptatretus bischoffii																		●	
Eptatretus burgeri													●						
Eptatretus caribbeaus				●															
Eptatretus carlhubbsi													●			●		●	
Eptatretus cirrhatus											●				●		●		
Eptatretus deani														●		●			
Eptatretus eos																	●		
Eptatretus fernholmi															●				
Eptatretus fritzi																●			
Eptatretus goliath																	●		
Eptatretus grouseri																		●	
Eptatretus hexatrema								●											
Eptatretus indrambaryai											●								
Eptatretus lakeside																		●	
Eptatretus longipinnis											●								
Eptatretus mcconnaugheyi																●			
Eptatretus mccoskeri																		●	
Eptatretus mendozai				●															
Eptatretus menezesi							●												
Eptatretus minor				●															
Eptatretus multidens				●			●												
Eptatretus nanii																		●	
Eptatretus octatrema								●											
Eptatretus okinoseanus													●						
Eptatretus polytrema																		●	
Eptatretus profundus								●											
Eptatretus sinus																●			
Eptatretus stoutii														●		●			
Eptatretus strahani															●				
Eptatretus wisneri																		●	
Paramyxine ancon				●															
Paramyxine atami													●						
Paramyxine cheni													●						
Paramyxine chinensis													●						
Paramyxine fernholmi													●						
Paramyxine moki													●						
Paramyxine nelsoni													●						
Paramyxine sheni													●						
Paramyxine springeri				●															
Paramyxine taiwanae													●						
Paramyxine walkeri													●						
Paramyxine wayuu				●															
Paramyxine wisneri													●						
Paramyxine yangi													●		●				

	GEOGRAPHICAL DISTRIBUTION																		
SPECIES	Major Areas for Statistical Purposes																		
	18	21	27	31	34	37	41	47	48	51	57	58	61	67	71	77	81	87	88
Myxine affinis							●											●	
Myxine australis							●		●									●	
Myxine capensis								●											
Myxine circifrons																●		●	
Myxine debueni																		●	
Myxine fernholmi							●											●	
Myxine formosana													●						
Myxine garmani													●						
Myxine glutinosa		●	●	●		●													
Myxine hubbsi																●		●	
Myxine hubbsoides																		●	
Myxine ios			●		●			●											
Myxine jespersenae		●	●																
Myxine knappi							●												
Myxine kuoi													●						
Myxine mccoskeri				●															
Myxine mcmillanae				●															
Myxine paucidens													●						
Myxine pequenoi																		●	
Myxine robinsorum				●															
Myxine sotoi							●												
Notomyxine tridentiger							●											●	
Nemamyxine elongata																	●		
Nemamyxine kreffti							●												
Neomyxine biniplicata																	●		

MAJOR FISHING AREAS FOR STATISTICAL PURPOSES



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CAPÍTULO IV

Conclusões

Michael M. Mincarone

CONCLUSÕES

Os resultados obtidos através da revisão taxonômica foram, tanto quanto possível, incorporados no formato e padrão editorial estabelecidos pelos editores da FAO (Capítulo III). Entretanto, o formato do referido catálogo exclui aspectos importantes que dizem respeito às conclusões gerais deste estudo, as quais seguem abaixo relacionadas.

- A família Myxinidae Rafinesque, 1815, tem sido historicamente dividida em duas subfamílias, Eptatretinae Bonaparte 1850 e Myxininae Rafinesque 1815 (Nelson, 2006). Recentemente, Wisner (1999) descreveu duas novas subfamílias, Paramyxininae e Quadratinae, as quais abrigariam os gêneros *Paramyxine* Dean, 1904 e *Quadratus* Wisner, 1999, respectivamente. Ambas as subfamílias, e também o gênero *Quadratus*, foram estabelecidos com base na análise de poucos caracteres morfológicos considerados isoladamente. Na ausência de estudos filogenéticos que suportem a validade das subfamílias propostas por Wisner, ambas são aqui rejeitadas. Além disso, o nome Paramyxinidae já havia sido anteriormente proposto por Berg (1947), o que foi aparentemente ignorado por Wisner (1999).

- Da mesma forma, o gênero *Quadratus* Wisner, 1999 foi descrito com base na diferença de posição e no grau de proximidade entre as aberturas branquiais externas, um caráter subjetivo sujeito à extrema variação inter- e intra-específica. Na ausência de outros caracteres que justifiquem a validade do gênero, o mesmo é considerado sinônimo júnior de *Paramyxine*.

- Além dos caracteres usualmente utilizados na definição das subfamílias Eptatretidae e Myxinidae, a ramificação dos raios da nadadeira caudal (Fig. 1) constitui uma nova sinapomorfia para estes táxons, corroborando a atual classificação do grupo (Fig. 2).

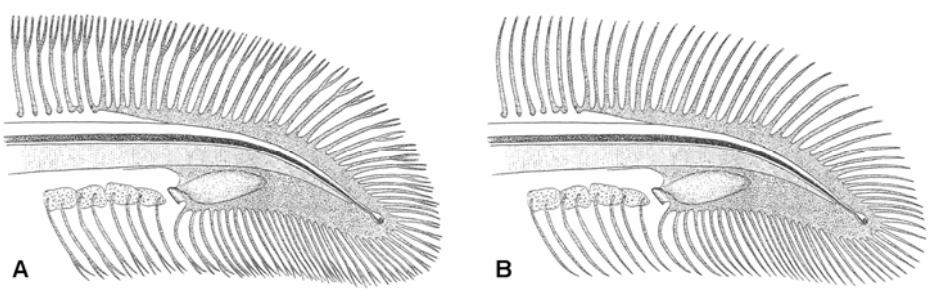

Figura 1. Ramificação dos raios da nadadeira caudal de peixe-bruxa. A – Subfamília Eptatretinae. B – Subfamília Myxininae.

Myxinidae

Eptatretinae

Eptatretus

Paramyxine

Myxininae

Myxine

Notomyxine

Nemamyxine

Neomyxine

Figura 2. Classificação da família Myxinidae

- Duas novas espécies foram descritas: *Eptatretus lakeside* Mincarone & McCosker, 2004, das Ilhas Galápagos; e *Eptatretus goliath* Mincarone & Stewart, 2006, da Nova Zelândia.

- *Eptatretus carlhubbsi* McMillan and Wisner, 1984 foi considerada sinônimo sênior de *Eptatretus laurahubbsae* McMillan and Wisner, 1984. *Eptatretus laurahubbsae* foi originalmente descrita com base em oito espécimes juvenis (240-375 mm TL) das Ilhas Juan Fernández, sudeste do Pacífico. Ela foi considerada diferente de *Eptatretus carlhubbsi* do Pacífico Norte por apresentar uma nadadeira ventral conspícua (ausente em *E. carlhubbsi*). Todos os demais caracteres se mostraram idênticos para ambas as espécies (Tab. 1). Entretanto, como previamente observado

por outros autores, a nadadeira ventral, usualmente bem desenvolvida em exemplares juvenis, tende a diminuir de tamanho e até mesmo desaparecer completamente em animais adultos. Com base nesta evidência, e na ausência de outros caracteres que distingam as espécies em questão, considera-se que os espécimes de *E. laurahubbsae* são na verdade juvenis de *E. carlhubbsi*.

- *Myxine glutinosa* Linnaeus, 1758 foi considerada sinônimo sênior de *Myxine limosa* Girard, 1859. A população do Atlântico Norte ocidental havia sido por algum tempo considerada como espécie (*Myxine limosa*) e Wisner and McMillan (1995) sugeriram o retorno desta prática com base no tamanho máximo dos espécimes (os do Atlântico Norte oriental são menores) e nas diferenças de coloração de espécimes preservados. Na ausência de caracteres morfológicos adicionais (Tab. 2), estas características parecem ser insuficientes para justificar a separação das populações do Atlântico Norte em duas espécies. Estudos moleculares mais conclusivos se fazem necessários para elucidar este complexo taxonômico.

- *Myxine knappi* Wisner and McMillan, 1995 foi considerada sinônimo sênior de *Myxine dorsum* Wisner and McMillan, 1995. Ambas as espécies foram descritas com base em poucos espécimes disponíveis (3 de *M. knappi* e 2 de *M. dorsum*). Alguns tipos de *M. knappi* (SIO 90-144) e *M. dorsum* (SIO 92-21) pertenciam antigamente ao mesmo lote (ZIN 721-966), mas foram doados à SIO separadamente e injustificadamente descritos como espécies distintas por Wisner & McMillan (1995). A análise do material tipo e de nove espécimes adicionais revelaram a ausência de evidências morfológicas que suportem diferenças entre as espécies (Tab. 3).

- Pela primeira vez são fornecidas chaves de identificação e mapas de distribuição para todas as espécies de Myxinidae, sendo que várias delas tiveram suas distribuições geográficas ampliadas, com destaque para: *Eptatretus multidens*, previamente conhecida do norte da América do Sul e agora registrada ao largo do nordeste e sudeste do Brasil; *Eptatretus strahani*, anteriormente conhecida das Filipinas e registrada agora no noroeste da Australia; e *Myxine ios*, conhecida da Irlanda e do noroeste da África e registrada ao largo da Angola.

- Como base nos resultados da revisão taxonômica, um novo arranjo nomenclatural é proposto para gêneros (Tab. 4) e espécies (Tab. 5). Das 82 espécies nominais descritas de Myxinidae, 69 são consideradas válidas, enquanto que 13 são sinônimos (Tab. 6).

- Os peixes-bruxa possuem distribuição global em ambientes marinhos, ocorrendo desde o sul do Ártico até a Península Antártica, com notável ausência de registros no Oceano Índico, com distribuição vertical que se estende desde a superfície até aproximadamente 2800 m, embora Martini (1998) tenha registros fotográficos de espécimes a 5000 m. A diversidade de espécies de peixe-bruxa é visivelmente assimétrica em relação à localização geográfica (Fig. 3), seguindo o padrão já observado para outros grupos de peixes marinhos, ou seja, maior diversidade no Pacífico ocidental, seguida pelo Atlântico ocidental, Pacífico oriental, Atlântico oriental, e Índico.

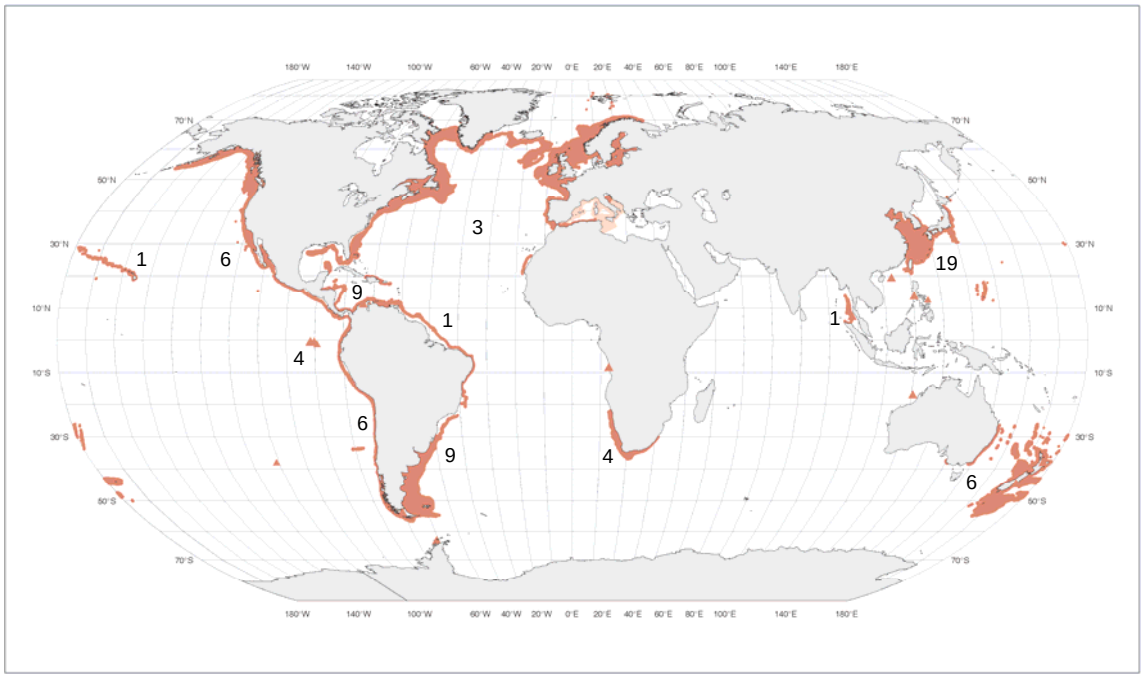

Figura 3. Diversidade de Myxinidae para regiões geográficas selecionadas. Números no mapa representam o número de esécies em cada região.

- De uma perspectiva histórica, as descrições das espécies de peixes-bruxa iniciaram em um ritmo muito lento, permanecendo assim de 1758 até aproximadamente 1900. Um pequeno aumento no ritmo das descrições foi observado entre 1904 e 1930. Porém, a partir de 1975 é que a freqüência de descrição de novas espécies aumentou consideravelmente (Fig. 4).

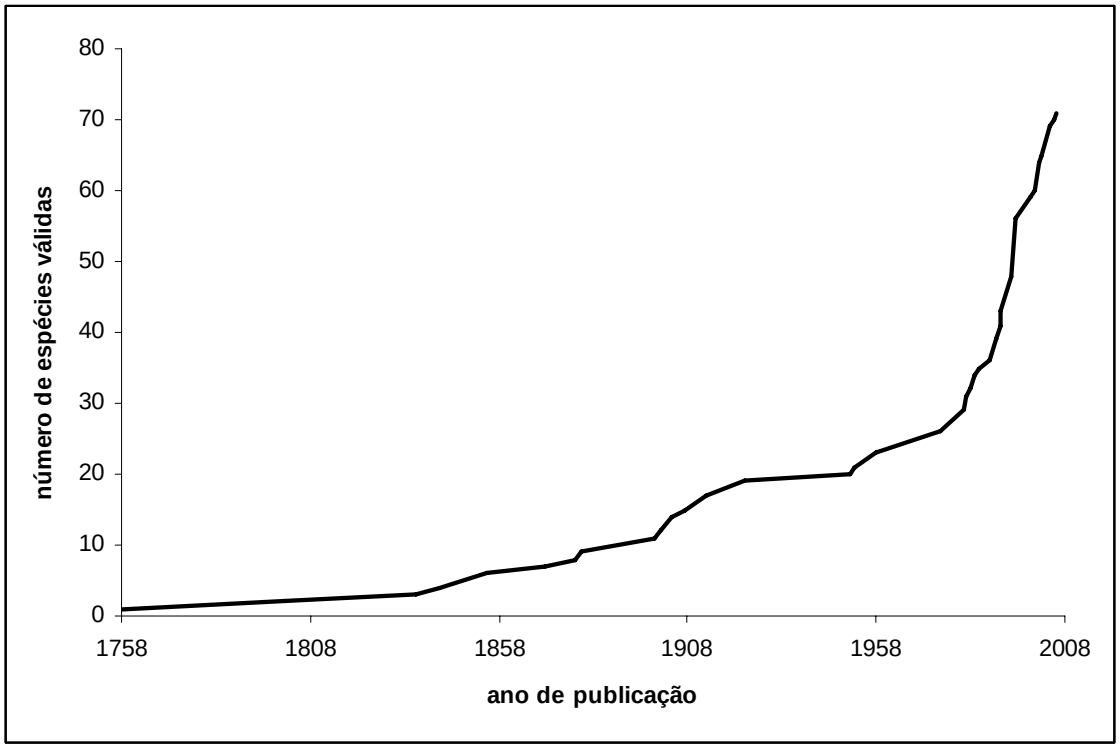

Figura 4. Curva acumulativa da diversidade temporal de espécies de Myxinidae, considerando o número de espécies válidas e seus respectivos anos de publicação.

- Quando analisamos o número de espécies válidas de Myxinidae descritas em intervalos de 50 anos desde 1758 (Fig. 5), notamos que apenas 21 espécies (30% da diversidade conhecida) foram descritas em um período de 200 anos (1758-1957), enquanto que a grande maioria das espécies (70%) foram descobertas nos últimos 50 anos. Isso é reflexo de explorações científicas em novas regiões geográficas, mas principalmente do uso de novas tecnologias empregadas nas últimas décadas, as quais permitiram a captura de espécimes em ambientes profundos antes inexplorados. A inclinação da curva acumulativa de diversidade temporal (Fig. 4) indica que o número de espécies de Myxinidae ainda está longe de ser completamente conhecido. O recente exame de uma pequena coleção do oeste da

Austrália revelou a ocorrência de três espécies novas, ainda em fase de descrição e não incluídas no presente trabalho. Cruzeiros de pesquisa direcionados a regiões pouco ou não exploradas (por exemplo, o oeste do Oceano Índico) podem sem dúvida revelar espécies ainda não descritas.

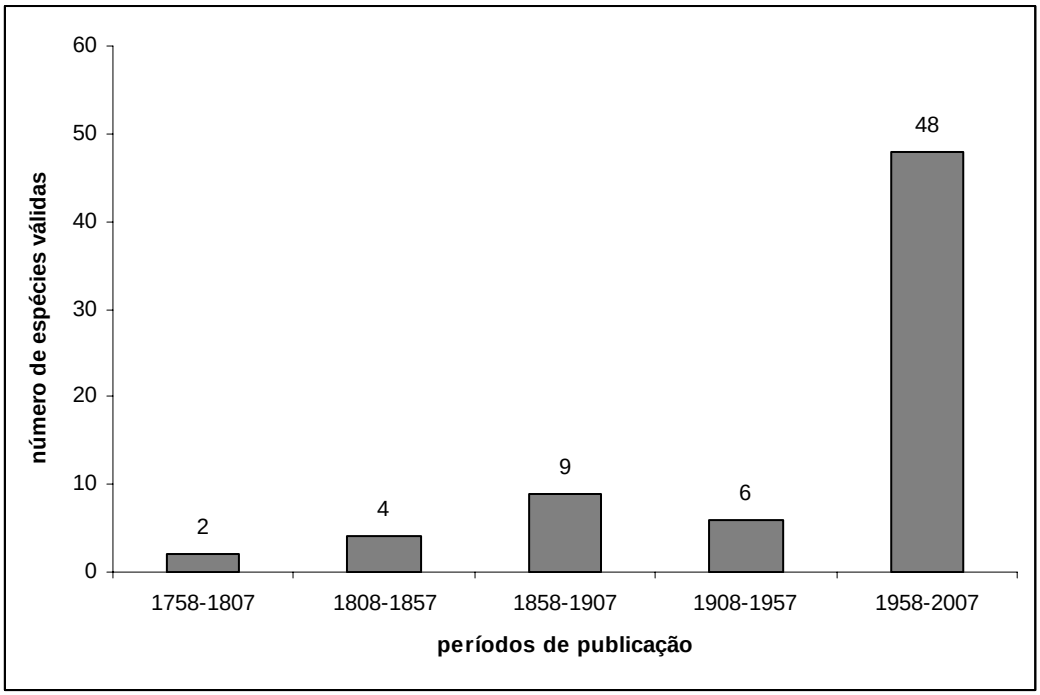

Figura 5. Número de espécies válidas de Myxinidae descritas em intervalos de aproximadamente 50 anos.

Tabela 1. Contagens de dentes (cúspides) e poros de *Eptatretus carlhubbsi* (n=18) e *Eptatretus laurahubbsae* (n=16) (extraído de McMillan & Wisner, 1984).

	Cúspides anteriores										
	13	14	15	16	17						
E. carlhubbsi			5	10	3						
E. laurahubbsae	1	1	4	7	3						
	Cúspides posteriores										
	11	12	13								
E. carlhubbsi	3	8	7								
E. laurahubbsae	1	10	4								
	Poros pré-branquiais										
	12	13	14	15	16	17	18	19	20		
E. carlhubbsi	1	7	2	5	2	1					
E. laurahubbsae			2	3	8	3					
	Poros branquiais										
	6	7	8								
E. carlhubbsi	4	12	2								
E. laurahubbsae	7	6	3								
	Poros do tronco										
	60	61	62	63	64	65	66	67	68	69	70
E. carlhubbsi	1	2			3		1	4	5		2
E. laurahubbsae	3	1	2	2		1	2	5			
	Poros caudais										
	12	13	14	15	16						
E. carlhubbsi	2	4	3	8	1						
E. laurahubbsae			2	12	2						

Tabela 2. Contagens de dentes (cúspides) e poros de *Myxine glutinosa* (n=143) e *Myxine limosa* (n=78) (extraído de Wisner & McMillan, 1995).

	Cúspides anteriores																				
	4	5	6	8																	
M. glutinosa	1	28	184	11																	
M. limosa		2	25	40	8																
	Cúspides posteriores																				
	5	6	7	8																	
M. glutinosa	2	66	151	5																	
M. limosa	1	10	38	26																	
	Poros pré-branquiais																				
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
M. glutinosa	1	1	2	6	15	17	16	25	13	15	13	8	8	1		1	1				
M. limosa			1	2		1	8	10	6	10	10	7	9	6	7	5	2	2	1		1
	Poros do tronco																				
	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	
M. glutinosa	2	4	5	14	17	14	20	12	26	12	9	3	3	2							
M. limosa			1		1	4	8	10	6	10	8	7	5	3	5	4	3	6	6	1	
	Poros caudais																				
	8	9	10	11	12	13	14	15	16												
M. glutinosa	1	2	16	22	47	37	16	2													
M. limosa	1	3		25	20	25	10		4												

Tabela 3. Contagens de dentes (cúspides) e poros de *Myxine knappi* e *Myxine dorsum* (extraído de Wisner & McMillan, 1995).

	Cúspides anteriores					
	6	7	8			*n*
M. knappi	2		1			3
M. dorsum		1	1			2
	Cúspides posteriores					
	7	8	9			*n*
M. knappi	1	1	1			3
M. dorsum		2				2
	Poros pré-branquiais					
	31	32				*n*
M. knappi	1	1				2
M. dorsum	1	1				2
	Poros do tronco					
	61	62	63	64	65	*n*
M. knappi	1				1	2
M. dorsum					2	2
	Poros caudais					
	11	12	13			*n*
M. knappi	1		1			2
M. dorsum	2					2

Tabela 4. Lista de gêneros de Myxinidae e atual arranjo taxonômico.

Gêneros nominais	Gêneros válidos
Anopsus Rafinesque 1815	*Myxine*
Bdellostoma Müller 1836	*Eptatretus*
Dodecatrema Fowler 1947	*Eptatretus*
Eptatretus Cloquet 1819	*Eptatretus*
Gastrobranchus Bloch 1791	*Myxine*
Heptatrema Duméril 1832	*Eptatretus*
Homea Fleming 1822	*Eptatretus*
Muraenoblenna Lacepède 1803	*Myxine*
Myxine Linnaeus 1758	*Myxine*
Nemamyxine Richardson 1958	*Nemamyxine*
Neomyxine Richardson 1953	*Neomyxine*
Notomyxine Nani & Gneri 1951	*Notomyxine*
Paramyxine Dean 1904	*Paramyxine*
Polistotrema Gill 1881	*Eptatretus*
Quadratus Wisner 1999	*Paramyxine*

Tabela 5. Lista de espécies de Myxinidae e atual arranjo taxonômico.

Espécies nominais	Atual arranjo
acutifrons, *Myxine* Garman, 1899	*Myxine australis*
affinis, *Myxine* Günther, 1870	*Myxine affinis*
ancon, *Quadratus* Mok, Saavedra-Diaz and Acero P., 2001	*Paramyxine ancon*
atami, *Paramyxine* Dean, 1904	*Paramyxine atami*
atlantica, *Myxine* Regan, 1913	*Myxine glutinosa*
australis, *Myxine* Jenyns, 1842	*Myxine australis*
banksii, *Homea* Fleming, 1822	*Eptatretus cirrhatus*
biniplicata, *Myxine* Richardson and Jowett, 1951	*Neomyxine biniplicata*
bischoffii, *Bdellostoma* Schneider, 1880	*Eptatretus bischoffii*
burgeri, *Bdellostoma* Girard, 1855	*Eptatretus burgeri*
capensis, *Myxine* Regan, 1913	*Myxine capensis*
caribbeaus, *Eptatretus* Fernholm, 1982	*Eptatretus caribbeaus*
carlhubbsi, *Eptatretus* McMillan and Wisner, 1984	*Eptatretus carlhubbsi*
cheni, *Paramyxine* Shen and Tao, 1975	*Paramyxine cheni*
chinensis, *Eptatretus* Kuo and Mok, 1994	*Paramyxine chinensis*
circifrons, *Myxine* Garman, 1899	*Myxine circifrons*
cirrhatus, *Petromyzon* Forster, 1801	*Eptatretus cirrhatus*
coecus, *Gastrobranchus* Bloch, 1791	*Myxine glutinosa*
curtissjamesi, *Polistotrema* Townsend and Nichols, 1925	*Eptatretus deani*
deani, *Polistotrema* Evermann and Goldsborough, 1907	*Eptatretus deani*
debueni, *Myxine* Wisner and McMillan, 1995	*Myxine debueni*
decatrema, *Heptatretus* Regan, 1912	*Eptatretus bischoffii*
dorsum, *Myxine* Wisner and McMillan, 1995	*Myxine knappi*
elongata, *Nemamyxine* Richardson, 1958	*Nemamyxine elongata*
eos, *Eptatretus* Fernholm, 1991	*Eptatretus eos*
fernholmi, *Eptatretus* McMillan and Wisner, 2004	*Eptatretus fernholmi*
fernholmi, *Myxine* Wisner and McMillan, 1995	*Myxine fernholmi*
fernholmi, *Paramyxine* Kuo, Huang and Mok, 1994	*Paramyxine fernholmi*
formosana, *Myxine* Mok and Kuo, 2001	*Myxine formosana*
forsteri, *Bdellostoma* Müller, 1836	*Eptatretus cirrhatus*
fritzi, *Eptatretus* Wisner and McMillan, 1990	*Eptatretus fritzi*
garmani, *Myxine* Jordan and Snyder, 1901	*Myxine garmani*
glutinosa, *Myxine* Linnaeus, 1758	*Myxine glutinosa*
goliath, *Eptatretus* Mincarone and Stewart, 2006	*Eptatretus goliath*
grouseri, *Eptatretus* McMillan, 1999	*Eptatretus grouseri*
heptatrema, *Bdellostoma* Müller, 1836	*Eptatretus cirrhatus*
heterotrema, *Bdellostoma* Müller, 1836	*Eptatretus hexatrema*
hexatrema, *Bdellostoma* Müller, 1836	*Eptatretus hexatrema*
hubbsi, *Myxine* Wisner and McMillan, 1995	*Myxine hubbsi*
hubbsoides, *Myxine* Wisner and McMillan, 1995	*Myxine hubbsoides*
indrambaryai, *Eptatretus* Wongratana, 1983	*Eptatretus indrambaryai*
ios, *Myxine* Fernholm, 1981	*Myxine ios*
jespersenae, *Myxine* Møller *et al*., 2005	*Myxine jespersenae*
knappi, *Myxine* Wisner and McMillan, 1995	*Myxine knappi*
kreffti, *Nemamyxine* McMillan and Wisner, 1982	*Nemamyxine kreffti*
kuoi, *Myxine* Mok, 2002	*Myxine kuoi*
lakeside, *Eptatretus* Mincarone and McCosker, 2004	*Eptatretus lakeside*
laurahubbsi, *Eptatretus* McMillan and Wisner, 1984	*Eptatretus carlhubbsi*
limosa, *Myxine* Girard, 1859	*Myxine glutinosa*
longipinnis, *Eptatretus* Strahan, 1975	*Eptatretus longipinnis*
mcconnaugheyi, *Eptatretus* Wisner and McMillan, 1990	*Eptatretus mcconnaugheyi*

Tabela 5. Continuação

mccoskeri, *Eptatretus* McMillan, 1999	*Eptatretus mccoskeri*
mccoskeri, *Myxine* Wisner and McMillan, 1995	*Myxine mccoskeri*
mcmillanae, *Myxine* Hensley, 1991	*Myxine mcmillanae*
mendozai, *Eptatretus* Hensley, 1985	*Eptatretus mendozai*
menezesi, *Eptatretus* Mincarone, 2000	*Eptatretus menezesi*
minor, *Eptatretus* Fernholm and Hubbs, 1981	*Eptatretus minor*
moki, *Paramyxine* McMillan and Wisner, 2004	*Paramyxine moki*
multidens, *Eptatretus* Fernholm and Hubbs, 1981	*Eptatretus multidens*
myxine, *Petromyzon* Walbaum, 1792	*Myxine glutinosa*
nanii, *Eptatretus* Wisner and McMillan, 1988	*Eptatretus nanii*
nelsoni, *Paramyxine* Kuo, Huang and Mok, 1994	*Paramyxine nelsoni*
octatrema, *Heptatretus* Barnard, 1923	*Eptatretus octatrema*
okinoseana, *Homea* Dean, 1904	*Eptatretus okinoseanus*
paucidens, *Myxine* Regan, 1913	*Myxine paucidens*
pequenoi, *Myxine* Wisner and McMillan, 1995	*Myxine pequenoi*
polytrema, *Bdellostoma* Girard, 1855	*Eptatretus polytrema*
profundus, *Heptatretus* Barnard, 1923	*Eptatretus profundus*
robinsi, *Myxine* Wisner and McMillan, 1995	*Myxine robinsorum*
sheni, *Paramyxine* Kuo, Huang and Mok, 1994	*Paramyxine sheni*
sinus, *Eptatretus* Wisner and McMillan, 1990	*Eptatretus sinus*
sotoi, *Myxine* Mincarone, 2001	*Myxine sotoi*
springeri, *Paramyxine* Bigelow and Schroeder, 1952	*Paramyxine springeri*
stoutii, *Bdellostoma* Lockington, 1878	*Eptatretus stoutii*
strahani, *Eptatretus* McMillan and Wisner, 1984	*Eptatretus strahani*
taiwanae, *Paramyxine* Shen and Tao, 1975	*Paramyxine taiwanae*
tridentiger, *Myxine* Garman, 1899	*Notomyxine tridentiger*
walkeri, *Paramyxine* McMillan and Wisner, 2004	*Paramyxine walkeri*
wayuu, *Eptatretus* Mok, Saavedra-Diaz and Acero P., 2001	*Paramyxine wayuu*
wisneri, *Eptatretus* McMillan, 1999	*Eptatretus wisneri*
wisneri, *Paramyxine* Kuo, Huang and Mok, 1994	*Paramyxine wisneri*
yangi, *Paramyxine* Teng, 1958	*Paramyxine yangi*

Tabela 6. Espécies nominais, número de espécies consideradas válidas no presente estudo e número de sinônimos para cada gênero de Myxinidae.

Gêneros	Espécies nominais	Espécies válidas	Sinonímias
Eptatretus	37	30	7
Paramyxine	14	14	0
Myxine	27	21	6
Notomyxine	1	1	0
Nemamyxine	2	2	0
Neomyxine	1	1	0
Total	82	69	13

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