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First record of the Deepsea pigfish *Congiopodus coriaceus* (Scorpaeniformes: Congiopodidae) in the Great Australian Bight with new data on morphology

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ABSTRACT

The Deepsea pigfish *Congiopodus coriaceus* Paulin et Moreland, 1979 is recorded from the waters off the southern coast of Australia, Great Australian Bight for the first time, based on a juvenile specimen *SL* 64 mm collected in 1966. This is the westernmost known locality of the species, 3500 km from the type locality off New Zealand. The lack of published data after the original description of the species revealed the need to clarify a number of meristic and morphometric parameters. Based on x-ray images of 28 ZIN specimens of *C. coriaceus* from New Zealand, the range of individual variability in the number of vertebrae, the number of rays of the dorsal and anal fins is shown. The number of procurrent and principal rays in the caudal fin has been clarified. In some cases, the range of morphometric parameters published in the original description has been expanded, for example, the maximum body height and head length. The original description was supplemented with 16 new measurements. For the first time, data on the lengths of the ventral and caudal fins, the length and height of the caudal peduncle, and the interorbital distance were published. Because of contradictory published data on the number of gill rakers on the first branchial arch, their number was clarified, the diagnostic value of this parameter was confirmed.

Keywords: Australia, biodiversity, *Congiopodus coriaceus*, distribution, horsefishes, New Zealand, racehorses

Первая находка *Congiopodus coriaceus* (Scorpaeniformes: Congiopodidae) в Большом Австралийском заливе, с дополнениями по морфологии

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РЕЗЮМЕ

Описан экземпляр *Congiopodus coriaceus* Paulin et Moreland, 1979 стандартной длиной 64 мм, пойманный в акватории Большого Австралийского залива в 1966 г. Ранее вид был известен только из вод Новой Зеландии, эта находка расширяет ареал вида почти на 3500 км на запад. Отсутствие, помимо первоописания, опубликованных данных выявило необходимость уточнения ряда счётных и пластических признаков. На основе рентгенограмм 28-ми экземпляров *C. coriaceus* из вод Новой Зеландии, хранящихся в фондовой коллекции ЗИН, показан диапазон индивидуальной изменчивости в числе позвонков, количестве лучей спинного и анального плавников. Уточнено количество краевых и основных лучей в хвостовом плавнике. В ряде случаев расширен диапазон пластических признаков, опубликованных в первоописании, например, максимальная высота тела и длина головы. Ряд пластических признаков дополнен 16-ю измерениями по сравнению с первоописанием. Впервые

опубликованы данные по длинам брюшного и хвостового плавников, длине и высоте хвостового стебля, межглазничному расстоянию. В связи с противоречивыми опубликованными данными по числу тычинок на первой жаберной дуге уточнено их количество, подтверждено диагностическое значение этого признака.

Ключевые слова: Австралия, биоразнообразие, *Congiopodus coriaceus*, распространение, конгиоподовые, Новая Зеландия, свинорылые

INTRODUCTION

The pigfishes inhabit only the waters of the Southern Hemisphere. *Congiopodus* Perry, 1811 have no commercial value but large specimens are quite edible. They are small benthic fishes, usually dwelling on the bottom searching for small invertebrates. The epibenthic species are also found in kelps.

The position of the family Congiopodidae in the order Scorpaeniformes continues to be debatable. The presence of a wide range of morphological (Mandritsa 2001) and genetic (Li et al. 2008) differences from the closest families allows one to take a different look at the position of Congiopodidae. Some researchers put these fishes in their own suborder Congiopodoidei (Greenwood et al. 1966; Nelson 1976; Lloris and Rucabado 1991; Mandritsa 2001). Now, most researchers recognize the pigfishes as a family in the suborder Scorpaenoidei (Eschmeyer 1998; Van der Laan et al. 2014; Nelson et al. 2016; Fricke et al. 2020). The sister group is the clade encompassing Gnathanacanthidae and Pataecidae (Imamura 2004; Ishii and Imamura 2008; Honma et al. 2013), both of which are small families distributed in the waters of the Southern Hemisphere.

The taxonomy of Congiopodidae has been repeatedly reviewed over the past decades and now the family includes 3 genera (Ishii and Imamura 2008; Honma et al. 2013): *Congiopodus* with six species, monotypic *Alertichthys* Moreland, 1960 (Nelson et al. 2016) and *Zanclorhynchus* Günther, 1880 with two species and four subspecies (Balushkin and Zhukov 2016; Zhukov and Balushkin 2018; Zhukov 2019). The six *Congiopodus* species are distributed as pairs of sister species with overlapping ranges in waters off southern South America [*C. kieneri* (Sauvage, 1878) and *C. peruvianus* (Cuvier, 1829)], southern South Africa [*C. spinifer* (Smith, 1839) and *C. torvus* (Gronow, 1772)] and southern New Zealand [*C. coriaceus* Paulin et Moreland, 1979 and *C. leucopaecilus* (Richardson, 1846)].

Before the present work, only one species from a pair, *C. leucopaecilus*, was described from the waters off Australia. The type locality was written by Richardson (1848) as the South-Australian Sea. Since the mid-20th century, some authors consistently have not included a type locality into the range of *C. leucopaecilus* due to the lack of representatives from the waters of Australia in museums of Australia (Paulin and Moreland 1979). For this reason, the majority of literature does not mention the occurrence of *Cogiopodus* in Australian waters.

During the examination of the pigfishes in the ZIN collection the author discovered a specimen from Great Australian Bight collected in 1966, which was initially identified as *C. leucopaecilus* and later reidentified as *C. coriaceus*. The examined specimen is fully consistent with the diagnosis in the original description of Paulin and Moreland (1979). This specimen represents a range extension from the closest known locality (Auckland Islands) of about 3500 km to the west, and the westernmost record of this species. This new record is reported and discussed in the present paper.

METHODS

Counts and measurements followed Paulin and Moreland (1979) and Zhukov (2019). Sensory system terminology follows Balushkin (1984), where the "sense" refers to the section of the sensory canal between two pores containing one neuromast. The axial skeleton was studied under X-ray images obtained on a PRDU-02 X-ray diffractometer. Ray elements supported with posteriormost dorsal- and anal-fin pterygiophore, so-called stay, were counted as separate rays. The urostyle was counted as the last caudal vertebra.

Abbreviations: AMS – Australian Museum (Sydney, Australia), BMNH – Natural History Museum (London, United Kingdom), BPBM – The Bernice Pauahi Bishop Museum, Department of Zoology

(Honolulu, USA), NMNZ – Museum of New Zealand Te Papa Tongarewa (Wellington, New Zealand), MFFT – medium freezer fish trawler, SRV – scientific-research vessel, USNM – National Museum of Natural History, Smithsonian Institution (Washington D.C., USA), WAM – Western Australian Museum (Perth, Australia), ZIN – Zoological Institute of the Russian Academy of Sciences (Saint Petersburg, Russia)

RESULTS

Family Congiopodidae Gill, 1889

Genus *Congiopodus* Perry, 1811

Congiopodus coriaceus Paulin et Moreland, 1979 – Deepsea pigfish

(Fig. 1)

Material examined. Great Australian Bight: ZIN 39185 – *TL* 79 mm, *SL* 64 mm, SRV "Academic Berg", 1966, collector V.V. Kondyrin.

Other material studied. South and south-east off New Zealand, 27 specimens: ZIN 45365 – *TL* 312 mm, *SL* 265 mm, MFFT "Kavalerovo", 48°00′S, 179°10′E, 250 m depth, 9 August 1975, collector A.I. Blagoderov; ZIN 50281 – 24 specimens, *TL* 111–256 mm, *SL* 88–218 mm, SRV "Dmitriy Mendeleev", cruise no. 16, st. 1278, Southern Ocean, north off Campbell Island, 51°46′S, 169°35′E, 230–286 m depth, 15 January 1976, collectors A.P. Andriashev and V.P. Prirodina; ZIN 50282 – 2 specimens, *TL* 46–84 mm, *SL* 37–67 mm, SRV "Dmitriy Mendeleev", cruise no. 16, st. 1279, Southern Ocean, north off Campbell Island, 52°44′S, 169°33′E, 182–186 m depth, 16 January 1976, collectors A.P. Andriashev and V.P. Prirodina.

Description. Gill rakers on first branchial arch 3+9=11. Dorsal fin origin over rear of eye. Pectoral-fin unbranched rays 8, pelvic-fin with 1 spine and 5 unbranched soft rays. Lateral lines with 14 pores, 12 of them in continuous canal, the last two on separate sense right in front of caudal fin rays.

Radiograph. Vertebrae 15+22=37. Dorsal-fin spines XVII, fifth spine longest, dorsal-fin soft rays 12, fifth ray branched. First 5 dorsal fin proximal pterygiophores are inserted between first and second neural spines. Three empty gaps (without inserted

Fig. 1. *Congiopodus coriaceus*, *TL* 79 mm, *SL* 64 mm (ZIN 39185).

Table 1. Meristic parameters of the *Congiopodus coriaceus*.

Region	Great Australian Bight	SE off New Zealand	Campbell Island Rise, SE off New Zealand
Material, ZIN Nos	39185	45365, 50281, 50282	Type and additional specimens*
n	1	27	45
Vertebrae	15+22=37	14–15 + 21–23 = 35–38 (75% 15+22=37)	14 + 21–22 = 35–36
Dorsal-fin rays	XVII, 12	XVI–XVIII, 12–14 (43% XVII, 12)	XVII, 11–12
Anal-fin rays	10	9–11 (64% 10)	8–9
Pectoral –fin rays	8	8	8
Pelvic-fin rays	I, 5	I, 5	
Caudal-fin rays	8+12+8=28	7–9 + 12 + 6–9 = 26–29 (57% 8+12+7=27)	
Gill rakers	3+9		2–4 + 9–10 (79% 3+9)

Notes. The first numbers refers to the range of values, the most frequent is in parentheses with the percentage frequency. * – Holotype NMNZ P.76.50; paratypes: AMS 1.20544-001, BMNH 1978.12.4.47, BPBM 22417, NMNZ P.7651-4, USNM 218908, WAM P.26435-001; additional specimens: NMNZ P.6348, NMNZ P.7278, NMNZ P.7248, NMNZ P.7161 (data from: Paulin and Moreland 1979).

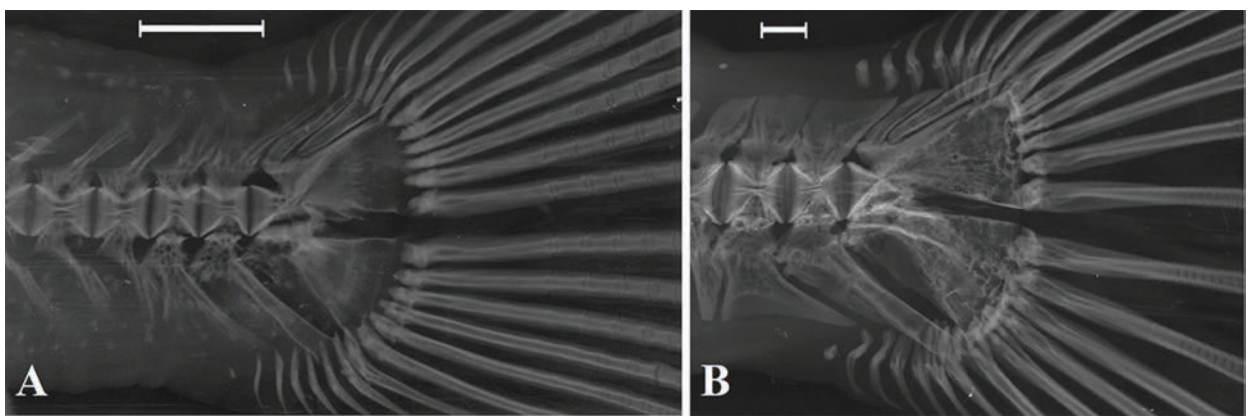

Fig. 2. *Congiopodus coriaceus,* caudal fin radiograph: A – *SL* 64 mm (ZIN 39185); B – *SL* 179 mm (ZIN 50281-10). Scale bar 2 mm.

pterygiophores) between 3rd and 4th, 6th and 7th, 8th and 9th neural spines. Last two dorsal fin proximal pterygiophores enter together between 26th and 27th neural spines, stay supports two rays. Anal-fin unbranched soft rays 10, stay supports two rays. Caudal fin with 12 principal rays, 6 on each hypural plate (all branched except uppermost and lowermost), 8 unbranched upper procurrent rays, 8 unbranched lower procurrent rays, lowermost rudimentary (Fig. 2A).

Meristic parameters as well as the ranges of individual variability and most frequent formulas are given in Table 1.

Measurements as % *SL* with a range of values are given in Table 2. Measurements, as % *c*: *ch* 70.3, *lmx* 18.9, *io* 9.9, *ao* 34.4, *o* 29.8.

Colour of head and body after fixation in formalin and storage in alcohol dark beige. Single pale stripe along lateral line.

Table 2. Morphometric parameters of the *Congiopodus coriaceus*

Region	Great Australian Bight	SE off New Zealand	Campbell Island Rise, SE off New Zealand
Material, ZIN Nos	39185	45365, 50281, 50282	Type and additional specimens*
n	1	27	45
TL, mm	79.0	46.0–312.0 (178.8)	
SL, mm	64.0	37.0–265.0 (149.6)	62.8–273.0
as % *SL*			
h	22.8	18.0–23.2 (21.1)	
H	34.5	22.2–36.8 (32.3)	29.4–37.0 (33.5)
aD	26.6	22.4–27.3 (24.2)	21.3–29.0 (25.0)
hD_{spine}	22.8	18.6–27.0 (23.9)	
hD_{soft}	13.0	9.8–17.2 (12.7)	
hA	15.9	10.0–16.7 (13.5)	12.9–18.9 (16.1)
aA	67.8	66.5–73.5 (70.4)	
hBr	5.9	6.0–8.6 (7.4)	
lP	28.1	22.6–30.1 (25.8)	22.9–31.8 (26.3)
lV	26.4	20.6–27.1 (24.3)	
lC	22.2	16.8–22.7 (19.8)	
lcp	12.3	12.5–25.2 (15.0)	
hcp	8.3	5.8–7.4 (6.6)	
c	33.1	27.1–34.5 (30.1)	29.9–34.7 (31.9)
ch	23.3	18.7–24.0 (20.3)	
lmx	6.3	5.6–6.6 (6.1)	
io	3.3	4.3–7.7 (5.2)	
ao	11.4	11.3–13.7 (12.5)	11.6–23.3 (14.0)
o	9.7	7.2–10.7 (8.1)	6.3–10.3 (7.8)
hD_1	8.8	4.6–10.1 (6.7)	3.9–9.2 (7.9)
hD_2	11.4	8.3–18.4 (13.1)	
hD_3	17.5	15.0–26.1 (20.7)	
hD_4	20.8	18.3–27.0 (23.3)	
hD_5	22.8	18.6–26.6 (23.1)	18.1–27.5 (22.1)
hD_6	20.8	15.4–24.0 (20.2)	

Notes. The first numbers refers to the range of values; the arithmetic mean is in parentheses. *TL* – total length; *SL* – standard length; *h* – body depth at the anal-fin origin; *H* – maximal body depth; *aD* – predorsal distance; hD_{spine} and hD_{soft} – maximal depths of the dorsal fin spine and the soft ray respectively; *hA* – maximal depth of the anal fin; *aA* – preanal distance; *hBr* – depth of branchial aperture; *lP* and *lV* – length of the pectoral and ventral fins; *lC* – length of the caudal fin; *lcp* and *hcp* – length and depth of the caudal peduncle; *c* – head length; *ch* – head depth through middle of eye; *lmx* – length of the os maxillare; *ao* – snout length; *io* – interorbital distance (the minimal distance measured at the vertical line of the anterior margin of the eye); *o* – longitudinal orbit diameter; hD_1–hD_6 – length (height) of the respective dorsal spine. * – same as in Table 1 (measurements from: Paulin and Moreland 1979).

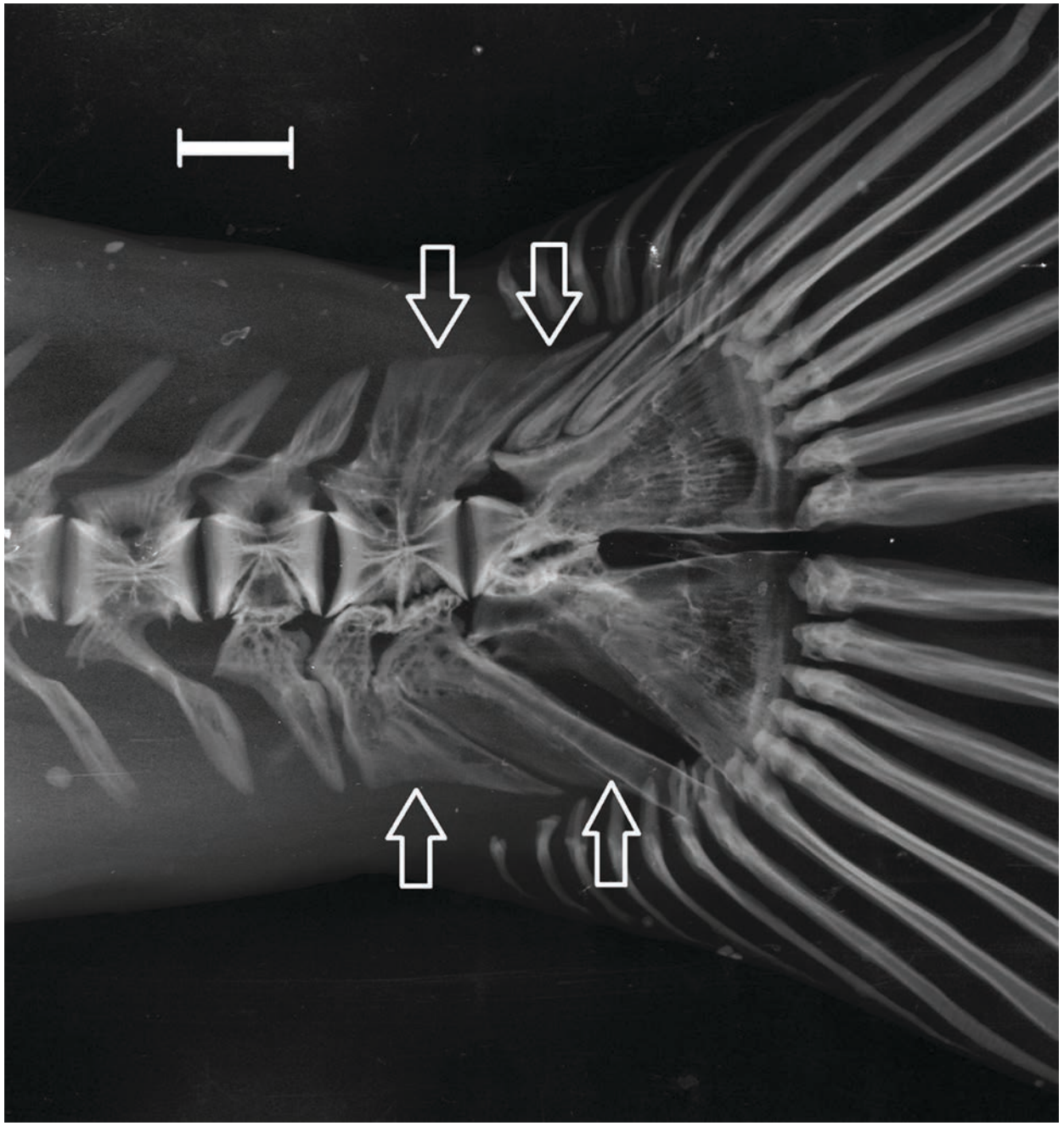

Fig. 3. *Congiopodus coriaceus,* caudal fin radiograph, *TL* 176 mm, *SL* 146 mm (ZIN 50281-6). Neural and haemal spines of the complex preurostylar vertebra marked by arrows. Scale bar 2 mm.

Comparative notes. The dorsal-fin, as well as the anal-fin formulas of ZIN 39185 correspond to the most common values in the studied specimens (Table 1). The fifth spine is longest, as in all specimens in the original description (n = 45) by Paulin and Moreland (1979). However, in the examined material (n = 28) the fifth spine is longest only in 13 cases, while in the other 15 cases the fourth spine is longest. The caudal fin formula is 8+12+8=28, the same was found in 24% of the examined specimens.

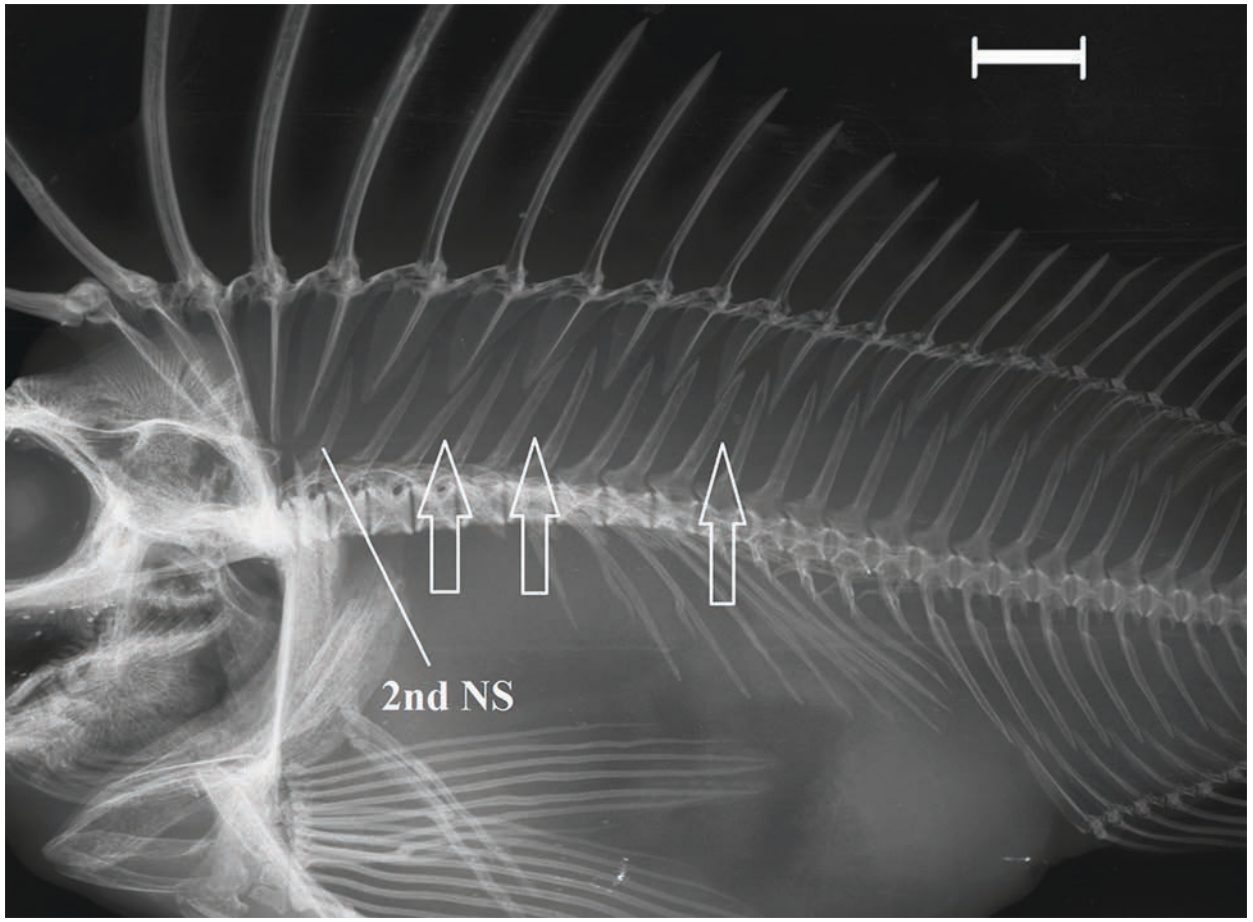

Fig. 4. *Congiopodus coriaceus* radiograph, *TL* 215 mm, *SL* 179 mm (ZIN 50281-2). Empty gaps without proximal pterigiophores marked with arrows. 2nd NS – second neural spine. Scale bar 10 mm.

The ventralmost procurrent ray is usually strongly reduced (Fig. 2A, B). The smallest studied specimen (ZIN 50282-2 *SL* 37 mm) has all rays unbranched, including those of the caudal fin; with age, a single branch appears in up to 9 rays of the dorsal fin and up to three rays of the anal fin. In ZIN 39185 *SL* 64 mm and ZIN 50282-1 *SL* 67 mm, 10 rays in the caudal fin are already branched.

There are 11–17 lateral line pores in the comparative New Zealand material (with a mean of 14, which is consistent with the original description); the last section is always separated and usually bounded by two pores, in 15% of cases there are two separate last senses near the caudal fin, i.e. 4 pores are separated from the main canal. Specimen ZIN 50281-4 has a separate section on the left side containing two senses with three pores.

DISCUSSION

Congiopodus coriaceus can be easily distinguished from its sister species *C. leucopaecilus* by its colour pattern, number of gill rakers and the dorsal head profile. The described specimen is fully consistent with the keys for *C. coriaceus* published in Paulin and Moreland (1979): single lateral line, snout without spines, dorsal rays XVII, 12, skin smooth, first dorsal spine less than half length of the longest dorsal spine (Table 2), gill rakers 3+9, head profile oblique (dorsal fin origin over rear of eye).

There is small variability in the number of vertebrae (Table 1) that slightly expands the range in Paulin and Moreland (1979). One specimen in comparative material ZIN 50281-6 has the smallest number of vertebrae: 14+21=35. The reduction

was, among other things, due to the fusion of two preurostylar vertebrae, which is clearly visible on the radiograph – the last preurostylar vertebra is wider than the previous one and has two neural and haemal spines (Fig. 3), in contrast to ordinary vertebra (Fig. 2). Such a case can be easily identified by the shape of the haemal spine on the second preurostylar vertebra – if it is wide (Fig. 2), then the next posterior vertebra is simple, and if it is narrow, then the wide haemal spine was incorporated into the complex last vertebra (Fig. 3). The same fusion is common in the closely related genus *Zanclorhynchus* (Zhukov 2018). By contrast, in the studied material of *C. coriaceus* a complex first preurostylar vertebra was found in only one specimen.

The number of dorsal-fin proximal pterygiophores supporting spines is equal to the number of vertebrae +1, as in the closely related *Zanclorhynchus* (Zhukov 2018). However, in horsefishes there are two proximal pterigiophores positioned anteriorly to second neural spine, and then all other pterygiophores with supported spines are arranged in a row, while in *C. coriaceus* there are five of them anteriorly to second neural spine. Three are three gaps between neural spines that lack pterigiophore (Fig. 4). These gaps are located up to the 11th vertebra, separated by one to three proximal pterygiophores.

The number of gill rakers on the first branchial arch of the described specimen corresponds to the most common number in the original description (Table 1). The gill rakers' formula indicated by Stewart and Struthers (2015) should be considered as a reprint of the error published in Ishida's annotated list (Ishida 1990). The range 5–6 + 11–12 mentioned in these publications contradicts the diagnosis in the original description: 2–4 + 9–10 (Paulin and Moreland 1979).

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