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A new pipefish, *Stigmatopora narinosa* (Syngnathidae) from South Australia

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Abstract

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A new species of pipefish, *Stigmatopora narinosa* sp. nov. (Teleostei, Syngnathidae) is described from Gulf St. Vincent and Spencer Gulf, South Australia. *S. narinosa* shares with the other three described *Stigmatopora* species a similar fin placement, fully enclosed brood pouch, superior and inferior trunk and tail ridges continuous, a lateral trunk ridge ending midlaterally. *S. narinosa*, *S. nigra* Kaup, 1853, and *S. argus* Richardson, 1840, have long prehensile tails and all *Stigmatopora* lack caudal fins. *S. narinosa* is most similar in meristics to *S. nigra* in having the dorsal fin initiating on about the fifth to seventh trunk ring and the lateral trunk ridge terminating across the second tail ring. In other *Stigmatopora* species the dorsal fin originates on the ninth to thirteenth trunk ring, the lateral trunk ridge terminates between the eighth to thirty-second tail ring, *S. narinosa* is distinguished from sympatric *S. nigra* in having nine (range, 8.2–9.8), rather than six sub-dorsal tail rings (range, 4.8–7.1), a greater number of sub-dorsal tail and total rings, a greater number of dorsal-fin rays, a shorter laterally flattened and dorsally elevated snout, a distinct banded pattern in both live and preserved specimens, a larger brood number and a double layer of eggs in the brood pouch. The brood pouch is under the anterior portion of the tail and extends for 15–18 rings from the anal ring; pouch plates are absent or vestigial, and the folds of the semi-pouch enclosure meet on the ventral midline. The eggs are deposited in up to two layers, one lining the dorsum of the pouch and the other separated by a membranous partition, and the brood of up to 98 eggs is larger than the maximum number of 41 found in *S. nigra* and *S. argus*. *S. narinosa* young at birth are approximately 18 mm, *S. nigra* 13 mm, and S. *argus* 32 mm total length. *S. narinosa* has a very restricted known range and habitat, inhabiting patchy open beds of sea-grasses with brown algae on sandy rubble substrate between 1 m and 5 m depth over less than 200 km of coastline.

Keywords

New species, syngnathid, marine, *Stigmatopora narinosa*, taxonomy, *Stigmatopora nigra*.

Introduction

In 2003, we examined syngnathids in the South Australia Museum collection to collect data on range, brood size, and different brood morphologies. Among the specimens were several examples of a *Stigmatopora* sp. with a unique sub-dorsal tail ring count, snout shape, and coloration. The earliest of these was collected in 1964. In the collection these were identified as *Stigmatopora sp.* or unnamed, with several specimens lacking accession numbers (Browne, 2003).

The Southern Australasian genus of pipefish the *Stigmatopora* was first described by Kaup (1853). *Stigmatopora* shares with the more tropical *Syngnathoides* Bleeker, 1851 and *Solegnathus* (*Runcinatus*) Whitley, 1929 confluent inferior ridges and superior ridges, dorsal-fin origin on the trunk, absence of a caudal fin, presence of pectoral fins in adults and a lateral trunk ridge ending without a ventral deflection. These genera differ through the positioning of the male brood region beneath the tail in *Stigmatopora* and *Solegnathus* (*Runcinatus*) rather than beneath the trunk in *Syngnathoides* (Dawson, 1982) and the development of a semi-pouch enclosure in *Stigmatopora* compared with unprotected membranous compartments in *Syngnathoides* and *Solegnathus* (*Runcinatus*) (Dawson, 1985). When preserved *Stigamotopora* lacks the distally coiled prehensile tail found in representatives of both *Syngnathoides* and *Runcinatus* (Dawson, 1982). Nevertheless, we have observed *S. narinosa* sp. nov., *S. nigra* Kaup, 1853, and *S. argus* Richardson, 1840 holding seaweed with their prehensile tails (fig. 1).

Dawson (1982) reviewed *Stigmatopora* and found considerable differences in meristic values between populations within the three recognized species: the Australian and New Zealand *S. nigra*, the Australian *S. argus*, and the New Zealand *S. macropterygia* Duméril, 1870. Despite the variation, *S. nigra* was distinguished from the other two *Stigmatopora* spp. by its dorsal-fin origin on the fifth to seventh trunk ring

and the lateral trunk ridge ending median on the second tail ring; *S. argus* and *S. macropterygia* have the dorsal-fin origin on the ninth to thirteenth trunk ring, while the lateral trunk ridge in *S. argus* terminates on the eighth to twentieth tail ring and the twenty-fourth to thirty-fifth tail ring in *S. macropterygia*. Dawson (1982) examined specimens of *S. nigra* from New Zealand and from southern Queensland, New South Wales, Victoria, Tasmania, and Western Australia but not South Australia, He examined specimens of *S. argus* from these states and also South Australia. Photos of *S. narinosa* sp. nov. from Edithburg, South Australia, (Kuiter, 2000) were identified as *S. olivacea* (Castelnau, 1872). Examinations of images of the type of *S. olivacea* (Muséum National d'Histoire Naturelle, Paris, France, A.738) revealed a typical *S. argus*. Besides the above, no other *Stigmatopora* spp. were recognized by Dawson (1982).

Consequently, we conducted field surveys to obtain further specimens of *Stigmatopora narinosa* sp. nov.. We sampled ten specimens of *S. nigra* within the range of *S. narinosa* for meristic and morphometric comparison. In addition, we collated biological information through literature searches of all species in the *Stigmatopora* and compared their biology and ecology with that of *S. narinosa*.

Materials and methods

Specimens of *S. narinosa* sp. nov. that were examined are lodged in the South Australian Museum (SAM), Adelaide, South Australia, Australia; and in the Museum Victoria (NMV), Melbourne, Victoria, Australia. Tail ring counts and total length were recorded only for specimens with unbroken tails. Meristic values of SAM F10190 and NMV A29231 were used for brood pouch position and egg counts. The drawing in fig. 2 was taken from the paratype SAM 10186 to reduce damage through handling of the holotype.

Counts and measurements follow the methodology of Dawson (1982). Lengths were measured to the nearest 0.1 mm. Data as ratios were Arcsine transformed before testing for normality (Shapiro-Wilk W test) and homogeneity of variance (O'Brian's). Counts or transformed data were then subject to *t*-tests. All statistical analyses were performed using the JMP 5.1 software package (SAS Institute Inc., Cary, NC, USA).

The morphological abbreviations used are: DO = dorsal origin; D = dorsal ray count; P = pectoral ray count; A = anal-fin ray count; TR = trunk rings; TAR = tail rings; SDTR = sub-dorsal trunk rings; SDTAR = sub-dorsal tail rings; SDR = total sub-dorsal rings; SD = snout depth, least vertical dimension posteriad of mouth; SnL = snout length, from tip of lower to posterior side of eye socket; SW = snout width, least horizontal measurement between the tip of the snout and the anterior eye socket; HL = head length, from tip of lower jaw to rear margin of operculum; TrL = trunk length , length from posterior of operculum to vent; TL = total length; STR = superior trunk ridge; STAR = superior tail ridge; ITR = inferior trunk ridge; ITAR = inferior tail ridge; LTR = lateral trunk ridge; LTAR = lateral tail ridge.

Figure 1. *S. narinosa* sp. nov. from Port Victoria, Spencer Gulf, with its prehensile tail coiled around macroalgae. The parasite is an isopod which is also commonly found on the leafy seadragon (*Phycodurus equis*). Image Graham Short.

Stigmatopora narinosa sp. nov.

Figures 2–5. Tables 1, 2.

Figured as *Stigmatopora olivacea* Castelnau, 1872: Gulf Pipefish in Kuiter (2000): 199: figs A–D. Note that female in fig. C is *S. argus*. In contradiction to the captions these images were taken at Edithburgh, South Australia (Kuiter, pers. com).

Holotype: male, SAM F10190, 150 mm TL, South Australia, Edithburg Pool, 35°05'S, 137°45'E, 31 Dec 2003. Hand netted at 10.30 am while scuba diving 30 m offshore at 2-m depth MLWS, in an open bed of mixed *Posidonia* sp. and *Zostera* sp. sea-grasses, with brown algae, on a sandy rubble substrate.

Paratypes: South Australia: SAM F10186, 135 mm TL, Edithburgh Pool, 35°05'S, 137°45'E, 29 Dec 2004. SAM F10194, 60 and 64 mm TL, Magazine Bay, Pt. Turton, 34°55'S, 137°20'E, 18 Jan 2004. SAM F10195, 72 mm TL, Port Victoria, 34°29'S, 137°28'E, 7 Jan 2004. NMV A29230-001, 143, 130, 122, 131 mm TL, Edithburg Pool, 35°05'S, 137°45'E, 22 Oct 2005. NMV A29231-001, 141, 117, 141, 128, 130 mm TL, Port Hughes Jetty, 34°04'S, 137°32'E , 30 Oct 2005.

Other material examined. SAM F 7458, 122 and 94 mm TL, Edithburgh Jetty, 35°05'S, 137° 45'E, 13 Apr 1992. SAM F 7550, 95 mm TL, Edithburgh Jetty, 35°05'S, 137°45'E, 15 Mar 1994. SAM F 7551, 73 mm TL, Edithburgh Jetty, 35°05'S, 137°45'E, 13 Apr 1992. SAM F10159, 90 mm TL, Seacliff, 35°02'S, 138°31'E, 5 Mar 2003. SAM F10160, 92 mm TL, Seacliff, 35°02'S, 138°31'E, 5 Mar 2003. SAM F10171, 114 mm TL, Port Hughes Jetty, 34°04'S, 137°32'E, 18 Mar 1994. F10186, 135 mm TL, Edithburgh Pool, 35°05'S, 137°45'E, 29 Dec 2004. SAM F10191, 74 mm TL, Port Vincent, 34°46'S, 137°52'E, 1964. SAM F10192, 70 mm TL, Seacliff, 35°02'S, 138°31'E, 5 Mar 2003. SAM F10193, 65 mm TL, Edithburgh Jetty, 35°05'S, 137°45'E, 1981. F10194, 60 and 64 mm TL, Magazine Bay, Pt. Turton, 34°55'S, 137°20'E, 18 Jan 2004. F10195, 72 mm TL, Port Victoria, 34°29'S, 137°28'E, 17 Jan 2004.

Specimens of *S. narinosa* sp. nov. (n = 7) for statistical meristic and morphometric comparison were SAM F 7458, SAM F 7550, SAM F 7551, SAM F10159, SAM F10160, SAM F10171. Comparative material of *S. nigra* (SAM F10185, n = 10) used for statistical comparison was collected at O'Sullivans Beach Marina (35°02'S, 138°31'E). Other comparisons were with Dawson (1982).

Table 1. Meristic counts for *S. narinosa*, and *S. nigra* from South Australia.

Species / counts	Dorsal		Pectoral		SDTR		SDTAR		SDR	
S. nigra	36.0 ± 1.1	34–38	13.0 ± 0.0	13–13	10.57 ± 0.45	10.0–12.5	6.23 ± 0.18	4.8–7.1	16.8 ± 0.6	16.00–18.00
S. narinosa	40.8 ± 2.3	37–45	12.4 ± 0.5	12–13	11.75 ± 1.00	9.0–12.5	9.08 ± 0.17	8.2–9.8	19.8 ± 1.1	19.25–22.25
Probability	P<0.01		NS		NS		P<0.01		P<0.05	

P for *t*-test. NS = not significant, Dorsal = dorsal ray count; Pectoral = pectoral ray count; SDTR = sub-dorsal trunk rings ngs; SDTAR = sub-dorsal tail rings; SDR = total sub-dorsal rings. Values are expressed as means ± SD, range.

Table 2. Measurement ratios for *S. narinosa* and *S. nigra* from South Australia.

Species / ratios	SD/SnL		SW/SnL		HL/TrL		SnL/TrL		SnL/HL	
S. nigra	0.09 ± 0.01	0.08–0.10	0.06 ± 0.01	0.05–0.06	0.68 ± 0.13	0.59–0.76	0.43 ± 0.03	0.39–0.48	0.64 ± 0.02	0.60– 0.67
S. narinosa	0.13 ± 0.02	0.10–0.17	0.14 ± 0.03	0.10–0.18	0.66 ± 0.05	0.58–0.68	0.38 ± 0.02	0.34–0.40	0.61 ± 0.03	0.56–0.65
Probability	P<0.01		P<0.01		NS		P<0.01		P<0.01	

SD = snout depth, least vertical dimension posteriad of mouth; SnL = snout length; SW = snout width; HL = head length; TrL = trunk length, length from posterior of operculum to vent. Values are expressed as means ± SD, range.
P for t-test, NS = not significant.

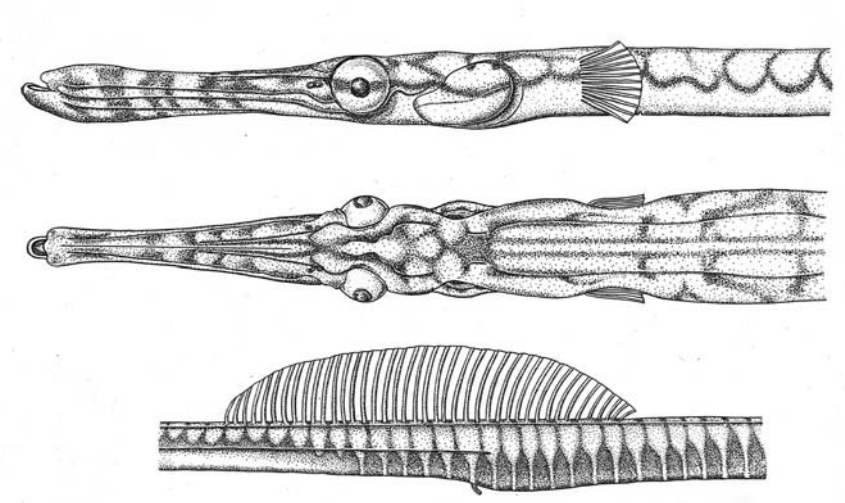

Figure 2. (a) Side view of the head, (b) dorsal view of the head, and (c) side view of the posterior trunk and anterior tail of a male *Stigmatopora narinosa* sp. nov. (Paratype SAM I0186) preserved in alcohol. The sub-dorsal ring count is 12 + 8.2 = 20.2. The broad snout is particularly elevated near the tip. The ridges on the snout and trunk are less prominent in fresh specimens. The lateral trunk ridge ends across the second tail ring. Drawing by Lisa Waters.

Figure 3. Side view of *Stigmatopora narinosa* sp. nov. (Paratype SAM F10195). The tail tapers to a point without a caudal fin.

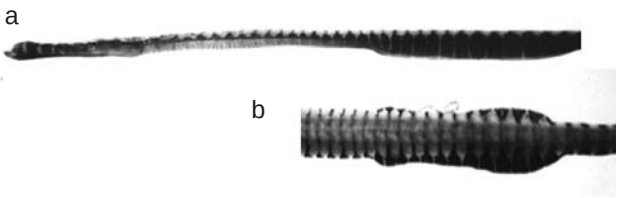

Figure 4. (a) Side view of the head, trunk and anterior of the tail of a male *Stigmatopora narinosa* sp. nov, (Holotype, SAM F10190) showing the prominent brood-pouch posterior to the vent, (b) dorsal view of the brood-pouch extending 14 tail rings from the vent, (c) ventral view of the brood pouch showing the well-developed pouch folds . This male gave birth when captured. *S. narinosa* is atypical of the genus in having up to 98 eggs in two layers, instead of 20–40 eggs in one layer.

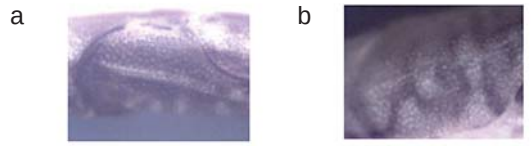

Figure 5. A side (a) and dorsal (b) view of *Stigmatopora nigra* (upper; Kaup, 1853) and also of *S. argus* (lower, b,c; Richardson, 1840) from South Australia. Both species have a relatively longer more tubular snout than *S. narinosa*, with *S. argus* having a longer snout than *S. nigra*.

Figure 6. A side (a) and dorsal (b) view of *S. nigra* (upper; Kaup 1853) and also of *S. argus* (lower, b,c; Richardson 1840) from South Australia. Both species have a relatively longer more tubular snout than *S. narinosa*, with *S. argus* having a longer snout than *S. nigra*.

Diagnosis. In contrast to other described species of *Stigmatopora*, trunk and tail ridges, and particularly lateral trunk ridge, indistinct in fresh specimens. Lateral trunk ridge terminates 1.5 body rings posterior to anal ring. Short, wide and slightly elevated snout. 9 sub-dorsal tail rings. Distinct banded pattern in both live and preserved specimens.

Description. STR and STAR continuous, ITR and ITAR continuous. LTR not confluent with LTAR, LTR terminating about 1.5 body rings posterior to anal ring (fig. 2). Meristic and morphometric values given in Tables 1, 2. The opercular ridge longitudinal and angled little dorsally, prominent in juveniles, reduced in adults (fig. 5). Brood pouch (fig. 4) under the anterior portion of tail, extends for 15 to 18 rings from anal ring; pouch plates absent or vestigial, brood protected by well-developed pouch folds which develop from the inferior tail ridges and touch or overlap at ventral midline within length of 1 ring.

Holotype. ♂, DO 6.5, D 40, P 13, A 4, TR 18, TAR 68, SDTR 11.5, SDTAR 7.5, SDR 19, SD/SnL 0.14, SW/SnL 0.15, HL/TrL 0.64, SnL/TrL 0.37, SnL/HL 0.62.

Colouration. Base color variably brown, red, yellow and grey-green, tending to fade to cream, brown and red in preservative. Adults mainly grey-green above with reddish-brown or dark brown markings. Red dominates toward tip of tail with the tip frequently only bright red. Pattern of dark transverse bands on each ring with the pattern changing along length of body and varying between individuals and possibly also with age. Anterior and dorsal margins of each ring dark brown or reddish brown, distinct or smudged, form a transverse band at each joint. Bands broaden ventrally, with only thin pale line remaining in middle of rings, resulting in appearance of a series of inverted saddles. Central part of bands sometimes pale resulting in double bands. Elongated spots sometimes present in these double dark bands or bands broken, further disrupting banded pattern and giving spotted or scribbled appearance. Banding often obscured, especially on the anterior half of trunk (figs 2, 4). Similar spotting sometimes under head. Juveniles often brown or golden yellow.

Reproduction. When compared to the other *Stigmatopora spp.* the most distinguishing characteristics of the reproduction of *S. narinosa* are a lack of dorso-ventral compression in females, a specialized reproductive morphology, the number and size of

the young. Sexual dimorphism characteristic of *S. nigra*, *S. argus*, and *S. macropterygia* is the dorso-ventral compression of the trunk which is exaggerated in the females during courtship. Female *S. nigra* also display bright red banding on the ventral surface during courtship.

S. narinosa has a distinctive brood pouch and potentially a greater number of brooded eggs than its congeners *S. nigra* or *S. argus*. The brood pouch is under the anterior portion of the tail and extends for 15–18 rings from the anal ring; pouch plates are absent or vestigal, and well-developed pouch folds meet on the ventral midline. The eggs of *S. narinosa* are deposited in two layers, a basal layer and then an external layer. In the specimen with the greatest recorded number of eggs there were 3 staggered rows of 64 basal membranous egg compartments on the tail, with this basal layer of eggs covered by a membrane with matching rows of egg pouches; a 2nd layer with 34 eggs within the brood pouch folds resulted in a total of 98 eggs. The total lengths of *S. narinosa* larvae at hatching are 18 mm, those of *S. nigra* 13 mm, and those of *S. argus* 32 mm. Male *S. narinosa* have extended brood patches from December to March, and juveniles < 90 mm seen from December to March. Males of *S. narinosa* can mature at 113 mm. The maximum recorded brood of *S. narinosa* of 98 eggs was far greater than that recorded by Dawson (1982) of approximately 25 for *S. nigra* and 41 for *S. argus* (IFG 2007).

Comparisons. The dorsal fin origin of *S. narinosa* is similar to that of *S. nigra* at the 5th to 7th trunk ring but contrasts with other *Stigmatopora* which have the dorsal fin origin at the 9th to 13th trunk ring. However, *S. narinosa* sp. nov. is easily distinguished from *S. nigra* in having 9, rather than 6 sub-dorsal tail rings. Other distinguishing characteristics of *S. narinosa* when compared to *S. nigra* are a greater number of dorsal rays, total sub-dorsal rings; and ratios of snout depth and snout width to snout length, lower ratios of snout length to trunk length and head length (Tables 1, 2).

S. narinosa has a distinct banded pattern in both live and dead specimens. *S. nigra* and *S. argus* also both have banding. The banding on *S. nigra* on the dorsal surface consists of dark bars between the ventral rings on the trunk and extending to the tail. Dark bands on the ventral surface of the trunk are wider than on the dorsal surface. There may be no banding on the dorsal surface of the trunk of *S. argus* or the bands may appear as narrow dark or pale bars on the trunk and anterior 3rd of the tail. *S. narinosa* has inverted saddle-like dark transverse bands on each ring, broadening ventrally, with only thin pale line remaining in middle of rings. The anterior and tip of tail of *S. narinosa* is frequently colored red to yellow with those of *S. nigra* and *S. argus* green. A further distinguishing feature of *S. argus* are dark spots or ocelli on the dorsal trunk.

S. nigra and *S. argus* have elongated narrow and shallow snouts (fig. 6). However, the snout of *S. narinosa* is short, wide and slightly elevated. The brood pouch of *S. narinosa* extends 15–18 rings from the anal ring (fig. 3). In *S. argus* the brood pouch extends 14–24 tail rings, in *S. nigra* 12–16 tail rings, and in *S. macropterygia* 21–24 tail rings.

Etymology: *S. narinosa* "naris, Latin nostril; narinosus, broad-nosed" (Brown, 1954) is named after the wide and distinctive spatulate shape of its snout (fig. 2). Kuiter (2000) gives this species as *S. olivacea*, and the common name 'Gulf Pipefish'. Because this common name is used for the North American *Syngnathus scovelli* (Evermann and Kendall, 1896), for *S. narinosa* we adopt the common name 'Southern Gulf Pipefish'.

Distribution. *S. narinosa* is currently known only from South Australia along 200 km of inshore habitat from Seaciff (35°02'S, 138°31'E) on the southeastern coast of the Gulf St. Vincent, along the south-western shore of the Gulf St. Vincent from Pt. Vincent (34°46'S, 137°52'E) south to the Edithburgh Jetty (35°05'S, 137°45'E), and along the south-eastern shore of Spencer Gulf from Pt. Hughes Jetty (34°04'S, 137°32'E), at Pt. Victoria (34°29'S, 137°28'E), and south to Magazine Bay, Pt. Turton (34°55'S, 137°20'E) (fig. 7). Photographs appearing to be *S. narinosa* were taken at Pt. Hughes (2003) and Edithburgh Jetty (35°05'S, 137°45'E) and by Kuiter (2000) at Edithburg (in Kuiter, 2000, image title from Cape Jarvis, Kuiter pers. com.) and Pt. Victoria (34°29'S, 137°28'E). All specimens of *S. narinosa* have been collected or photographed in sheltered shallow open water of 1–5 m depth over a substrate of a mosaic of patches of brown algae, with *Posidonia*, or *Zostera*. The only hand-netted specimen of *S. narinosa* was sampled at Stansbury (34°53'S, 137°49'E) at low tide. Deeper water trawl surveys offshore from locations inhabited by *S. narinosa* have yielded no specimens. Deeper SCUBA surveys have not found *S. narinosa*. Therefore, *S. narinosa* appears to have a very limited inshore distribution along patches of moderate energy coastlines with low turbidity and a broken vegetation pattern of sea-grass and brown algae.

The northern sections of both the Gulf St. Vincent and Spencer Gulf are low energy coastlines with typically dense *Posidonia* sea-grass beds extending from low tide mark to considerable depths. They lack an open patchy mosaic of brown algae, *Posidonia*, and *Zostera* on sand and probably do not offer suitable habitat for *S. narinosa* . Both *S. argus* and *S. nigra* generally inhabit sea-grass beds, with the larger *S. argus* (TL 254 mm; Dawson, 1982) preferring the long (~ 60 cm) and wide (~ 1 cm) *Posidonia sp.* beds, and the smaller *S. nigra* (TL 162 mm, Dawson, 1982) inhabiting the short (~ 5-14 cm) and narrow (~ 2-4 mm) *Zostera sp.* sea-grass. Both *S. argus* and *S. nigra* are colored green to grey-green. The generally reddish/brown colour of *S. narinosa* would provide better camouflage among its apparently preferred habitat of mixed sea-grass and brown algae. Seasonal water temperatures at one site inhabited by *S. narinosa* (Edithburgh Pool; 35°05'S, 137°45'E) ranged from 12–20ºC.

This restricted inshore habitat of *S. narinosa* may be particularly vulnerable to pollutants or exotic marine species. On the other hand, the readily accessible inshore distribution of *S. narinosa* could facilitate the monitoring and investigation of its populations and contribute to conservation measures. The finding of a new *Stigmatopora* species in shallow inshore sites adjacent to populated areas indicates the potential for other novel species of pipefish to be discovered across southern Australia.

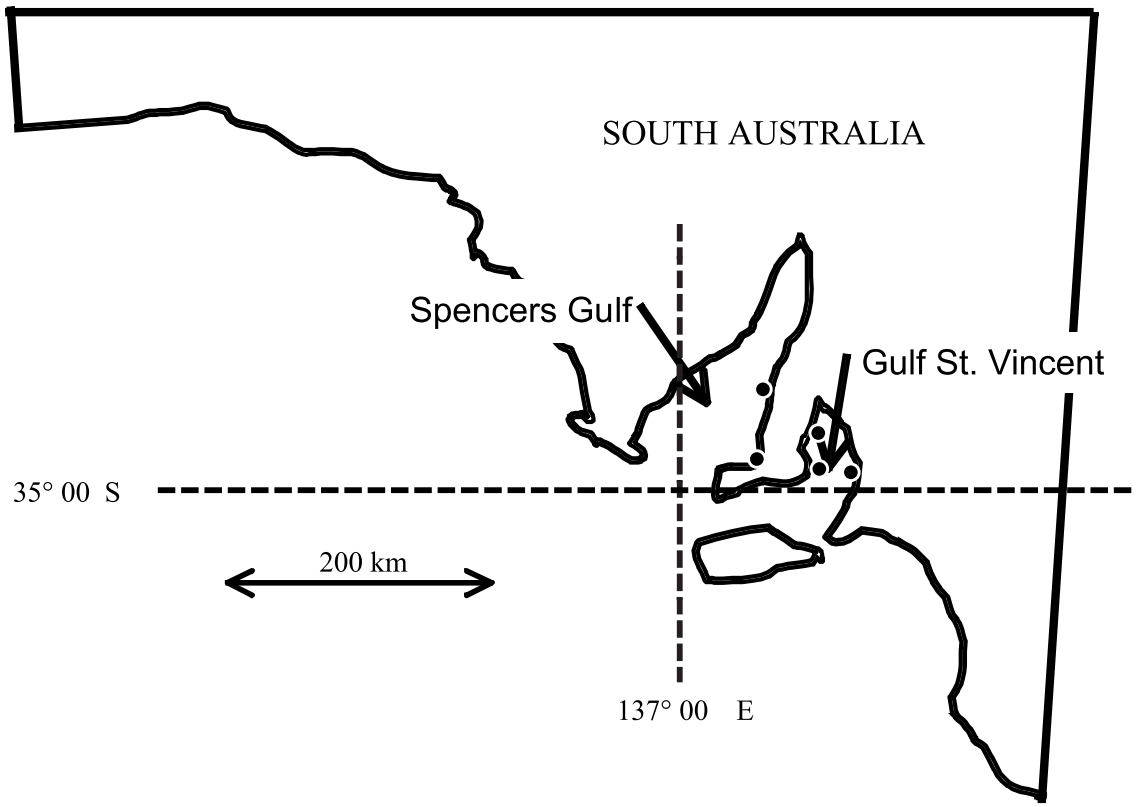

Figure 7. Known locations (•) of the Southern Gulf Pipefish *Stigmatopora narinosa* sp. nov. in South Australia . The range of *S. narinosa* extends from south-eastern Spencer Gulf, along the lower half of western Gulf St.Vincent with a localised population in eastern Gulf St Vincent.

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