

# Fishes of the genus *Artedidraco* (Pisces, Artedidraconidae) from the Ross Sea, Antarctica, with the description of a new species and a colour morph

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**Abstract:** Notothenioid fish of the artedidraconid genus *Artedidraco* are a little studied component of the bottom fauna on the Antarctic continental shelf. Trawling in the south-western Ross Sea, especially in shallow areas with sponge beds, yielded a collection of 65 specimens of *Artedidraco*. These included all four species occurring in the Ross Sea as well as a new species. The new species *Artedidraco glareobarbatus* is described and illustrated. This species is most similar to *A. orianae*, but is distinguished by barbel morphology, by higher counts for dorsal rays and vertebrae, by lower counts for upper lateral-line scales and by colour pattern and visceral anatomy. A distinctive spotted colour morph of *A. shackletoni* is also documented and compared with the typical barred morph. Depth distribution and meristic variation among species of *Artedidraco* are summarized, and a taxonomic key to the six species is provided.

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## Introduction

Plunderfishes of the notothenioid family Artedidraconidae are a distinctive and important element of the bottom fauna on the Antarctic continental shelf and upper slope. For example, during two recent cruises of the RV *Nathaniel B. Palmer* in the south-western Ross Sea, bottom trawling yielded 142 artedidraconids comprising 14.5% of the total catch of 979 specimens of fish. The family includes 24 species and four genera (*Artedidraco*, *Dolloidraco*, *Histiodraco*, and *Pogonophryne*) of small to medium-sized (100–300 mm TL) benthic, sculpin-like fishes (DeWitt 1971, Eakin 1990). Although these genera were formerly included with *Harpagifer* in the Harpagiferidae, now a monogeneric family containing only *Harpagifer*, many distinctive morphological features warrant separation of the two families (Andriashev 1967, Eakin 1981, 1990). Molecular evidence suggests that the Artedidraconidae is monophyletic (Ritchie *et al.* 1997), but a cladogram of relationships within the family is not yet available.

In the past 85 years, only the speciose genus *Pogonophryne* has contributed new artedidraconid species to the Antarctic ichthyofauna. This trend continues with the revision of *Pogonophryne* and the description of additional new species (Balushkin & Eakin 1998, Eakin & Eastman 1998). *Dolloidraco* and *Histiodraco* are monotypic; the former differs significantly from the other genera, while the latter is close to *Pogonophryne* (Eakin 1981, 1990). Although *Artedidraco* has been little studied and is poorly represented in museum holdings, we obtained a good collection of all four species inhabiting the Ross Sea and East Antarctica (Table I). A fifth

species, *Artedidraco mirus* Lönnberg, is endemic to South Georgia. Since the appearance of the species descriptions in 1905–14, only two papers have dealt with any aspect of the biology of *Artedidraco* (Eakin 1981, Wyanski & Targett 1981). Given the length of time since the last species was added to the genus and the extent of subsequent international fishing effort, especially in the Weddell Sea, (Kock *et al.* 1984, Kock 1992, Schwarzbach 1988, Eka 1990, Hubold 1992), our discovery of a new species of *Artedidraco* is noteworthy. Even in relatively shallow water, knowledge of specific and infraspecific diversity in the Artedidraconidae is incomplete.

In this paper, we

- 1) summarize collection data for *Artedidraco* in the south-western Ross Sea,
- 2) describe a new species of *Artedidraco*,
- 3) describe a distinctive spotted colour morph of *A. shackletoni* Waite, and
- 4) provide meristic and morphometric data and a key to species of the genus *Artedidraco*.

## Materials and methods

We conducted bottom trawling during cruises 96–6 (11 December 1996–8 January 1997) and 97–9 (20 December 1997–10 January 1998) of the RV *Nathaniel B. Palmer* in the south-western Ross Sea. We used a 9.1 m long Marinovich

Gulf Coast style flat trawl, a type of otter trawl. The footrope was 11 m long, but the effective width or mouth opening covered by netting was only 7.6 m. The trawl body consisted of 70 mm mesh; the inner liner was 13 mm mesh. We also used a far less effective Blake trawl with a frame measuring 1.5 m wide by 0.5 m high. The netting was identical to that of the Marinovich trawl. During the two cruises a total of 20 trawls were made, 15 with the Marinovich trawl and five with the Blake trawl. Because of damage, one of the 20 tows resulted in no fish and nine others yielded six or fewer specimens. Towing speed was 2.0–3.0 knots for a duration of 30–60 min with a Simrad EK500 scientific echo sounder used to determine bottom depth. Values in Table I are specified as either mean or maximum depths.

We followed Eakin & Eastman (1998) in performing measurements and counting meristic elements on specimens. The abbreviations for measurements and counts given in Table II were used in all subsequent tables. All measurements were expressed as percent of standard length unless otherwise indicated. Tubular upper lateral-line scales were determined by counting pores (one pore equivalent to one scale), whilst vertebrae and dorsal and anal rays were determined from radiographs. We used institutional abbreviations from Leviton *et al.* (1985), with the addition of AAD in reference to the Australian Antarctic Division, Kingston, Tasmania.

## Results and discussion

### *Artedidraco* from the Ross Sea

Four species of *Artedidraco* were collected in East Antarctica (Table I). Species of the genus separate into a deeper-bodied robust group (*A. mirus*, *A. orianae* Regan, *A. shackletoni* and *Artedidraco glareobarbatus*) and a slender group (*A. loennbergi* Roule and *A. skottsbergi* Lönnberg) of generally smaller size. All species are moderately eurybathic, and there were no obvious associations between body form and depth. Depth records summarized by Eakin (1990) and presence of darker visceral pigmentation (see below) suggest that *A. orianae* lives at the greatest depths. Our collections extended the shallowest known occurrence of *A. loennbergi* to 130 m.

**Table I.** Number of specimens and depth distribution by station for species of *Artedidraco* collected on cruises 96–6\* and 97–9 of the RV *Nathaniel B. Palmer* in the south-western Ross Sea.

Station no.	88	1	13	58	6*	46	Previously reported depth (m) <sup>b</sup>
Depth (m) <sup>a</sup>	130†	250†	261	344	360†	466	
<i>A. loennbergi</i>	1	1		14		4	230–608
<i>A. orianae</i>				1	1	3	82–801
<i>A. shackletoni</i>	6	3					56–460
<i>A. skottsbergi</i>	2	8	19				5–666
<i>A. glareobarbatus</i>	2						

<sup>a</sup>Mean depths indicated by (†), other depths are maximums

<sup>b</sup>Eakin (1990)

At station 88 near Franklin Island, trawling up a rise (287–107 m) and through a thick sponge bed with a diverse invertebrate fauna (see remarks below concerning the holotype), all four species of *Artedidraco* were captured (Table I). In the Ross Sea *Artedidraco* were associated with the topographically complex habitat provided by sponge beds or the vicinity of sponge beds in relatively shallow water.

**Table II.** Measurements and counts for *Artedidraco glareobarbatus*. Unless indicated otherwise, measurements are expressed as percent of standard length.

	Holotype USNM 348711	Paratype USNM 348712
Total length (TL, mm)	132	135
Standard length (SL, mm)	108	110
Head length (HL)	35.5	35.6
Head depth (HD)	20.2	20.0
Head width (HW)	23.5	25.2
Orbital diameter (O)	10.0	9.0
Narrowest bony interorbital width (IO)	2.3	2.6
Mental barbel length (MB)	13.9	11.2
Terminal expansion of mental barbel/ mental barbel length (TE/MB)	46.7	35.0
Snout length (Sn)	8.3	9.1
Internostril distance (N-N)	5.0	5.5
Upper jaw length (JL)	13.9	13.6
Jaw width (JW)	18.1	18.6
Postorbital length of head (PO)	35.2	34.9
Body depth at origin of anal fin (BD)	17.6	19.1
Body depth at origin of second dorsal fin (BDatD2)	25.0	25.5
Depth of caudal peduncle (CPD)	6.9	8.2
First antedorsal distance (Sn-D1)	31.3	31.8
Second antedorsal distance (Sn-D2)	47.2	44.1
Anteanal distance (Sn-A)	63.0	60.0
Length of longest spine in first dorsal fin (LD1S)	15.7	14.5
Length of longest ray in second dorsal fin (LD2R)	15.7	14.5
Interdorsal distance (D1-D2)	9.6	5.5 <sup>a</sup>
Length of base of second dorsal fin (D2BL)	53.9	55.8
Length of base of anal fin (ABL)	35.2	34.9
Length of caudal fin (CL)	25.0	24.5
Length of pectoral fin (PL)	25.0	23.2
Width of base of pectoral fin (PBW)	10.2	9.1
Length of pelvic fin (VL)	22.2	20.9
Spines in first dorsal fin (D1)	4	4
Rays in second dorsal fin (D2)	28	29
Anal fin rays (A)	19	19
Pectoral fin rays (P)	18 & 18	16 & 17
Anterior gill rakers on first gill arch (AGR)	8	8
Posterior gill rakers on first gill arch (PGR)	1	1
Scales (pores) in upper lateral line (ULL)	10 & 10	10 & 13
Scales (pores) in middle lateral line (MLL)	16	19
Vertebrae (abdominal+caudal) (Vert)	15 + 25 = 40	15 + 25 = 40
Sex	female	female

<sup>a</sup>low value attributable to fourth D1 spine being separate from third spine and located farther posteriorly than normal

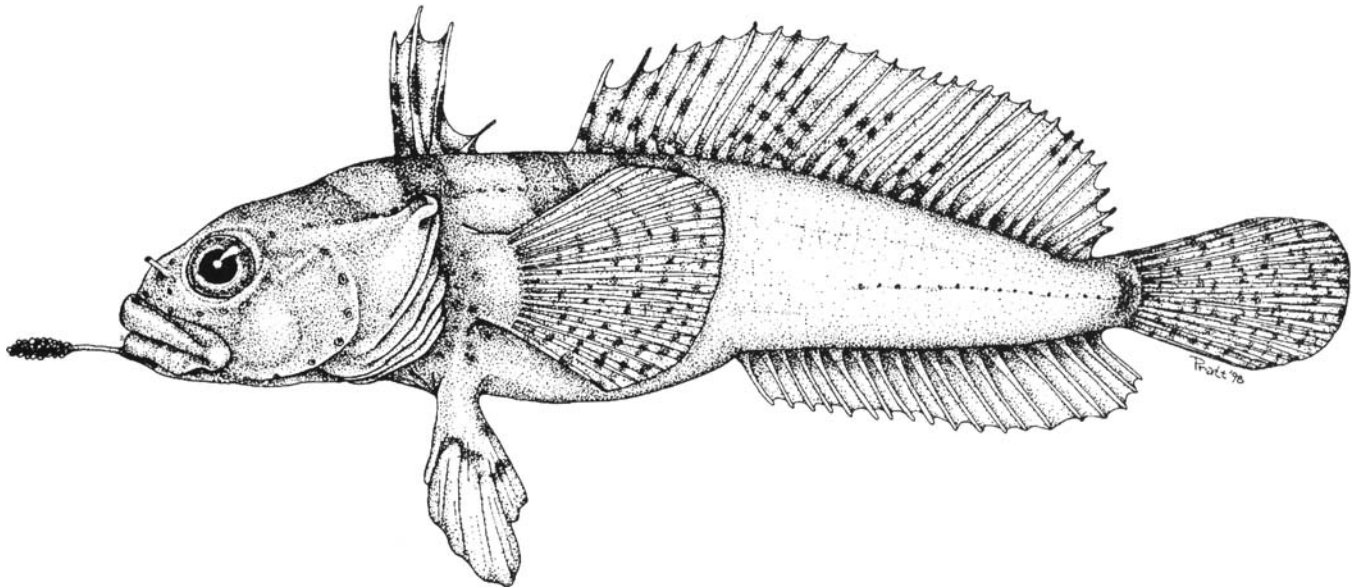


Fig. 1. *Artedidraco glareobarbatus* n. sp., USNM 348711, holotype. x 1.2.

*Description of a new species of Artedidraco*

*Artedidraco glareobarbatus* n. sp.  
Figs. 1–3

**Material:** Two specimens from the same locality in the south-western Ross Sea. Holotype: USNM 348711; specimen no. 88–3; gravid female, 108 mm SL (132 mm TL; wt 28.3 g). Paratype: USNM 348712; specimen no. 88–2; female, 110 mm SL (135 mm TL; wt 30.2 g). RV *Nathaniel B. Palmer*, cruise 97–9, Station 88, Ross Sea, Antarctica (76°00'52.6"S, 168°22'12.8"E to 76°02'34.3"S, 168°26'23.4"E); depth of capture 287–107 m; the trawl was towed up a rise, but at least one-half of the 60 min tow was at depths of less than 130 m; 8 January 1998. Collected by J.T. Eastman, M.J. Lannoo and C.F. Jensen. The trawl began 5.8 n miles and ended 4.4 n miles due north of the eastern cape of Franklin Island. Ice cover was 4/10ths, consisting of thin cakes and brash. Bottom temperature was -1.8° to -1.9°C. Both holotype and paratype were collected with the Marinovich flat trawl. The sample of bottom fauna taken by the trawl weighed 450–900 kg and was dominated by sponges, especially large hexactinellid (volcano) sponges and the associated spicule mat. Other groups represented in this diverse fauna were bryozoans, amphipods, nemertean worms, echiurid worms, ophiuroids, brittle stars, tunicates, anemones, sea urchins, chitons, sea lillies, sea whips, isopods, polychaetes, holothurians, crinoids, sea cucumbers, euphausiids, shrimps, octopuses, gastropods and clams.

**Diagnosis:** This species of *Artedidraco* has a relatively long, club-shaped mental barbel with a conspicuous terminal expansion composed of densely packed, blunt and somewhat flattened, processes, unlike those of any known species. It also has high numbers of vertebrae (40) and second dorsal-fin rays (28–29) and a moderate number of tubular upper lateral-

line scales (10–13). The overall bicoloured pattern of this species is distinctive: dorsal and lateral surfaces of the head are medium to light brown; the anterior part of the body, to about the tips of the pectoral fins, is marked on its dorsal and lateral surfaces with several broad, dark brown bars. In contrast, the ventral surface of the head and abdomen and the posterior half of the body are considerably lighter in colour (tan or grey). In overall shape, this species more closely resembles the relatively deep-bodied *A. mirus*, *A. oriana*,

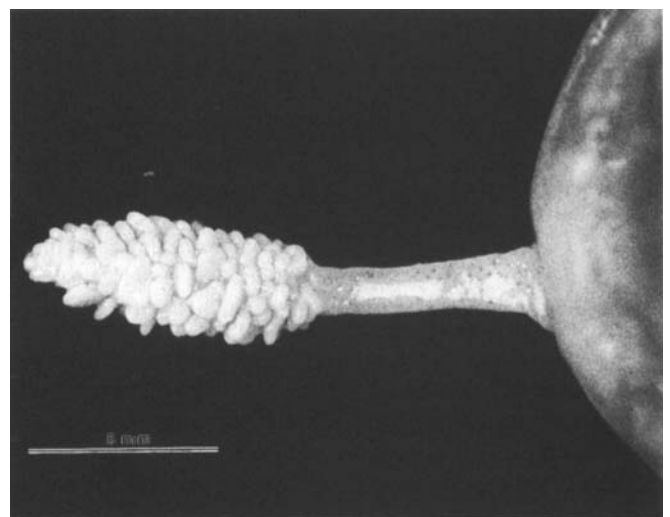


Fig. 2. Dorsal view of mental barbel of the holotype of *Artedidraco glareobarbatus*. Barbel is extended as in Fig. 1. Photo shows skin of terminal expansion arranged as densely packed, blunt and somewhat flattened and irregular processes. This barbel morphology is unique to this species of *Artedidraco*. x 5.0.



and *A. shackletoni* than the more uniformly slender *A. loennbergi* and *A. skottsbergi*.

*Artedidraco glareobarbatus* is also distinct from *A. oriana* in a number of features of visceral anatomy. Compared to *A. glareobarbatus*, the pyloric caeca of *A. oriana* are longer and more finger-like, and the intestine is longer with a proximal and distal loop as in most nototheniids (Eastman & DeVries 1997a). The new species lacks the distal loop. The oral and branchial cavities of *A. oriana* are dusky to dark grey. Dorsally the parietal peritoneum ranges from dark brown to black. The visceral peritoneum or tunica serosa of the oesophagus ranges from lightly speckled with melanophores to medium grey. In these aspects of intestinal anatomy and in the generally light visceral pigmentation, the new species more closely resembles *A. shackletoni* than *A. oriana*.

**Description of holotype** (paratype in parentheses), see also Table II: Body somewhat robust anteriorly, tapering to relatively low caudal peduncle. Length of head 35.5 (35.6); depth of head at post-temporals 20.2 (20.0); width of head at preoperculars 23.5 (25.2). Depth of body at origin of second dorsal fin 25.0 (25.5); depth of body at origin of anal fin 17.6 (19.1); width of body at origin of anal fin 7.9 (10.7); depth of caudal peduncle 6.9 (8.2). Snout rounded in dorsal view; internostril distance 5.0 (5.5); length of snout 8.3 (9.1); diameter of orbit 10.0 (9.0). Interorbital width (bony measurement) 2.3 (2.6). Postorbital length of head 35.2 (34.9). Width of jaws 18.1 (18.6). Length of upper jaw 13.9 (13.6); lower jaw even with upper, not projecting beyond it. Teeth in both jaws small and conical, forming multiple rows near symphysis and about 1–2 rows posteriorly. Mental barbel (Fig. 2) long and club-shaped, with a prominent terminal expansion composed of densely packed and somewhat flattened processes; these are rather thick, blunt and variable in shape, ranging from almost round to flat (processes smaller and slightly less variable in shape in paratype). Length of barbel 13.9 (11.2); terminal expansion 46.7 (35.0) of barbel length and about twice as wide as stalk. Anterior gill rakers on first arch 1 + 0 + 8 = 9; posterior gill rakers 0 + 1 + 7 = 8; total 17 (1 + 0 + 8 = 9; 0 + 1 + 6 = 7; total 16); rakers short and blunt, without teeth. First antedorsal distance 31.3 (31.8); second antedorsal distance 47.2 (44.1); anteanal distance 63.0 (60.0). Length of second dorsal-fin base 53.9 (55.8); length of anal-fin base 35.2 (36.4); length of caudal fin 25.0 (24.5); length of pectoral fin 25.0 (23.2), not reaching origin of anal fin; width of pectoral-fin base 10.2 (9.1); length of pelvic fin 22.2 (20.9). Interdorsal distance 9.6 (5.5). First dorsal fin with four spines (last very short and separate from rest of fin in paratype); length of longest (second) spine 15.7 (14.5). Second dorsal fin with 28 (29) rays; length of longest (eighth) ray 15.7 (fifth, 14.5; first very short). Anal rays 19 (19). Pectoral rays 18 (16 left, 17 right). Upper lateral line with 10 (10 & 13) tubular scales, beginning behind the sixth temporal pore and extending posteriorly to the base of the second (left) and third (right) rays (fifth left, seventh right) of the second dorsal fin. Middle

lateral line with about 16 disc-shaped scales or free neuromasts (about 19). Cephalic lateral-line pores typical for Artedidraconidae: preoperculo-mandibular canal with 9 pores; infraorbital canal with 7 pores; supraorbital canals with 2 nasal pores, 2 interorbital pores, and 1 unpaired coronal pore; temporal canal with 6 pores (third double on right side of paratype); supratemporal canal incomplete across occiput with one pore on each side. Vertebrae 15 + 25 = 40 (15 + 25 = 40). Length of stomach 9.4 (14.7); contents entirely polychaetes. Length of intestine 25.9 (25.4). Three short, blunt pyloric caeca. Oral and branchial cavities light to medium grey. Parietal peritoneum lightly speckled with melanophores; visceral peritoneum without melanophores.

**Colour of holotype in life:** Overall appearance bicoloured: dorsal and lateral surfaces of head medium to light brown in contrast with the tan or grey ventral surface of head and most of body. Three (left side) and four (right side) broad, dark brown vertical bars on body (which is otherwise unpigmented) mainly above upper lateral line, some extending onto dorsal fins. Three anteriormost bars longest and widest, resulting in a relatively dark-patterned anterior body (to about tips of pectoral fins). First bar spans anterior half of first dorsal fin on both sides; second bar just anterior to second dorsal fin on both sides. Third bar spans third to fifth rays of second dorsal fin on left side and second to fourth rays on right side. Fourth (much reduced) marking on right side only, at bases of ninth and tenth rays. Similar dark brown markings on both sides of caudal peduncle at base of caudal fin; these markings almost continuous with dark base of anal fin which is light distally. First dorsal spine with three dark spots, second with one, third with one. Five groups of second dorsal-fin rays marked with spots forming dark areas on fin (less conspicuous posteriorly): 1–5 (darkest on 3–5), 8–11, 12–14, 17–18, 22–23. Posteriormost marking, visible on a photograph, not seen on preserved specimen (due to fading?). Pectoral fins light with about 8–10 dark, vertical stripes. Pelvic fins light with some dark spots, most distinct and numerous on innermost (fifth)

**Fig. 3.** (opposite) Living specimens of *Artedidraco* captured at station 88 during cruise 97–9 of RV *Nathaniel B. Palmer*. Photos a–c are dorsal views of fish resting on bottom in bucket of water; photo d is lateral view of fish in air. Images were obtained from 35 mm Kodachrome slides that were scanned into Adobe Photoshop, edited to remove extraneous material and to align the fish, and printed on a Textronix Phaser 440 dye-sublimation printer. **a.** Paratype of *Artedidraco glareobarbatus* (USNM 348712). **b.** Spotted morph of *Artedidraco shackletoni* (USNM 348713). **c.** Barred morph of *A. shackletoni*. Specimens of both morphs of *A. shackletoni* are females of the same size, collected at the same time and in the same locality. **d.** Spotted morph of *A. shackletoni* (same specimen as in photo b. showing size and pattern of spots, and eye and fin colour. Mental barbel and first dorsal fin are not extended. x 1.0



**2 cm**

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ray. Caudal fin light with dark spots on rays forming about 10 dark, vertical stripes (spots on uppermost ray darkest). Corners of mouth (posterior tips of maxillaries) whitish in contrast with darker lips and cheeks. Mental barbel whitish. Basic pigmentation pattern persisted after fixation in formalin and storage in alcohol for four months. However, the dark brown bars faded to medium brown and the tan or grey ground colour faded to a lighter greyish-white tone.

*Colour of paratype in life* (Fig. 3a): Generally similar to holotype in overall bicoloured pattern with the following differences: Preoperculars lighter than operculars, with some dark spots on posteroventral borders of both; lips lighter than snout and faintly spotted. Broad dark brown vertical bars on anterior part of body (four on left side and five on right side) darker, more distinct, and connected ventrally (at about middle lateral line) by a broad horizontal stripe (more distinct on right side), but not extending as far onto second dorsal fin, so that this fin appears lighter overall and lacks dark areas present on that of holotype. First bar extends from just anterior to first dorsal fin to about its mid-point on both sides. On right side second bar extends from just anterior to fourth spine of first dorsal fin to about mid-point between dorsal fins; third bar spans second and third rays; fourth bar spans fifth through eighth rays; fifth bar (much reduced) spans eleventh and twelfth rays. A small dark spot at base of twentieth ray. On left side, second bar extends from about mid-point between dorsal fins to third ray of second dorsal fin; third bar spans sixth to ninth rays; a small dark marking spans nineteenth and twentieth rays. Patches of small, dark spots on both sides of body below middle lateral line from about origin of anal fin posteriorly to about ninth ray. Colour in alcohol and fading of bars and ground colouration similar to holotype.

*Etymology*: The specific name refers to the smooth, slightly irregular pebble or stone-like arrangement of the skin on the terminal expansion of the mental barbel (Latin: glare, gravel; barb, beard)

#### *A spotted colour morph of Artedidraco shackletoni*

In the last few years, distinctive spotted specimens of *Artedidraco* have appeared in collections from Prydz Bay (R. Williams and R.R. Eakin, personal observation) and, as reported here, in the Ross Sea. While not described in the literature, they have been regarded as *A. shackletoni* even though this colour pattern is unlike any previously described for this species (Waite 1911, 1916, Eakin 1990). As *A. shackletoni* is a little known species, we describe the spotted specimens and compare them with the typical barred or drably coloured morph.

*Material*: There are four known specimens of the spotted colour morph of *Artedidraco shackletoni*. One specimen (USNM 348713, specimen no. 88-1; Table III, Fig. 3b & d) was collected in the Ross Sea at the locality for the holotype and paratype of *A. glareobarbatus* described above. This trawl also captured the typical barred or drably coloured morph (Fig. 3c) of *A. shackletoni* (Table IV). The other three specimens of the spotted morph (Table III), taken in Prydz Bay, are in the collections of the Australian Antarctic Division (AAD), Kingston, Tasmania. Collection data for these specimens are: S918548 (Prydz Bay, Antarctica, 68°31.08'S, 77°29.35'E, 399–415 m, 3 February 1991); S86054 (Prydz Bay, Antarctica, 67°05.9'S, 70°16.4'E, 256 m, 2 February 1986); S870243 (Prydz Bay, Antarctica, 67°10.9'S, 69°14.8'E, 319 m, 21 February 1987).

*Diagnosis*: With the exception of the distinctive colour pattern (Fig. 3b & d), meristic counts, morphometric measurements and barbel morphology of the spotted specimens (Table III) generally fall within the range of variability for typical specimens of *Artedidraco shackletoni* (Table IV and Eakin 1990, p. 335). The number and shape of gill rakers and pyloric caeca, intestinal length and coiling pattern and visceral pigmentation are the same in both forms. In our opinion colour pattern alone is insufficient for recognition of a new

**Table III.** Measurements and counts for the four known specimens of the spotted morph of *Artedidraco shackletoni*. Head length and mental barbel length are expressed as percent of standard length.

Locality Cat. no	Ross Sea		Prydz Bay (AAD specimens)		Mean	s d
	USNM 348713	S86054	S870243	S918548		
TL (mm)	129	131	110	120	122.50	9.61
SL (mm)	106	108	87	93	98.50	10.15
HL	35.6	35.0	36.2	33.3	35.02	1.25
MB	11.8	6.7	6.4	11.8	9.18	3.03
D1	5	5	5	4	4.75	0.50
D2	29	26	29	28	28.00	1.41
A	21	19	19	19	19.50	1.00
P	17 & 17	16 & 17	18 & 18	18 & 18	17.38	0.74
ULL	18 & 18	9 & 16	18 & 17	17 & 15	16.00	3.02
Vert	15 + 25 = 40	15 + 24 = 39	15 + 26 = 41	?	40.00	1.00
Sex	female	female	male	?		

**Table IV.** Measurements and counts for *Artedidraco shackletoni* collected on NBP cruise 97–9 in the Ross Sea. All specimens are the typical barred morph. Head length and mental barbel length are expressed as percent of standard length.

Station	88								1		
Spec. no.	1	2	3	4	5	6	7	8	Mean	s d	
TL (mm)	133	105	101	89	63	139	125	115	108.75	24.97	
SL (mm)	109	81	81	69	49	111	100	91	86.38	20.98	
HL	36.0	36.5	34.9	35.4	35.3	35.5	35.9	36.3	35.72	0.54	
MB	9.5	11.9	12.6	13.5	13.1	10.1	10.2	13.4	11.79	1.63	
D1	4	3	4	4	4	4	4	4	3.88	0.35	
D2	28	28	27	28	28	28	27	28	27.75	0.46	
A	19	19	18	19	19	19	18	19	18.75	0.46	
P	18 & 17	17 & 17	18 & 18	18 & 17	16 & 16	17 & 17	17 & 17	18 & 18	17.25	0.68	
ULL	17	11	11	15	15	12	12	14	13.38	2.20	
Vert	15 + 25 = 40	14 + 25 = 39	15 + 25 = 40	15 + 25 = 40	15 + 25 = 40	16 + 25 = 41	16 + 24 = 40	15 + 25 = 40	40.00	0.53	
Sex	female	male	male	male	male	female	male	female			

species, and we therefore identify the spotted specimens as a colour morph of *A. shackletoni*. This is an example of intraspecific variation or phenotypic plasticity. An alternative interpretation is that the spotted morph is a cryptic or sibling species, but this hypothesis cannot be substantiated without data on genetic divergence.

*Colour pattern of the spotted morph in life* (details based on USNM 348713, Fig. 3b & d): Ground colour light brown, with the anterior one-half of the body darker than the posterior one-half (Fig 3b & d). Dorsal and lateral surfaces of head, both lips, and dorsal and lateral surfaces of body covered with conspicuous, dark brown, rounded spots ranging in diameter from about 1–5 mm. Some larger spots have pale centres and others are composed of several smaller spots, much like of those of a leopard. Spots on head more uniform in size (1–3 mm) than those on body. Spots smaller and more sparsely distributed (sometimes absent) on posterior part of body (from about origin of anal fin to caudal peduncle). Ventral surfaces of head and body largely pale and unpigmented. Iris of eye yellow dorsally and silver ventrally. Pelvic fins distinctly yellow; caudal fin slightly yellow. Base of caudal peduncle dusky. Fins spotted, often resulting in a striped appearance: dorsal fins with dark spots on rays; anal fin with some faint spots on rays; caudal fin with about 10 vertical stripes; pectoral fins with about 8–9 vertical stripes; pelvic fins with a few very faint spots, mostly confined to inner ray. Mental barbel light. After four months in alcohol, ground colour faded from light brown to greyish-white.

*Discussion:* Eakin (1981) had available only two specimens of *A. shackletoni*, both collected from stomachs of *Dissostichus mawsoni* Norman, and considered them too valuable to clear and stain for osteological purposes. These specimens were very pale, with no noticeable pigment pattern, perhaps a result of having been subjected to stomach acidity. The specimen figured by Eakin (1990, p. 335) exhibits some isolated patches of small, dark spots on an otherwise uniformly pale body. According to Waite's (1911, p. 16) original description, the

holotype of *A. shackletoni* "is almost colourless, but bears traces of darker markings across the back, and spots on the outer caudal rays". Waite (1916, p. 23) expanded this description of *A. shackletoni* with the addition of a second specimen: "The original example had the appearance of being bleached, with indications of dark markings on the anterior part of the back and the outer caudal rays. The recent specimen shows the same disposition of colour, but much more intensified. There are three dark-brown bars on the back, the last of which is placed near the termination of the upper lateral line and extends downward to one-third the depth of the body; the belly and underside of the hinder portion of the body are spotted with brown, and there are indications of spots on all the fins, but those on the ventrals are confined to the proximal half."

Figure 3 depicts living representatives of the spotted and barred morphs of *Artedidraco shackletoni*. Since both individuals are females of identical size captured at the same station, the spotting is not attributable to sexual dimorphism or to an ontogenetic colour phase. As evidenced by Fig. 3, the spotted pattern also persists through the stress and handling associated with a one hour trawl, and remains prominent in specimens preserved in formalin and stored in alcohol. Thus it is not an instance of rapid, short term or physiological colour change due to the motile activity of chromatophores. It is instead a long term or morphological colour pattern involving a modification in the number and arrangement of chromatophores in the skin (Fujii 1993).

Spotting is a common form of disruptive colouration or camouflage in fish (Marshall 1966, p. 186), especially sedentary benthic marine species including some anguilliforms, serranids, clinids, blenniids, pleuronectiforms, diodontids and tetraodontids. The base colour of the body of both morphs of *A. shackletoni* was light brown, similar to that of the sponge beds in which they live. In its resemblance to the pore pattern of sponges, the spotting may provide effective camouflage for fish living there. The drab or barred morph may occupy adjacent hard bottom habitat.



### Spotting – another instance of morphism in notothenioids

Although there are a number of examples of morphism or phenotypic plasticity in freshwater fish from various habitats (Skúlason & Smith 1995), it is a recently recognized phenomenon in marine notothenioid fish from Antarctica. It is evident in different body systems and at various levels of biological organization. For example, the common inshore nototheniid *Trematomus newnesi* Boulenger includes two trophic morphs; the typical semipelagic morph as well as a large mouth/broad headed morph, easily separable by visual inspection (Eastman & DeVries 1997b). It is not known whether there is genetic divergence between these morphs. Another widely distributed nototheniid, *Trematomus bernacchii* Boulenger, exists as the typical brown morph and a morph characterized by a white blotch on the occiput and nape. Mitochondrial DNA sequences from 12S and 16S ribosomal genes indicate no differences between the two morphs (Bernardi & Goswami 1997). The harpagiferid *Harpagifer antarcticus* Nybelin exhibits almost individual cryptic colouration and the bathydraconid *Parachaenichthys georgianus* (Fischer) has red and grey colour morphs at South Georgia (M.G. White, personal communication). The population of *Trematomus loennbergii* Regan from Terra Nova Bay exhibits two karyomorphs, each with a different

number of diploid chromosomes (Morescalchi *et al.* 1992). With the addition of the spotted morph of *Artedidraco shackletoni* to these examples, it appears that intraspecific variation is widespread among fish inhabiting the Antarctic shelf, and that much remains to be learned about its evolutionary significance.

### Taxonomy of *Artedidraco*

Lönnberg (1905) established the genus *Artedidraco* for the endemic *A. mirus* from South Georgia and *A. skottsbergi* from the Antarctic Peninsula. Naming the new genus after Peter Artedi, the “father of ichthyology”, Lönnberg distinguished it from *Harpagifer* by the presence of a mental barbel and the lack of spines on the opercular and subopercular bones. Descriptions of three additional species, *A. shackletoni* (Waite 1911), *A. loennbergi* (Roule 1913), and *A. orianae* (Regan 1914), brought the total number of known species in the genus to five. Norman (1938) distinguished *Artedidraco* from the three other genera of the Artedidraconidae by the more posterior position of its first dorsal fin which is situated above the base of the pectoral fin rather than above the operculum. There is a tendency in this genus for the dark pigment on the body to take the form of broad, vertical bars or blotches on the dorsolateral surface, sometimes extending

**Table V.** Counts for key meristic characters in species of *Artedidraco*. With the exception of *A. mirus*, all data are from the Ross Sea specimens listed in Table I. Values for *A. shackletoni* are those for the typical barred morph.

	Vertebrae										Mean	s d												
	33	34	35	36	37	38	39	40	41															
<i>A. mirus</i> <sup>a</sup>	—																							
<i>A. orianae</i>			2	3							35.60	0.55												
<i>A. skottsbergi</i>					6	20	3				37.90	0.56												
<i>A. loennbergi</i>					1	16	3				38.10	0.45												
<i>A. shackletoni</i>							1	6	1		40.00	0.53												
<i>A. glareobarbatus</i>								2																
	Second dorsal-fin rays								Mean	s d														
	23	24	25	26	27	28	29																	
<i>A. mirus</i> <sup>a</sup>	—																							
<i>A. orianae</i>		1	3	1					25.00	0.71														
<i>A. skottsbergi</i>			7	17	4	1			25.97	0.73														
<i>A. loennbergi</i>				2	14	4			27.10	0.55														
<i>A. shackletoni</i>					2	6			27.75	0.46														
<i>A. glareobarbatus</i>							1	1																
	Tubular upper lateral-line scales <sup>b</sup>																Mean	s d						
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			18	19	20	21	22	
<i>A. loennbergi</i>	1	2	6	7	4																		4.55	1.10
<i>A. skottsbergi</i>		2	10	13	1	1		1															4.75	1.18
<i>A. mirus</i> <sup>a</sup>	—																							
<i>A. glareobarbatus</i>								2																
<i>A. shackletoni</i>									2	2		1	2			1							13.38	2.20
<i>A. orianae</i>																	1		1		3		20.80	1.79

<sup>a</sup>Values from Eakin (1990)

<sup>b</sup>Counts from left side only



**Table VI.** Measurements and counts for *Artedidraco orianae* from the Ross Sea. Head length and mental barbel length are expressed as percent of standard length.

Cruise Station Spec. no.	NBP 97-9			NBP 96-6		Mean	s d
	1	2	3	1	6		
TL (mm)	119	168	143	122	90	128.4	29.09
SL (mm)	92	135	110	96	68	100.2	24.64
HL	35.5	35.2	33.7	35.5	37.1	35.4	1.21
MB	5.3	*	*	6.7	7.1	6.4	0.94
D1	3	3	3	3	4	3.2	0.45
D2	24	25	25	25	26	25.0	0.71
A	17	17	17	18	17	17.2	0.45
P	17 & 17	17 & 16	17 & 16	17 & 17	16 & 16	16.6	0.52
ULL	22	22	22	20	18	20.8	1.79
Vert	14 + 22 = 36	13 + 23 = 36	13 + 22 = 35	13 + 22 = 35	13 + 23 = 36	35.6	0.55
Sex	male	female	male	male	female		

\*used for barbel histology

onto the dorsal fins. This pattern is less obvious, if present at all, in *A. skottsbergi* and *A. shackletoni*, both of which may be more or less spotted and lack the broad bands found in the other species.

Species of *Artedidraco* are poorly represented in museum collections, sample sizes are small and there has been little study of intraspecific variation. We have therefore summarized variation in certain meristic characters for the five species from the Ross Sea (Tables IV–VI) as these characters are essential in the taxonomy of the genus. Below we also provide a revised key for the six species in the genus.

#### Key to the species of *Artedidraco*

- 1a Upper lateral line with 6 or more tubular scales, the row of tubular scales extending to below 2 or more rays of second dorsal fin 2
- 1b Upper lateral line with 2–9 tubular scales, the row of tubular scales not extending beyond first ray of second dorsal fin 4
- 2a Second dorsal-fin rays 26–30 3
- 2b Second dorsal-fin rays 23–26 5
- 3a Mental barbel tapered to a point; tubular upper lateral-line scales extending to below 7 or more rays of second dorsal fin; pectoral fin extending beyond origin of anal fin *A. shackletoni*
- 3b Mental barbel expanded distally; tubular upper lateral-line scales not extending beyond seventh ray of second dorsal fin; pectoral fin not reaching origin of anal fin *A. glareobarbatus*
- 4a Depth of caudal peduncle 19–23% HL; length of pectoral fin 60–72% HL *A. loennbergi*
- 4b Depth of caudal peduncle 23–30% HL; length of pectoral fin 73–88% HL *A. skottsbergi*
- 5a Upper lateral line with 18–22 tubular scales *A. orianae*

5b Upper lateral line with 6–16 tubular scales *A. mirus*

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