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# Redescription of *Martialia hyadesi* Rochebrune and Mabille, 1889 (Mollusca: Cephalopoda) from the Southern ocean

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SYNOPSIS. Martialia hyadesi Rochebrune & Mabille, 1889 is redescribed from material obtained aboard commercial squid jigging vessels at the Antarctic Polar Frontal Zone, in the vicinity of South Georgia, and on the Patagonian Shelf. The new material confirms the position of the species in the sub-family Todarodinae and indicates a closer affinity with the genus *Todarodes* than *Nototodarus*. Distribution is related to the cool, temperate waters of the Southern Ocean and Antarctic Polar Frontal Zone. It is known to occur in the South Atlantic and western Pacific sectors of the Southern Ocean.

# **INTRODUCTION**

Rochebrune & Mabille (1889) first described the ommastrephid squid *Martialia hyadesi*, somewhat briefly, from a single specimen taken at Orange Bay, Cape Horn in 1882. Further data from the type specimen were later reported by Wormuth (1976), but this specimen was in too poor a condition for a full redescription to be made, or for it to be illustrated. Further material was collected in the region of the Falkland Islands in 1966 and described by de Castellanos (1967). A mass stranding of the species occurred at Macquarie Island in 1971 (O'Sullivan *et al.*, 1983) and Nesis & Nigmatullin (1972) report its presence in the Patagonian Shelf area and illustrate the hectocotylus and spermatophore.

Martialia hyadesi has recently been recorded as a minor bycatch in the fishery for *Illex argentinus* on the Patagonian Shelf (Anon., 1989). In 1986 it contributed some twenty six thousand tonnes to the total catch of this fishery (Masutomi, Pers. comm.) and a substantial collection of frozen and formalin fixed specimens was obtained for study.

Comparison of this material with mandibles and soft parts from the regurgitations and gut contents of wandering and grey-headed albatross (*Diomedea exulans* and *D. chrysostoma*) chicks from Bird Island, South Georgia revealed that *Martialia hyadesi* is an important component of the cephalopod diet of these birds, especially the grey-headed albatross (Rodhouse *et al.*, 1987; Rodhouse *et al.*, 1990). Comparison with earlier material from grey-headed albatross and blackbrowed albatross (*D. melanophris*) at Bird Island, provisionally identified by Clarke & Prince (1981) as *Todarodes* (?) *sagittatus*, revealed that this was also *Martialia hyadesi* (Rodhouse *et al.*, 1990). It therefore became apparent that the species is ecologically important in the sub-Antarctic waters of the south Atlantic and is also a potential candidate for commercial exploitation in the region (Rodhouse, in press).

In 1989 two Japanese fishing vessels, equipped with squid jigging gear (Hamabe et al., 1983), carried out commercial fishing trials in the vicinity of South Georgia and caught some 8 tonnes of Martialia hvadesi at the Antarctic Polar Front Zone to the west of the island. These trials were observed by British Antarctic Survey scientists and a further collection of frozen and fixed M. hyadesi was made. These two collections thus provided an opportunity to examine a large sample of well preserved specimens from two areas separated by a distance of some 1000 km. In view of the ecological and commercial importance of M. hyadesi in the Southern ocean we give here a full redescription of the species based on both the type specimen and the new material. The original brief description was based on a single specimen. This redescription gives a fully illustrated account of both sexes and includes quantitative data from a size range of specimens.

Specimens from these collections have been deposited at The Natural History Museum (BM(NH)), London, the Royal Scottish Museum, Edinburgh (NMSZ 1990005), the Museum National d'Histoire Naturelle, Paris, and the Smithsonian Institution, Washington D.C. (USNM 817585).

# MATERIALS AND METHODS

Samples of *Martialia hyadesi* were taken aboard a commercial Japanese squid jigging vessel, 'Showa Maru No. 23', on the Patagonian Shelf between 7 and 26 March 1986 within a rectangle 46° 17'S to 49° 48'S and 059° 27'W to 060° 58'W. Further samples were obtained aboard two jigging vessels, 'Seishu Maru No. 26' and 'Zenpo Maru No. 61' at the Antarctic Polar Frontal Zone between 9 and 10 February 1989 within a small rectangle 52° 42'S to 52° 45'S and 047° 01'W to 047° 04'W.

Samples from both areas were divided and some specimens fixed in 5% formaldehyde in seawater and others frozen at  $-20^{\circ}$ C. Both fixed and thawed specimens were examined subsequently at the British Antarctic Survey's laboratories in Cambridge. Illustrations of the whole squid, most soft parts, beaks and the statolith were prepared using thawed material. Sucker and gill lamellae counts and the illustrations of the funnel organ and spermatophore were prepared from formalin-fixed material.

Definitions of characters and indices are taken from Roper & Voss (1983) and Roper *et al.* (1984), an index of a character being the ratio of its length to the mantle length expressed as percentage. Definitions of detailed features of the beak are taken from Clarke (1986) and of the statolith from Clarke (1978). Measurements were made on a total of seventy thawed specimens; thirty-five each from the Patagonian Shelf and Antarctic Polar Frontal Zone. All linear measurements of characters were made to the nearest 1.0 or 0.1 mm. Samples were weighed on a top loading balance to the nearest g. Sexual maturity was assigned to specimens according to the scale given by Lipinski (1979).

The type specimen of *Martialia hyadesi* was obtained on loan by kind permission of the Museum National d'Histoire Naturelle, Paris. It has a mantle length of 302 mm which falls within the range (216–319 mm) of the new material reported here. The poor condition of this specimen dictated that no additions to previous descriptions could be made, but the characters in the new material, described below, were examined with reference to the type where possible.

#### **REDESCRIPTION AND RESULTS**

#### Synonomy

Martialia hyadesi Rochebrune and Mabille, 1889, pp. 9–10, pl. 1 (type: Orange Bay, Cape Horn; Museum Nationale d'Histoire Naturelle, Paris)

Ommastrephes hyadesi Pfeffer, 1912, p. 451 Ommastrephes hyadesi Dell, 1952, p. 119

Ommusicepnes nyuuesi Den, 1952, p. 119

A label with the type specimen records that it was collected at Cook Bay, not Orange Bay as given by Rochebrune & Mabille (1889). Also the date of publication given by these authors with the original description is 1887. However, the 82

work was not published until 1889 which is thus the valid starting-point date.

# **Description of characters**

MANTLE. Powerful, robust, cylindrical for most of length, tapering slightly towards point of insertion of fins, then tapering abruptly to a somewhat elongated tail. Dorsal margin at anterior opening extends to a low point; ventral margin slightly excavated below funnel (Fig. 1a, c). Mantle of type in poor condition but agrees with new specimens.

GLADIUS. Strong, elongate; rachis reinforced with one central and two lateral ribs; vane extends less than one fifth total length of gladius; conus extends less than one seventh length of vane (Fig. 1b). Conus on type appears to have unfurled during preservation but otherwise agrees with new specimens. However, a note by M. Roeleveld with the gladius accompanying the type suggests that this may belong to another specimen.

FINS. Extend about two fifths length of mantle. Approximately rhomboidal; posterior edge, which is concave for most of length, is longer than anterior edge which is convex; lobes at point of insertion of anterior edges with mantle (Fig. 1a, c). Fin angle:  $47-55^{\circ}$ , slightly larger than the type specimen's fin angle of  $45^{\circ}$ .

HEAD. Slightly narrower than width of mantle opening (Fig. 1a, c). Three prominent nuchal folds on each side; one above level of eye, one approximately level with middle of eye, one below level of eye. These are poorly preserved in the type but agree with the new specimens on the left side of the head. Width of head variable in thawed material due to variation in quality of preservation of eyes.

FUNNEL. Strong, broadly conical, extending to approximately middle of eye. Funnel valve a flap close to funnel opening. Funnel organ with a 'V' shaped dorsal member, apex pointing anteriorly, and two ovoid ventral members (Fig. 2a). Funnel groove deep with foveola possessing seven longitudinal folds. These were not apparent and could not be counted in thawed specimens but were prominent in formalin fixed material (Fig. 2b). No side pockets. All features of funnel in new specimens agree well with the type.

FUNNEL MANTLE LOCKING CARTILAGE. Strong, typical ommastrephid inverted 'T' shape (Roper *et al.*, 1969); straight, simple, longitudinal groove, straight mantle component (Fig. 2c). Apparently identical to type.

ARMS. Moderately robust and less than half length of mantle. Arms I and IV approximately equal in females and shorter than arms II and III which are also approximately equal. Hectocotylised right arm IV shorter than arm I in males (see below). Swimming keel well developed on proximal half of arm III. Cross sections of arms roughly ovoid or rounded triangular in central part. Protective membrance poorly developed; trabeculae strongly developed and prominent. Relatively small arm suckers in biserial longitudinal rows; largest suckers on central part of arms; each sucker associated with a trabeculum so there are equal numbers of each. Transverse rows oblique (Fig. 3a). Depending upon sucker size, rings armed with 5, 7 or 9 teeth which occupy more than half circumference on distal edge. Central tooth generally slightly larger than lateral teeth; shape asymmetric in some suckers (Fig. 3c). Arm sucker counts for a sample of al.

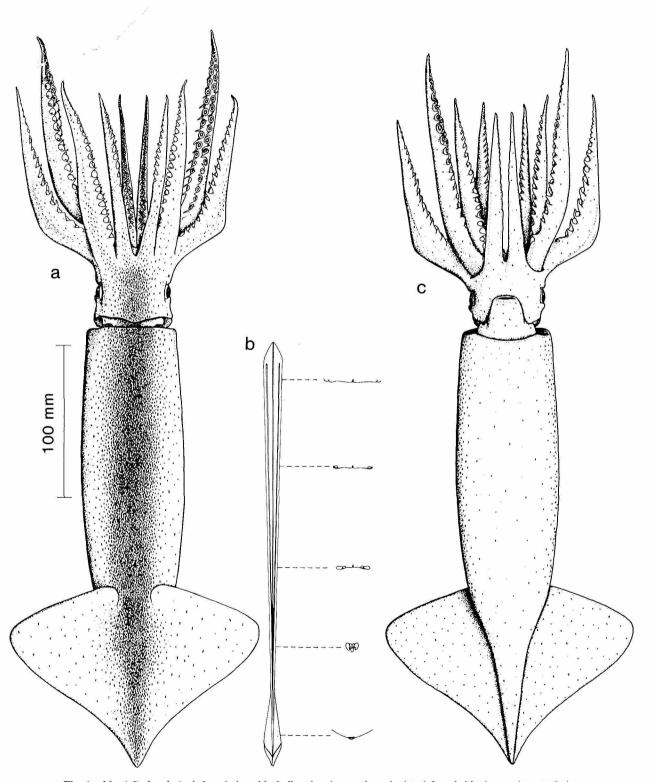


Fig. 1 Martialia hyadesi: a) dorsal view, b) gladius showing sections depicted dorsal side down, c) ventral view.

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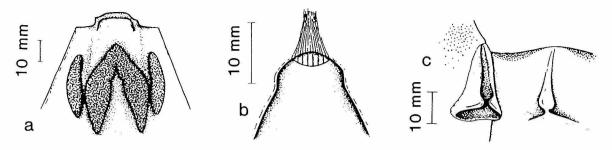


Fig. 2 Martialia hyadesi: a) funnel organ, b) funnel groove, c) funnel locking-cartilage.

 Table 1
 Sucker counts on the arms and tentacular club of Martialia hyadesi: new specimens and the type

	New sp	ecimens			Type specimen
	Range	Mean	±sd	n	•• •• •• •• •
Arm I	6682	75.3	4.5	11	66
II	67-87	74.7	5.3	11	72
III	66-78	74.0	4.3	11	70
IV (Female)	74-84	78.0	5.3	3	74
Carpus	17-21	19.3	2.1	3	20
Manus	88-93	90.0	2.6	3	92
Dactylus	42-48	45.3	3.1	3	48

new specimens, and the type, are given in Table 1. The arms and arm sucker counts agree with the type.

HECTOCOTYLUS. On modified right arm IV which is somewhat shorter and thicker than unmodified, or slightly modified, left arm IV. In stage III, preparatory, and stage IV, maturing males, proximal part of modified arm is similar to unmodified arm with two rows of suckers; each sucker associated with a trabeculum and with largest suckers on central part of arm. At distal end, arm becomes modified, suckers much smaller than on unmodified arm. Hectocotylus occupies distal third of right arm. On ventral side trabeculae are disassociated from the suckers at stalk base and form rounded flaps; on dorsal side trabeculae become reduced towards end of arm and are absent on hectocotylised part (Fig. 3b). Slight modification of left arm IV of males limited to elongation of sucker stalks on distal third of arm (Fig. 3b). No comparison could be made with the type which is female.

TENTACLE AND CLUB. Tentacle length greater than half length of the mantle; most of tentacle occupied by club which is not expanded and is rounded/triangular in cross section. Protective membrane poorly developed; trabeculae strongly developed, prominent. Club not clearly differentiated into carpus, manus and dactylus (Fig. 3a); its structure is interpreted here according to the scheme given by Roeleveld (1982) for other ommastrephids. No fixing apparatus. Approximately 7–9 paired finger-like projections present at proximal end of carpal area. On rest of carpal area suckers arranged in biserial longitudinal rows, each sucker attached by a stalk to base of a trabeculum, as on arms. Transverse rows oblique. Dentition of ten or so pairs of suckers on carpal area resembles that on arm suckers, usually seven teeth occupying more than half circumference on distal edge of sucker ring (Fig. 3c). On manus area suckers arranged in tetraserial longitudinal rows: outer rows consist of small suckers attached by stalks to bases of trabeculae as on arms; inner rows consist of larger suckers attached by stalks to central part of club. Dentition on these suckers usually consists of fifteen relatively large, sharp teeth alternating with fifteen smaller, flatter teeth or plates which together occupy entire circumference of ring; teeth, and especially plates, larger on distal edge. On largest manus suckers one tooth is larger than rest, but extent of enlargement is variable (Fig. 3c). On dactylus area, small suckers arranged in tetraserial longitudinal rows, trabeculae reduced, low protective membrane better developed on the ventral side. Dentition of suckers on dactylus area similar to that on manus area (Fig. 3c). Well developed keel on distal third of club. Sucker counts for the carpus, manus and dactylus areas of club are given in Table 1. Tentacle and club on new specimens agree with the type.

BUCCAL MASS. Buccal membrane formula: DDVD (Fig. 3a) in new specimens and type.

BEAK. Lower beak possesses typical ommastrephid features: a shoulder which forms a tooth, a transparent strip below jaw angle, a low wing fold, a broad hood with a notch and a long rostral edge approximately equal to length of hood in midline (Clarke, 1986). No fold in lateral wall and rostrum characterised by a pronounced hook (Fig. 4a). Keratinisation tends to be blacker than in most other ommastrephid beaks (Fig. 4a, b). Darkened patch on wing of more mature specimens. Beak not removed from type but shape of rostrum, which could be examined, agreed well with new specimens.

The calculated regression of lower rostral length (r) in mm against wet weight in grams (w) is:

 $\ln w = 2.405 + 2.012 \ln r (r^2 = 0.756; n = 67)$ 

and against mantle length in mm (l) is:

 $l = 102.0 + 29.47 r (r^2 = 0.736; n = 67)$ 

RADULA. Lateral tooth row contains a rhachidian tooth, three pairs of lateral teeth and a pair of marginal plates. Heterodont, first and second teeth similar in size to rhachidian, third lateral teeth long and sharply pointed, marginal plates poorly developed but usually visible, especially under polarised light. A small cusp on each side of base of rhachidian tooth; a single cusp on outer edge of base of first lateral tooth (Fig. 4c). Radula of type not examined.

GILLS. Gill lamellae counts fell in the range 61-67 (mean:  $64.8 \pm 2.7$ ; n = 6). Gills of type not examined.

SKIN AND CHROMATOPHORES. In live specimens skin on dorsal surface of mantle smooth and has a very dark and dense

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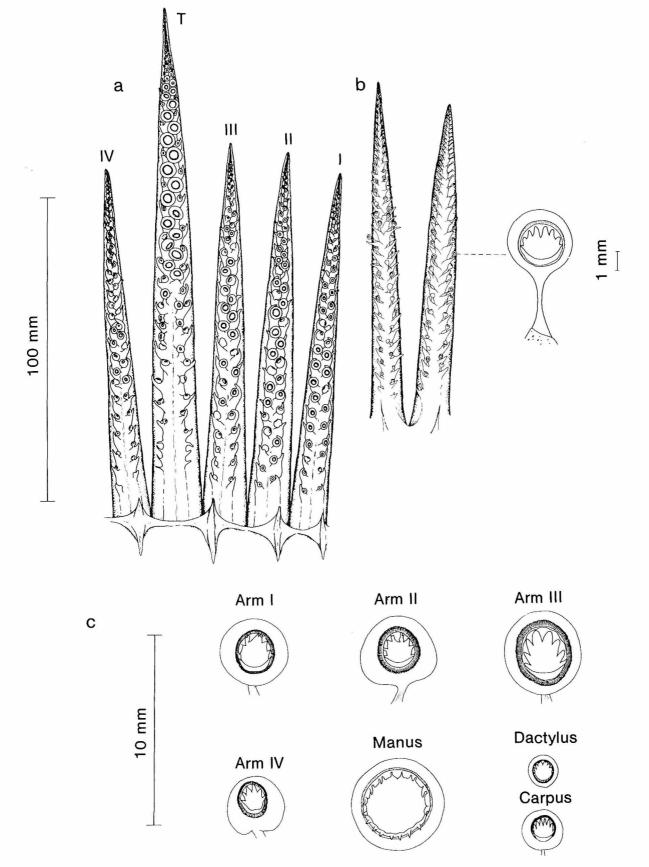


Fig. 3 Martialia hyadesi: a) right arms and tentacle, b) male arms IV showing hectocotylised right arm, c) largest sucker from each arm and tentacular club region.

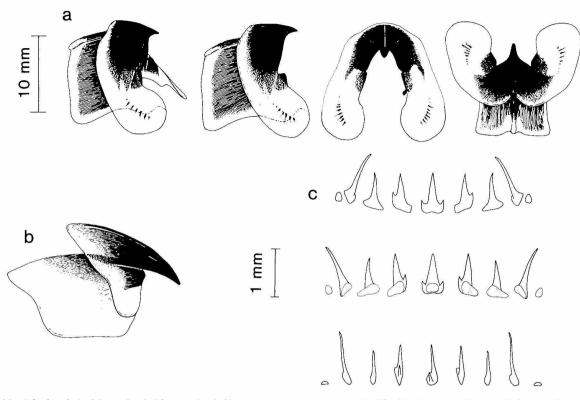


Fig. 4 Martialia hyadesi: a) lower beak, b) upper beak (drawn to some scale as lower beak), c) tooth row on the radula (top: oral view; middle: rotated 180°; bottom: rotated 90°.

purple colouration. Laterally this becomes red/brown and ventrally the skin is silver/white. Pronounced red patch on head above eye. Chromatophores small. A colour photograph of a live specimen from the Patagonian Shelf is given by Rodhouse (1989).

No photophores were found on the skin or elsewhere.

Skin of type has deteriorated and no useful comparison could be made with new specimens.

SPERMATOPHORES. Elongate and slender. A mature spermatophore is illustrated in Fig. 5a. No comparison could be made with the type which is female.

STATOLITH. All statoliths examined were adult stage (Morris and Aldrich, 1984). Seen from the anterior side (Fig. 5b) the dorsal dome is large and virtually indistinguishable from the lateral dome; no distinct lobes on the lateral dome or rostrum. Tip of rostrum flexed anteriorly; rostral angle obtuse and approximately 150°. Dorsal and ventral indentation well defined; spur prominent forming a distinct protrusion on the anterior surface. No obvious anterior ridge. Medial fissure present. Statoliths of type not examined.

#### **Measurements and indices**

All measurements of characters are given in the appendix. Mean  $(\pm sd)$  and range of calculated indices are given in Table 2 together with data for the type specimen taken from Wormuth (1976).

Comparison of the character indices for the type specimen of *Martialia hyadesi*, with data for the new material (Table 2), shows that the type specimen falls within the range for all indices calculated for the new material, apart from MWI and HLI. Mantle width is a low precision measurement (Wormuth, 1976) and in any case the MWI for the type specimen was only slightly less than for the present material. The head length of the type specimen is apparently somewhat longer relative to the mantle length than the longest head measured in our recent collections.

# DISCUSSION

The specimens described here, which are indisputably Martialia hyadesi on the basis of the above comparisons, confirm the position of the species within the sub-family Todarodinae on the basis of the funnel groove, which has a foveola but no side pockets, and because of the absence of photophores (Roper, Young & Voss, 1969). The sub-familial position is also confirmed on the alternative basis of the ventral distal development of the trabeculae on the hectocotylus (Roeleveld, 1988). The genus Martialia (de Castellanos, 1967) is distinguished from the other genera of the sub-family by two features: 1) the tentacular club which extends almost to the base of the tentacle, is not expanded-an atypical feature in the Ommastrephidae (Young & Roper, 1968)and possesses a biserial row of finger-like projections on the proximal part; and 2) well developed trabeculae, associated with a reduced protective membrane, on the arms and tentacles (Roper et al., 1984; Nesis, 1987).

In the males from the present collections only the right

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Table 2 Character indices for male and female *Martialia hyadesi* (MWI: mantle width index; HLI: head length index; HWI: head width index; FLI: fin length index; FWI: fin width index; ALI I-IV: arm length indices, arms I-IV; HcLI: hectocotylus length index; TtTI: tentacle length index; CLI: club length index; GLI: gladius length index; GWI: gladius width index; RLI: rachis length index; RWI: rachis width index). Indices from the type specimen given by Wormuth (1976) are also indicated.

Character	Range	mean	±sd	Type specimen indices		
i						
Males			00 8			
MWI	19.0-29.7	23.4	2.1			
HLI	12.9-17.4	15.8	1.0			
HWI	12.0-18.4	15.5	1.4			
FLI	38.2-45.6	41.6	1.9			
FWI	54.3-66.5	60.0	2.8			
ALI 1	29.5-43.8	37.8	3.3			
ALI 2	34.6-48.8	41.5	3.0			
ALI 3	35.5-49.2	42.0	3.2			
ALI 4	27.7-36.5	32.5	2.3			
HcLI	6.6-14.9	10.5	2.3			
TtLI	49.3-66.9	58.6	4.7			
CILI	38.2-55.6	48.4	4.1			
GLI	91.9-100.0	95.1	1.6			
GWI	2.8-4.7	3.3	0.4			
RLI	74.5-85.5	78.5	2.6			
RWI	3.8-4.7	4.3	0.2			
Females						
MWI	19.9-26.8	22.8	1.6	19.0		
HLI	12.6-17.6	15.7	1.0	19.0		
HWI	13.2-17.7	15.5	1.2			
FLI	38.4-45.5	42.0	1.8	43.0		
FWI	55.5-64.3	59.4	2.3	55.5		
ALI 1	29.9-43.2	36.9	2.8	37.0		
ALI 2	35.2-45.7	40.4	2.7	41.0		
ALI 3	35.7-46.1	40.9	2.6	43.0		
ALI 4	30.1-40.8	35.2	2.6	37.0		
TtLI	44.9-70.2	59.8	5.2			
CILI	37.3-57.0	48.6	4.2	50.0		
GLI	91.9-98.9	95.5	1.6			
GWI	2.6-3.7	3.1	0.2			
RLI	72.6-81.7	77.4	2.0			
RWI	3.9-5.0	4.3	0.3			
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fourth arm is extensively modified to form a hectocotylus, which suggests a closer affinity with *Todarodes* than *Nototo-darus*, in which both fourth arms are modified. However, the relationship between *Martialia* and *Todarodes* is not resolved and awaits further analysis (see Roeleveld, 1988).

Records for Martialia hyadesi presently exist from Cape Horn (Rochebrune & Mabille, 1889), Macquarie Island (O'Sullivan, 1983), the Patagonian Shelf, the Antarctic Polar Frontal Zone in the vicinity of South Georgia (this study), and from predators sampled at South Georgia (Hunter, 1983; Rodhouse et al., 1987; Rodhouse et al., 1990), Macquarie Island and Campbell Island (M. J. Imber, Pers. comm.). These records suggest that its distribution is related to the cool temperate waters of the Southern Ocean southwards to the Antarctic Polar Frontal Zone and possibly extending south of the Front. The sporadic appearance of the species in the Patagonian Shelf fishery suggests that it does not normally extend as far north as the Southern sub-Tropical Convergence. It is unclear whether its distribution is circumpolar or discontinuous. Imber & Berruti (1981) reported a single Martialia hyadesi beak among beaks from wandering albatrosses at Marion Island but none among beaks from sooty and light-mantled sooty albatrosses, *Phoebetria fusca* and *P. palpebrata*. Given the worn state of the beak (M. J. Imber, Pers. comm.) and the potential range of wandering albatrosses, this record does not confirm the occurrence of *M. hyadesi* near the Prince Edward Islands.

The distribution of *Martialia hyadesi* may overlap that of three other members of the family Ommastrephidae, *Todarodes filippovae* Adam, 1975, *Nototodarus sloani* (Gray, 1849) and *Illex argentinus* (de Castellanos, 1960), which are well described and illustrated (Roper *et al.*, 1984; Roper *et al.*, 1985). Complete specimens are unlikely to be confused with any of these. Beaks from gut contents and regurgitations of vertebrate predators should be readily identifiable as being from an ommastrephid and distinguishable from other species in the family (Clarke, 1986) by the narrow appearance, the presence of a distinctively hooked rostrum, a very low wing fold and the blackish keratin of the darkened areas.

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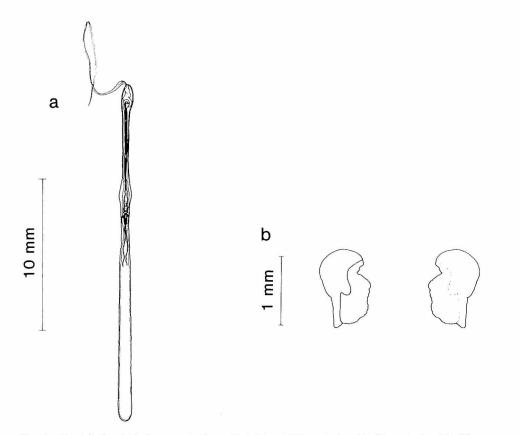


Fig. 5 Martialia hyadesi: a) spermatophore, b) right statolith: anterior side (i); posterior side (ii).

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#### APPENDIX

Raw data from measurements of *Martialia hyadesi* from the Antarctic Polar Frontal Zone and the Patagonian Shelf (all measurements are in g or mm; S: sex; MS: maturity stage; TW: total weight; TL: total length; ML: dorsal mantle length; MW: mantle width; HL: head length; HW: head width; FL: fin length; FW: fin width; FA: fin angle; AL1: length arm I: AL2: length arm II; AL3: length arm III; AL4: length arm IV; HcL: hectocotylus length; TtL: tentacle length; CL: club length; GL: gladius length; GW: gladius width; RL: rachis length; RW: rachis width; LRL: lower rostral length).

#### MARTIALIA MYADESI FROM THE SOUTHERN OCEAN

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S m f f f f f f f f f f f f f f f f f f f	MS III III III III III III III I	TW 242 442 385 392 210 245 575 505 527 464 344 239 330 295 503 331 433 422 401 285 342 255 342 290 338	TL * * 463 488 369 408 535 524 * 505 446 408 535 524 * 505 446 403 521 455 466 486 475 434 419 446 423 450	242 295 285 278 236 298 297 302 286 265 241 258 260 300 274 281 271 279 263 249 266 235 266	$\begin{array}{c} 46\\ 63\\ 57\\ 62\\ 47\\ 52\\ 74\\ 68\\ 72\\ 57\\ 47\\ 56\\ 56\\ 68\\ 64\\ 59\\ 64\\ 59\\ 64\\ 59\\ 50\\ 60\\ 64\\ 59\\ 59\\ 59\\ 59\\ \end{array}$	38 43 36 46 34 38 47 50 53 44 43 36 45 39 47 41 38 46 40 40 41 37 41	36 44 38 46 32 36 41 50 48 42 44 36 43 41 46 40 38 43 44 37 35 35 33 39	$\begin{array}{c} 103\\ 125\\ 121\\ 116\\ 93\\ 106\\ 115\\ 129\\ 124\\ 125\\ 114\\ 105\\ 112\\ 125\\ 112\\ 122\\ 116\\ 115\\ 112\\ 122\\ 116\\ 115\\ 114\\ 110\\ 118\\ 98\\ 113 \end{array}$	$\begin{array}{c} 139\\ 175\\ 168\\ 164\\ 131\\ 150\\ 189\\ 173\\ 166\\ 173\\ 166\\ 173\\ 166\\ 152\\ 155\\ 151\\ 163\\ \end{array}$	50 51 52 50 47 52 55 51 52 53 49 51 52 51 52 51 52 52 52 52 52 50 49 * 49	83 115 101 102 79 79 109 108 * 106 99 92 94 98 116 94 108 117 102 * 90 96 102 98	95 118 107 111 84 88 130 129 115 121 103 99 104 105 127 99 114 119 105 98 104 109 110	97 121 113 116 86 92 128 135 123 120 104 108 106 116 129 105 114 119 108 95 96 105 112 106	73 101 94 95 71 78 110 105 101 85 74 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 89 87 105 100 100 100 100 100 100 100 100 100	29 * * * * * * * * * * * * * * * * * * *	* * 148 165 106 135 194 192 * 177 151 140 131 152 210 161 163 183 162 138 140 137 138 155	* * 1266 1333 888 104 164 164 142 * 151 132 123 117 124 171 130 132 154 131 119 118 112 118 1124	234 286 271 269 223 290 288 292 275 254 230 245 251 285 263 267 268 266 249 285 263 267 268 266 249 285	7 10 8 9 7 8 10 9 9 9 8 8 8 8 9 8 8 9 10 9 8 8 8 9 10 9 8 8 7 11 8	190 230 221 215 186 235 229 236 223 203 188 204 198 226 211 215 217 215 202 217 215 202 217 215 212	$\begin{array}{c} 10\\ 13\\ 11\\ 13\\ 10\\ 10\\ 15\\ 13\\ 13\\ 13\\ 13\\ 12\\ 10\\ 11\\ 11\\ 11\\ 12\\ 12\\ 12\\ 12\\ 11\\ *\\ 11\\ 11\\ 11\\ 11\\ \end{array}$	$\begin{array}{c} 4.7\\ 6.0\\ 5.8\\ 5.9\\ *\\ 5.1\\ 6.1\\ 5.7\\ 6.1\\ 5.5\\ 5.9\\ 5.4\\ 6.6\\ 6.0\\ 5.8\\ 6.2\\ 5.6\\ 5.3\\ 5.8\\ 5.6\\ 6.0\\ \end{array}$
S m f f f f f f f f f f f f f f f f f f f	MS III III III III III III III III III I	TW 242 442 385 392 210 245 575 505 527 464 344 239 330 295 503 331 433 422 401 282 255 342 255 242 255 342 255	TL * * 463 488 369 408 535 524 * 505 446 403 521 455 466 486 475 434 419 446 423 450 562	242 295 285 278 236 248 297 302 286 265 241 258 260 300 274 281 271 279 263 249 265 249 265 241 271 279 263 249 265 235 235 235 235 235 235 236 235 236 236 236 236 236 236 236 236 236 236	$\begin{array}{c} 46\\ 63\\ 57\\ 62\\ 47\\ 52\\ 74\\ 68\\ 72\\ 57\\ 47\\ 56\\ 56\\ 68\\ 64\\ 59\\ 64\\ 59\\ 64\\ 59\\ 50\\ 60\\ 64\\ 59\\ 59\\ 67\\ \end{array}$	38 43 36 46 34 38 47 50 53 44 43 36 45 39 47 41 38 46 40 40 41 37 41 50	36 44 38 46 32 36 41 50 48 42 44 36 43 41 46 40 38 43 44 37 35 35 33 39 52	$\begin{array}{c} 103\\ 125\\ 121\\ 116\\ 93\\ 106\\ 115\\ 129\\ 124\\ 125\\ 114\\ 105\\ 105\\ 112\\ 122\\ 135\\ 112\\ 122\\ 116\\ 115\\ 114\\ 110\\ 118\\ 98\\ 113\\ 145 \end{array}$	$\begin{array}{c} 139\\ 175\\ 168\\ 164\\ 131\\ 150\\ 189\\ 183\\ 176\\ 173\\ 166\\ 173\\ 154\\ 193\\ 161\\ 173\\ 166\\ 152\\ 155\\ 151\\ 163\\ 198\\ \end{array}$	50 51 52 50 47 52 55 51 52 53 49 51 52 51 52 51 52 51 52 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 53 49 51 52 52 53 49 51 52 53 49 51 52 52 53 49 51 52 52 50 47 52 52 50 47 52 52 50 47 51 52 52 50 47 51 52 52 50 47 51 52 50 47 51 52 50 49 51 52 50 49 51 52 50 49 51 52 50 49 51 52 50 49 52 50 49 51 52 50 49 52 50 49 52 50 50 49 50 50 50 50 50 50 50 50 50 50	83 115 101 102 79 79 109 108 * 106 99 92 94 98 116 94 108 117 102 * 90 96 102 98 110	95 118 107 111 84 88 130 129 115 121 103 99 104 105 127 99 114 119 105 105 105 105 104 109 110 121	97 121 113 116 86 92 128 135 123 120 104 108 106 116 129 105 114 119 108 95 96 105 112 106 128	73 101 94 95 71 78 110 105 101 85 74 89 87 105 89 87 105 94 * 77 86 84 89 106	29 * * * * * * * * * * * * * * * * * * *	* * 148 165 106 135 194 192 * 177 151 140 131 152 210 161 163 183 162 138 140 137 138 155 179	* * 1266 1333 888 104 164 164 142 * 151 132 123 117 124 171 130 132 154 131 119 118 112 118 1124 151	234 286 271 269 223 239 290 288 292 275 254 230 245 255 254 285 263 267 268 266 249 245 267 268 266 249 235 267 268 267 268 267 269 239 239 290 290 290 290 290 290 290 290 290 29	7 10 8 9 7 8 10 9 9 8 8 8 8 9 9 8 8 8 9 9 8 8 7 11 8 10	190 230 221 215 186 235 229 236 223 203 188 204 203 218 204 211 215 217 215 202 217 215 201 212 238	$\begin{array}{c} 10\\ 13\\ 11\\ 13\\ 10\\ 10\\ 15\\ 13\\ 13\\ 13\\ 12\\ 10\\ 11\\ 11\\ 14\\ 11\\ 12\\ 12\\ 12\\ 12\\ 11\\ *\\ 11\\ 11\\ 11\\ 14\\ \end{array}$	$\begin{array}{c} 4.7\\ 6.0\\ 5.8\\ 5.9\\ *\\ 5.1\\ 6.1\\ 5.7\\ 6.1\\ 5.5\\ 5.9\\ 5.4\\ 6.6\\ 6.0\\ 5.8\\ 6.2\\ 5.6\\ 5.5\\ 5.3\\ 5.8\\ 5.6\\ 6.0\\ 6.9\\ \end{array}$
S m f f f f f f f f f f f f m f f m f f f m f f m f f m f f m f f m f f m f f m f f f f	MS III III III III III III III III III I	TW 242 442 385 392 210 245 575 527 464 344 239 330 295 503 331 433 422 401 282 255 342 290 338 658 493 508	TL * * 463 488 369 408 535 524 * 505 524 446 403 424 435 521 455 5466 486 486 486 423 450 562 558 486	242 295 285 278 236 248 297 302 286 265 241 258 260 300 274 271 279 263 249 266 235 266 235 266 319 255 265	$\begin{array}{c} 46\\ 63\\ 57\\ 62\\ 47\\ 52\\ 74\\ 68\\ 72\\ 57\\ 47\\ 56\\ 68\\ 64\\ 59\\ 64\\ 59\\ 50\\ 60\\ 64\\ 59\\ 59\\ 67\\ 67\\ 68\\ 59\\ 67\\ 68\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 67\\ 68\\ 59\\ 59\\ 68\\ 59\\ 59\\ 59\\ 59\\ 68\\ 59\\ 59\\ 59\\ 50\\ 50\\ 50\\ 50\\ 50\\ 50\\ 50\\ 50\\ 50\\ 50$	38 43 36 46 34 38 47 50 53 44 43 36 45 39 47 41 38 46 40 40 41 37 41 50 43 48	36         44         38         46         32         36         41         50         48         42         44         36         43         41         46         40         38         43         44         37         35         33         39         52         40         45.	$\begin{array}{c} 103\\ 125\\ 121\\ 116\\ 93\\ 106\\ 115\\ 129\\ 124\\ 125\\ 114\\ 105\\ 105\\ 112\\ 135\\ 112\\ 135\\ 112\\ 116\\ 115\\ 114\\ 110\\ 118\\ 98\\ 113\\ 134\\ 122 \end{array}$	$\begin{array}{c} 139\\ 175\\ 168\\ 164\\ 131\\ 150\\ 189\\ 183\\ 176\\ 173\\ 166\\ 173\\ 166\\ 154\\ 193\\ 161\\ 173\\ 166\\ 155\\ 151\\ 163\\ 198\\ 176\\ 165\\ \end{array}$	50 51 52 50 47 52 55 51 52 53 49 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 52 51 52 53 49 51 52 51 52 53 49 51 52 51 52 53 49 51 52 51 52 53 49 51 52 52 51 52 52 50 47 52 52 50 47 50 47 50 47 50 47 50 47 51 52 50 47 51 52 50 47 51 52 50 47 51 52 52 50 47 50 47 51 52 52 50 49 51 52 52 50 49 51 52 52 50 49 51 52 52 50 49 51 52 52 50 49 51 52 50 49 51 52 52 50 49 50 49 50 49 50 49 50 50 49 50 50 49 50 50 49 50 50 50 50 50 50 50 50 50 50	83 115 101 102 79 79 109 108 * 106 99 92 94 98 116 94 108 117 102 * 90 96 102 98 110 112 106	95 118 107 111 84 88 130 129 115 121 103 99 104 105 127 99 114 119 105 105 98 104 109 110 121 114 111	97 121 113 116 86 92 128 135 123 120 104 108 106 116 129 105 114 119 108 95 96 105 112 106 128 114 113	73 101 94 95 71 10 110 105 101 85 74 89 87 105 89 87 105 94 * 77 86 84 89 106 105 86	29 * * * * * * * * * * * * * * * * * * *	* 148 165 106 135 194 192 * 177 151 140 131 152 210 161 163 183 162 138 140 137 138 155 179 155 155 155 156 155 166 155 194 155 155 194 155 155 194 155 155 155 194 155 155 155 155 155 155 155 15	$\begin{array}{c} * \\ * \\ 126 \\ 133 \\ 88 \\ 104 \\ 164 \\ 142 \\ * \\ 151 \\ 132 \\ 123 \\ 123 \\ 123 \\ 123 \\ 123 \\ 123 \\ 123 \\ 131 \\ 130 \\ 132 \\ 154 \\ 131 \\ 119 \\ 118 \\ 124 \\ 151 \\ 152 \\ 125 \\ $	234 286 271 269 223 239 290 288 292 275 254 230 245 251 285 263 263 263 263 266 249 * * 268 266 249 * * 255 302 255 254 255 254 269 203 203 209 203 209 203 209 203 209 203 209 203 209 209 203 209 209 203 209 209 209 209 209 209 209 209 209 209	$\begin{array}{c} 7\\ 10\\ 8\\ 9\\ 7\\ 8\\ 10\\ 9\\ 9\\ 9\\ 8\\ 8\\ 8\\ 9\\ 9\\ 10\\ 9\\ 8\\ 8\\ 7\\ 11\\ 8\\ 10\\ 10\\ 9\end{array}$	190 230 221 215 186 235 229 236 223 203 188 204 198 204 219 215 202 211 215 202 * * 211 201 212 238 221 238 221 215 236 223 203 188 221 219 236 223 223 223 223 223 223 223 223 223	$\begin{array}{c} 10\\ 13\\ 11\\ 13\\ 10\\ 10\\ 15\\ 13\\ 13\\ 12\\ 10\\ 11\\ 11\\ 12\\ 12\\ 12\\ 11\\ *\\ 11\\ 11\\ 11\\ 11\\ 11\\ 14\\ 13\\ 12 \end{array}$	$\begin{array}{c} 4.7\\ 6.0\\ 5.8\\ 5.9\\ *\\ 5.1\\ 6.1\\ 6.2\\ 6.1\\ 5.7\\ 6.1\\ 5.5\\ 5.9\\ 5.4\\ 6.6\\ 6.0\\ 5.8\\ 5.5\\ 5.3\\ 5.8\\ 5.6\\ 6.0\\ 6.9\\ 6.4\\ 6.1\\ \end{array}$
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