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

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CONTENTS

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 by-catch 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 black-browed 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 hyadesi* 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°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

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 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°, slightly larger than the type specimen's fin angle of 45°.

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

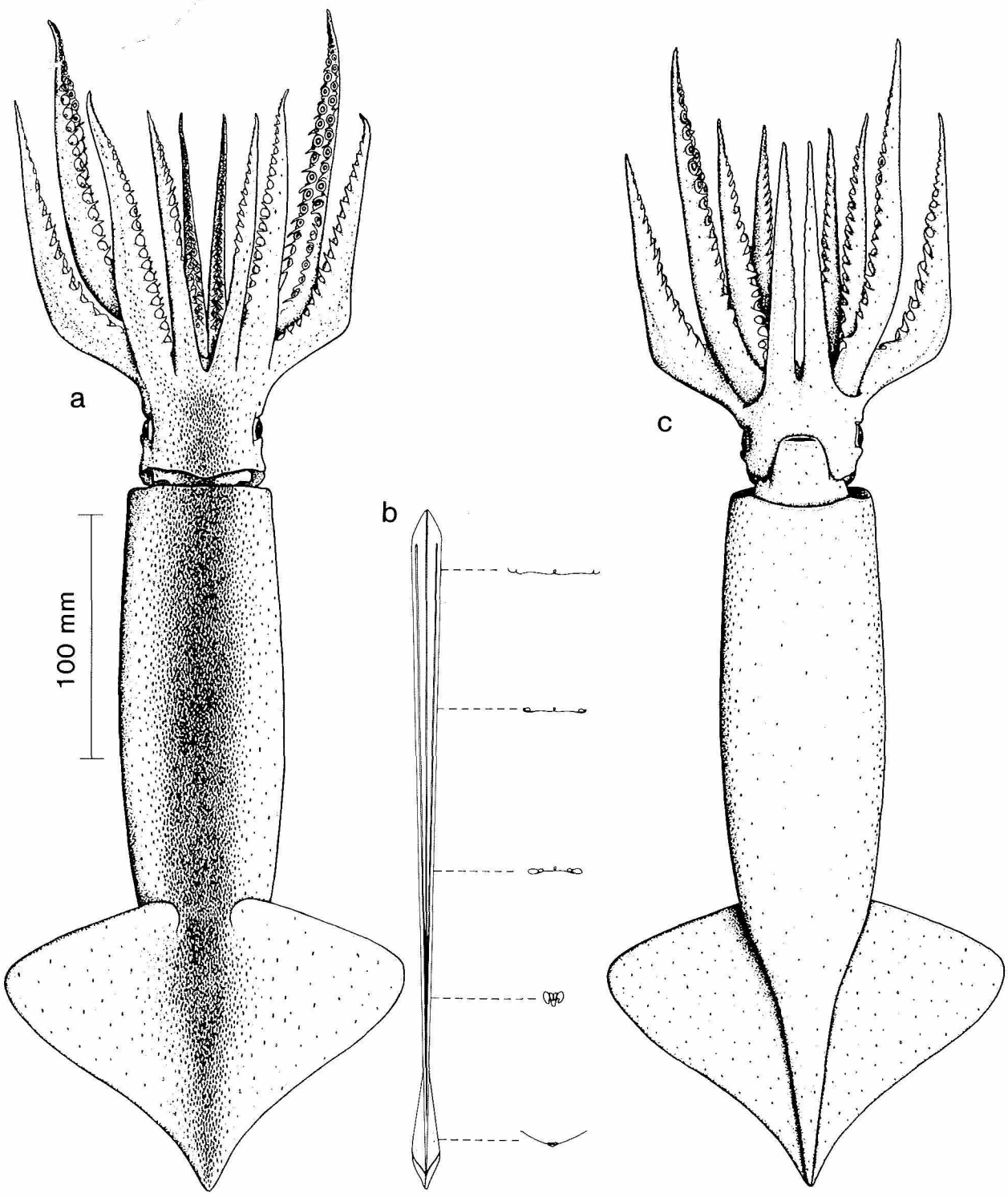

Fig. 1 *Martialia hyadesi*: a) dorsal view, b) gladius showing sections depicted dorsal side down, c) ventral view.

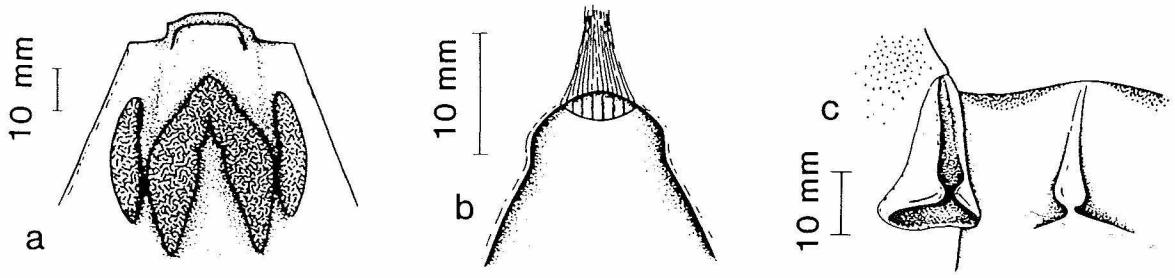

Fig. 2 *Martialia hyadesi*: a) funnel organ, b) funnel groove, c) funnel locking-cartilage.

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

	New specimens				Type specimen
	Range	Mean	±sd	n	
Arm I	66–82	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:

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

and against mantle length in mm (l) is:

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

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 ± 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

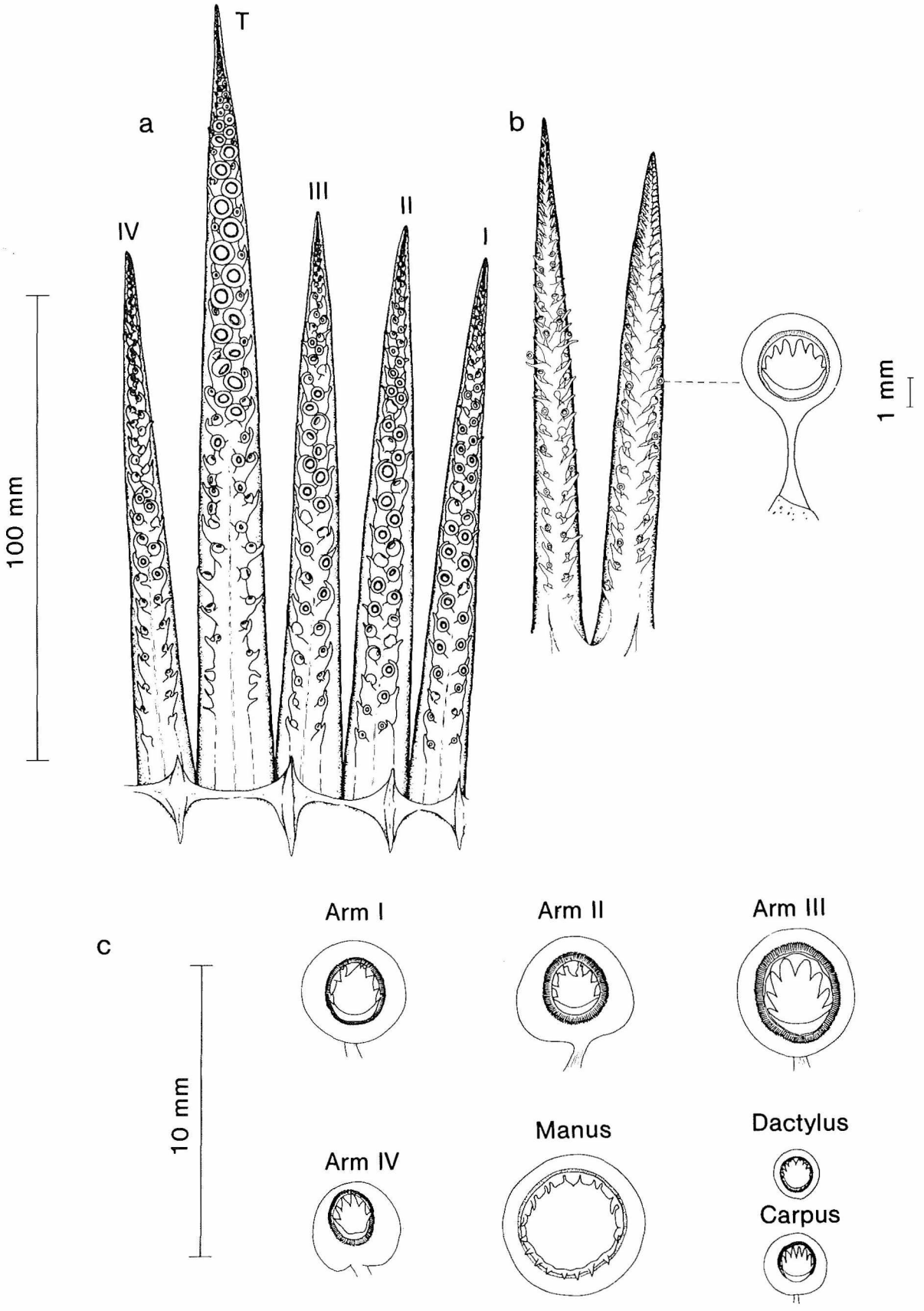

Fig. 3 *Martialia hyadesi*: a) right arms and tentacle, b) male arms IV showing hectocotylised right arm, c) largest sucker from each arm and tentacular club region.

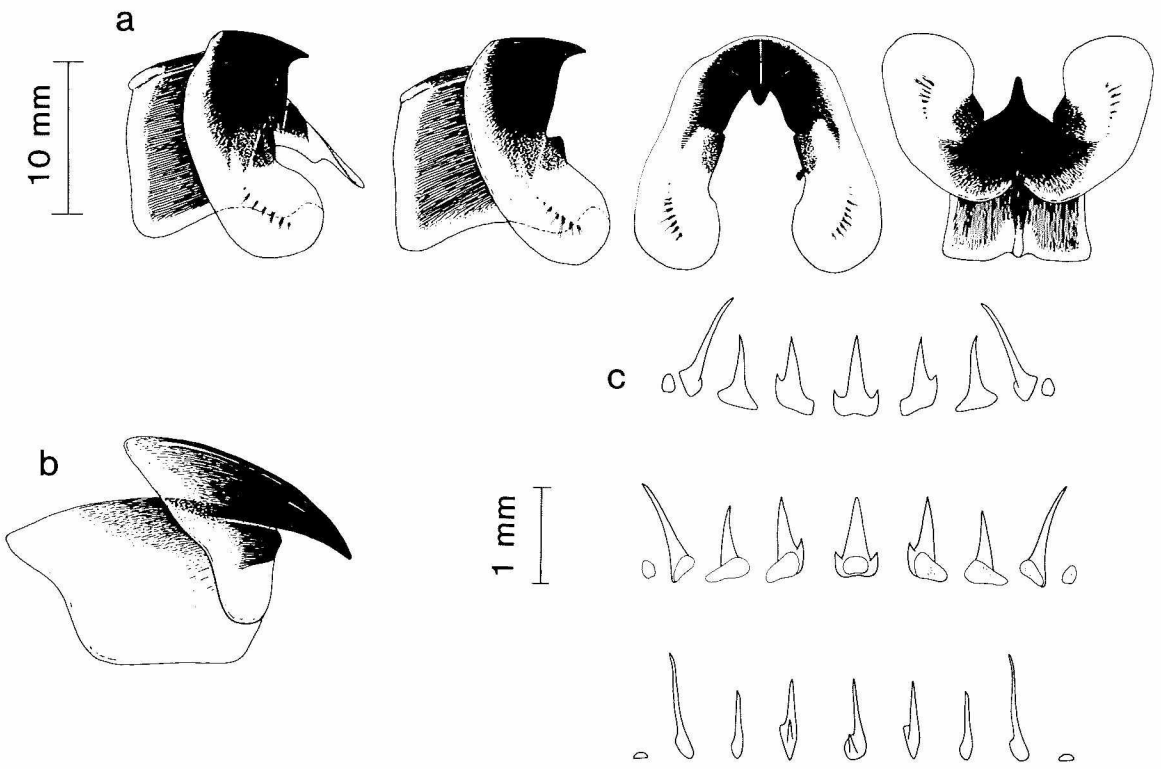

Fig. 4 *Martialia hyadesi*: a) lower beak, b) upper beak (drawn to some scale as lower beak), c) tooth row on the radula (top: oral view; middle: rotated 180°; bottom: rotated 90°.

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 (±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

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
Males				
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	
ClLI	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	
ClLI	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	

fourth arm is extensively modified to form a hectocotylus, which suggests a closer affinity with *Todarodes* than *Nototodarus*, 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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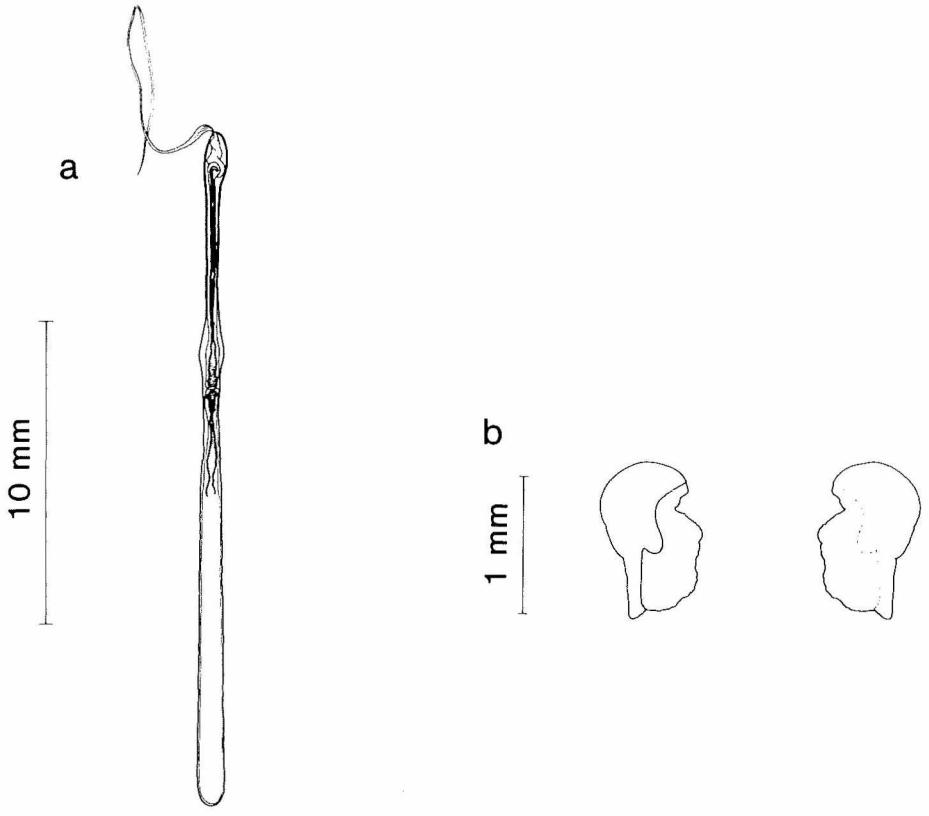

Fig. 5 *Martialia hyadesi*: a) spermatophore, b) right statolith: anterior side (i); posterior side (ii).

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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).

Antarctic Polar Frontal Zone

S	MS	TW	TL	ML	MW	HL	HW	FL	FW	FA	AL1	AL2	AL3	AL4	HcL	TtL	CL	GL	GW	RL	RW	LRL
f	II	219	381	224	60	*	*	91	140	53	79	86	80	74	*	126	101	220	6	183	10	4.9
f	II	234	411	241	57	36	40	98	140	52	82	94	92	87	*	135	109	230	7	195	10	4.5
f	II	259	413	244	61	42	40	99	140	52	93	106	100	95	*	146	123	233	8	190	11	5.0
f	II	200	*	226	57	39	39	88	128	52	86	96	87	81	*	*	*	216	7	178	10	4.5
m	III	224	376	230	59	36	34	93	134	52	84	94	99	74	*	121	97	218	7	178	10	4.4
m	III	207	381	228	55	37	37	87	130	52	87	96	89	*	*	137	121	217	7	177	9	4.2
m	III	242	387	241	59	38	37	97	143	52	100	102	*	76	*	142	114	228	7	187	11	4.5
m	III	286	406	243	62	40	44	104	146	52	100	105	101	80	*	146	117	231	8	189	10	4.5
m	*	167	345	219	54	36	33	88	119	51	75	81	82	*	*	112	92	203	7	166	9	4.3
m	II	271	418	247	61	36	38	102	149	53	104	*	108	82	*	151	124	228	8	184	11	4.5
f	II	209	390	232	55	39	40	94	132	50	83	95	91	84	*	138	103	218	7	175	10	4.4
f	II	206	383	225	54	37	36	90	133	52	88	98	95	87	*	137	113	212	7	174	9	4.2
m	III	246	400	237	61	39	36	101	144	52	85	95	99	75	21	144	119	224	8	181	10	4.3
f	II	257	416	245	60	39	40	103	139	53	84	98	93	88	*	152	123	234	8	191	11	*
m	II	251	402	236	60	34	32	97	135	52	89	94	103	78	*	147	124	225	8	183	10	4.5
m	II	243	403	240	59	39	39	92	143	52	92	108	104	75	*	150	125	227	8	187	11	4.6
m	III	358	456	260	62	41	43	108	165	53	114	127	128	95	*	164	135	250	9	201	12	5.6
f	II	310	455	258	64	40	41	110	154	52	91	100	115	101	*	181	145	246	8	197	11	4.6
f	II	243	405	248	55	39	38	104	143	52	87	100	105	88	*	149	120	230	8	180	10	4.5
f	II	282	427	255	55	40	42	103	149	51	105	115	115	100	*	166	135	236	8	192	11	5.0
m	II	273	402	246	54	39	39	102	149	52	*	102	105	83	*	147	117	231	7	187	11	5.0
m	II	234	386	228	55	39	42	88	149	52	82	96	103	77	*	140	115	219	9	183	10	4.3
f	II	182	350	216	51	34	33	83	121	51	80	89	86	74	*	123	98	206	6	175	9	4.3
f	II	271	435	259	58	42	41	107	144	52	97	106	99	92	*	151	128	238	7	194	11	4.7
f	II	301	435	264	60	41	38	113	148	52	106	112	110	103	*	148	121	249	9	201	11	5.0
f	II	281	429	249	60	40	43	100	152	51	106	112	110	88	*	167	140	235	8	187	11	5.1
m	III	298	421	246	63	40	41	99	145	54	103	109	112	80	*	162	127	236	7	194	11	4.8
f	II	301	440	258	62	41	41	103	151	52	110	118	119	94	*	166	137	240	9	104	12	4.8
m	II	250	408	246	58	40	37	96	137	51	90	103	96	80	27	155	123	226	8	191	10	4.9
m	II	253	406	239	56	39	36	100	148	51	87	101	102	75	23	149	123	221	8	193	10	4.6
f	II	222	401	238	54	36	37	99	136	49	86	97	100	91	*	141	117	227	8	187	10	4.4
f	II	315	448	255	56	41	45	111	160	51	92	105	107	104	*	160	128	240	8	195	11	5.4
f	II	259	425	240	57	38	37	101	143	52	97	104	102	89	*	157	128	230	8	185	10	4.9
m	III	316	425	239	61	39	42	109	159	53	97	112	109	87	28	160	133	239	8	204	11	5.4
m	II	215	374	222	53	33	38	97	131	52	86	89	90	70	*	124	101	216	7	181	10	4.4

Patagonian Shelf

S	MS	TW	TL	ML	MW	HL	HW	FL	FW	FA	AL1	AL2	AL3	AL4	HcL	TtL	CL	GL	GW	RL	RW	LRL
m	III	242	*	242	46	38	36	103	139	50	83	95	97	73	29	*	*	234	7	190	10	4.7
f	III	442	*	295	63	43	44	125	175	51	115	118	121	101	*	*	*	286	10	230	13	6.0
f	II	385	463	285	57	36	38	121	168	52	101	107	113	94	*	148	126	271	8	221	11	5.8
f	II	392	488	278	62	46	46	116	164	50	102	111	116	95	*	165	133	269	9	215	13	5.9
f	II	210	369	236	47	34	32	93	131	47	79	84	86	71	*	106	88	223	7	186	10	*
f	II	245	408	248	52	38	36	106	150	52	79	88	92	78	*	135	104	239	8	195	10	5.1
f	III	575	535	298	74	47	41	115	189	55	109	130	128	110	*	194	164	290	10	235	15	6.1
f	III	505	524	297	68	50	50	129	183	51	108	129	135	110	*	192	142	288	9	229	13	6.2
f	III	527	*	302	72	53	48	124	176	52	*	115	123	105	*	*	*	292	9	236	13	6.1
m	IV	464	505	286	57	44	42	125	173	53	106	121	120	101	36	177	151	275	9	223	13	5.7
f	II	344	446	265	57	43	44	114	166	49	99	103	104	85	*	151	132	254	8	203	12	6.1
m	III	239	403	241	47	36	36	105	145	51	92	99	108	74	16	140	123	230	8	188	10	5.5
m	III	330	424	258	56	45	43	105	157	52	94	104	106	89	34	131	117	245	8	204	11	5.9
f	II	295	435	260	56	39	41	112	154	51	98	105	116	87	*	152	124	251	8	198	11	5.4
f	III	503	521	300	68	47	46	135	193	50	116	127	129	105	*	210	171	285	9	226	14	6.6
f	II	331	455	274	64	41	40	112	161	47	94	99	105	89	*	161	130	263	8	211	11	6.0
m	IV	433	466	281	59	38	38	122	173	51	108	114	114	87	34	163	132	267	9	215	12	5.8
f	II	422	486	271	64	46	43	116	173	52	117	119	119	105	*	183	154	268	10	217	12	6.2
f	III	401	475	279	59	46	44	115	166	52	102	105	108	94	*	162	131	266	9	215	12	5.6
m	III	282	434	263	50	40	37	114	156	52	*	105	95	*	*	138	119	249	8	202	11	5.5
f	II	255	419	249	60	40	35	110	152	50	90	98	96	77	*	140	118	*	8	*	*	5.3
f	II	342	446	266	64	41	35	118	155	49	96	104	105	86	*	137	112	263	7	211	11	5.8
m	III	290	423	235	59	37	33	98	151	*	102	109	112	84	35	138	118	*	11	201	11	5.6
f	II	338	450	266	59	41	39	113	163	49	98	110	106	89	*	155	124	255	8	212	11	6.0
f	III	658	562	319	67	50	52	145	198	50	110	121	128	106	*	179	151	302	10	238	14	6.9
f	III	493	508	295	64	43	40	134	176	49	112	114	114	105	*	186	152	280	10	221	13	6.4
m	IV	508	486	*	59	48	45	122	165	51	106	111	113	86	36	150	125	275	9	219	12	6.1
f	II	377	484	281	58	42	38	125	164	50	84	99	*	88	*	160	130	266	9	216	12	5.7
f	III	437	474	269	60	45	43	118	160	50	98	112	110	90	*	172	137	258	10	210	13	5.7
f	II	358	460	269	59	35	39	118	161	51	100	111	119	101	*	166	132	255	8	213	12	5.7
m	II	169	343	217	43	28	26	89	120	52	64	75	77	58	18	107	83	208	7	171	9	4.2
m	III	327	445	258	63	44	43	117	157	51	88	104	103	74	22	140	111	246	9	195	12	4.6
m	III	243	395	236	55	36	35	98	144	52	83	92	99	78	20	136	110	225	8	187	9	5.1
f	II	443	475	288	58	42	40	122	171	50	101	105	112	96	*	162	137	281	9	230	14	*
m	II	208	363	224	51	37	36	93	138	52	81	88	92	74	22	120	102	212	7	184	10	5.0