

## A NEW SPECIES OF *GRANELEDONE* (CEPHALOPODA: OCTOPODIDAE) FROM THE SOUTHWEST ATLANTIC OCEAN

JÜRGEN GUERRERO KOMMRITZ

Malakologie, Zoologisches Museum, Universität Hamburg, Martin Luther King Platz 3, 20146 Hamburg, Germany

(Received 22 July 1999; accepted 20 May 2000)

### ABSTRACT

A new species of eledonid octopus is described from the southwestern Atlantic Ocean from depths between 90 and 1000 m off the coasts of southern Brazil, Uruguay, and Argentina. This species, *Graneledone yamana* is characterized by having a papillose skin, two well developed ‘horns’ above the eyes, small gills with 5–7 lamellae on the outer demibranch, arms with uniserial suckers, 35–80 on females and 26–70 on males. The third right arm is hectocotylyzed, the ligula is small, the calamus is large and well differentiated. Ink sac absent. These characters differ from all other known *Graneledone* species from the southern oceans.

### INTRODUCTION

The octopods of the southwest Atlantic Ocean are still poorly studied and little information is available on eledonid octopods, with genera like *Vosseledone* Palacio, 1978, known only from this area. A little known group of octopods from deeper water is the interesting genus *Graneledone* Joubin, 1918. This genus is defined by having the body covered with warts, dorsum covered with numerous clusters of rough, cartilaginous tubercules, one or more multifid ocular cirri, uniserial suckers, the funnel organ V V-shaped, no ink sac, the crop reduced or absent, small gills, small posterior salivary glands, and a partly reduced homodont radula. In males the penis possesses a large and sacular diverticulum, a small hectocotylus, and a well-differentiated ligula with a large calamus.

Currently the genus comprises seven described and recognized species, one doubtful species, and at least three undescribed species (Guerra *et al.*, 2000; Kubodera & Okutani, 1994; Nesis, 1987; Sweeney & Roper, 1998; Voss, 1988). *Graneledone* species live in the lower bathyal

and abyssal ecosystems (Guerra *et al.*, 2000) and have been reported from the southern oceans in Antarctic waters with *G. challengeri* (Berry, 1916); *G. antarctica* Voss, 1976 and *G. macrotyla* Voss, 1976; off the coast of the Kerguelen Islands with *G. gonzalezi* Guerra, Gonzalez & Cherel, 2000; in boreal waters of the north Atlantic with *G. verrucosa* (Verrill, 1881), and in the north Pacific with *G. boreopacifica* Nesis, 1982 and *G. pacifica* Voss & Pearcy, 1990.

From 1966 to 1971 several cruises were conducted with the research vessel ‘Walther Herwig’ to the southwestern Atlantic Ocean. During these voyages, several cephalopods were caught and most of the material was deposited in the collections of the Zoological Museum Hamburg (ZMH). During the examination of the Octopoda material several octopuses could not be recognized as any described species. The most abundant of these species, an eledonid, is described as new in this paper.

### MATERIAL AND METHODS

All specimens were captured during the expeditions of the FS ‘Walther Herwig’ to the southwest Atlantic Ocean during 1966, 1968, and 1971. Twenty-three individuals of an undescribed species of *Graneledone* were found in the material, including 10 females and 13 males representing growth stages from juvenile to adult (4 adult males and 2 females with eggs). All specimens were caught with a bottom trawl (BT200) in depths from 90 to 1000 m. The material was fixed in 10% formalin and preserved in 70% ethanol. Counts, measurements and indices follow Roper & Voss (1983).

Abbreviations and definitions are as follows, TL: total length; ML: mantle length; MWI: mantle width index (mantle width/ML  $\times$  100); HWI: head width index (head width/ML  $\times$  100); MAI: mantle arm index (ML/longest arm length  $\times$  100); ALI: arm length index (arm length/ML  $\times$  100); AWI: arm width

index (arm width at widest point on stoutest arm/ML  $\times$  100); ASC: arm sucker count (of intact arms); GLC: gill lamellae count (number of outer gill lamellae); FLI: funnel length index (funnel length/ML  $\times$  100); HALI: hectocotylized arm index (hectocotylized arm length/ML  $\times$  100); OAI: opposite arm length index (HAL/left arm III length  $\times$  100); HASC: hectocotylized arm sucker count; OPSC: opposite arm sucker count; LLI: ligula length index (ligula length/HAL  $\times$  100); CLI: calamus length index (calamus length/ligula length  $\times$  100); PLI: penis length index (penis length/ML  $\times$  100).

NMNH: National Museum of Natural History, Washington, U.S.A.

ZMH: Zoological Museum Hamburg.

#### Material examined

*Graneledone antarctica* Voss, 1976. Holotype, NMNH 00729679, male, 41 mm ML, Ross Sea, Eltanin, Station 2110, 74° 05.6'S, 175° 05.2'W, 2341 m depth, 8.2. 1968.

*Graneledone macrotyla* Voss, 1976. Holotype, NMNH 00729678, female, 34 mm ML, Eltanin, Station 1592, 54° 43'S, 55° 30'W, 1647–2044 m depth, 14. 3. 1966.

*Graneledone verrucosa verrucosa* (Verrill, 1881). Syn-type, NMNH 00729732, male, 44 mm ML of Cape Cod, 810 fm (1458 m) depth, 28. 6. 1880.

## SYSTEMATIC DESCRIPTION

### *Graneledone yamana* new species:

*Holotype*: Male, 52 mm ML, ZMH 2781, FS 'Walther Herwig' 1971, Station 240, 54° 56'S, 58° 05'W, 485–506 m deep, Bottom Trawl (BT), 3. 2. 1971.

*Paratypes*: 12 males ZMH 2784–2794, 2796 with ML: 5–75 mm from depths of 100–600 m; 10 females ZMH 2797–2806 with ML: 17–80 mm from depths of 90–1000 m.

*Description*: Animals small, with maximum observed mantle length of 80 mm. Mantle firm, not very thick, ovoid, slightly separated from head by small constriction. Mantle aperture wide. Head not as wide as mantle, bearing large eyes with two prominent supraocular cirri of different lengths, proximal one short and distal large (Fig. 1A, 1B). Funnel short (FLI 17.1–37.7) with anterior half free and conical. Funnel organ V V-shaped. Arms short, 1.6 to 4.1 times ML in females and 1.9 to 2.8 times ML in males, narrow (AWI 11.7–29.26); arms of females longer than those of males. Arm formula 1>2>3>4; variable, dorsal arms usually largest.

Suckers small and uniserial, those of females slightly larger than those of males (SDI 7.4 for females and 7.2 for males). Females with 35 to 80 suckers on arms and males with 42 to 70 on unhectocotylized arms. Web shallow (WDI 11.3–38.3), extending over one third of arm length and decreasing from dorsal to ventral surface. Web formula A:B:C:D:E, apparently also variable; sector E always shallowest. Third right arm in males hectocotylized (HAI 198–252), with 26 to 38 suckers. Ligula small (LLI 4.58–13.83), calamus large and well differentiated (CLI 50 to 100) (Fig. 2A). Gills small, with 5 to 7 lamellae on outer demibranch, most frequently 7 in males and 6 in females. Buccal mass well developed, with small anterior and large triangular posterior salivary glands. Oesophagus stout and slightly dilated in middle portion, leading to two-part stomach and short spiral caecum united by two ducts to digestive gland. Digestive gland ovoid, occupying one third of the mantle cavity in mature animals. Intestine stout and short (Fig. 1F). Anal pore round, no surrounding structures observed. Ink sac absent.

Radula (Fig. 1E) with tricuspid rachidian tooth, 3 lateral teeth, and one marginal plate.

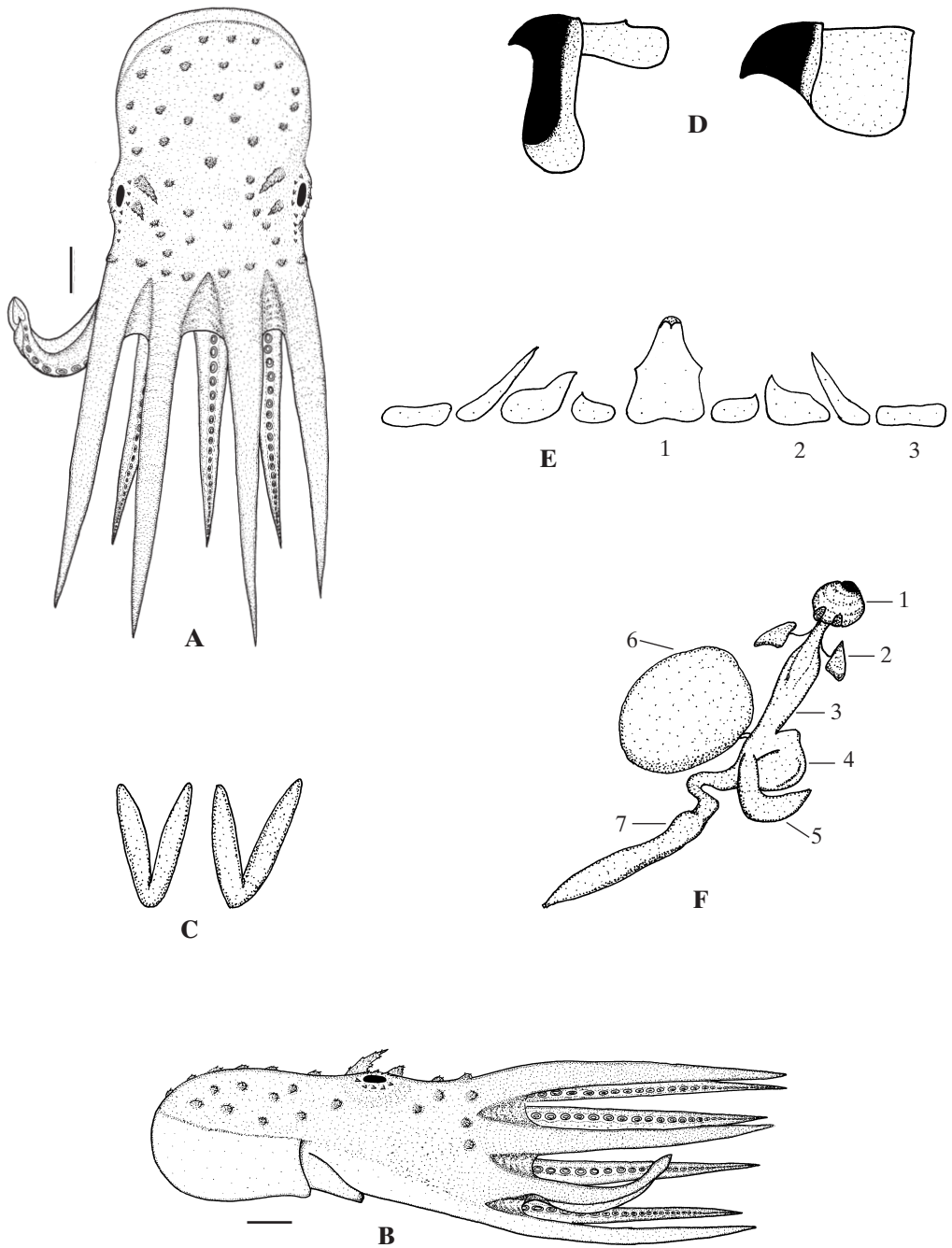
Beak without any unusual features (Fig. 1D).

Male reproductive tract with no special features (Fig. 2C); penis long and tubular (Fig. 2B), with large sacular diverticulum. Spermatophores long and slender, 75–94 mm long. Spermatophore tube straight near distal end and with 10 coils just prior to end (Fig. 2D). Female reproductive tract with no special features (Fig. 2E). Ovary large with stout proximal oviducts. Ovary glands round, distal oviducts larger than proximal. One dissected ovary contained 40 eggs, striated, 12 mm long by 4.7 mm wide (Fig. 2F).

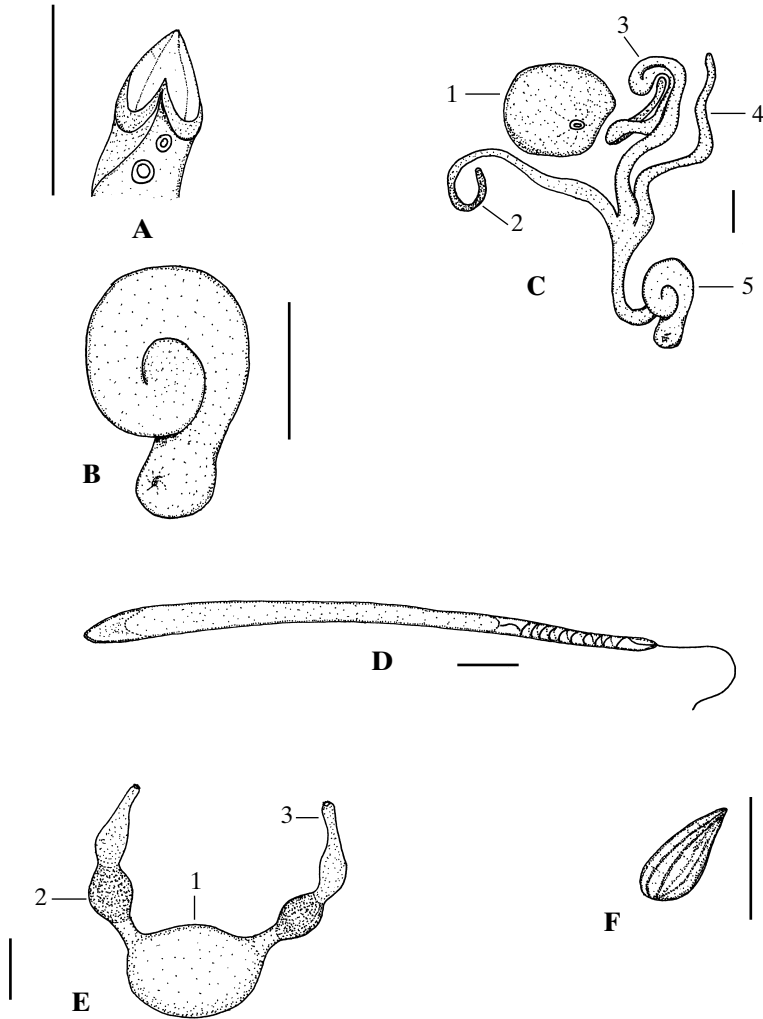
Body surface covered by complex papillose warts with many tiny spine-like structures typical of the genus *Graneledone*. Warts covering body dorsally from mantle to base of arms, not reaching dorsal side of web; ventral body without warts. Colour of specimens in alcohol, pale reddish violet dorsally and pale pink ventrally. Adult males smaller than adult females; males reaching maturity at 59 mm ML and females at 75 mm ML.

*Type locality*: off southern Argentina, 54° 56'S, 58° 05'W between 485 and 506 m depth.

*Etymology*: The name *yamana* refers to the Yamana Indians who inhabited the southern part of Tierra del Fuego.



**Figure 1.** *Graneledone yamana*, new species (Holotype, ZMH 2781): **A.** Dorsal view of male. **B.** Lateral view of male. **C.** Funnel organ. **D.** Lower and upper mandible. **E.** Radula, 1-rachidian tooth, 2-lateral teeth, 3-marginal plate. **F.** Digestive tract, 1-buccal mass, 2-salivary glands, 3-oesophagus, 4-stomach, 5-caecum, 6-digestive gland, 7-intestine. Scale bar = 10 mm.



**Figure 2.** *Graneledone yamana*, new species: **A.** Hectocotylus. **B.** Penis, 1—saccular diverticulum. **C.** Male genitalia, 1—testis, 2—vas deferens, 3—accessory gland, 4—spermatophore sac, 5—penis. **D.** Spermatophore. **E.** Female genitalia (From ZMH 2801): 1—ovary, 2—oviducal gland, 3—oviduct. **F.** Egg. Scale bar = 10 mm.

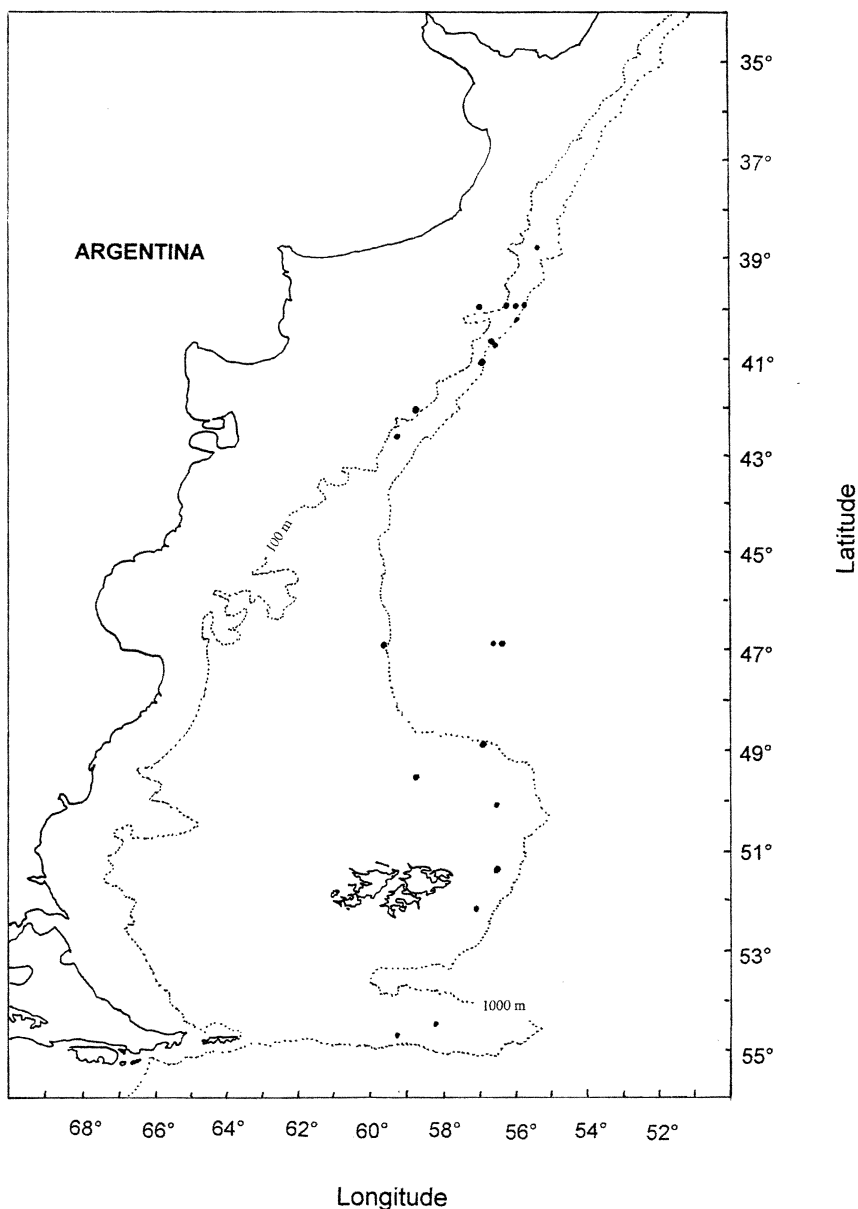
**Distribution:** *Graneledone yamana* is known from localities as far south as 54° 56'S and as far north as 26° 30'S. The bathymetric distribution is from 90–1000 m.

#### DISCUSSION

This new species was placed in the genus *Graneledone* because of the following generic characters : ink sac absent, body covered by large cartilaginous spiny warts, crop absent,

radula partly reduced, hectocotylus small, suckers uniserial, and funnel organ V V-shaped.

At present, the genus is represented by four species in the southern oceans: *G. challengerii* (Berry, 1916); *G. antarctica* Voss, 1976 and *G. macrotyla* Voss, 1976; *G. gonzalezi* Guerra, González & Cherel, 2000. Kubodera and Otkutani (1994) also reported two unidentified *Graneledone* (sp A. and sp B.) from this region; species A is said to be similar to *G. antarctica* and species B to *G. challengerii*. Voss (1988) recorded another possible graneledonid from the Gulf of Panama that had been reported by



**Figure 3.** Distribution map of *Graneledone yamana* new species.

Hoyle in 1904. None of these specimens have been formally described. Robson (1932) described another species, *Graneledone setebos*, from a single badly preserved animal from Antarctica but it is considered a doubtful species and uncertain if it belongs to the genus *Graneledone* (Voss, 1988; Guerra *et al.*, 2000). There is an interesting and unusual observation,

that the stomach content was seaweed (Robson, 1932).

*Graneledone yamana* new species is the fifth member of the genus *Graneledone* reported from the southern oceans. It resembles *G. verrucosa* in general external appearance, but the configuration of warts on the body is different, and *G. verrucosa* also has many more warts

**Table 1.** Ranges and means of measurements (mm) of 13 males and 10 females of *Graneledone yamana* new species.

Index	Males (n = 13)			Females (n = 10)		
	Lower limit	Mean	Upper limit	Lower limit	Mean	Upper limit
Total length (TL)	108	159.2	234	53	170.5	358
Mantle length (ML)	37	52.2	75	17	47.8	80
Mantle width index (MWI)	65.57	79.5	110.7	73.7	94.1	110.9
Head width index (HWI)	61.0	70.4	86.4	62.5	88.2	100
Mantle arm index (MAI)	33.2	44.6	69.1	25.9	39.2	56.0
1° right arm length index (I ALI)	140.4	185.0	239.1	176.4	227.8	340
2° right arm length index (II ALI)	115.3	193.7	283	172.5	253.6	385.3
3° right arm length index (III ALI)	105.7	163.3	252.4	172.5	212.1	413.3
4° right arm length index (IV ALI)	138.8	167.9	263.9	194.1	205.3	353.3
Arm formula		1:2:3:4			1:2:3:4	
Arm width index (AWI)	14.2	19.3	27.7	11.7	18.1	29.26
Sucker diameter index (SDI)	5.3	7.2	11.1	4.1	7.4	10
Web depth index (WDI)	11.3	15.8	38.3	13.8	17.9	24.1
Web formula		A:B:C:D:E			A:B:C:D:E	
Arm sucker count (ASC)	40–54	52–60	66–70	35–45	50–60	73–80
Gill lamellae count (GLC)	5	6	7	5	6	7
Funnel length index (FLI)	17.1	28.5	37.7	18.1	30	36
Hectocotylus arm index (HALI)	105.7	163.3	252.4			
Opposite arm index (OAI)	63.3	80.8	132.9			
Hectocotylus sucker count (HASC)	26	28.7	38			
Opposite arm sucker count (OPSC)	42	52.3	66			
Lingula length index (LLI)	4.5	7.1	13.8			
Calamus length index (CLI)	50	64.1	100			
Penis length index (PLI)	24.1	36.6	53.1			

on the mantle. *Graneledone verrucosa* also differs from *G. yamana* by the fact that it has 8 lamellae on the outer demibranch, rather than 5–7 and the hectocotylized arm bears 44 suckers, whereas *G. yamana* only has 26–38. The supraocular cirri of *G. verrucosa* are small and not very prominent. *Graneledone yamana* possesses very prominent ‘horns’ above the eyes.

Until now *G. verrucosa* has been reported from the northern Atlantic and so its distributional range does not overlap with that of *G. yamana*.

*Graneledone macrotyla* possesses only one huge supraocular cirrus, and the papillose wart structure and configuration is very unique. Because of these external characters, it can be easily differentiated from other *Graneledone* species. *Graneledone antarctica* has a very characteristic body sculpture with no enlarged supraocular cirri. *Graneledone gonzalezi* resembles *G. antarctica*, but the papillae on head, mantle and web are not so pronounced. Because of the lack of the supraocular cirri, they can be easily distinguished from *G. yamana*.

From its general appearance, *G. yamana* could be misidentified as *Vosseledone charrua*

Palacio, 1978, because both have supraocular cirri and warts covering the body. However, they can be easily differentiated because *G. yamana* does not possess an ink sac and its wart structure is typical for *Graneledone*, i.e. papillose warts with tiny spine-like structures. Furthermore the radula structure is very different; that of *Vosseledone* consists of only a rachidian tooth with flat plates on either side (Palacio, 1978), whereas *G. yamana* possesses a radula that is simplified but has a prominent rachidian tooth, three well-differentiated lateral teeth, and one marginal plate.

The bathymetric distribution of *G. yamana* is very wide, it is not only a deep-sea octopod as are the other members of the genus, but has also been found on the continental shelf at depths of only 90 m. Most of the other species of *Graneledone* are reported from the deep ocean below 800 m (Voss, 1988; Voss & Pearcy, 1990). *Graneledone gonzalezi* is reported from the upper continental slope at depths from 510 to 540 m (Guerra *et al.*, 2000). All mature individuals from *G. yamana* were found at depths from 300 to 830 m. It is possible that *G. yamana* also occurs in deeper water, and has a wider

distribution, but further research is needed to verify this assumption. No relation was found between the depth and date of capture.

## ACKNOWLEDGEMENTS

Thanks are due to Dr. C. F. Roper who sent me the type material for comparison and to Dr. Bernhard Hausdorf, Ramona Timon and Hans Dieter Totzke for their help and support, to Dr. Brigitte Hilbig and Dr. Carol Schöne for the first revision of the draft manuscript, to Dr. Louise Allcock and the anonymous reviewers for comments on the manuscript.

## REFERENCES

- GUERRA, A., GONZALES, A. & CHEREL, Y., 2000. *Graneledone gonzalezi* sp. nov. (Mollusca: Cephalopoda): a new octopod from the Îles Kerguelen. *Antarctic Science* **12**: 33-40.
- KUBODERA, T. & OKUTANI, T., 1994. Eledonine octopods from the Southern Ocean: systematics and distribution. *Antarctic Science*, **6**: 205-214.
- NESIS, K.N., 1987. *Cephalopods of the world*. TFH Publications. Translated from Russian by B.S. Levitov.
- PALACIO, F. J., 1978. *Vosseledone charrua*: a new patagonian cephalopod (Octopodidae) with notes on related genera. *Bulletin of Marine Science*, **28**: 282-296.
- ROBSON, G.C., 1932. *A monograph of the Recent Cephalopoda based on the collections of the British Museum (Natural History). Part 2. The Octopoda (Excluding the Octopodinae)*. British Museum (Natural History). London.
- ROPER, C.F. & VOSS, G.L. 1983. Guidelines for taxonomic descriptions of cephalopod species. *Memoirs of the National Museum of Victoria*, **44**: 49-63.
- SWEENEY, M.J. & ROPER, C.F., 1998. Classification, type localities, and type repositories of recent Cephalopoda. *Smithsonian Contributions to Zoology*, **586**: 561-595.
- VOSS, G.L., 1976. Two new species of the genus *Graneledone* (Mollusca: Cephalopoda) from the Southern Ocean. *Proceedings of the Biological Society of Washington* **88**: 447-458.
- VOSS, G.L., 1988. The biogeography of deep-sea Octopoda. *Malacologia* **29**: 295-307.
- VOSS, G.L. & PEARCY, W.G., 1990. Deep-water octopods (Mollusca; Cephalopoda) of the northeastern Pacific. *Proceedings of the California Academy of Sciences*, **47**: 47-94.

