Eledone gaucha, a New Species of Eledonid Octopod (Cephalopoda: Octopodidae) from Southern Brazil

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ABSTRACT

A new species of *Eledone* is described from the southwestern Atlantic at depths of 60 to 160 m, off Rio Grande do Sul, Brazil. The characters that distinguish this species from the other species of the genus are presented, as well as a morphometric comparison with the sympatric *Eledone massyae* Voss, 1964.

INTRODUCTION

Several cephalopods were collected during a survey of the demersal resources of the inner shelf of Rio Grande do Sul between Solidão (30°40′S) and Chui (34°20′S) at depths to 100 m (figure 1) by the R/V "Atlântico Sul" of Fundação Universidade de Rio Grande (FURG). Haimovici and Andriguetto (1986) stated that two species of the octopod genus *Eledone* were found. One of them, *E. massyae*, was described by Voss (1964) and the second was a new species. Both sympatric species possess the generic character of papillae at the tips of the non-hectocotylized arms of the males. Morphological analysis presented here as well as biochemical differences found by Levi *et al.* (1985) separate these two similar species.

MATERIALS AND METHODS

All specimens studied were killed with fresh water, fixed in 10% formalin for 24 hr and preserved in 70% ethanol. Measurements were taken in millimeters, and all measurements and indices used are among those described by Roper and Voss (1983). The drawings of *E. gaucha* are by Jose Angel Alvarez Perez. The types are deposited in the Museu Oceanografico de Rio Grande (MORG), Museu Nacional de Rio de Janeiro (MNRJ), Museu de Zoologia da Universidade de São Paulo (MZUSP), Museo Nacional de Historia Natural, Uruguay (MNHN), Museo de Ciencias Naturales de La Plata, Argentina (MCNLP), University of Miami Mollusks Laboratory (UMML) and National Museum of Natural History, Smithsonian Institution (USNM).

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Eledone gaucha new species
(figures 2–14, table 1)

Material examined: Holotype: ♂ 32.5 mm ML, R/V Atlântico Sul, cruise 13/83, Sta. 37, 32°58′S, 51°19′W, 56 m, trawl, 17 Nov. 1983, MORG 23544. Paratypes: 7 ♂ 27–41 mm ML and 5 ♀ 32–34 mm ML, R/V Atlântico Sul, cruise 13/83, Sta. 37, 32°58′S, 51°19′W, 56 m, trawl, MORG 23544; 2 ♂ 32–34 mm ML, R/V Atlântico Sul, cruise 13/83, Sta. 39, 32°50′S, 50°45′W, 87 m, trawl, 18 Nov. 1983, MORG 23545; 1 ♂ 21 mm ML, R/V Atlântico Sul, cruise 13/83, Sta. 2, 31°46′W, 100 m, 9 Nov. 1983, MORG 23846; 1 ♀ 33 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 51, 33°43′S, 52°13′W, 60 m, trawl, 29 Aug. 1983, MORG 23547; 4 ♀ 28–33 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 57, 33°13′S, 51°25′W, trawl, 60 m, 30 Aug. 1983, MORG 23548; 1 ♂ 33 mm ML and 1 ♀ 44 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 53, 33°52′S, 51°55′W, 52 m, trawl, 29 Aug. 1983, UMML 32.2066; 1 ♂ 34 mm ML and 1 ♀ 42 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 53, 33°52′S, 51°55′W, 52 m, trawl, 29 Aug. 1983, USNM 816613; 1 ♂ 26 mm ML and 1 ♀ 29.5 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 51, 33°43′S, 52°13′W, 74 m, trawl, 29 Aug. 1983, MZUSP 25242; 1 ♂ 32 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 55, 32°52′S, 51°43′W, 140 m, trawl, 30 Aug. 1983, MCNLP 4681; 1 ♀ 29.5 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 57, 33°13′S, 51°25′W, 60 m, trawl, 30 Aug. 1983, MCNLP 4682; 1 ♂ 30 mm ML and 1 ♀ 38 mm ML, R/V Atlântico Sul, cruise 10/83, Sta. 53, 32°52′S, 51°55′W, 52 m, trawl, 29 Aug. 1983, MNHN 14762, MNHN 14763; 1 ♂ 35 mm ML and 1 ♀ 42 mm ML, R/V Atlântico Sul, cruise 3/83, Sta. 42, 33°02′S, 51°30′W, 130 m, trawl, 17 June 1980, MNRJ 5626, MNRJ 5627.

DESCRIPTION

Animal small, maximum observed mantle length 65 mm (figures 2, 3). Mantle firm, not very thick, ovoid and elongated (MWI ♂: 61.0; ♀: 59.2) separated from head by small constriction. Body surface smooth with some papillae on the dorsal mantle and head. Head narrower than mantle (HWI ♂: 36.2; ♀: 37.3); eyes slightly protuberant. One supraocular cirrus. Funnel long (FLI ♂: 44.6; ♀: 45.4) with anterior half free (FFuLI ♂: 21.6; ♀: 21.1); funnel organ (figure 4) W shaped.

Arms long and rather slim. Arms length order 1>2>3>4 in most specimens with dorsal arms markedly longer than others. All arms longer in males (except hectocotylized arm) than in females (ALI I to IV ♂: 273.2–239.8–134.9–208.1; ♀: 250.0–213.8–200.6–191.0).

Suckers small, uniserial, well separated and deeply set into arms. Suckers somewhat crowded near tips of the arms on females. Two rows of minute fleshy papillae on all non-hectocotylized arms of males (figure 10). Number of suckers on basal half of the first right arms varies from 17 to 23 (ASC ♂: 20.1; ♀: 19.4), suckers slightly larger on all arms of males (IASI ♂: 7.7; ♀: 6.5).

Web extends over half the length of arms and decreases from dorsal to ventral surface; web formula most frequently A:B:C:D:E. Web indices similar in both sexes; 24.4–24.1–21.6–18.6–15.6 for males and 24.4–23.9–21.1–18.3–14.9 for females.

Third right arm in males hectocotylized (figure 9) (HcAI: 58.9). Ligula small (LLI: 8.8), without differentiated calimus (figure 9); spermatophore grove deep.

Gill count in external hemibranch from 7 to 10, most frequently 8 in males and 9 in females (Gilc ♂: 8.2; ♀: 8.9).

Males reproductive system with no special figures (figure 11). Penis long and tubular (PLI: 23.4) with a rather short diverticulum (PdLI: 7.8). Spermatophores undifferentiated (figure 13) from 12 to 20 mm (SpLI: 45; SpLWI: 1.56). Number of spermatophores in a sample of 40 mature males from 7 to 92 (mean 32.1).

The proximal oviduct long, the oviductal glands small, the distal oviducts shorter and somewhat stouter (figure 12). Intraovaric eggs oval (figure 14); maximum lengths of apparently mature eggs approximately 8 mm. Number of developing eggs in a sample of 42 maturing females ranged 10–55 (mean 30.2).

Buccal mass well developed, with small anterior salivary glands and larger posterior salivary glands. Esophagus connects to developed crop leading to muscular stomach and smaller spiral caecum united by two ducts to the large digestive gland. Intestine thin and leads to the anus adjacent to ink sac opening. Ink sac superficially embedded in the digestive gland (figure 7). Radula with a tricuspid rachidean tooth, three lateral teeth and a marginal plate (figure 8).

Color of living animals changed from brown to almost white dorsally always remaining clear ventrally. Color of specimens preserved in alcohol purplish gray dorsally and pale yellow ventrally. Inner surface of the arms, mouth, and ventral mantle with few chromatophores.

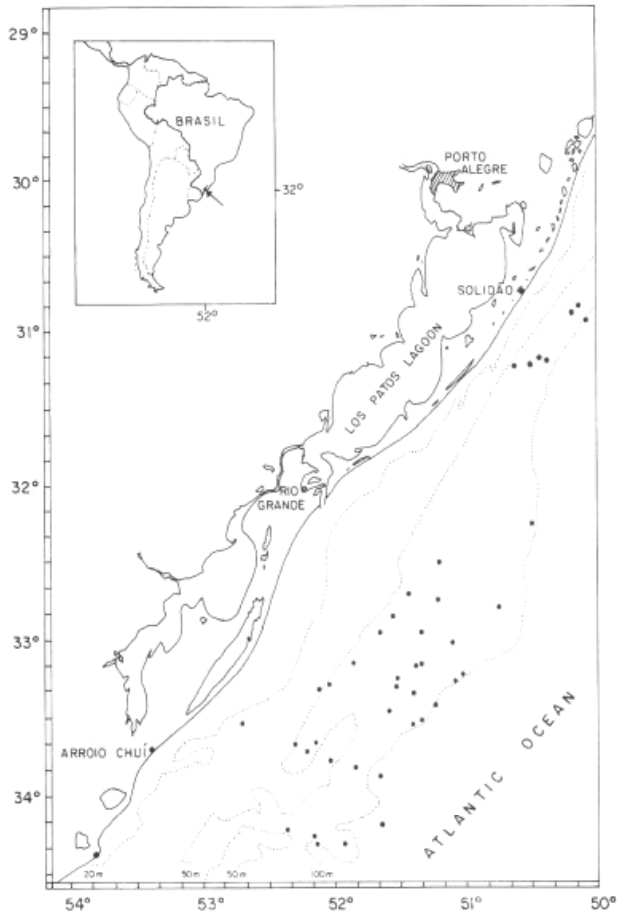

Figure 1. Sample localities of *Eledone gaucha* new species.

Type locality: 32°58′S, 51°19′W, south Rio Grande, Brazil in 56 m.

Etymology: The name *gaucha* refers to the coastal planes of Argentina, Uruguay, and southern Brazil and its people.

Distribution: *Eledone gaucha* is known only from off Rio Grande do Sul between Solidao (30°40′S) and Chui (34°20′S) (figure 1).

DISCUSSION

The new species belongs in the genus *Eledone* because of a single row of suckers, the heteromorphic arms in the males, with the non-hectocotylized arms having the suckers at their tips modified into fleshy papillae or laminae, and the hectocotylus without a differentiated calimus. These characters distinguish *Eledone* from related genera *Pareledone*, *Vosseledone*, *Graneledone* and others (Palacio, 1978).

The genus *Eledone* occurs on the Atlantic continental shelves of South America, Africa, and Europe and in the Mediterranean Sea. It includes six described species: *E. moschata* (Lamarck, 1798) and *E. cirrhosa* (Lamarck,

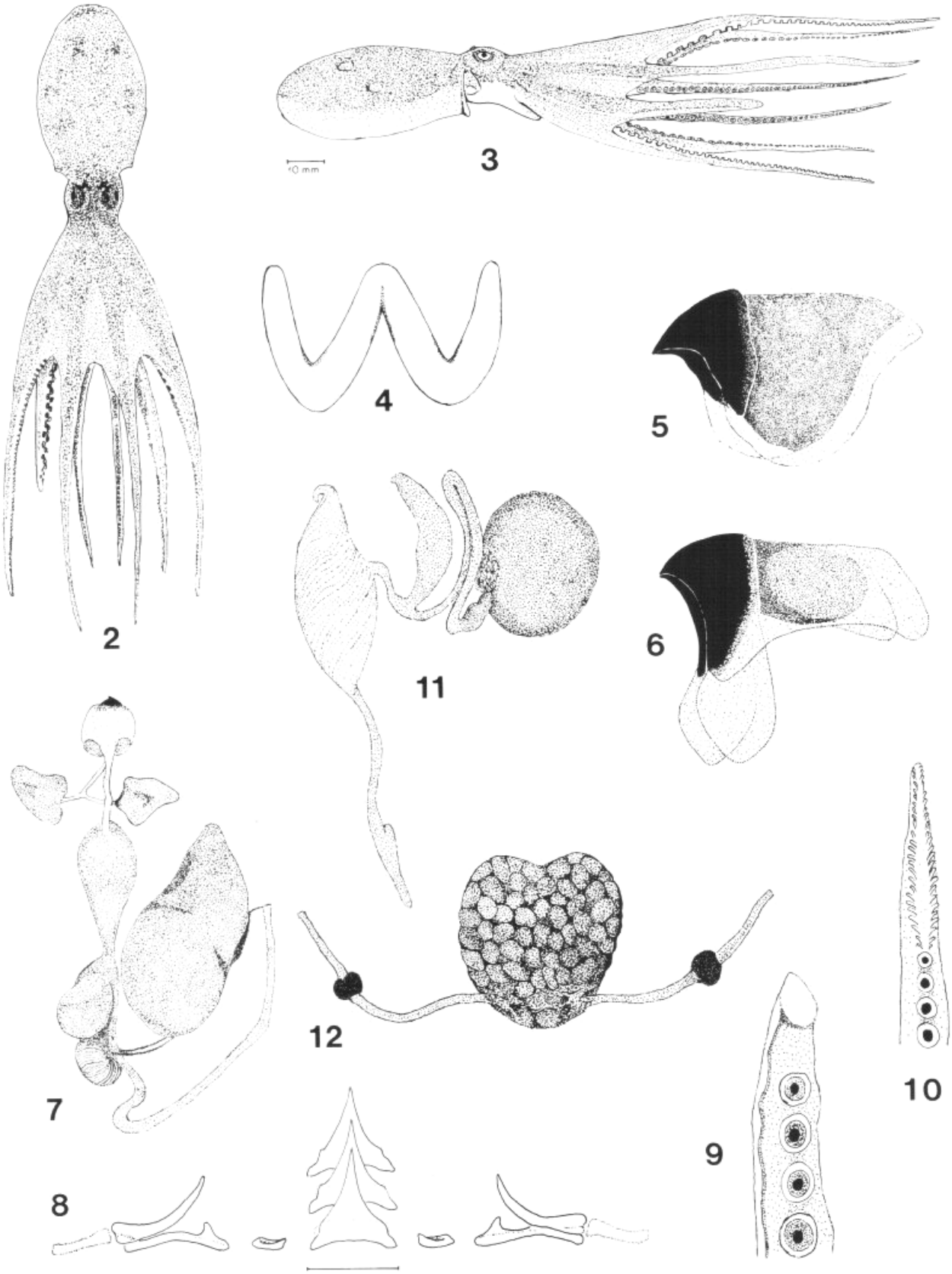
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Table 1. Ranges and means of measurements and indices of 10 males and 10 females each of *Eledone massyae* Voss, 1964 and *Eledone gaucha* new species, from southern Brazil.

	Eledone massyae Voss, 1964						*Eledone gaucha* new species					
	Males			Females			Males			Females		
Index	Lower limit	Mean	Upper limit	Lower limit	Mean	Upper limit	Lower limit	Mean	Upper limit	Lower limit	Mean	Upper limit
Total length (TL)	148.0	176.4	207.0	195.0	218.2	236.0	81.0	123.2	137.0	100.0	131.9	178.0
Mantle length (ML)	45.0	54.0	63.0	60.0	65.3	71.0	21.0	31.6	41.0	28.0	35.5	50.0
Mantle width index (MWI)	65.1	76.2	88.2	75.8	79.3	88.9	47.6	61.0	71.9	40.0	59.2	70.0
Head width index (HWI)	40.4	47.4	56.5	38.2	41.9	45.0	34.2	37.5	40.0	28.0	36.2	43.6
1° right arm length index (I ALI)	184.0	201.4	216.0	185.0	209.9	247.0	244.0	275.2	322.0	227.0	250.0	284.0
2° right arm length index (II ALI)	195.0	203.3	235.0	190.0	217.3	248.0	193.0	239.8	281.0	162.0	213.8	242.0
3° right arm length index (III ALI)	155.0	199.1	225.0	185.0	214.1	252.0	85.0	134.9	159.0	155.0	200.6	236.0
4° right arm length index (IV ALI)	191.0	204.0	224.0	186.0	215.5	243.0	134.0	208.1	256.0	162.0	191.0	213.0
Arm formula (AF)		4:2:1:3			2:4:3:1			1:2:3:4			1:2:3:4	
A web depth index (A WDI)	19.1	24.3	28.5	19.8	22.5	27.4	16.8	24.2	30.9	18.9	24.4	28.6
B web depth index (B WDI)	18.2	24.5	27.5	21.0	23.8	29.6	19.0	24.1	30.1	18.9	23.9	25.8
C web depth index (C WDI)	22.9	25.9	28.3	21.2	24.1	28.9	18.8	21.6	28.9	17.6	21.1	23.7
D web depth index (D WDI)	22.7	24.8	28.6	20.9	24.3	27.6	14.6	18.6	23.0	15.8	18.3	20.5
E web depth index (E WDI)	13.4	20.6	25.3	18.6	20.8	22.9	11.5	15.6	21.6	12.3	14.9	17.4
Web formula (WF)		C:D:B:A:E			D:C:B:A:E			A:B:C:D:E			A:B:C:D:E	
Gill lamellae count (GiLC)	8/10	9.4/9.2	11/7	9/10	9.7/9.6	8/10	7/9	8.2/8.5	9/9	8/8	8.9/8.5	10/10
Funnel length index (FLI)	37.8	41.9	45.9	40.8	44.2	48.2	36.6	44.6	51.9	32.5	45.4	51.7
Free funnel length index (FFuLI)	17.5	23.2	29.5	20.9	23.8	27.9	14.6	21.6	31.0	10.0	21.1	30.3
Arm sucker count (ASC)	16	18.1	20	16	17.8	20	17	19.4	22	18	20.1	23
Arm sucker index I (I ASI)	6.3	7.7	9.1	7.0	7.9	8.7	4.7	7.7	9.3	6.0	6.5	8.0
Arm sucker index II (II ASI)	6.3	8.0	9.1	7.0	8.2	9.6	4.7	7.3	9.3	5.0	6.4	8.0
Arm sucker index III (III ASI)	5.5	7.4	8.9	7.0	7.9	8.5	4.7	7.6	9.6	5.0	6.0	7.5
Arm sucker index IV (IV ASI)	5.5	7.2	8.9	6.7	7.7	8.4	4.7	6.7	7.8	3.0	5.1	6.7
Penis length index (PLI)	19.3	28.1	39.3				19.5	23.4	28.1			
Penis diverticulum length index (PdLI)	6.6	15.0	22.2				4.9	7.8	10.5			
Spermatophore length index (SpLI)	20.9	31.6	37.7				38.3	45.0	50.0			
Spermatophore width index (SpWI)	1.8	2.5	3.1				1.2	1.6	2.1			
Hectocotylized arm index (HcAI)	59.0	69.2	81.4				41.7	58.9	67.4			
Ligula length index (LLI)	5.3	8.0	9.7				4.9	8.8	12.5			

1798) both from the NE Atlantic and Mediterranean, *E. thysanophora* Voss, 1962 and *E. caparti* Adam, 1950 from the SE Atlantic, and *E. massyae* Voss, 1964 and *E. gaucha* from the SW Atlantic.

Eledone gaucha seems to be a relatively abundant species off Rio Grande do Sul. The possible reasons why it has not been recognized to date are its small size, its similarity to *E. massyae*, and the scarcity of scientific cephalopod collections by research vessels in this area. Due to its small size it is not retained in the cod ends of commercial trawlers and even in the R/V Atlântico Sul surveys it most often was found entangled in the wings of the net. Palacio (1977) reviewed several museum collections of Argentina, Uruguay, and Brazil and found

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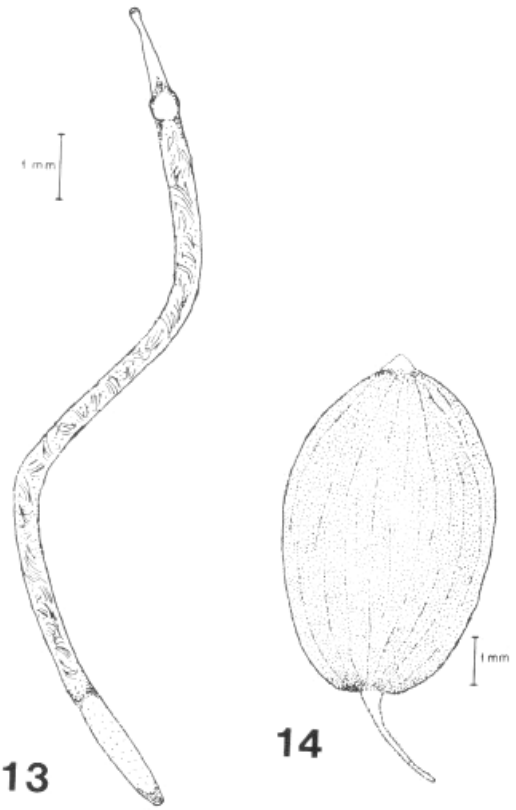
Figures 2–12. Anatomical features of *Eledone gaucha* new species. **2, 3.** Dorsal (2) and lateral (3) views of holotype (MORG 23544, 32 mm ML). **4.** Funnel organ. **5.** Upper mandible. **6.** Lower mandible. **7.** Digestive tract. **8.** Radula. **9.** Hectocotylized arm tip. **10.** Non-hectocotylized arm tip of male. **11.** Male reproductive organs. **12.** Female reproductive organs.



Figures 13, 14. Reproductive products of *Eledone gaucha* new species. **13.** Spermatophore. **14.** Egg.

only one eledonid, *E. massyae*. A survey of the MORG collection by the author showed one specimen of *E. gaucha* (MORG 15341) formerly classified as *E. massyae*. It is expected that reviews in other collections will expand the range of *E. gaucha*.

The sympatric species *E. massyae* and *E. gaucha* initially look similar but many differences may be seen in a more detailed study. In order to compare both species morphologically, the same indices were calculated for 10 males and 10 females of *E. massyae* (collected in the same survey) which were fixed, preserved, and measured in the same way as the new species (table 1). *Eledone gaucha* is smaller and has a narrower mantle and head. The arms are thinner, longer, and decrease in size while in *E. massyae* all arms are approximately the same length. The hectocotylized arm is shorter and the web depth decreases from the dorsal to the ventral surface in *E. gaucha*, while in *E. massyae* the web is shorter only between the ventral arms. The funnel organ is W shaped in *E. gaucha*, vv shaped in *E. massyae*. The number of inner and outer gill lamellae is one unit lower and the arms sucker count two units higher in *E. gaucha*. Arm sucker indices are similar in males of both species, but in females they are smaller in *E. gaucha*. Perhaps the best single diagnostic character to distinguish mature males of both species is the spermatophore, which is shorter and much thinner in *E. gaucha*. Externally, the best distinctive character is the arm length pattern.

Eledone caparti was described by Adam (1950) based on five specimens, two males and three females collected in the equatorial west Africa at depth ranging from 60 to 170 m. No figures or tables were included in the original description. The decreasing arm length and web depth of *E. caparti* are similar to those of the new species. However, *E. caparti* does not have a supraocular cirrus, has enlarged suckers at the base of the lateral arms of the males, and the number of suckers on the dorsal arms is almost double that in *E. gaucha*. The radula of *E. caparti* has an A2 seriation and the spermatophore is insufficiently described for comparisons.

Eledone thysanophora was described by Voss (1962) based on a single male specimen collected in a tide pool in western South Africa. The morphometric description is short, but the number of papillae on the tips of the non-hectocotylized arms and the structure of the spermatophore, with the inner wall of the horn portion lined with teeth, differentiate *E. thysanophora* from the new species.

Summary descriptions of *E. cirrhosa* (Lamarck, 1798) and *E. moschata* (Lamarck, 1798) are presented in Roper *et al.* (1984), and the species are compared by Rees (1956). Both species can be distinguished from *E. gaucha* by several characters. *Eledone cirrhosa* has moderately short arms, a ridge along the mantle, non-hectocotylized arms of males with a single row of compressed sucker-like cirri, and spermatophores with spines. *Eledone moschata* has subequal arms, 11 to 12 filaments on the outer hemibranch of the gills, big, sausage-shaped eggs 15 mm long, and a characteristic musk odor.

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