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The variation of *Halocordyle disticha* (Cnidaria, Athecata) from the Brazilian coast: an environmental indicator species?

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Abstract

The rediscovery of *Halocardyle fragilis* Vannucci, of which the type material is lost, led us to consider it a variety of *Halocardyle disticha* (Goldfuss) that occurs in calm waters on soft bottoms. The typical *H. disticha* is open feather-shaped, with branching in one plane, while *H. fragilis* is bushy, much larger, with branching in many planes. The different habit of *H. disticha* is probably due to environmental conditions. The bushy and pinnate forms are considered extremes of a range of morphological variation.

Introduction

Vannucci (1951) described *Halocordyle fragilis* (= *Halocordyle* sp. Vannucci, 1950; = *Pennaria fragilis* Vannucci, 1954) dredged from depths of 15–57 m off the coast of SE Brazil. She stated: 'The present species can be readily separated from the others of the genus by the peculiar habit of the colony. It does not have the feather-shaped aspect of the remaining species; on the contrary, it looks like a long irregularly branched wire, with hydrocladia scattered along the stem'.

Although many species of *Halocordyle* Allman, as redefined by Millard (1975), have been proposed, various authors (Hirohito, 1977; García-Corrales & Aguirre, 1985; Wedler & Larson, 1986; Calder, 1988) consider them variations of *Halocordyle disticha* (Goldfuss, 1820). Hirohito (1977) compared specimens from different regions and concluded that *H. disticha* is a senior synonym of 17 other names. However, he still listed and discussed 8 uncertain species, among which was *Halocordyle fragilis*. We (Migotto & da Silveira, 1987) could not clarify the relation between *H. disticha* and *H. fragilis*, because the type material of the latter had been lost from the collection of the Instituto Oceanográfico da Universidade de São Paulo. Nevertheless, we examined 3 whole-mount preparations of fragments of *H. fragilis* given by Dr Vannucci to Dr Navas-Pereira, and we observed that the hydranths in the slides were similar in most microscopic details to *H. disticha*. The preparations were deposited in the collection of Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ 889-891). We found specimens identical to those described by Vannucci (1951), and compared them with the pinnate forms we studied earlier and with other recently collected ones.

Material and methods

The comparisons made are based on data from the literature and on the study of colonies collect-

ed from Brazilian localities between 1985 and 1988. We studied the cnidome of material preserved in seawater formalin. Only undischarged nematocysts were measured, in several squashes. Each preparation consisted of only the hypostome with its capitate tentacles or only the circlet of filiform tentacles, both of a single hydranth; they were arbitrarily classified as *Few* (F) (<30 per preparation); and *Numerous* (N) (>30 per preparation). Weill's (1937) and Millard's (1975) nematocyst nomenclature was used.

The stems of bushy form (radial colonies) are those with the highest number of 1st order branches.

The abbreviations MNRJ and MS refer to the

Table 1. Comparison of some morphological character variation of *Halocordyle disticha* based on specimens previously studied in Brazil and on new samples. A: 30 pinnate colonies from São Sebastião (see Migotto & da Silveira, 1987). B: 8 pinnate colonies from Cabo Frio. C: indefinite number of bushy colonies (see description of *Halocrdyle fragilis* Vannucci, 1951). D: 1 bushy colony from Florianópolis. E: 1 bushy colony from São Sebastiän. Abbreviations: || character not given; $ character not observed.

Material	Pinnate form				Bushy form					
Structures	A Values		B Values		C Values		D Values		E Values	
	Range	(Mean)	Range	(Mean)	Range	(Mean)	Range	(Mean)	Range	(Mean)
Hydrocaulus										
Stem										
length (mm)	30–95	(53)	14.2–34.7	(20.9)	250–300	||	155–263	(209)	28.7–163	(99.2)
diameter (mm)	0.2–0.6	(0.38)	0.2–0.4	(0.3)	0.4–1.0	||	0.4–0.5	(0.45)	0.35–0.60	(0.41)
n° of rings	2–10	(4)	1–4	(3)	||	||	3–11	(5)	2–32	(6)
1 order of branching										
n° per stem	14–40	(24)	4–13	(8)	||	||	28–40	(34)	8–36	(24)
length of longest (mm)	5–18	(9.3)	0.8–13.5	(6.8)	||	||	57.5–89.8	(72.4)	11.6–111	(49.5)
diameter (mm)	0.16–0.2	(0.19)	0.2–0.2	(0.2)	0.2–0.3	||	0.3–0.5	(0.38)	0.2–0.4	(0.28)
distance between bases (mm)	1.10–4.7	(3.20)	1.7–5.2	(2.3)	5–10	||	5.86–6.17	(6.02)	1.1–9.8	(3.70)
n° of rings	1–6	(3)	1–7	(3)	5–9	||	2–10	(7)	3–27	(6)
Hydranth										
Pedicel										
length (mm)	0.20–1.40	(0.60)	0.8–04	(1.64)	2–3	||	1.5–3.6	(2.03)	1.2–3.0	(1.80)
diameter (mm)	0.06–0.12	(0.09)	0.1–0.2	(0.16)	||	||	0.2–0.3	(0.22)	0.1–0.2	(0.17)
n° of proximal rings	2–4	(3)	3–9	(5)	7–10	||	5–9	(7)	3–11	(6)
n° of distal rings	$	$	$	$	||	||	3–10	(5)	2–10	(5)
maximum n° per order	3–11	(7)	1–4	(2)	45–50	||	22–64	(36)	20–42	(31)
Length (mm)*	0.40–2.00	(1.10)	0.9–1.5	(1.32)	||	||	0.8–1.8	(1.44)	0.80–2.00	(1.00)
Diameter (mm)**	0.20–0.40	(0.32)	0.4–0.7	(0.53)	||	||	0.45–0.65	(0.53)	0.30–0.70	(0.49)
N° of tentacles***										
aboral	5–12	(9)	8–14	(10)	||	±14	10–15	(10)	10–15	(13)
oral	7–23	(16)	6–14	(10)	||	±12	9–18	(9)	9–15	(11)
Gonophores										
length (mm)	0.42–0.81	(0.70)	0.25–1.05	(0.69)	||	||	$	$	$	$
diameter (mm)	0.20–0.64	(0.50)	0.20–0.75	(0.56)	||	||	$	$	$	$

* from hydranth base to hypostome apex.
** at the level of the aboral tentacles.
*** in hydrants at the end of 1st and 2nd order branches.

collection of the Museu Nacional, Universidade federal do Rio de Janeiro and to the authors' collection, respectively.

I) Pinnate forms
Material A: 30 colonies from São Sebastião (23° 49′ S 45° 25′ W), 1984–85 (mentioned, Migotto & da Silveira, 1987: 112, Table 1).
Material B: 8 colonies from the ropes of a shipworm (Mollusca, Teredinidae) collecting device, up to 60‰ salinity, 4 July 1987, Lagoa de Araruama (22° 40′ S 42° 10′ W), Cabo Frio, (MNRJ 1150), M.J.M. Silva coll.

II) Bushy forms
Material C: indefinite number of colonies from Ilha de Trindade (20° 30′ S 29° 20′ W), São João da Barra (21° 40′ S 41° 00′ W) and Cabo Frio (mentioned, Vannucci, 1951: 76–77).
Material D: 3 colonies collected with trawl net, 11 Nov. 1987, Praia dos Ingleses (27° 26′ S 48° 24′ W), Florianópolis, (MNRJ 0382, MS), M. Kammers coll. 1 colony (kept dry) brought ashore in trawl, Sept. 1987, Praia do Pântano do Sul (27° 47′ S 48° 31′ W), Florianópolis, MS, M. Kammers coll.
Material E: 1 colony from partially buried rock, 6 m, 23 June 1988, Ponta do Baleeiro (23° 49′ 45″ S 45° 25′ 30″ W), São Sebastião, (MNRJ 0383, MS), A.E. Migotto coll.

Results

Material A: see Migotto & da Silveira (1987: 97–99, 111, Figs 1–2 and 112, Table 1).
Material B: colonies unfascicled, average 2 cm tall. Branched hydrorhiza. Dark brown stems and hydrocladia, separated by nodes with varied number of transverse rings. Hydrocladia alternate, biseriate, pinnate. Pedicels simple, some with rings at base. Hydranths on tips of stems and hydrocladia. Aboral tentacles filiform, oral tentacles capitate, latter usually in 3 alternating rows,

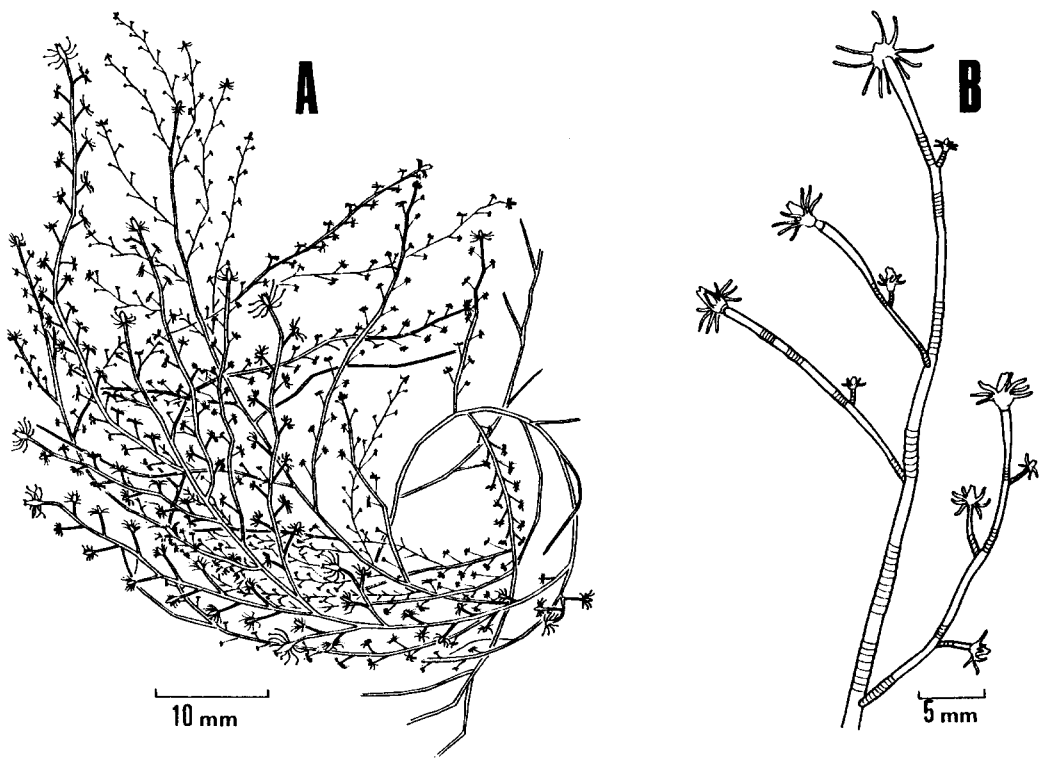

Fig. 1. Bushy colony of *Halocardyle disticha* (Goldfuss). A) general shape, B) distal portion with hydranths.

Table 2. Halocordyle disticha nematocysts: comparison of types, measurements (in μm), and distribution. A: pinnate colonies from São Sebastião (see Migotto & da Silveira, 1987). D: bushy colonies from Florianópolis (11 Aug. 1987). E: bushy colonies from São Sebastião (23 June 1988). Abbreviations: (N) numerous nematocysts; (F) few nematocysts.

Materials / Nematocysts	A	D	E
Oral tentacles			
Stenotele			
large	46.2–33.0 × 29.0–23.1 (N)	40.5–29.7 × 21.0–15.4 (N)	36.1–19.1 × 22.1–11.6 (N)
small	15.8–6.6 × 12.5–3.3 (N)	10.6–8.4 × 9.9–5.9 (N)	9.5–7.5 × 6.9–3.5 (N)
Microbasic mastigophore			
large	15.8–13.9 × 7.3–5.9 (F)		
small	10.6–8.9 × 4.0–2.6 (F)		
intermediate		14.9–7.3 × 6.4–2.1 (N)	14.2–7.8 × 5.3–1.9 (N)
Desmoneme	6.6–4.6 × 4.6–3.3 (N)	6.7–3.6 × 4.3–2.7 (F)	5.5–3.9 × 4.3–2.1 (F)
Aboral tentacles			
Stenotele	9.2–7.3 × 7.3–5.9 (N)	13.4–8.1 × 8.4–4.5 (N)	9.9–8.4 × 7.3–5.4 (N)
Microbasic mastigophore			
large	45.5–13.9 × 7.3–5.9 (N)	14.7–10.4 × 9.6–6.4 (N)	15.0–11.8 × 6.9–4.6 (N)
small	10.6–9.2 × 4.0–3.3 (F)	9.6–4.4 × 6.4–2.2 (F)	9.8–8.3 × 3.0–2.3 (F)
Desmoneme	6.6–4.6 × 4.6–2.6 (N)	6.3–4.3 × 5.0–2.2 (N)	6.7–3.1 × 5.4–3.0 (F)

that most aboral with 2–4 tentacles. Gonophores (= eumedusoids) symmetrical, elliptical, borne on hydranth between filiform and capitate tentacles. Eumedusoids with 4 radial canals; with manubrium almost as long as bell.

Material C: see Vannucci (1951: 76–77, 101, Figs 2–3).

Material D and E: large, subspherical, unfascicled colonies up to 30 cm across (dry specimen), with much entangled branches. Hydrorhiza branched, very crooked, stems almost black, barely distinguishable, nodes with varied number of transverse rings, and with 3 orders (Material D) and 4 orders (Material E) of branching. Branches alternate, almost black, some flexuose, in various planes. Pedicels simple, ringed basally and at tip. Hydranths on tips of stems and branches. Filiform aboral tentacles and capitate oral tentacles, latter usually arranged in 3 alternate rows, that nearest mouth with 4–8 tentacles. Gonophores immature, borne on hydranth between filiform and capitate tentacles.

Table 1 presents the morphological data of several pinnate and bushy colonies. Measurements of the gonophores of the bushy forms were not included because they were undeveloped. Figure 1 illustrates the bushy colonies. Table 2 presents a comparison of types, measurements, and distribution of *H. disticha* nematocysts.

Discussion

So far, 2 types of *Halocardyle* have been found on the Brazilian coast: a pinnate form with branches in one plane (Migotto & da Silveira, 1987), and a bushy form with branching in many planes (Fig. 1; see also description as *H. fragilis* Vannucci, 1951).

Vannucci (1951) considered the distinctive features of *H. fragilis* to be: 1) the general habit of the colony, 2) the low hydranth density, 3) the

great fragility of the perisarc, 4) the dimensions of the hydranths, 5) the redistribution of the perisarc rings, 6) the number and distribution of the tentacles.

The data concerning characters 4, 5, and 6 fall within the range of variation of our pinnate forms (Table 1). The number of pedicel rings (adding the distal and proximal) in the bushy forms is greater than in the pinnate forms. Thecate hydroids such as *Obelia* and *Campanularia* living in fast flowing water have fewer pedicel rings than in calm waters (Hughes, 1980). Among comments on *H. disticha*, showing its great phenotypic plasticity, Hirohito (1977) concluded that there is variation in the general dimensions and habits of the colonies, in the number of hydranths, and in the arrangement and number of perisarc rings and hydrocladia.

We did not observe in our live specimens the fragility of the perisarc described by Vannucci (1951). However, the fixative renders the perisarc stiff and more fragile, making it difficult to handle the colonies.

The cnidome (Table 2) of the bushy forms was similar to that of the pinnate forms studied by Migotto & da Silveira (1987). The size and abundance of the microbasic mastigophores of the oral tentacles of the bushy colonies differed from those in the pinnate colonies studied previously by us ('intermediate' in Table 2). Bouillon (1985) and Calder (1988) stated the cnidome of *H. disticha* to include desmonemes, stenoteles, microbasic euryteles and basitrichous haplonemes. We believe that their microbasic euryteles were actually mis-identified microbasic mastigophores. We have never seen any basitrichous haplonemes and neither did Östman *et al.* (1991).

The general habit of the bushy form (Fig. 1) is its most distinctive feature, readily separating it from the pinnate. The first is larger, with longer stems and branches, resulting in an apparent lack of hydranths. In fact there is no reduction in their number: they are merely spaced out.

For some time, bushy *H. disticha* were treated as a different species. But these forms do not even fit in most definitions of the family Halocordylidae. Brinckmann-Voss (1970) and Millard (1975), for instance, considered the Halocordylidae one of the few athecate families to have a regular, pinnate, branching colony.

However, there are descriptions of *H. disticha* without this typical pattern. Hirohito (1977) reported specimens with 3 orders of branching. Vervoort (1959) and Calder (1971), besides this type of branching, described another having a single order of branches irregularly arranged all round the stem. The forms studied by Calder were not so large or complex as our bushy colonies. However, we believe the occurrence of irregular 3rd and 4th orders of branching in various planes is the basic feature of bushy colonies.

Phenotypic variation is a problem in hydrozoan taxonomy. The direction of water flow determines significant morphological changes in hydrozoans. Many species in a more or less uni- or bi-directional flow have branching in one plane, perpendicular to the current. Other species from calm or turbulent waters under changing directions of flow have branching in many planes (see review by Wainwright *et al.*, 1976).

Wedler (1975) and Bandel & Wedler (1987) observed that the size and form of *H. disticha* colonies from hard bottoms varied with depth. In Colombia, *H. disticha* is small, compact, and crooked in the surf zone, and pinnate at depths of 1–50 m (Wedler, 1975). Bandel & Wedler (1987) found *H. disticha* in different environments in Colombia: from coral reefs and moderately exposed rocky shores, to the roots of the mangrove tree *Rhizophora*, in turbid, calm, hypersaline lagoons. The largest colonies were found in mildly turbulent waters, '... whereas in areas with strong surf and deeper more shaded zones colonies remain small.'

Mergner (1977), working in the coral reefs of the Red Sea and Caribbean, tried to characterize distinct biophysiographic zones using hydrozoans as indicator species (summary in Mergner, 1987). Out of 37 species, only 7 could be used as good indicators. Each had a different morphological response to water flow, light, or a combination of these two factors. *H. disticha* was considered a species from shallow, well-lit waters, where wave action was moderate.

We presume that the bushy and the typical

pinnate colonies are extremes of a range of morphological variation due to environmental influence. The large size of the bushy colonies that live on soft bottoms might be a response to weak water flow.

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