

Association between the polychaete *Procerastea halleziana* (Polychaeta: Syllidae: Autolytinae) and the hydroid *Tubularia crocea* (Cnidaria: Hydrozoa) from the Mar del Plata intertidal zone, Argentina.

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Abstract: Clumps of the hydroid *Tubularia crocea* (Cnidaria, Hydrozoa, Anthomedusae) are substrata for many epizoites, among them many species of polychaetes. The most frequently encountered species of polychaete in *Tubularia* clumps in Mar del Plata (Argentina) is the syllid *Procerastea halleziana*. The main aim of this study was to analyse the annual frequency and abundance of this polychaete associated with colonies of the tubularid in that area and to describe this species, new to Argentina and the Southern Hemisphere. *Procerastea halleziana* was frequent on *Tubularia crocea*, with maximum prevalences at the end of summer and the beginning of fall (March-April = 53.8–58.3% of the colonies are associated with the polychaete) and minimum in winter (August = 23.5%). The highest abundances were found during the warm season, but abundances were always low. The polychaetes live inside membranous tubes, which are attached along the stems of the colony. They were observed to feed by piercing the wall of hydranths and this relationship appears to be a kind of contramensalism, + -, with negative effects on the colonies.

Résumé: Association entre le polychète *Procerastea halleziana* (Polychaeta: Syllidae: Autolytinae) et l'hydraire *Tubularia crocea* (Cnidaria, Hydrozoa) dans la zone intertidale de Mar del Plata, Argentina. Les colonies de l'hydraire *Tubularia crocea* servent de substrat à de nombreux épibiontes parmi lesquels de nombreuses espèces de polychètes. Dans la zone intertidale de Mar del Plata, l'espèce d'épibionte la plus fréquente est le Syllidien *Procerastea halleziana*. Le but principal de notre étude était d'analyser, la fréquence et l'abondance de cette association au cours d'un cycle annuel et de décrire ce polychète nouveau pour l'Argentine et l'Hémisphère Sud. *Procerastea halleziana* est fréquent sur *Tubularia crocea* avec des valeurs maximum (53,8-58,3 %) à la fin de l'été et au début de l'automne (mars-avril) et des valeurs minimum (23,5 %) en hiver (août). Les fréquences et les abondances les plus élevées s'observent durant la saison chaude, mais les abondances sont toujours faibles. Le polychète vit dans un tube membraneux attaché le long de l'axe de l'hydraire ; il se nourrit en perçant la paroi des hydranthes de sorte que cette association apparaît comme une sorte de contracomensalisme + - avec des effets négatifs sur les colonies.

Keywords: Association, polychaetes, *Procerastea halleziana*, hydro-polyps.

Introduction

In the rocky intertidal of Mar del Plata, Zamponi & Genzano (1992) reported more than 10 phyla living on hydrocauli and hydrorhiza of *Tubularia crocea* (Agassiz, 1862), the most abundant hydroid in this zone. Colonies 5-9 cm in height occur all the year round, reaching their maximal abundance in summer and fall (Genzano, 1994). The clumps of *T. crocea* are substrata for many epizoites, among which the polychaete *Procerastea halleziana* Malaquin, 1893, (Syllidae, Autolytinae) is a frequent and constant associated species. The associations between polychaetes and other marine organisms were exhaustively reviewed by Martín & Britayev (1998), who consider *P. halleziana* as a facultative parasite.

Procerastea halleziana is a tubicolous syllid, living inside mucous tubes attached to stems of hydrozoan colonies. The species has been previously reported in Northern Europe, from the Skagerrak to the Bay of Biscay, as well as in the Western Mediterranean, parasiting *Syncoryne eximia* and *Tubularia indivisa* (Allen, 1921; Caullery, 1925; Gildholm, 1967). However, the presence of *P. halleziana* in Argentina is reported for the first time in the Southern Hemisphere, and its parasitic association with *Tubularia crocea* is also new to science.

The aim of this study was to analyse the seasonal pattern of frequency and the abundance of *Procerastea halleziana* associated with colonies of *Tubularia crocea* in Mar del Plata (Argentina) and to describe the polychaete specimens. The type of relationship between the polychaete and the hydroid is discussed here and the geographical distribution of the syllid is presented.

Material and methods

This research was carried out on the intertidal zone of Punta Cantera, Mar del Plata, Argentina (38°05'S - 57°32'W). This zone of quartzitic rocks comprises both exposed and sheltered areas, such as channels and crevices, inhabited by several benthic organisms (see Genzano, 1994; Acuña & Zamponi, 1995).

The hydroid *Tubularia crocea* is a common epizoic hydroid living on the small mussel *Brachydontes rodriguezii* (d'Orbigny, 1846) and each sampled "clump" on a bivalve was considered as one colony (see Genzano, 2002). Colonies of *Tubularia crocea* were collected monthly during low tide from February 2000 to January 2001 (except in September due to bad weather conditions) and immediately fixed in a 5% formaldehyde solution in sea water. A possible sample-area effect was minimized in choosing clumps 4 - 5 cm in height which occupied the total surface area of mytilids 2.5-3 cm in height.

The following quantitative descriptors were calculated for each sample according to Bush et al. (1997): prevalence (number of colonized colonies/total number of examined colonies); mean intensity (total number of polychaetes/number of colonized colonies) and mean abundance (total number of polychaetes/total number of colonies) which is equivalent to prevalence multiplied by mean intensity.

The polychaetes were isolated under a stereo microscope and studied under a microscope with an interferential system (Nomarsky) and a camera lucida. Body width measurements were taken across the proventricle and excluding parapodia or cirri. Body length measurements were taken excluding antennae and cirri. Some specimens were examined using a Scanning Electron Microscope (SEM), after critical point drying and coating with gold, at the SIDI (Servicio Interdepartamental de Investigación) of the Universidad Autónoma of Madrid. Specimens are deposited in the Laboratorio de Biología de Cnidarios (LABIC) (Argentina).

Results

Taxonomy

Genus *Procerastea* Langerhans, 1884

Procerastea halleziana Malaquin, 1893 figs 1, 2

Malaquin, (1893): 81: 26, 12:1-14. Allen (1921): 131-176, pl. 12-16. Fauvel (1923): 325, figs 126 d-h. Okada (1929): 325, fig. 1. Gidholm (1967): 208-210, figs 29 A-F. Alós (1989): 330-333, figs 2,3.

Material examined. Colonies of *Tubularia crocea* with associated *Procerastea halleziana* and isolated specimens of the polychaete are deposited in the Laboratorio de Biología de Cnidarios (LABIC) (Argentina). Reference: Asociados - Intermareal Punta Cantera, 0 - 1 m (2-00 to 12-00 and 1-01).

Description

Body long and slender up to 25 mm long, 0.25 mm wide, for 42 chaetigers. Prostomium ovate to semicircular; two pairs of eyes in an open trapezoidal arrangement. Three thick cylindrical antennae; the lateral ones originating in the anterior margin of the prostomium (about 2.5 times longer than prostomium), and the median one (about twice longer and thicker than lateral antennae) located slightly posteriorly (Figs 1b, 2a). Palps completely reduced, not perceptible (Figs 1b, 2a, b). Peristomium dorsally reduced; two pairs of tentacular cirri, similar in shape to antennae, but shorter, the ventral ones somewhat shorter than the dorsal (Figs 1b, 2a). Chaetiger 1 with dorsal cirri similar to the dorsal tentacular cirri; the remaining chaetigers without dorsal cirri (Figs 1b, 2a, b). Ventral cirri absent on all parapodia (Fig. 2c). Pygidium small, with two oval, short

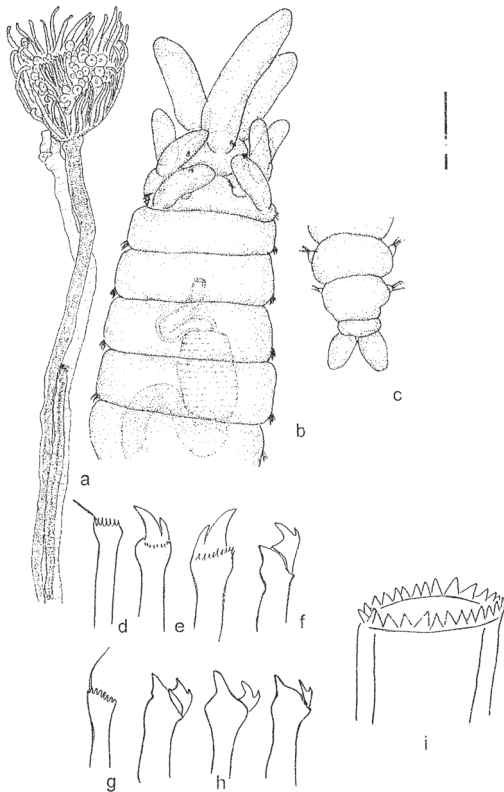


Figure 1. a. Polyp of *Tubularia crocea* with a tube of *Procerastea halleziana* attached. b-i. *Procerastea halleziana*. b. anterior end, dorsal view; note the three antennae, two pairs of tentacular cirri and the very similar pair of first parapodial cirri. c. posterior end, dorsal view. d. dorsal simple chaeta, anterior chaetiger. e. two simple chaetae, anterior chaetigers. f. compound chaetae, anterior chaetiger. g. dorsal simple chaeta, midbody chaetiger. h. three compound chaetae, midbody chaetigers. i. trepan.

Scales. a: 2 mm. b, c: 0.18 mm. d-i: 20 μ m

Figures 1. a. Polype de *Tubularia crocea* sur lequel est attaché un tube de *Procerastea halleziana*. b-i : *Procerastea halleziana* : b. extrémité antérieure, vue dorsale ; notez les trois antennes, les deux paires de cirres tentaculaires et la première paire de cirres parapodiaux semblable aux cirres précédents. c. extrémité postérieure, vue dorsale ; d. soie dorsale simple d'un sétigère antérieur ; e. deux soies simples d'un sétigère antérieur ; f. soie composée d'un sétigère antérieur ; g. soie dorsale simple d'un sétigère du milieu du corps ; h. trois soies composées d'un sétigère du milieu du corps ; i. trépan.

Echelles. a : 2 mm. b, c : 0,18 mm. d-i : 20 μ m.

anal cirri (Fig. 1c). Parapodia of the three anterior chaetigers each with about 3-4 simple chaetae and 1-3 compound chaetae. The simple chaetae have a blade fused to the shaft, hooked, with short distal teeth, sub-distally enlarged with a crown of small spines (Figs 1e, 2e); the compound chaetae with a long subdistal tooth and a short distal tooth, have

shafts subdistally enlarged, with some short spines (Figs 1f, 2e). From chaetiger 5, each parapodium with only three compound chaetae, similar to those of the anterior chaetigers, but with smaller blades (Fig. 1h). Only one dorsal simple chaeta from chaetiger one, with a wide distal end, provided with 7-8 short and one long spine (Figs 1d, g, 2e). Pharynx sinuose, short, extending through about 2-3 segments (Fig. 1b); trepan with 15-30 similar, triangular teeth (Fig. 1i). Proventriculus small, with 24-32 muscle cell rows.

Both male and female stolons provided with short, oval, dorsal cirri on all chaetigers (Fig. 2f). A pair of short, ciliated nuchal lappets, inconspicuous on a male stolon, is perceptible under SEM (Fig. 2d).

Distribution. This species was only known from the European Atlantic coasts, from the Skagerrak to the Gulf of Biscay; there is a single record in the Mediterranean Sea (Cabo de Creus, NE Iberian peninsula) (Alós, 1989). This is the first report for Argentina and the Southern Hemisphere. A similar species, *Procerastea nematodes* Langerhans, 1884, was reported for the Malvinas Islands (as *P. perrieri* Gravier, 1900) (Fauvel 1916); this species differs from *Procerastea halleziana* in the shape of the antennae, more elongated in *P. nematodes* (see Gidholm, 1967, fig. 30), and the presence of only eight teeth in the trepan, instead of 15-30.

Remarks

The Argentinian specimens of *Procerastea halleziana* differ slightly from Gidholm's description of North-Europe specimens in having fewer chaetae per parapodium and shorter blades on the compound chaetae. However the general aspect of the body, the proventriculus shape and the number of teeth on the trepan are inside the variability of the species, so we assume that the Argentinian specimens belong to *P. halleziana*.

The specimens live inside mucous, translucent tubes, attached externally to the stems of *Tubularia crocea*, usually with the upper opening located near the tentacles of the polyp, and the prostomium of the worm placed upwards (Fig. 1a). The worms are easily broken and regenerate quickly; many fragments with a simultaneous anterior and posterior regeneration have been found. The nuchal organs on the regenerated fragments are present and appear as two elongate ciliated areas (Fig. 2g).

Frequency and abundance of *P. halleziana*

A total of 213 colonies of *Tubularia crocea* were analysed: 83 of them had *P. halleziana* (N = 155 individuals) associated with their stems.

Prevalence values indicated that *P. halleziana* living on the hydroids were frequent all the year round, with maximum values at the end of summer and beginning of fall

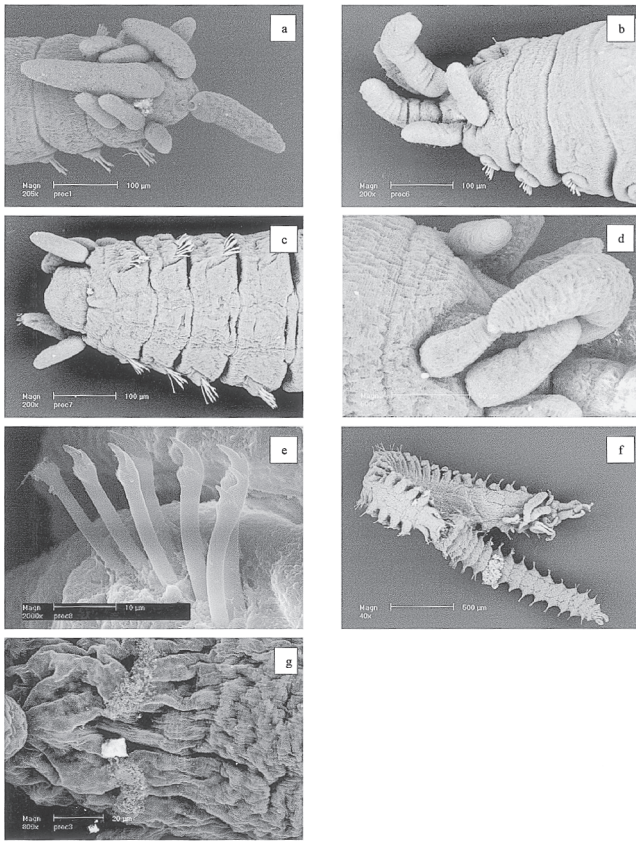


Figure 2. *Procerastea halleziana*, Scanning electron micrographs. **a.** anterior end, dorsal view. **b.** anterior end, latero-dorsal view. **c.** anterior end, ventral view. **d.** detail of a male stolon (*Polybostrichus*), anterior end, dorsal view. **e.** chaetae of chaetiger 3. **f.** male stolon. **g.** detail of nuchal organs of a regenerated specimen.

Figures 2. *Procerastea halleziana*, Microscopie électronique à balayage. **a.** extrémité antérieure, vue dorsale ; **b.** extrémité antérieure, vue latéro-dorsale ; **c.** extrémité antérieure, vue ventrale ; **d.** détail d'un stolon mâle (*Polybostrichus*), extrémité antérieure, vue dorsale ; **e.** soies du sétigère 3 ; **f.** stolon mâle ; **g.** détail des organes nucaux d'un spécimen régénéré.

(March–April) and minimum values in winter (August). The highest values of mean intensity and mean abundance were found during the warm season, but abundances were always low (Table 1, Fig. 3). In this study, 48.2% of the colonies had only one syllid associated on their hydrocaulus, and 26.5%, 16.9% and 6.0% of the colonies showed two, three and four polychaetes respectively, the maximum number of *P. halleziana* on a colony was six individuals (January, 2001), but an earlier exceptional record of 13 individuals was observed on a colony in April, 1998 (Genzano, unpublished).

Table 1: *Procerastea halleziana* associated with *Tubularia crocea* colonies. For each sample: Nt = total number of colonies; NC = number of colonies with *P. halleziana*; NP= number of polychaetes; * = no sample in this month.

Tableau 1: *Procerastea halleziana* associés aux colonies de *Tubularia crocea*. Pour chaque mois sur une année (sauf septembre, *) : Nt = nombre total de colonies ; NC = nombre de colonies avec *P. halleziana* ; NP= nombre de polychètes.

Date:	Nt	NC	NP
February 17, 2000	14	6	13
March 14, 2000	12	7	15
April 11, 2000	13	7	16
May 10, 2000	18	7	13
June 08, 2000	16	7	13
July 08, 2000	18	7	12
August 07, 2000	17	4	5
September, 2000	*	--	--
October 17, 2000	28	9	18
November 15, 2000	19	7	6
December 13, 2000	32	12	19
January 15, 2001	26	10	25
total	213	83	142

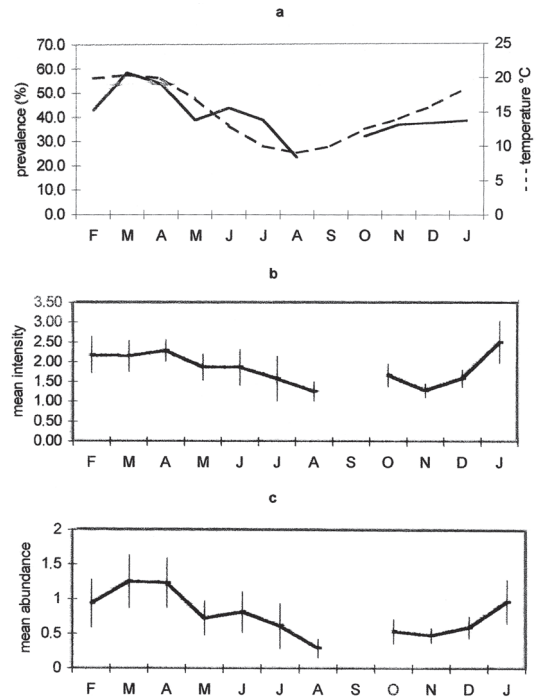


Figure 3. *Procerastea halleziana* associated with *Tubularia crocea* colonies. Quantitative descriptors calculated for each sample. **a.** prevalence (--- --- water temperature); **b.** mean intensity (± 1 SD); **c.** mean abundance (± 1 SD).

Figures 3. *Procerastea halleziana* associés aux colonies de *Tubularia crocea*. Descripteurs quantitatifs calculés pour chaque mois sur une année (sauf septembre). **a.** prévalence (--- --- température de l'eau) ; **b.** intensité moyenne (± 1 SD) ; **c.** abondance moyenne (± 1 SD).

Discussion

Colonies of *Tubularia crocea* support an important number of associated organisms from diatoms and protozoans to tunicates (Genzano, 2001; Zamponi & Genzano, 1992), and the tubicolous syllid *Procerastea halleziana* is a frequent epizoite on colonies from the rocky intertidal zone.

In the port area of Mar del Plata or concrete blocks of artificial defences *T. crocea* was present only for short periods of time during the warm season and the syllids were not found on those colonies. This fact suggests that the most adequate conditions for the presence of *P. halleziana* all the year round is the constant occurrence of *T. crocea* colonies.

Nine hydroid species cohabit with *Tubularia crocea* in the rocky intertidal of Mar del Plata (Genzano, 1994). However, tubes of *P. halleziana* were only found on *Sarsia* (= *Syncoryne*) *sarsii* (Loven, 1836). One hundred colonies of this species were analysed during 1990 and the syllid was found on only two of them. In the sublittoral, the presence of *Procerastea halleziana* was only noted on few colonies of the Sertulariidae *Amphisbetia operculata* (L.) (Genzano, unpublished).

Procerastea halleziana has already been reported as a common epibiont on other hydroids (Caullery, 1925; Gidholm, 1967). Furthermore this species was reported inside ascidians, among algae, on stones and shells, on the bryozoan *Flustra foliacea* (Gidholm, 1967), among mussels and on the gorgonian *Paramuricea clavata* (Alós, 1989). Allen (1921) found individuals associated with *Syncoryne eximia* living on floating wood, one way to achieve widespread dispersal and this suggests that *P. halleziana* could have colonized some distant areas of the Atlantic Ocean by means of floating substrates with hydroids.

The polychaete live inside membranous tubes, attached along the stems of *Tubularia crocea* colonies, open at both ends, and usually much longer than the worm. The upper tube opening is situated just below the base of the hydranth. In vivo observations showed that the worms move up and down the tubes and frequently leave them. Afterwards, the individuals returned to their tubes or occupy any other empty tube. The worms have their heads near the tentacles of the polyps. Some individuals were observed to feed by piercing the wall of the hydranths, a behaviour also reported by Allen (1921) for *P. halleziana* associated with *Syncoryne eximia*.

In addition to sexual reproduction, *P. halleziana* multiplies by means of fragmentation and regeneration of the anterior and posterior ends. Some tubes were occupied by two, exceptionally three small individuals, possibly as a consequence of this asexual reproductive process.

Lagardère & Tardy (1980) recorded an Autolytinae, *Alluandella* sp., associated with the tubularid *Ectopleura dumortieri* (Van Beneden, 1844). This tubicolous syllid protected the hydranths of their host from being attacked by predators (mutualistic association +). This behaviour was

not observed in the association *P. halleziana*-*T. crocea*. Some of the hydranths were associated with predators, such as caprellids, gammarids and pycnogonids, but the polychaetes did not react to their presence. As the syllids were observed to feed on the hydranths, the relationship appears to be a kind of contramensalism + - (Arthur & Mitchel, 1989), with only negative effects on the colonies.

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