

## Infestation of *Polydora rickettsi* (Polychaeta: Spionidae) in shells of *Crepidula fecunda* (Mollusca: Calyptraeidae) in relation to intertidal exposure at Yaldad Bay, Chiloe, Chile\*

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**SUMMARY:** We studied the infestation of the burrowing polychaete *Polydora rickettsi* on the shells of *Crepidula fecunda* in relation to the degree of intertidal exposure in Yaldad Bay (Chile). 175 specimens of *C. fecunda* were collected from five stations located at tidal levels experiencing air exposures of 0, 2, 4, and 6 hours, respectively. The spionid *Polydora rickettsi* inhabited *C. fecunda* shells and occurred at all the sampling stations. However, only those gastropods exposed for two hours showed significantly higher degrees of infestation. Gastropods collected under and over that tidal level exhibited lower degrees of infestation and were not significantly different among them. There was not a clear relationship between shell surface and polychaete infestation. Large *P. rickettsi* were found only at the station with the highest gastropod aggregation at the lower intertidal, suggesting that exposure exerts some limitation to old but not necessarily young infesting polychaetes.

*Key words:* Polychaeta, Spionidae, *Polydora rickettsi*, intertidal, *Crepidula fecunda*.

**RESUMEN:** INFESTACIÓN POR *POLYDORA RICKETTSI* (POLYCHAETA: SPIONIDAE) EN CONCHAS DE *CREPIDULA FECUNDA* (MOLLUSCA: CALYPTRAEIDAE) EN BAHÍA YALDAD, ISLA DE CHILOÉ, CHILE, Y SU RELACIÓN CON EL PERÍODO DE EXPOSICIÓN INTERMAREAL. – Se estudio la infestación del poliqueto perforador *Polydora rickettsi* en conchas de *Crepidula fecunda* en relación a los niveles de exposición mareal en Bahía Yaldad (Chile). Se recolectaron 175 especímenes de *C. fecunda* desde cinco estaciones ubicadas a niveles mareales expuestos a desecación por 0, 2, 4 y 6 horas, respectivamente. El espionido *Polydora rickettsi* fue encontrado habitando conchas de *C. fecunda* en todas las estaciones. Sin embargo, solo aquellos gastrópodos expuestos por 2 horas mostraron grados de infestación significativamente más altos. La infestación sobre gastrópodos recolectados por debajo y encima de ese nivel mareal fue menor y no significativamente diferente. No se detectó una clara relación entre superficie de la concha y el grado de infestación. Las mayores tallas de *P. rickettsi* fueron observadas en el intermareal inferior donde se agregaron la mayor cantidad de gastrópodos. Este resultado sugiere que la exposición mareal limita la distribución de poliquetos infestantes maduros, pero no necesariamente la de juveniles.

*Palabras clave:* Polychaeta, Spionidae, *Polydora rickettsi*, intermareal, *Crepidula fecunda*.

### INTRODUCTION

Polychaetes include free-living, tube-dwelling and substrate-burrowing species, the latter developing

relations with other invertebrates which may include strict commensal associations (Martin and Britayev, 1998). A large portion of the burrowing polychaetes belong to the family Spionidae, particularly the genera *Polydora* and *Boccardia*, and typically cause great damage to the mollusc shells that they colonize

\*Received April 26, 2004. Accepted July 16, 2004.

(Owen, 1957; Bower and Meyer, 1994; Martial *et al.*, 1990). The burrowing activity of these polychaetes may be carried out by glandular or mechanical mechanisms, the latter of which is carried out by specialized chaetae of the fifth modified setiferous segment, which is a taxonomic character for the two genera mentioned above (Heigler, 1969).

Diverse species of *Polydora* associated with molluscs have been described from Chile. They inhabit bivalves (e.g. *Aulocomya ater*, *Choromytilus chorus*, *Ostrea chilensis*, *Crassostrea gigas*, *Argopecten purpuratus* and *Perumytilus purpuratus*) and gastropods (*Concholepas concholepas* and *Fissurella maxima*) (Rozbaczylo *et al.*, 1994; Rozbaczylo and Carrasco, 1996; Sato-Okoshi and Takatsuka, 2001). The association between *Polydora cf. rickettsi* and an unidentified *Crepidula* species was first documented by Sato-Okoshi and Takatsuka (2001).

*Crepidula fecunda* Gallardo, 1979 is a common sedentary filter-feeding snail occupying boulders from the intertidal to subtidal zones bordering the shores of channels and interior bays of the southern Chilean archipelagos. Intertidal individuals are exposed to physical and chemical changes regulated by exposure and immersion cycles (Sanders, 1968; 1969; Slobodkin and Sanders, 1969; Newell, 1976). The burrowing polychaetes inhabiting shells of intertidal molluscs feed on the organic fraction of sedimentary particles, as well as on planktonic and meiobenthic organisms, and are considered to be both filter and sedimentary feeders (Daro and Polk, 1973; Fauchald and Jumars, 1979; Dauer, 1980; Owen, 1957). In both cases, the polychaetes are limited to feeding during immersion.

The objective of the present study was to study the infestation of *Polydora rickettsi* Woodwick, 1961 on *Crepidula fecunda* and whether or not the period of tidal exposure affecting *C. fecunda* influences the populations of *Polydora rickettsi* inhabiting their shells.

## MATERIALS AND METHODS

Samples of polychaetes were from shells of *C. fecunda*, a mollusc inhabiting a boulder beach of Yaldad Bay (Chiloe Island, Chile; 73°43'15"W; 43°07'30"S). Five sampling stations were established from the subtidal zone (Stations 1, 2) up through the intertidal zone (stations 3, 4, 5). The stations were located at 5 different levels and each level was nine

TABLE 1. – Exposure time (hrs) of *Crepidula fecunda*, Density (ind. m<sup>-2</sup>) of *Crepidula* and size range (cm)

	St. 1	St. 2	St 3	St. 4	St. 5
Exposure	0	0	2	4	6
Density	26	30	51	20	16
Size range	1.2-2.5	1.0-3.0	0.5-4.5	0.5-2.5	0.5-2.5

metres apart. The station's exposure at low tide was estimated using a 1:12 method (Guías Glénans, 1995), which is calculated as the difference between high and low tides, divided by 12. A total of 175 snails (35 snails per station, collected along the beach) were collected and all specimens were individually fixed in 10% formalin-seawater and stored for subsequent examination in the laboratory.

Each snail collected was photographed in the laboratory using a Pixera model # 100c, using an ATI "All in Wonder" card ®. These photographs were processed using Scion Image 3.0 ® software to estimate the shell's surface area available for polychaete settlement. The shells were then decalcified by maintaining them for 12 h in 5% HNO<sub>3</sub>. These preparations were neutralised for a further 12 h with a 5% of sodium sulphate solution. After intense washing with tap water, the polychaetes from each snail were collected and counted.

The polychaetes were filmed using a Sony video tape recorder, and all images were digitalized in JPG format using the ATI "All in Wonder" card for subsequent measurement using the Scion Image 3 software. Lengths of incomplete individuals were estimated based on an exponential relation between the width of the fifth setiferous segment and the total length of 25 previously calculated individuals ( $y = 1.1191e^{4.5402x}$ ;  $R^2 = 0.9107$ ).

The level of infestation of *C. fecunda* was expressed as a percentage of all individuals sampled at each station which had polychaetes in their shells.

Data were checked for normality, independence and homogeneity of variances before one-way analysis of variance was conducted. A Tukey HSD a posteriori test was applied to discriminate between paired samples when significant differences were detected. The taxonomic analysis was done following the key presented by Blake (1996).

## RESULTS

Stations 1 and 2 (subtidal) were always covered with water, while stations 3, 4 and 5 had mean times

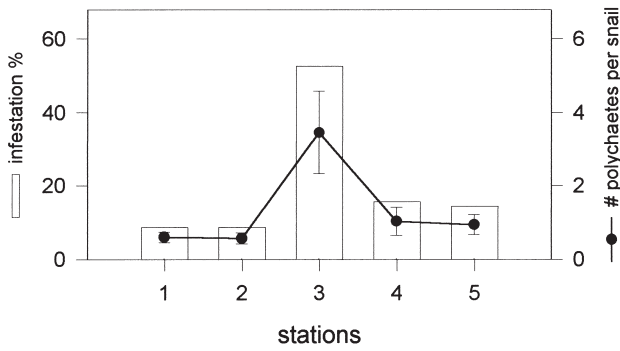


FIG. 1. – Percentage of *C. fecunda* shells infested with *P. rickettsi* (open bars), and rate of infestation per individual shell (line), at the five stations.

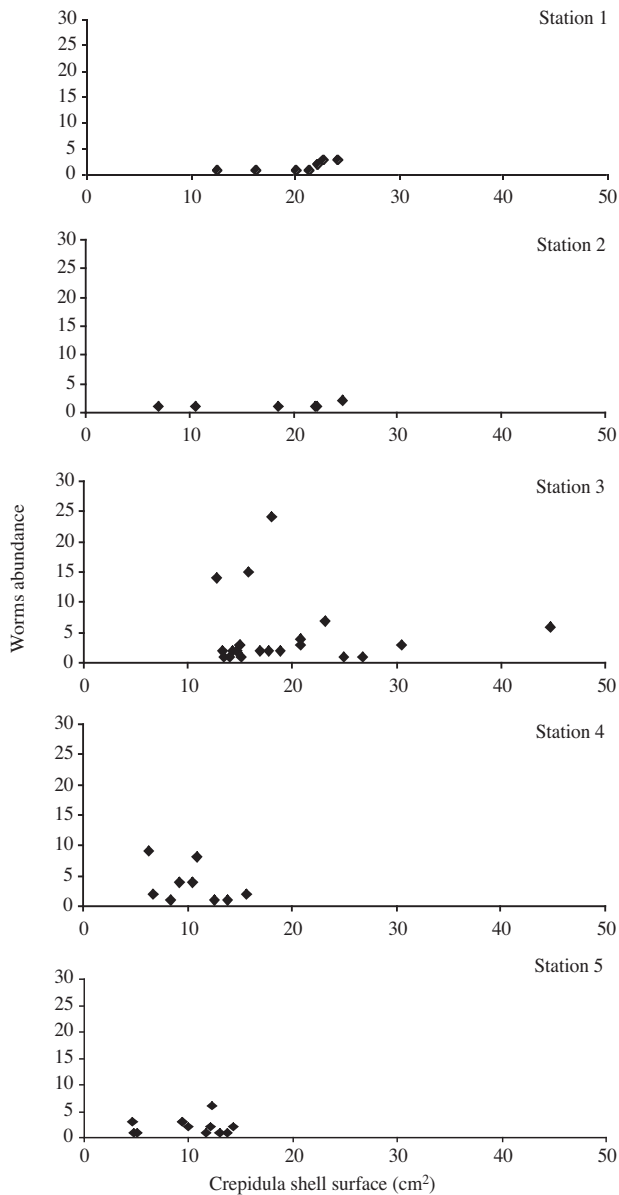


FIG. 2. – Relationship between abundance of *P. rickettsi* and surface area of shells of *C. fecunda*.

of intertidal exposure of 2, 4, and 6 hours respectively (Table 1).

The highest infestations by polychaetes were detected at station 3 (52%), while the remaining stations showed infestations of less than 20% (Fig. 1).

The abundance of *P. rickettsi* in *C. fecunda* showed significant differences ( $F_{4,170} = 4.78$ ,  $P = 0.001$ ) between the stations sampled (Fig. 1). Station 3 was found to be responsible for this effect, having a significantly greater abundance than the remaining stations (Tukey HSD  $P < 0.05$ ), whereas there were no significant differences between the remaining stations.

Infestation of *P. rickettsi* in relation to shell surface of *C. fecunda* did not vary significantly with regard to sampling stations. The highest polychaete infestation occurred at shell surfaces ranging between 5 and 30 cm<sup>2</sup>. Polychaete densities were not

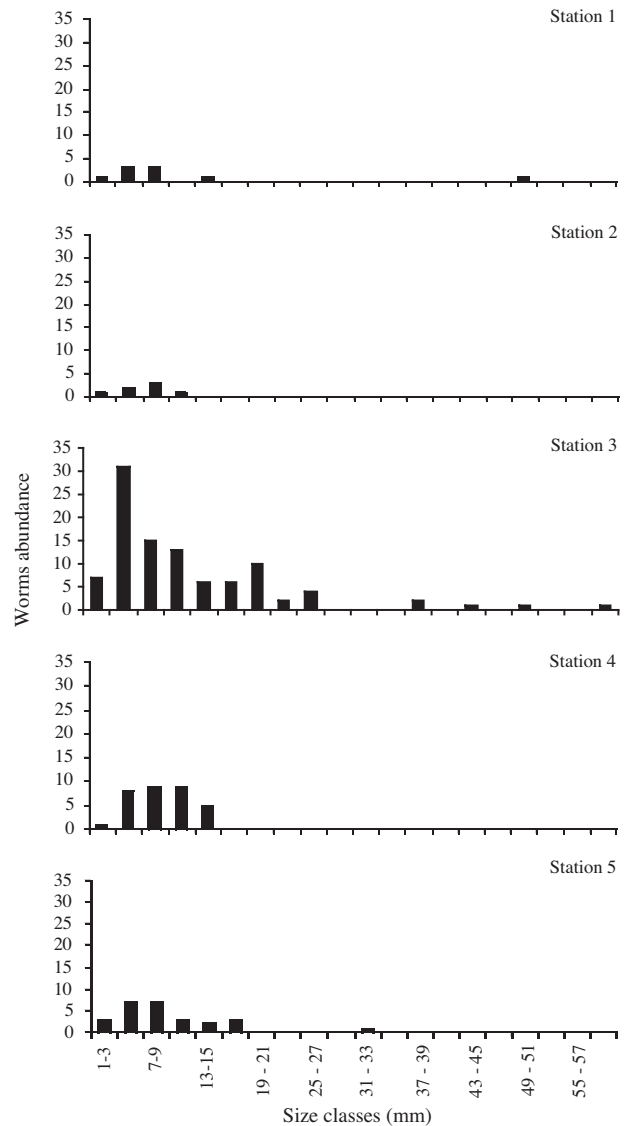


FIG. 3. – Abundance of polychaetes in relation to their size.

significantly related to *C. fecunda* shell surface ( $F_{4; 170} = 1.90$ ,  $P = 0.1$ ) (Fig. 2).

The polychaete size with the greatest abundance of individuals was 3 to 6 mm at all the stations, except at station 3, which showed a greater size variety, including the longest polychaetes. The size distribution of *P. rickettsi* showed a significant relation ( $F_{19; 80} = 5.04$ ,  $P = 0.0001$ ) with their abundance (Fig. 3).

## DISCUSSION

Densities of *P. rickettsi* were significantly higher in station 3. This suggests that polychaetes prefer a given zone of the intertidal that coincides with the highest abundance of *Crepidula fecunda* (Segura 2001). Furthermore, beneath a depth of 3 metres, the bottom changes from boulders to mud (pers. obs.). Schleyer (1991) suggested that the greatest density of polychaetes infesting the oyster *Striostrea margaritacea* were found in those occurring subtidally. Our results disagree with that, as we found the highest level of infestation at a two hour tidal exposure level.

Tidal changes and wind action produced sediment resuspension in the study area, serving as a food source for suspension feeders. *Polydora* spp. and *Crepidula dilatata* (like *C. fecunda*, Chaparro *et al.*, 1998) feed on plankton and suspended food particles, and thus benefit from local resuspension of fine sediments (Daro and Polk, 1973; Fauchald and Jumars, 1979; Dauer, 1980; Owen, 1957). This resuspension of sediments and organic material probably benefits *P. rickettsi*, and may be limited by exposure at low tide.

Our statistical analyses show that there is no significant relationship between polychaete density and snail surface area. That result suggests that *P. rickettsi* does not prefer shells already heavily occupied by conspecifics, although there is some degree of aggregation in surfaces ranging between 5 and 30 cm<sup>2</sup>.

Occurrence of small sized *P. rickettsi* (3-6 mm) across all the stations, suggests that juvenile stages of this species are not limited by tidal exposure. In contrast, the distribution of larger (older) worms was restricted to station 3 only, suggesting that exposure to desiccation (among other factors) might limit late stages to a more discrete tidal range. The presence of older stages of *P. rickettsi* at station 3 partially differs from observations by Zajac (1991), Stephen (1978) and Wisely *et al.* (1979). These authors suggested that salinity and desiccation exerted a strong impact on *Polydora* populations

and reduced their densities, especially in rainy seasons and at stations with greater exposure times.

Our results suggest that intertidal exposure alone does not limit the infestation of *C. fecunda* by young stages of *P. rickettsi*, but may limit the distribution of older stages to a fringe located in relatively low intertidal levels.

## ACKNOWLEDGEMENTS

We thank Dr Oscar Chaparro (Instituto de Biología Marina, Universidad Austral de Chile, Valdivia Chile) who collaborated in sample collection and ms preparation, and Dr Daniel Martín (Centre d'Estudis Avançats (C.S.I.C.) Camí de Santa Bàrbara, Blanes (Girona), Spain) who read and improved an earlier ms.

We also thank two anonymous reviewers who improved a previous manuscript and Dr. Sandor Mulsow for his help in correcting the English of this manuscript.

This study was carried out with financial assistance provided by the FONDECYT Project 1980984 and Sub-Program 45703926, Facultad de Ciencias, Universidad Austral de Chile.

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Scient. ed.: G. Pequeño

