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## Parasite communities of *Scartichthys viridis* (Pisces: Blenniidae) from Central Chile: locality vs. host length

Comunidades de parásitos de *Scartichthys viridis* (Pisces: Blenniidae) de Chile central: localidad vs. longitud del hospedador

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**Resumen.** Se describen y comparan las comunidades de parásitos en el pez blénido *Scartichthys viridis* de El Tabo y Las Cruces, dos localidades cercanas de Chile central. Catorce especies parásitas fueron encontradas, cuatro de ellas fueron persistentes a través de las muestras. Hubo una correlación positiva y significativa entre la riqueza, la abundancia infracomunitaria de parásitos y la longitud total del hospedador. *Scartichthys viridis* de ambas localidades tuvo similar

composición parasitaria, aunque las diferencias locales en los descriptores parasitarios poblacionales y comunitarios, mayores en peces de Las Cruces, podrían atribuirse a que el tamaño corporal del hospedador fue significativamente mayor en Las Cruces que en el Tabo.

Palabras clave: Parásitos metazoos, pez blénido, tamaño corporal del hospedador

### Introduction

The diminishing proportion of shared species between two communities with increasing geographical distance is an obvious feature of natural systems (Hengeveld 1990, Huston 1994, Rosenzweig 1995, Brown & Lomolino 1998, Hubbell 2001). This relationship observed in parasite communities, in which there is evidence that distance between host populations affects similarity in the species composition of parasite communities (Poulin & Morand 1999). However, some studies have demonstrated that hosts, of a certain species, collected from close localities may have different parasite communities (e.g. Muñoz *et al.* 2002). These results indicate that other factors, such as specific environmental conditions of each locality and displacement capacities of hosts and parasites may produce differences in parasite communities in hosts from close localities.

In 2007, during several sampling surveys performed in ponds from two close localities, observations showed apparent differences in the parasite communities of blennies. The blenny *Scartichthys viridis* (Valenciennes, 1836) (Pisces: Blenniidae) is an abundant species that lives in intertidal ponds along the rocky coast of Central Chile (Varas & Ojeda 1990, Muñoz & Ojeda 2000, Ojeda *et al.* 2000). This fish recruits into intertidal ponds when reaches 30 mm of total length, whereas adults can measure up to 310 mm (Muñoz & Ojeda 2000). There

are two previous studies on parasites of this fish species, one considered temporal variation of parasite communities in a locality of central Chile (Díaz & George-Nascimento 2002) and the other compared the parasites between host species of *Scartichthys* and localities of northern Chile (Flores & George-Nascimento 2009).

*Scartichthys viridis* has 30-40% of site fidelity, which means that this fish returns constantly to the same ponds (pers. comm. Dr. Ojeda<sup>1</sup>). This life feature can affect the relationship with other species, such as competitors, prey and parasites, in different localities because the flora and fauna of each place are usually not the same. Therefore, it is possible to expect that specimens of *S. viridis* may harbor different composition and load of parasites even though they come from close localities. In this context, this research describes and compares the parasite communities of *S. viridis* using samples from two close localities from Central Chile.

### Material and methods

Fish samples were collected from intertidal ponds found in the rocky shore at El Tabo (33°27'S; 71°40'W) and Las Cruces (33°30'S, 71°37'W), Central Chile. These

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two localities are about 4 km apart from each other. The study was done comparing three samples from similar times periods in each locality, to check if the differences of the parasite communities between localities were persistent among the samples. These samples were taken in different austral winter months, July 2007 (sample 1), August 2007 (sample 2) and July 2008 (sample 3), from El Tabo and Las Cruces. The sample sizes were variable among months and localities (Table 1); the total sample size corresponded to 131 specimens from El Tabo and 87 from Las Cruces.

Endo and ectoparasites were collected from each fish according to classical dissection techniques (Díaz & George-Nascimento 2002). At a parasite population level, prevalence and average abundance were calculated for each parasite species, locality and sample (Bush *et al.* 1997). At a parasite infracommunity level, average of total abundance and species richness were obtained for sample and locality (Bush *et al.* 1997). The total prevalence of parasites was also calculated (Díaz & George-Nascimento 2002). The community descriptors were compared between localities by the means of

**Table 1**

**Parasites found in *S. viridis*. Prevalence (P, %) and average abundance (A) ± standard deviation for each parasite species, sample and locality**

Parásitos encontrados en *S. viridis*. Prevalencia (P, %) y abundancia media (A) ± desviación estándar para cada especie parásita, muestra y localidad

Parasites		EL TABO			LAS CRUCES		
		Sample 1 (n= 30)	Sample 2 (n= 56)	Sample 3 (n= 45)	Sample 1 (n= 20)	Sample 2 (n= 16)	Sample 3 (n= 51)
<b>ECTOPARASITES</b>							
Piscicolidae gen sp. (Pisc) †	P	16.7	47.4	44.4	40.0	87.5	49.0
	A	0.30 ± 0.84	0.61 ± 0.97	0.60 ± 0.78	0.65 ± 0.99	3.94 ± 3.91	1.12 ± 1.84
<i>Acanthochondria sicyasis</i>	P				5.0		
	A				0.05 ± 0.22		
<i>Lepeophtheirus zbigniewi</i> (Lzib)	P	6.7			30.0	18.7	1.9
	A	0.10 ± 0.40			0.65 ± 1.27	0.38 ± 0.89	0.02 ± 0.14
<i>Colobomatus</i> sp. (Colo)†	P	46.7	51.4	75.6	55.0	93.7	74.5
	A	0.73 ± 0.87	0.68 ± 0.92	1.04 ± 0.74	1.10 ± 1.12	2.06 ± 1.06	1.25 ± 0.93
<i>Holobomolochus chilensis</i> (Hchi)	P		2.7			6.2	
	A		0.04 ± 0.27			0.13 ± 0.50	
<i>Microcotyle</i> sp. (Micr)	P	13.3	31.4	6.7	35.0	56.2	51.0
	A	0.33 ± 1.30	0.48 ± 0.97	0.24 ± 1.23	0.95 ± 1.99	2.00 ± 3.72	1.25 ± 1.25
<i>Neobenedenia mellen</i> (Nmel)	P			2.2	10.0		
	A			0.02 ± 0.15	0.10 ± 0.31		
<i>Gyrodactylus</i> sp.†	P	nm	nm	100.0	nm	nm	96.1
<b>ENDOPARASITES</b>							
Lecithasteridae gen sp. (Leci)†	P	20.0	25.7	46.7	30.0	56.2	35.3
	A	0.23 ± 0.50	0.71 ± 2.35	1.07 ± 1.83	1.05 ± 2.11	1.81 ± 2.26	0.59 ± 1.13
<i>Helicometrina nimia</i>	P		1.43				
	A		0.02 ± 0.13				
<i>Monascus filiformis</i>	P				5.0		
	A				0.05 ± 0.22		
<i>Hemipera</i> sp.	P	3.3	1.4				2.0
	A	0.03 ± 0.18	0.05 ± 0.36				0.02 ± 0.14
<i>Megasolena</i> sp. (Mega)†	P		12.9	2.2	25.0	50.0	17.6
	A		0.04 ± 0.19	0.02 ± 0.00	1.00 ± 2.92	1.25 ± 1.88	0.29 ± 0.73
<i>Corynosoma</i> sp.	P		1.4				
	A		0.02 ± 0.13				
Average total abundance		1.73 ± 2.58	2.66 ± 3.80	3.02 ± 2.61	5.65 ± 7.70	11.57 ± 6.38	4.56 ± 4.17
Average species richness		1.07 ± 1.28	1.32 ± 1.15	1.80 ± 1.10	2.40 ± 2.26	3.69 ± 0.95	2.33 ± 1.26

nm: not measured; † Undescribed species

ANOVA and contingency tables (Zar 1999). Data on species richness and abundance of parasite infracommunities were log-transformed ( $x+1$ ) to apply linear regressions with host body length (Zar 1999). ANCOVA was used to compare the slopes of those relationships between localities. A correspondence and a multivariate discriminant analysis was performed between localities to assess differences in composition parasite infracommunities, based in the infracommunity abundance, and a correspondence analysis was applied for prevalence and mean abundance of the parasite species with at least 5% of prevalence, to associate parasite species and localities (Clarke & Warwick 1994).

## Results

The total length of *Scartichthys viridis* had significant differences between localities (ANOVA:  $F_{(1,211)} = 80.69$ ;  $P < 0.001$ ) and samples (ANOVA:  $F_{(2,211)} = 11.28$ ;  $P < 0.001$ ). The total average length of fish collected from El Tabo ( $\bar{X} = 8.00 \pm 2.43$  cm) was significantly smaller than Las Cruces ( $\bar{X} = 11.00 \pm 4.45$  cm).

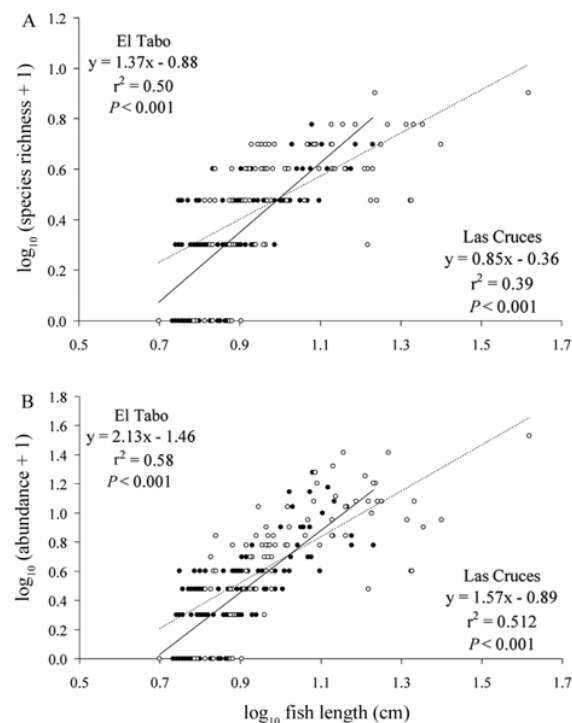
Fourteen parasite taxa were found; eight were ectoparasites and six endoparasites (Table 1). The total prevalence was 74% in El Tabo and 89% in Las Cruces, this parasite descriptor was significantly different between localities ( $\chi^2 = 5.92$ ;  $P = 0.015$ ).

Prevalence and abundance of all parasite species varied between localities and samples (Table 1), although these descriptors tended to be higher in Las Cruces than El Tabo. Four parasite species were the commonest throughout localities and samples (Table 1): *Colobomatus* sp. (Copepoda), an undetermined leech (Piscicolidae), *Microcotyle* sp. (Monogenea) and an undetermined species of Lecitasteridae (Digenea). *Colobomatus* sp. and the leech showed significant differences in abundance between localities ( $P = 0.001$  for both species), particularly because the sample 2 from Las Cruces had the highest abundance of these parasites; *Microcotyle* sp. had higher abundance in Las Cruces than El Tabo in all samples ( $P = 0.029$ ); whereas the abundance of Lecitasteridae gen sp. showed no differences between samples and localities ( $P = 0.067$ ). The prevalence of these four parasite species was consistently higher in Las Cruces than in El Tabo, when comparing between localities ( $P < 0.01$  for all species), however, there were some variations among samples; sample 3 from El Tabo had higher prevalence of Lecitasteridae gen. sp. than Las Cruces, and sample 3 from both localities had similar prevalence of the leech.

The infracommunity abundance was higher in Las Cruces ( $n = 87$ ,  $\bar{X} = 6.10 \pm 6.11$  parasite individuals)

than in El Tabo ( $n = 131$ ,  $\bar{X} = 2.57 \pm 3.18$  parasite individuals). Similarly, infracommunity species richness of parasites in Las Cruces ( $\bar{X} = 2.57 \pm 1.57$  species) was higher than in El Tabo ( $\bar{X} = 1.44 \pm 1.19$  species).

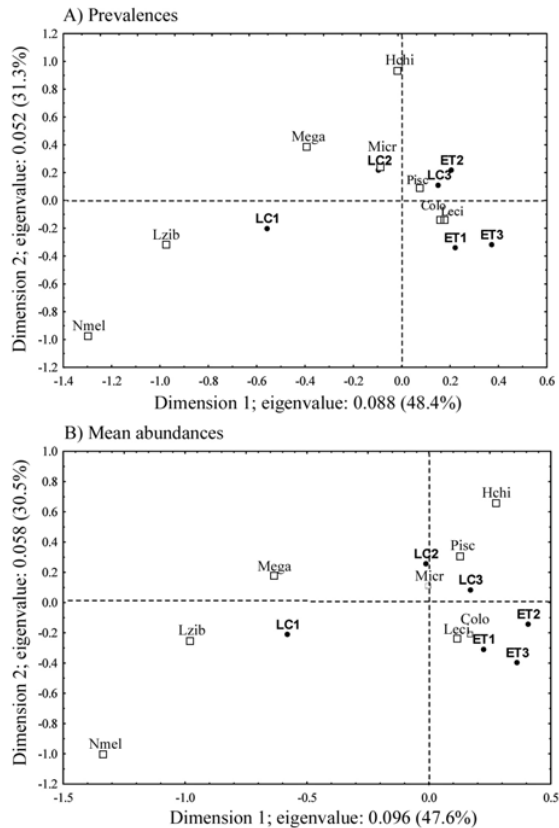
The abundance of the four commonest parasites significantly correlated to the fish total length ( $r_s > 0.32$ ,  $P < 0.05$  for these species). The parasite species richness and infracommunity abundance related significantly with host total length in both localities, El Tabo and Las Cruces (Fig. 1). There were significant differences in the slopes of the species richness ( $P = 0.002$ ) and the abundance ( $P = 0.016$ ) related to host body length between localities, although there were no differences in the adjusted means of species richness ( $P = 0.26$ ) and abundances of parasites ( $P = 0.27$ ) between localities.



**Figure 1**

**Relationship between A) species richness, B) abundance of parasites and fish total length (cm) of *S. viridis* sampled from El Tabo (black circles-complete line) and Las Cruces (white circles-pointed line)**

Relación entre A) riqueza de especies parásitas, B) abundancia y la longitud corporal del hospedador (cm) *S. viridis* recolectados de El Tabo (círculos negros-línea completa) y Las Cruces (círculos blancos-línea de puntos)



**Figure 2**

**Correspondence analysis between parasite species (□) of *Scartichthys viridis* and samples (1, 2 and 3) from different localities (●), ET: El Tabo, LC: Las Cruces, considering A) Prevalence and B) Mean abundance of parasites. Species abbreviation indicated in Table 1**

Análisis de correspondencia entre las especies de parásitos (□) de *Scartichthys viridis* y las muestras (1, 2 y 3) obtenidas de distintas localidades (●), ET: El Tabo, LC: Las Cruces, considerando A) Prevalencia y B) Abundancia media de parásitos.

Abreviaciones de las especies indicadas en la Tabla 1

The correspondence analyses, applied for prevalence and mean abundance of parasites, were represented by two dimensional axes that had the highest percentage of variation (Fig. 2a, b). Samples obtained in the same locality were closer than samples from different localities (ET and LC, Fig. 2a, b), especially when parasite mean abundances were considered (Fig. 2b). Some parasite species were associated to different localities, *L. zbigniewi*, *Microcotyle* sp., *Piscicolidae* gen. sp., *Colobomatus* sp., and *Lecithasteridae* gen. sp. and they

also differed in prevalence (Fig. 2a) mean abundance (Fig. 2b). One sample from Las Cruces (LC1) was characterized by *L. zbigniewi* and differed from all the other samples (Table 1, Fig. 2a,b). The discriminant analysis showed that the fish length, and some parasite species (*Piscicolidae* gen. sp., *Microcotyle* sp., and *Lecithasteridae* gen. sp.) had a strong influence in the differences between localities (with  $F\text{-remove}_{(1,209)} > 4.05$  and  $P < 0.045$ ), in particular the fish length ( $F\text{-remove}_{(1,209)} = 11.77$  and  $P < 0.001$ ).

## Discussion

This research has shown that *Scartichthys viridis* harbours a rich parasite community composed of 14 parasite species, which contrasts to the 8 metazoan parasites species found in the same fish species on a previous study from Central Chile (Díaz & George-Nascimento 2002), although the component community richness and composition of parasite communities were similar to those from Northern Chile (Flores & George-Nascimento 2009). The present study reports for the first time in *S. viridis* four parasite species, two ectoparasites, *Colobomatus* sp., *Gyrodactylus* sp., that had not been reported before in the parasito-fauna of fish from Chile (Muñoz & Olmos 2007), and two digenean species, *Helicometrina nimia*, and *Hemiperia* sp., whereas *Megasolena* sp. was called as *Lepidauchen* sp. in the other two previous studies (Díaz & George-Nascimento 2002, Flores & George-Nascimento 2009). *Colobomatus* sp. was not found in other studies probably due to its particular position, in the opercular channel, and *Gyrodactylus* sp. is a small parasite (0.15 mm long) that was not easy to observe, in fact, this species was detected during an advanced stage of this research, so only prevalence for the last sample of each locality was calculated.

Parasite communities of *Scartichthys viridis* from El Tabo and Las Cruces displayed similar specific composition, since the parasites present in only one locality were infrequent. However, fish from Las Cruces had more parasites, showing higher values in prevalence, species richness and abundance, than those from El Tabo. These results remained consistent among samples collected from both localities (Table 1, Fig. 2), meaning that the reported differences of parasite community descriptors occur at different times throughout the year.

The fish total length was a strong predictor for the parasite load, not only for parasite populations but also for parasite communities. The more abundant parasites, such as *Piscicolidae* gen. sp., *Colobomatus* sp., *Microcotyle* sp., and *Lecithasteridae* gen. sp., were correlated to the fish total length. In addition, the richness

and abundance of parasite infracommunities increased with the fish total length (Díaz & George-Nascimento 2002, Flores & George-Nascimento 2009, the present study). Despite this fact, we found significant differences in the slopes of the relationships of parasitological descriptors and the fish total length, which may be associated to different population dynamics of the parasites according to specific environmental conditions of each locality. There were also significant differences in the average of species richness and abundance of parasites between localities, even though the adjusted means of these two descriptors (according to a common average fish length) were similar between localities. Therefore, the differences found in infracommunity species richness and abundance of parasites might be due to differences in the fish total length, which was also corroborated by the discriminant analysis. Specimens of *S. viridis* from Las Cruces exhibited higher values of parasite descriptors than the fish from El Tabo, which could be accounted for the larger fish total length registered in the first locality. We do not know what caused the differences in total length of the fish coming from either localities, but the size of the rocky pools might be a factor. The sampled pools from Las Cruces were larger than those from El Tabo, so they might retain larger fish during the tidal ebbing.

Finally, we concluded that the composition of parasite communities of *Scartichthys viridis* is similar between close localities or localities apart from each other, considering the results by Flores & George-Nascimento (2009); however, in this research the numerical descriptors of populations and communities of parasites were different between localities just because the fish total length was different. Possibly, larger fish has more parasites than small ones because they are older and have been in contact with parasites for longer. On the other hand, the diet of this fish species changes through ontogeny and the invertebrates, which may transmit parasites, increase in the fish diet as the fish total length increases (Muñoz & Ojeda 2000).

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