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ARTICLE

Comparison of parasite diversity of intertidal fish assemblages from central California and central Chile

Comparación de la diversidad parasitaria de ensambles de peces intermareales de las costas de California y Chile central

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Resumen.- Las costas de Chile y California central representan importantes puntos de comparación para el estudio de convergencias ecológicas como la composición de parásitos en distintos hospederos. Ambas costas presentan similares condiciones ambientales junto con compartir muchas familias de distintas especies. Se analizó la diversidad parasitaria de especies de peces de ambas zonas comparando si existe similitud entre estas faunas, además se determinó la presencia de 6 grupos taxonómicos de parásitos a través de la literatura y en bases de datos para cada zona (Chile y California). Se creó una matriz de presencia ausencia para las especies de peces estudiadas de ambas zonas y se realizó un análisis de similitud para probar si la composición parasitaria era similar. Los taxones de parásitos mayormente encontrados en peces de California Central correspondieron a digeneos y nemátodos mientras que en Chile central se encontró una mayor diversidad (Digenea, Annelida, Copepoda, Acanthocephala y Nematoda). El análisis de similitud mostró que las comunidades parasitarias entre Chile y California son diferentes significativamente, sin embargo, se obtuvieron sobreposiciones en la diversidad parasitaria agrupándose los hospedadores en 3 grupos, uno de los cuales estuvo conformado por hospedadores de ambas zonas. Esta diferencia puede ser explicada por la reducida diversidad de parásitos en el ensamble de peces del intermareal rocoso en California, tal vez debido a los escasos estudios existentes sobre parásitos de peces intermareales en California, junto con posibles factores no estudiados hasta el momento.

Palabras clave: Peces intermareales, parásitos, Chile, California, similitud, diversidad parasitaria, convergencia evolutiva

Abstract.- The coasts of central Chile and central California are important points of comparison in the study of ecological convergence such as a host's parasite load because of their similar environmental conditions and the shared presence of many families of different species. In this study, the diversity of parasites in fish species from both zones was analyzed and compared to establish if there are similarities between them. The presence of 6 taxonomic groups of parasites was determined using published literature and databases for each location. A presence-absence matrix was created for the fish species studied in Chile and California, and a similarity analysis was carried out to prove whether the parasite loads of both zones were similar. The parasite taxa most frequently found in fish in central California were Digenea and Nematoda, whereas in central Chile the common taxa were Digenea, Annelida, Copepoda, Acanthocephala, and Nematoda. The similarity analysis showed that the parasite composition was different between zones. Nevertheless, overlaps were obtained in the parasitic diversity grouping the host in 3 host groups, one of which consists of hosts from both zones. This difference can be explained by the low parasitic diversity in the assemble of rocky intertidal fishes in California, potentially due to the limited amount of existing studies on intertidal fish parasites in California, along with other possible factors not explored in the present study.

Key words: Intertidal fish, parasites, Chile, California, similarity, parasite diversity, convergent evolution

INTRODUCTION

Parasites play an important role within ecosystems (Hudson *et al.* 2006). Understanding and studying the role that they play in trophic networks is particularly important since many have a negative impact on host biology (*e.g.*, greater vulnerability to predators). Lafferty (2008) describes how *Euhaplorchis californiensis* infects the brain of the California killifish, *Fundulus parvipinnis*, altering its behavior and making it 10-30 times more vulnerable to predation by birds. In addition, it is worth understanding parasites since many nematodes, trematodes, cestodes, and acanthocephalans depend on a definitive host and usually need intermediary hosts to complete their lifecycles (Lafferty 1999). Due to the fact that many parasites are trophically transmitted to their hosts, the diets of host animals act as indicators of the type of parasite that could appear in each host as well as the intensity of the parasitic transmission within the trophic chain (Aldana *et al.* 2002). Changes in the diet composition within the same species can affect the parasite load of the host. In that same vein, if two hosts share similar diet, it is likely that there are similarities in their parasite fauna as well. This comparability in parasite fauna could be associated with the level of specificity that parasites demonstrate with regard to their hosts (Muñoz *et al.* 2009). In this way, parasites can be generalists (*i.e.*, several species within a habitat assemblage may host a parasite) or specialists (*i.e.*, only select species may host a parasite), and may be due to phylogenetic factors (Bush *et al.* 1990, Cabaret 2003) as well as ecological factors (Rohde 1984). Genetically similar species are more likely to share a comparable collection of parasites than species that are more phylogenetically distant from one another. Nevertheless, parasite communities in one location may be modified by elements of the hosts' ecology such as the type of habitat, environmental conditions, host diet, and/or their distribution and its impact on the transmission of parasites (Muñoz & Castro 2012). Nonetheless, both factors play important roles in the parasitic community composition in any given habitat.

The coasts of central California (34-39°N) and those of central Chile (32-37°S) are part of the Eastern Boundary Current System (EBCS); California is more specifically associated with the California Current System, and Chile mainly with the Humboldt Current System. Both zones respond similarly to oceanographic and climatologic dynamics (*e.g.*, El Niño, La Niña) (Mendelssohn & Schwing 2002), and are also characterized by the appearance of cold water masses with high nutrient concentrations, a product of upwelling caused by both currents. This results in a large amount of primary productivity that provides energy to a rich, diverse community of both invertebrates and vertebrates in the pelagic and coastal zones (Arntz *et al.* 2006). The intertidal zones of both coasts provide habitats that have physical similarities such as climate, rocky outcrops, and tidal flow, all of which apply the same selective pressure on the organisms that live in the area. In turn, both coasts show great diversity in their intertidal fish assemblages (Boyle & Horn 2006). These comparable selective pressures could cause an evolutionary convergence between distinct, phylogenetically unrelated species, suggesting a certain degree of similarity in the ecology and morphology between them (Boyle & Horn 2006, Melville *et al.* 2006, Muñoz & Cortés 2009). For these reasons, these two geographical areas provide locations to carry out comparative studies, particularly regarding the study of ecological convergence of species assemblages from distinct geographical areas with similar selective pressures; such is the case of a host's parasitic diversity.

Both coasts boast extensive studies on coastal parasites in communities. There is a wide range of studies on parasites in rocky intertidal organisms along the coast of central Chile, including parasites of fish (*e.g.*, Flores & George-Nascimento 2009, Muñoz & Castro 2012). In central California, there has also been a great deal of concern surrounding the role played by parasites in the trophic networks of marine and marsh ecosystems, and this topic has been well studied (*e.g.*, Love & Moser 1983, Williams *et al.* 1992, Hudson *et al.* 2006).

Many studies have demonstrated a decline in the parasitic similarity in marine fish as geographical distance between host species increases, indicating that the number of specialist parasite species decreases as the distribution of hosts grows (Kennedy & Bush 1994, Poulin 2003, Oliva & González 2005). Despite this, these studies also take into account the parasitic similarity for the same species within a range of study that considers the hemisphere itself and its significant latitudinal variation with respect to oceanographic conditions (*e.g.*, significant climatic differences between northern, central, and southern Chile). The current study attempts to explore the parasitic similarity in phylogenetically unrelated hosts that experience comparable environmental pressures in different hemispheres.

For this study, two groups of fish belonging to the rocky intertidal habitats of California and central Chile were utilized, drawing on the work of Boyle & Horn (2006). According to Boyle & Horn (2006), these two groups are limited to 6 body forms, 4 of which the fish of both Chile and California share despite lacking a close phylogenetic relationship. In their study, the authors observed a close relationship between the morphology and diet of fish from both the Chilean and Californian assemblages, both of which belong to analogous alimentary guilds as a result of an evolutionary convergence between taxa of different regions.

The main objective of this study was to analyze and compare the parasite diversity of intertidal fish species assemblages from the central Californian and central Chilean coasts, and then determine whether the parasite communities within intertidal fish are similar in terms of diversity. Although these geographic areas differ in taxonomic composition, they occur in quite comparable physical habitats, suggesting that they would demonstrate similar biological patterns. The secondary objective was to establish whether the hosts groups themselves in categories of parasites by way of an overlapping of parasitic diversity.

Table 1. Presence-absence of parasite families occurring in intertidal fish species of central Chile (plain text) and central California (bold text). The presence of the parasite family in a host is represented with an 'X' / Presencia-ausencia de familia de parásitos que ocurren en peces intermareales de Chile central (texto simple) y California central (texto negrita). La presencia de cada familia de parásito se representa con una 'X'

Host (family) specie	Acanthocolpidae	Anisakidae	Aporocotylidae	Arhythmacanthidae	Bomolochidae	Bucephalidae	Caligidae	Capsalidae	Chondracanthidae	Cystidicolidae	Derogenidae	Fellodistomidae	Gorgoderidae	Guyanemidae	Gyrodactylidae	Haploporidae	Haplosplanchnidae	Hemiuridae	Lecithasteridae	Lernaeopodidae	Microcotylidae	Monorchiidae	Opecoelidae	Pennellidae	Philichthyidae	Philometridae	Piscicolidae	Polymorphidae	Raphidascarididae	Rhadinorhynchidae	Spiruridae	Toxocaridae	Zoogonidae
Blenniidae																																	
Hypsoblennius sordidus		x		x		x	x	x		x									x		x			x			x						
Scartichthys viridis		x			x	x	x	x	x	x	x	x		x		x			x		x		x		x		x	x					
Bovichthydae																																	
Bovichtus chilensis				x	x		x			x	x							x			x			x		x	x	x			x		
Clinidae																																	
Gibbonsia metzi													x										x										
Gibbonsia montereyensis																		x					x										
Cottidae																																	
Artedius harringtoni	x	x							x	x										x													
Clinocottus analis																		x					x				x						
Myxodes viridis				x			x		x		x								x				x	x			x	x		x			
Oligocottus maculosus		x			x				x					x	x			x	x				x				x						
Oligocottus snyderi																			x				x				x						x
Scorpaenichthys marmoratus					x	x	x		x	x								x					x				x						
Embiotocidae																																	
Micrometrus minimus																	x					x	x		x								x
Gobiesocidae																																	
Gobiesox maeandricus														x				x					x			x							
Gobiesox marmoratus			x	x	x		x	x		x	x	x		x					x		x		x	x			x	x		x			
Sicyases sanguineus						x	x		x			x			x				x				x	x			x						
Kyphosidae																																	
Girella laevifrons		x				x	x	x		x										x										x			
Graus nigra							x			x									x								x	x					
Labrisomidae																																	
Auchenionchus variolosus				x	x	x	x	x	x							x		x	x		x		x	x			x	x			x		
Calliclinus geniguttatus				x	x	x	x	x													x		x	x	x		x	x					
Auchenionchus microcirrhis		x		x	x	x	x	x	x	x	x								x		x		x	x	x		x	x					
Pholidae																																	
Apodichthys flavidus		x						x															x										
Stichaeidae																																	
Anoplarchus purpurescens		x								x								x	x													x	
Xiphister atropurpureus							x		x														x			x							
Xiphister mucosus																							x										
Tripterygiidae																																	
Helcogrammoides chilensis					x	x	x				x				x				x				x				x	x					
Helcogrammoides cunninghami				x		x												x								x							

Materials and methods

Bibliographic collection

Two lists of the most typical intertidal fish species were created, one for central California and another for central Chile. In total, the study covered 26 species of fish. For the assemblage from the coasts of central California, a list of 13 from 14 fish was taken from an assemblage described in the work of Boyle & Horn (2006). For central Chile, a list of 13 fish was taken from the work of Muñoz & Ojeda (1997), which Boyle & Horn (2006) also utilized. Subsequently, different studies and databases were consulted to check whether the parasite species – within to the taxonomic groups selected (annelids, cestodes, digeneans, nematodes, acanthocephalans, monogeneans, and copepods) - were hosted by the analyzed fish species. Due to a lack of information in the literature about their parasites, the host species *Xerepes fucorum* (Pholidae), *Micrometrus aurora* (Embiotocidae), *Scythalina cerdale* (Scytalinidae), *Artedius latteralis* (Cottidae), and *Oligocottus rubellio* (Cottidae) on the list of fish from central California were replaced by other abundant species of the Californian intertidal rocky zone in similar families: *Apodichthys flavidus* (Pholidae), *Micrometrus minimus* (Embiotocidae), *Scorpaenichthys marmoratus* (Cottidae), *Artedius harringtoni* (Cottidae), and *Oligocottus maculosus* (Cottidae). Only studies and databases that report parasite presence in a host within the range of study were selected, meaning those that were within or near the regions of central California (34-39°N) and central Chile (32-37°S). However, due to the low quantity of literature found for California, work completed in the more northern region of California was considered as belonging to the zoographic zone of the Oregonian Province. This zone extends from Point Conception to the border of British Columbia-Alaska. Thirteen scientific works from California were used, two of which correspond to the complete bibliographic lists of parasites and their hosts. Thirteen scientific works from Chile were also used in the present study, two of which also correspond to the same bibliographic lists. For the Chilean portion of the analysis, a data matrix from the project FONDECYT 1130304 involving the presence of parasites in distinct tidepool fish of Chile central was used. The parasite diversity for each species of fish was described in terms of the parasite species present in different study areas. For the purposes of this study, the absence of a species of parasite in a fish signifies that there was no record of parasitism for this species in the case of that particular individual. The presence of a parasite, on the other hand, means that there is at least one record of that species found in a host. Most larval cestodes have been described to order rather than by family, they were not considered in this study. The parasites identified up to family, genus, or species level were considered in analyses of this study. The entire list of parasite species found in each host species may be referenced in Appendix 1.

Parasite-host analyses

The species of parasites found were ordered and classified by family. Then, a similarity matrix of the parasitic diversity of each host was constructed, with the parasite family composition (Table 1) in a presence/absence matrix containing the two assemblages of fish from the rocky intertidal in central California and central Chile.

Using the software Primer 6, a similarity cluster for the parasite occurrence matrix using the Jaccard index was developed. Then, a similarity profile analysis (SIMPROF) was performed to detect the possibility of groups overlapping with respect to the parasite diversity between hosts. In order to evaluate if the parasitic diversity between both zones was similar, a two-dimensional MDS (Non-metric Multidimensional Scaling) graph was created. Nonparametric analyses were performed to analyze parasite similarity within and between the fish communities. In order to evaluate and statistically confirm the results obtained using the MDS, a one-way analysis of similarity (ANOSIM) was conducted, testing whether the parasite diversity in hosts from each site is similar to the other site in question. The test largely consists of comparing the differences in the parasite communities of each site with the differences within the site, in this case between central Chile and central California. Finally, a one-way similarity percentage analysis (SIMPER) was used to explore which genera of parasites contributed the most to the similarities as well as the differences between zones.

Results

Bibliographic collection

There is more information available with regard to parasitism in fish on the central Chile list than for those on the central California list. There were few studies available demonstrating incidences of parasitism in fish on the California list. Indeed, at times, only a single study determined the rate of parasitism by a certain taxon in a given species of fish. All taxa of parasites studied (cestodes, nematodes, digeneans, acanthocephalans, copepods) were found in the list of hosts within central Chile. However, in the case of California, there were no records of acanthocephalans in any of the fish, neither in the literature nor the consulted databases. Digenea is the only taxonomic group that was recorded in all fish species of both geographic regions. There were 65 new records of parasite species found

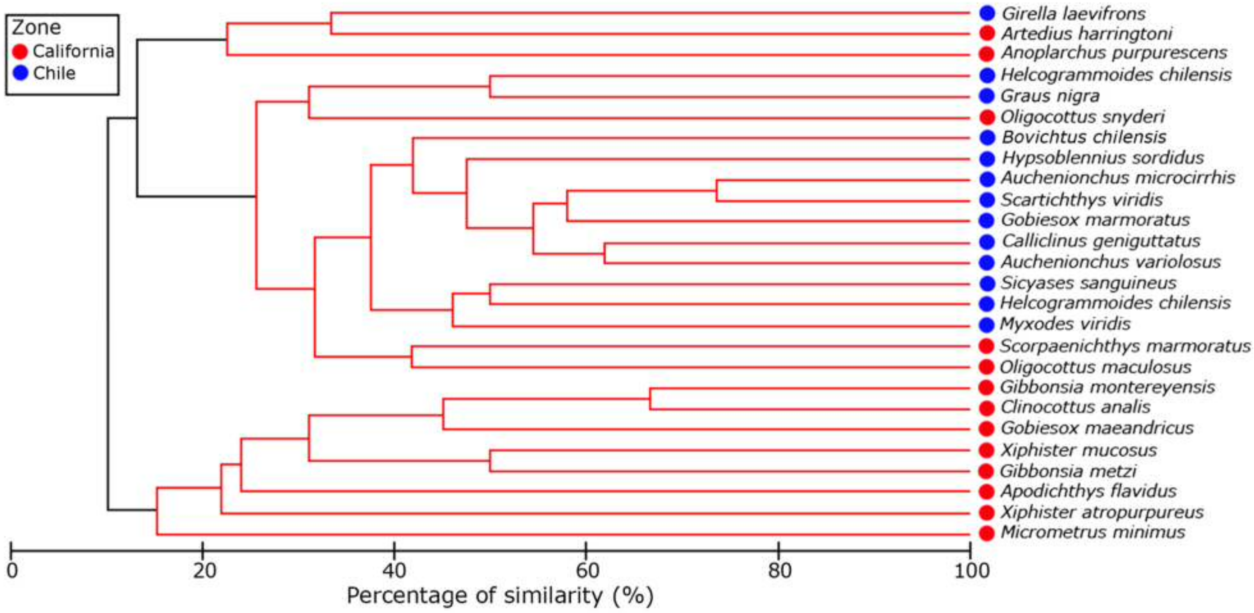

Figure 1. Parasitic similarity dendrogram (SIMPROF) for 13 Californian intertidal fish species (red circles) and 13 Chilean intertidal fish species (blue circles) / Dendrograma de similitud parasitaria (SIMPROF) para 13 especies de peces intermareales de California (círculos rojos) y 13 especies de peces intermareales de Chile (círculos azules)

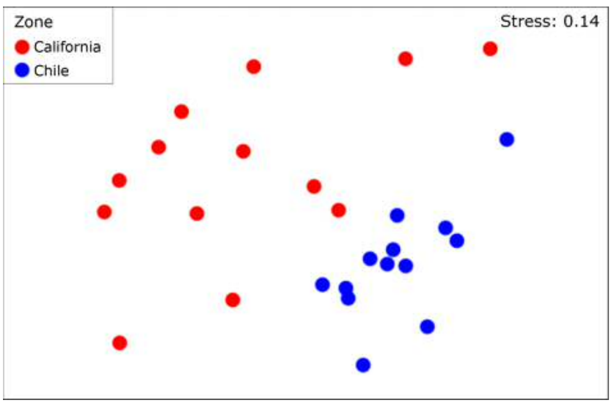

Figure 2. Spatial representation of the co-occurrence of parasite family from intertidal fishes of central Chile and central California (MDS). Blue circles represent fish species from central Chile and red circles represent fish species from central California / Representación gráfica de la co-ocurrencia de familia de parasitarios de los peces intermareales de Chile central y California central (MDS). Los círculos azules representan las especies de peces de Chile central y los círculos rojos representan las especies de peces de California central

within the 13 chosen hosts in the central Chilean assemblage. In total, 115 parasite species were identified, composing of 34 families, where the families Anisakidae, Bomolochidae, Bucephalidae, Caligidae, Chondracantidae, Cystidicolidae, Guyanemidae, Gyrodactylidae, Hemiuridae, Lecithasteridae, Lernaeopodidae, Opecoelidae, Philichthydae, Philometridae, and Piscicolidae were found in both the Californian and Chilean fish (Table 1). The species that showed the greatest parasitic diversity in central Chile were *Scartichthys viridis*, *Gobiesox marmoratus* and *Auchenionchus microcirrhis*, each with 20 parasitic species. The Californian fish species with the greatest parasitic diversity was *Scorpaenichthys marmoratus* with 14 species (Appendix 1).

Parasite-host analyses for parasite families

According to the results obtained from the cluster analysis and the SIMPROF analysis to determine the degree of overlap of parasitic diversity (Fig. 1), 3 groups of hosts were identified, according to their degree of overlap. A first group separated at a percentage similarity (PS) of 11% with respect to the other groups, composed of 8 host species belonging solely to the California assemblage, and mainly represented by parasites of Anisakidae (Nematoda) and Cysticolidae (Nematoda). Alongside this, 2 other groups are recognized: a second group composed of 2 host species from California and 1 from Chile

Table 2. Parasitic average similarity observed within intertidal fish assemblage of central Chile: The average similarity, the percentage contribution (PC %) and the accumulative percentage contribution of each family of parasites for this similarity with their average similarity / Similitud promedio de parásitos observada dentro del ensamble de peces intermareales de Chile: Similitud promedio, contribución porcentual de la similitud (PC %) y contribución porcentual acumulada para cada familia de parásito

Family of parasites	Fish assemblage of Chile (Average similarity: 52.83)		
	Average Similarity	PC (%)	Accumulative PC (%)
Caligidae	9.93	18.79	18.79
Piscicolidae	8.14	15.40	34.19
Lecithasteridae	5.66	10.71	44.90
Polymorphidae	3.92	7.42	52.33
Bucephalidae	3.18	6.01	58.34
Bomolochidae	3.04	5.76	64.10
Pennellidae	2.96	5.60	69.71
Opecoelidae	2.87	5.43	75.13
Cystidicolidae	2.43	4.59	79.73
Arhythmacanthidae	2.13	4.03	83.76
Capsalidae	2.12	4.01	87.77
Microcotylidae	1.97	3.73	91.50
Derogenidae	1.48	2.79	94.29
Chondracanthidae	0.98	1.85	96.15
Anisakidae	0.64	1.21	97.36
Rhadinorhynchidae	0.36	0.68	98.04
Fellodistomidae	0.28	0.53	98.57
Philichthyidae	0.26	0.50	99.07
Spiruridae	0.14	0.27	99.34
Gyrodactylidae	0.09	0.18	99.52
Hemiuridae	0.09	0.18	99.70
Haploporidae	0.08	0.15	99.85
Guyanemidae	0.08	0.15	100

(PS= 15%), mainly represented by parasite families Lecithasteridae (Digenea) and Piscicolidae (Annelida), and another group composed of 12 host species from Chile and 3 from California (PS= 26%), mainly represented by parasites of Piscicolidae (Annelida), Opecolidae (Digenea), and Caligidae (Copepoda).

The MDS analysis performed for the parasite community cluster for fish assemblages of Chile and California coasts showed a stress level of 0.14 (Fig. 2), suggesting an acceptable goodness of fit for the nonparametric regression behind the original similarity data (Clarke & Warwick 2001). By examining the MDS, it is clear that the parasite diversity of fishes of both coasts is significantly different from one another (Fig. 2), which was supported by ANOSIM (P= 0.001); the analysis also provided an R-value of 0.57, meaning that the hosts within the same region are much more similar to each other than they are to the hosts of the other location. With the results produced by the SIMPER analysis, it appears that the hosts belonging to the Chilean fish assemblage are much more similar among themselves, obtaining an average similarity of 52.83%, whereas the Californian host species displayed an average similarity of 30.9%. From Chile, the families that contributed approximately 50% of this similarity were Caligidae (Copepoda) with 18.79% contribution, Piscicolidae (Annelida) with a 15.4% contribution, Lecthasteridae (Digenea) with a 10.71% contribution, and Polymorphidae (Acanthocephala) with a 7.42% contribution (Table 2). From California, only the family Opecoelidae (Digenea) contributed to more than half of the observed similarity with a contribution of 65.3% (Table 3). Finally, a differentiation (dissimilarity) of 78.16% was observed between the two assemblages and the families that contributed most to this difference were Caligidae (Copepoda) with a 8.22% contribution, Piscicolidae (Annelida) with 6.5% of contribution, Lecithasteridae (Digenea) with a 6.29% of contribution, Polymorphidae (Acanthocephala) with 5.84% of contribution,

Table 3. Parasitic average similarity observed within intertidal fish assemblage of central California: The average similarity, the percentage contribution (PC%) and the accumulative percentage contribution of each family of parasites for this similarity with their average similarity / Similitud promedio de parásitos observada dentro del ensamble de peces intermareales de California: Similitud promedio, contribución porcentual de la similitud (PC %) y contribución porcentual acumulada para cada familia de parásito

Family of parasites	Fish assemblage of California (Average similarity: 30.93)		
	Average Similarity	PC (%)	Accumulative PC (%)
Opecoelidae	20.21	65.34	65.34
Hemiuridae	4.16	13.44	78.78
Anisakidae	1.48	4.78	83.56
Piscicolidae	1.37	4.45	88.00
Chondracanthidae	1.23	3.97	91.97
Lecithasteridae	0.67	2.15	94,12
Cystidicolidae	0.65	2.10	96,23
Philometridae	0.32	1.04	97.26
Zoogonidae	0.28	0.92	98.18
Caligidae	0.21	0.69	98.87
Guyanemidae	0.20	0.64	99.51
Bomolochidae	0.15	0.49	100

Table 4. Parasitic average dissimilarity obtained between intertidal fish assemblages of central Chile and central California: Average dissimilarity, percent contribution of each family of parasites for this dissimilarity (PC %) and accumulative percentage contribution / Disimilitud promedio de parásitos observada dentro de cada ensamble de peces intermareales de Chile y California central: Promedio disimilitud, contribución porcentual de la disimilitud para cada familia de parásito (PC %) y la contribución porcentual acumulada

Family of parasites	Fish assemblage of Chile and California Average dissimilarity: 78.16		
	Average similarity	PC (%)	Accumulative PC (%)
Caligidae	6.43	8.22	8.22
Piscicolidae	5.08	6.50	14.72
Lecithasteridae	4.92	6.29	21.01
Polymorphidae	4.56	5.84	26.85
Bucephalidae	4.06	5.19	32.05
Bomolochidae	4.02	5.14	37.19
Pennellidae	3.87	4.95	42.14
Cystidicolidae	3.73	4.77	46.91
Opecoelidae	3.67	4.70	51.61
Capsalidae	3.39	4.33	55.94
Hemiuridae	3.32	4.24	60.18
Arhythmacanthidae	3.28	4.19	64.37
Microcotylidae	3.09	3.95	68.33
Chondracanthidae	2.99	3.82	72.15
Anisakidae	2.94	3.76	75.91
Derogenidae	2.77	3.54	79.45
Rhadinorhynchidae	1.65	2.11	81.55
Philichthyidae	1.60	2.05	83.61
Guyanemidae	1.51	1.93	85.54
Gyrodactylidae	1.47	1.88	87.42
Philometridae	1.46	1.87	89.29
Fellodistomidae	1.35	1.72	91.01
Lernaeopodidae	1.13	1.45	92.46
Zoogonidae	1.09	1.39	93.85
Spiruridae	0.89	1.13	94.99
Haploporidae	0.77	0.99	95.97
Gorgoderidae	0.67	0.86	96.84
Acanthocolpidae	0.52	0.67	97.50
Haplosplanchnidae	0.52	0.67	98.17
Monorchiidae	0.52	0.67	98.84
Toxocaridae	0.52	0.67	99.51
Aporocotylidae	0.38	0.49	100

Bucephalidae (Digenea) with 5.19% of contribution, Bomolochidae (Copepoda) with a 5.14% of contribution, Pennellidae (Copepoda) with a 4.95% contribution, Cystidicolidae (Nematoda) with a 4.77% of contribution, and Opecoelidae (Digenea) with a 4.7% of contribution (Table 4).

Discussion

A species's morphology can be a reliable indicator of its organismal ecology in a particular habitat, as can the alimentary (*i.e.*, diet-related) specialization that they may possess, a relationship also known as form and function (Russell 1916, Koehl 1996, Ferry-Graham *et al.* 2002). In Boyle & Horn (2006), the authors found supporting evidence for a diet overlap between the fish species of central Chile and California, suggesting elements of convergent evolution between both regions. Therefore, it could be expected that the fish from these two separate assemblages would present comparable parasite communities. However, the results of the current study did not support this hypothesis; in fact, the parasite communities of each area were quite distinct, meeting one of the proposed goals. Even so, it is possible to observe a certain degree of overlap of said parasite diversity in the fish species of both assemblages, as the species grouped into four categories according to their parasitic load composition, and three of these categories consisted of central Chilean and Californian species in almost equal quantities. Interestingly, the species *Helcogrammoides chilensis* and *Helcogrammoides cunninghami* both displayed substantially low similarity in their respective parasitic communities, contrary to what has been described in the literature (Muñoz & Cortés 2009). Instead, they are found in contrasting groups, suggesting that other factors independent of the phylogenetic relationship may affect the similarity in the parasite population of a given species. Nevertheless, this overlap does not demonstrate a pattern of similarity neither in the diet of the hosts nor in other ecological characteristics of the studied species of each group.

Even though diet plays a fundamental role in a host's resulting parasite community, there are other ecological characteristics that may affect the parasitic diversity of a host, including the size of the host, ontogeny, type of habitat, residence and migration time, abundance of the host, and gregariousness (Morand *et al.* 2000, Muñoz & Cortés 2009). The body size and ontogeny combined with the residence time both play an important part in the similarity of parasites between fish species within the rocky intertidal. It has been well established that a larger body size allows for a larger quantity and diversity of parasites in a host, in part by presenting a greater resource for its parasites (Muñoz & Cortés 2009). The large majority of works utilized for the present study consist of complete checklists from different regions in which there failed to exist a distinction of size of the study species, which could have an unconsidered effect on the obtained results. The distinction of the ontogenetic change is important to the description of the parasitic community of a particular species. This ontogenetic change has been well documented in rocky intertidal fish species in Chile, as is the case with *Sicyases sanguineus* and *Bovichtus chilensis*, principally associated with the change of size and diet of these species (Muñoz *et al.* 2002, Muñoz & Zamora 2011). This is reflected in the separation of one species into different alimentary guilds, depending on the host's size (Muñoz & Ojeda 1997).

One characteristic that defines rocky intertidal fish species and distinguishes them from one another is their residence time in the rocky intertidal habitat, a feature by which they are classified into the categories of resident and transient species. Resident fish and transitory fish possess differences in parasitic composition due to the fact that temporal species, which are mainly represented by juveniles, spend a short period of time in the intertidal pools. The specificity of the host results from the environmental restrictions due to the barriers of transmission of parasite larval stages of one host to another; if the host changes sites, the parasites will be different and will infect the host through trophic transmission (Gibson & Yoshiyama 1999, Horn & Martin 2006, Muñoz & Cortes 2009, Muñoz & Delorme 2011). In the case of Chile, of the two transitory species found in the intertidal - *Girella laevifrons* and *Graus nigra* (Aldana *et al.* 2002) - only *Girella laevifrons* was grouped apart from the rest of the resident species. Contrarily, the transient species from California - *Micrometrus minimus* and *Scorpaenichthys marmoratus* (Horn & Martin 2006, Gibson & Yoshiyama 1999) - were classified into different groups, being categorized with the other intertidal resident species of California.

The most representative families of parasites of each of the three groups formed by the host fish species are characterized as abundant and generalist within the parasitic community of the rocky intertidal. Parasite species with a wide range of hosts from different fish families (*i.e.*, generalist) have been involved in adaptation processes in these hosts, which possibly implies host-switching, supporting the idea of similar trophic habits within the fish of each group and each site (Muñoz & Cortes 2009). It is no surprise that the families consisting of digeneans are common to both zones, especially in central California, since the family Opecoelidae is characterized by being found in many families of fish in the world. Digeneans, just like nematodes, show great success in the habitat in which they are found, likely because they are able to undergo both sexual and asexual reproduction. Additionally, a ciliated larval state provides the larval parasites with more opportunities to encounter a potential host, allowing them to have a less strict specificity with respect to other parasites (*i.e.*, cestodes and monogeneans) (Cribb 2005).

Although both the Chilean and Californian assemblages share families of parasites in common, California displays a lower parasitic diversity when compared to central Chile, represented almost solely by the digeneans. It is not common to observe such low parasitic diversity in such a complex and diverse community like California's rocky intertidal, which has a great diversity of tidepool fish and experiences environmental conditions similar to those of central Chile, a region that does have a quite diverse parasitic community. If one analyzes carefully how the registers of parasites found in fishes of the California intertidal are characterized, one can observe different factors that produce a low diversity of parasites in California and a consequently high difference between both zones. For example, there were not any registers of acanthocephalans for Californian intertidal fish. The recent works of parasites in Californian fish are focused mainly on freshwater and estuarine species (*e.g.*, Fingerut *et al.* 2003, Lafferty *et al.* 2006, Kaplan *et al.* 2009, Shaw *et al.* 2010). There are few studies dedicated to parasitism in the rocky intertidal fish of California (as compared to Chile), and these mainly correspond to works within the last century. We can suppose that the low diversity found in California is mainly because of the low effort that has been dedicated to the studies. However, Burrenson & Kalman (2006) shows that the annelid parasites of the Piscicolidae family are not very common in the rocky intertidal of California, a contradictory pattern to what has been studied of parasitic annelids in the intertidal of central Chile and the UK. Annelids are quite common parasites found on the coast of Chile as well as other assemblages of the rocky intertidal; since they are ectoparasites and undergo direct development, they are temporal in their hosts and environment (Moraga & Muñoz 2010).

Discovering a difference in presence of parasites (absence of acanthocephalans, low abundance of annelids, and variety being mostly explained by abundant and generalist species) in California with respect to other assemblages in the rocky intertidal (Chile and UK) suggests that - despite both zones of studies possessing similar environmental conditions, many host species, and evolutionary ecologic convergences in common – suggests that other factors not studied with anteriority could be affecting mainly the composition of parasites of fish in the Californian intertidal. One well-known characteristic of the rocky intertidal of California is the marked seasonal and spatial variability with regard to the abundance of tidepool fish (Yoshiyama 1981, Yoshiyama *et al.* 1986), which is not true for central Chile. It is possible to find species whose abundance decreases during winter, mainly because of the migration to deeper waters because of poor environmental conditions (*e.g.*, larger turbulence, less food). This includes species that are typically lower in abundance in the summer months as well as species that are found in relatively similar numbers throughout the year (Grossman 1982, Moring 1986, Gibson & Yoshiyama 1999, Horn & Martin 2006). A parasite community is affected by local biotic and abiotic factors, including the density and abundance of the primary host, the density of the target host, and variations in temperature (Thieltges *et al.* 2009). It is probable that these constant shifts in abundance of certain tidepool fishes species have some effect on the parasite community in rocky intertidal of California, which could be a process not occurring to such a degree in central Chile. Despite all of the aforementioned, the large difference in parasite diversity within tidepool fish of both zones seems to be explained primarily by the lower quantity of studies performed in California. It is necessary that the number of studies on this topic and within this region increase in order to compare these two zones more accurately. It is well known that with a larger amount of parasitologic studies done, a higher degree of diversity will be recorded (Poulin & Morand 2000). In addition to this, it is a priority to execute future studies on the spatial and temporal variation of tidepool fish abundances in central Chile, allowing for an improved foundation for ecological comparisons between the two zones.

This study is the first to apply a comparison of parasite communities in two intertidal fish assemblages that, although differing in taxonomic composition and occurring in remote places belonging to different hemispheres, are ecologically comparable to one another due to a similarity in habitat. Although four host groups were successfully formed as a result of the overlap in parasitic diversity within specimens from both regions, the parasitic communities between zones are significantly different. Additionally, the formed groups do not show a clear pattern with respect to the diet and phylogeny of the host. It will be necessary to perform new studies of registers in the parasitic community in the fishes of the rocky intertidal of California. This study calls attention to the lack of precedent information from this zone and the need to study and identify the factors that could be provoking this lack of parasitic diversity in the rocky intertidal of California.

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Appendix 1. List of intertidal fish species from central Chile and central California with their parasite species and the literature sources from where this information was gathered are indicated. *New record from fishes sampled between 2013-2015 during Project FONDECYT 1130304 in several localities of central Chile (32-37°S) / Lista de las especies de peces intermareales de Chile central y California central con sus especies de parásitos y la fuentes literarias de donde se obtuvo la información indicada. *Nuevos registros de peces muestreados entre 2013 y 2015 durante el Proyecto FONDECYT 1130304 en varias localidades de Chile central (32-37°S)

Family / Host species	Group of parasite	Family of parasite	Parasite species	Source
Bovichthydae				
Bovichtus chilensis Regan, 1913	Acanthocephala	Polymorphidae	*Corynosoma* sp.	Muñoz & Olmos 2008
	Acanthocephala	Arhythmacanthidae	*Hypoechinorhynchus magellanicus* (Szidat, 1950)	Muñoz & Olmos 2008
	Acanthocephala	Arhythmacanthidae	*Spiracanthus bovichthys* Muñoz & George-Nascimento, 2002	Muñoz & George-Nascimento 2002
	Annelida	Piscicolidae	Piscicolidae gen. sp.	Moraga & Muñoz 2010
	Copepoda	Caligidae	*Caligus* sp.	Muñoz & Olmos 2007
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	* New record
	Copepoda	Pennellidae	*Trifur tortuosus* Wilson, 1917	Muñoz & Olmos 2007
	Copepoda	Bomolochidae	*Holobomolochus chilensis* Cressey & Cressey, 1985	Muñoz & Olmos 2007
	Digenea	Derogenidae	*Hemipera cribbi* Díaz, Muñoz & George-Nascimento, 2016	Díaz, Muñoz & George-Nascimento 2016
	Digenea	Lecithasteridae	*Lecithaster* cf. *macrocotyle* Szidat & Graefe, 1967	* New record
	Monogenea	Microcotylidae	*Microcotyle* sp.	* New record
	Nematoda	Philometridae	*Philometra* sp.	Muñoz & Olmos 2008
	Nematoda	Cystidicolidae	*Similascarophis chilensis* Muñoz, Gonzalez & George-Nascimento, 2004	* New record
	Nematoda	Cystidicolidae	*Similascarophis maulensis* Muñoz, González & George-Nascimento, 2004	Muñoz & Olmos 2008
	Nematoda	Spiruridae	Spiruridae gen. sp.	Muñoz & Olmos 2008
Clinidae				
Gibbonsia metzi Hubbs, 1952	Digenea	Opecoelidae	*Genitocotyle acirrus* Park, 1937	Love & Moser 1983
	Digenea	Opecoelidae	*Helicometrina elongata* Noble & Park, 1937	Love & Moser 1983
	Digenea	Gorgoderidae	*Phyllodistomum borisbychowski* Caballero & Caballero, 1969	Love & Moser 1983
	Digenea	Opecoelidae	*Pseudopecoelus gibbonsiae* Manter & Van Cleave, 1951	Love & Moser 1983
Gibbonsia montereyensis Hubbs, 1927	Digenea	Hemiuridae	*Genolinea laticauda* Manter, 1925	Love & Moser 1983
	Digenea	Opecoelidae	*Helicometrina elongata* Noble & Park, 1937	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle* sp.	Love & Moser 1983
	Digenea	Hemiuridae	*Lecithochirium exodicum* (Mc Farlane, 1936)	Love & Moser 1983
Cottidae				
Artedius harringtoni (Starks, 1896)	Cestoda	Bothriocephalidae	*Bothriocephalus scorpii* Müller, 1776	Love & Moser 1983
	Copepoda	Lernaeopodidae	*Clavella parva* Wilson, 1912	Love & Moser 1983
	Copepoda	Chondracanthidae	*Haemobaphes intermedius* Kabata, 1967	Love & Moser 1983
	Digenea	Acanthocolpidae	*Stephanostomum californicum* Manter & Van Cleave, 1951	Love & Moser 1983
	Nematoda	Cystidicolidae	*Ascarophis sebastodis* Olsen, 1952	Love & Moser 1983
	Nematoda	Anisakidae	*Contracaecum* sp.	Love & Moser 1983
Clinocottus analis (Girard, 1858)	Annelida	Piscicolidae	*Heptacyclus buthi* (Burreson & Kalman, 2006)	Burreson & Kalman 2006
	Digenea	Hemiuridae	*Genolinea laticauda* Manter, 1925	Love & Moser 1983
	Digenea	Hemiuridae	*Genolinea montereyensis* Annereaux, 1947	Love & Moser 1983
	Digenea	Opecoelidae	*Helicometrina elongata* Noble & Park, 1937	Love & Moser 1983
	Digenea	Opecoelidae	*Helicometrina nimia* Linton, 1910	Love & Moser 1983

Appendix 1. Continued / Continuación

Family / Host species	Group of parasite	Family of parasite	Parasite species	Source
	Digenea	Opecoelidae	*Opecoelus adsphaericus* Manter & Van Cleave, 1951	Love & Moser 1983
	Digenea	Opecoelidae	*Opecoelus cameroni* (Caballero & Caballero, 1969)	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle californica* Park, 1937	Love & Moser 1983
Myxodes viridis Valenciennes, 1836	Acanthocephala	Polymorphidae	*Corynosoma* sp.	* New record
	Acanthocephala	Arhythmacanthidae	*Hypoechinorhynchus* spp.	* New record
	Acanthocephala	Rhadinorhynchidae	*Rhadinorhynchus* sp.	* New record
	Annelida	Piscicolidae	Piscicolidae gen. sp.	* New record
	Copepoda	Chondracanthidae	*Acanthochondria ophiidi* (Kroyer, 1863)	* New record
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	* New record
	Copepoda	Pennellidae	*Trifur* sp.	* New record
	Digenea	Opecoelidae	*Helicometrina* cf. *nimia* Linton, 1910	* New record
	Digenea	Derogenidae	*Hemipera cribbi* Díaz, Muñoz & George-Nascimento, 2016	Díaz *et al.* 2016
	Digenea	Lecithasteridae	*Lecithaster* cf. *macrocotyle* Szidat & Graefe, 1967	* New record
Oligocottus maculosus Girard, 1856	Annelida	Piscicolidae	*Heptacyclus buthi* (Burreson & Kalman, 2006)	Burreson & Kalman 2006
	Copepoda	Chondracanthidae	*Haemobaphes intermedius* Kabata, 1967	Love & Moser 1983
	Copepoda	Bomolochidae	*Hamaticolax spinulus* (Cressey, 1969)	Love & Moser 1983
	Digenea	Hemiuridae	*Genolinea laticauda* Manter, 1925	Love & Moser 1983
	Digenea	Lecithasteridae	*Lecithaster gibbosus* Rudolphi, 1802	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle califórnica* Park, 1937	Love & Moser 1983
	Digenea	Hemiuridae	*Tubulovesicula lindbergi* (Layman, 1930)	Love & Moser 1983
	Monogenea	Gyrodactylidae	*Gyrodactylus maculosi* Cone & Rotn, 1993	Cone & Roth 1993
	Nematoda	Anisakidae	*Anisakis* sp.	Love & Moser 1983
	Nematoda	Anisakidae	*Contracaecum* sp.	Love & Moser 1983
	Nematoda	Guyanemidae	*Pseudodelphis oligocotti* Adamson & Roth, 1990	Bennett 1999
Oligocottus snyderi Greeley, 1898	Annelida	Piscicolidae	*Heptacyclus buthi* (Burreson & Kalman, 2006)	Burreson & Kalman 2006
	Digenea	Lecithasteridae	*Lecithaster gibbosus* Rudolphi, 1802	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle californica* Park, 1937	Love & Moser 1983
	Digenea	Zoogonidae	*Zoogonoides viviparous* (Olsson, 1868)	Love & Moser 1983
Scorpaenichthys marmoratus (Ayres, 1854)	Annelida	Piscicolidae	*Malmiana diminuta* (Burrenson, 1977)	Love & Moser 1983
	Copepoda	Chondracanthidae	*Chondracanthus gracilis* Fraser, 1920	Love & Moser 1983
	Copepoda	Chondracanthidae	*Chondracanthus pinguis* Wilson, 1912	Love & Moser 1983
	Copepoda	Bomolochidae	*Acantholochus venustus* (Kabata, 1971)	Love & Moser 1983
	Copepoda	Caligidae	*Lepeophtheirus parviventris* Wilson, 1905	Love & Moser 1983
	Digenea	Opecoelidae	*Genitocotyle acirrus* Park, 1937	Love & Moser 1983
	Digenea	Hemiuridae	*Genolinea laticauda* Manter, 1925	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle californica* Park, 1937	Love & Moser 1983

Appendix 1. Continued / Continuación

Family / Host species	Group of parasite	Family of parasite	Parasite species	Source
	Digenea	Opecoelidae	*Podocotyle enophrysi* Park, 1937	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle* sp.	Love & Moser 1983
	Digenea	Bucephalidae	*Prosorhynchus scapellus* McFarlane, 1936	Love & Moser 1983
	Digenea	Piscicolidae	*Trachelobdella oregonensis* (Burrenson, 1976)	Love & Moser 1983
	Digenea	Hemiuridae	*Tubulovesicula lindbergi* (Layman, 1930)	Love & Moser 1983
	Nematoda	Cystidicolidae	*Caballeronema wardlei* (Smedley, 1934)	Love & Moser 1983
Embiotocidae				
Micrometrus minimus (Gibbons, 1854)	Copepoda	Philichthyidae	*Colobomatus embiotocae* Noble, Collard & Wilkes, 1969	Love & Moser 1983
	Digenea	Opecoelidae	*Genitocotyle acirrus* Park, 1937	Love & Moser 1983
	Digenea	Zoogonidae	*Neozoogonus californicus* Arai, 1954	Love & Moser 1983
	Digenea	Monorchiidae	*Postmonorchis donacis* Young, 1953	Love & Moser 1983
	Digenea	Haplosplanchnidae	*Schikhobalotrema girellae* (Manter & Van Cleave, 1951)	Love & Moser 1983
Gobiesox maeandricus (Girard, 1858)	Digenea	Opecoelidae	*Helicometrina elongata* Noble & Park, 1937	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle gibbonsia* Johnson, 1949	Love & Moser 1983
	Digenea	Hemiuridae	*Lecithochirium exodicum* (Mc Farlane, 1936)	Love & Moser 1983
	Nematoda	Philometridae	*Clavinema mariae* (Layman, 1930)	Love & Moser 1983
	Nematoda	Guyanemidae	*Pseudodelphis oligocotti* Adamson & Roth, 1990	Bennett 1999
Gobiesox marmoratus Jenyns, 1842	Acanthocephala	Polymorphidae	*Corynosoma* sp.	Pardo-Gandarillas *et al.* 2004
	Acanthocephala	Arhythmacanthidae	*Hypoechinorhynchus* sp.	* New record
	Acanthocephala	Rhadinorhynchidae	*Rhadinorhynchus* sp.	* New record
	Acanthocephala	Arhythmacanthidae	*Spiracanthus bovichthys* Muñoz & George-Nascimento, 2002	Muñoz & George-Nascimento 2002
	Annelida	Piscicolidae	Piscicolidae gen. sp.	Pardo-Gandarillas *et al.* 2004
	Cestoda	-	Pseudophyllidea (larva)	Muñoz 2014
	Cestoda	-	Tetraphyllidea (larva)	Muñoz 2014
	Copepoda	Caligidae	*Caligus* sp.	* New record
	Copepoda	Bomolochidae	*Holobomolochus chilensis* Cressey & Cressey, 1985	Muñoz 2014
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	Muñoz 2014
	Copepoda	Pennellidae	*Trifur* cf. *tortuosus* Wilson, 1917	Muñoz 2014
	Digenea	Aporocotylidae	*Aporocotyle* sp.	Muñoz & Olmos 2008
	Digenea	Opecoelidae	*Helicometrina cf nimia* Linton, 1910	Muñoz 2014
	Digenea	Derogenidae	*Hemipera cribbi* Díaz, Muñoz & George-Nascimento, 2016	Díaz *et al.* 2016
	Digenea	Lecithasteridae	*Lecithaster* cf. *macrocotyle* Szidat & Graefe, 1967	* New record
	Digenea	Fellodistomidae	*Proctoeces lintoni* Siddiqi & Cable, 1960	Muñoz 2014
	Monogenea	Microcotylidae	*Microcotyle* sp.	* New record
	Monogenea	Capsalidae	*Neobenedenia melleni* (MacCallum, 1927)	* New record
	Nematoda	Guyanemidae	*Pseudodelphis chilensis* Muñoz, 2010	Muñoz 2014
	Nematoda	Cystidicolidae	*Similascarophis chilensis* Muñoz, Gonzalez & George-Nascimento, 2004	* New record

Appendix 1. Continued / Continuación

Family / Host species	Group of parasite	Family of parasite	Parasite species	Source
Sicyases sanguineus Müller & Troschel, 1843	Annelida	Piscicolidae	Piscicolidae gen. sp.	Muñoz & Delorme 2011
	Cestoda	-	Pseudophyllidea gen. sp.	Muñoz & Zamora 2011
	Copepoda	Chondracanthidae	*Acanthochondria sicyases* (Kroyer, 1863)	Muñoz & Delorme 2011
	Copepoda	Caligidae	*Caligus* sp.	* New record
	Copepoda	Caligidae	*Lepeophtheirus* sp.	Muñoz & Zamora 2011
	Copepoda	Pennellidae	*Trifur* sp.	* New record
	Digenea	Opecoelidae	*Helicometrina nimia* Linton, 1910	Muñoz & Delorme 2011
	Digenea	Lecithasteridae	*Lecithaster* cf. *macrocotyle* Szidat & Graefe, 1967	* New record
	Digenea	Fellodistomidae	*Proctoeces lintoni* Siddiqi & Cable, 1960	Muñoz & Zamora 2011
	Digenea	Fellodistomidae	*Proctoeces* sp.	Muñoz & Delorme 2011
	Digenea	Bucephalidae	*Prosorhynchoides carvajali* Muñoz & Bott, 2011	Muñoz *et al.* 2014
	Monogenea	Gyrodactylidae	*Gyrodactylus* sp.	Muñoz & Zamora 2011
Kyphosidae				
Girella laevifrons (Tschudi, 1846)	Acanthocephala	Rhadinorhynchidae	*Rhadinorhynchus* sp.	* New record
	Copepoda	Lernaeopodidae	*Clavellotis dilatata* (Kroyer, 1863)	Muñoz & Delorme 2011
	Copepoda	Caligidae	*Lepeophtheirus chilensis* Wilson, 1905	Muñoz & Olmos 2007
	Copepoda	Caligidae	*Lepeophtheirus frecuens* Castro-Romero & Baeza, 1984	Muñoz & Olmos 2007
	Digenea	Bucephalidae	*Prosorhynchoides* sp.	Rebolledo *et al.* 2014
	Monogenea	Capsalidae	*Neobenedenia melleni* (MacCallum, 1927)	* New record
	Nematoda	Anisakidae	*Anisakis* sp.	* New record
	Nematoda	Cystidicolidae	*Similascarophis chilensis* Muñoz, Gonzalez & George-Nascimento, 2004	Muñoz & Delorme 2011
	Nematoda	Cystidicolidae	*Similascarophis maulensis* Muñoz, González & George-Nascimento, 2004	* New record
Graus nigra Philippi, 1887	Acanthocephala	Polymorphidae	*Corynosoma* sp.	* New record
	Annelida	Piscicolidae	Piscicolidae gen. sp.	Moraga & Muñoz 2010
	Cestoda	-	Pseudophyllidea gen. sp. (larva)	* New record
	Copepoda	Caligidae	*Lepeophtheirus chilensis* Wilson, 1905	Muñoz & Olmos 2007
	Digenea	Lecithasteridae	*Lecithaster* cf. *macrocotyle* Szidat & Graefe, 1967	* New record
	Nematoda	Cystidicolidae	*Similascarophis chilensis* Muñoz, Gonzalez & George-Nascimento, 2004	Muñoz & Olmos 2008
	Nematoda	Cystidicolidae	*Similascarophis maulensis* Muñoz, González & George-Nascimento, 2004	* New record
Labrisomidae				
Auchenionchus microcirrhis (Valenciennes, 1836)	Acanthocephala	Polymorphidae	*Corynosoma* sp.	Muñoz & Castro 2012
	Acanthocephala	Arhythmacanthidae	*Hypoechinorhynchus* sp.	* New record
	Annelida	Piscicolidae	Piscicolidae gen. sp.	Moraga & Muñoz 2010
	Cestoda	Tentaculariidae	*Nybelinia* sp.	Muñoz & Castro 2012
	Cestoda	-	Pseudophyllidea gen. sp.	Muñoz & Castro 2012
	Cestoda	-	Tetraphyllidea gen. sp.	Muñoz & Castro 2012
	Copepoda	Chondracanthidae	*Acanthochondria ophiidi* (Kroyer, 1863)	Muñoz & Castro 2012

Appendix 1. Continued / Continuación

Family / Host species	Group of parasite	Family of parasite	Parasite species	Source
	Copepoda	Philichthyidae	*Colobomatus tenuis* Castro Romero & Muñoz, 2011	Muñoz & Castro 2012
	Copepoda	Bomolochidae	*Holobomolochus chilensis* Cressey & Cressey, 1985	Muñoz & Castro 2012
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	Muñoz & Olmos 2007
	Copepoda	Pennellidae	*Trifur* cf. *tortuosus* Wilson, 1917	Muñoz & Castro 2012
	Digenea	Opecoelidae	*Helicometrina* cf. *nimia* Linton, 1910	Muñoz & Castro 2012
	Digenea	Derogenidae	*Hemipera* sp.	Muñoz & Castro 2012
	Digenea	Lecithasteridae	*Lecithaster* cf. *macrocotyle* Szidat & Graefe, 1967	* New record
	Digenea	Bucephalidae	*Prosorhynchoides carvajali* Muñoz & Bott, 2011	Muñoz & Castro 2012
	Monogenea	Microcotylidae	*Microcotyle* sp.	* New record
	Monogenea	Capsalidae	*Neobenedenia melleni* (MacCallum, 1927)	Muñoz & Castro 2012
	Nematoda	Anisakidae	*Anisakis* sp.	Muñoz & Castro 2012
	Nematoda	Cystidicolidae	*Similascarophis chilensis* Muñoz, Gonzalez & George-Nascimento, 2004	Muñoz & Castro 2012
	Nematoda	-	Spirurida gen. sp.	Muñoz & Castro 2012
Auchenionchus variolosus (Valenciennes, 1836)	Acanthocephala	Polymorphidae	*Corynosoma* sp.	Muñoz & Castro 2012
	Acanthocephala	Arhythmacanthidae	*Hypoechinorhynchus* spp.	* New record
	Acanthocephala	Arhythmacanthidae	*Spiracanthus bovichthys* Muñoz & George-Nascimento, 2002	Muñoz & George-Nascimento 2002
	Annelida	Piscicolidae	Piscicolidae gen. sp.	Moraga & Muñoz 2010
	Cestoda	-	Tetraphyllidea gen. sp.	Muñoz & Castro 2012
	Copepoda	Chondracanthidae	*Acanthochondria ophiidi* (Kroyer, 1863)	Muñoz & Castro 2012
	Copepoda	Bomolochidae	*Holobomolochus chilensis* Cressey & Cressey, 1985	Muñoz & Castro 2012
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	Muñoz & Castro 2012
	Copepoda	Pennellidae	*Trifur* cf. *tortuosus* Wilson, 1917	Muñoz & Castro 2012
	Digenea	Opecoelidae	*Helicometrina* cf. *nimia* Linton, 1910	Muñoz & Castro 2012
	Digenea	Hemiuridae	Hemiuridae gen. sp.	Muñoz & Castro 2012
	Digenea	Lecithasteridae	*Lecithaster* sp.	Muñoz & Castro 2012
	Digenea	Haploporidae	*Megasolena* sp.	* New record
	Digenea	Bucephalidae	*Prosorhynchoides carvajali* Muñoz & Bott, 2011	Muñoz & Castro 2012
	Monogenea	Microcotylidae	*Microcotyle* sp.	Muñoz & Castro 2012
	Monogenea	Capsalidae	*Neobenedenia melleni* (MacCallum, 1927)	* New record
	Nematoda	-	Spirurida gen. sp.	Muñoz & Castro 2012
Calliclinus geniguttatus (Valenciennes, 1836)	Acanthocephala	Polymorphidae	*Corynosoma* sp.	* New record
	Acanthocephala	Arhythmacanthidae	*Hypoechinorhynchus* sp.	* New record
	Acanthocephala	Arhythmacanthidae	*Spiracanthus bovichthys* Muñoz & George-Nascimento, 2002	Muñoz & George-Nascimento 2002
	Annelida	Piscicolidae	Piscicolidae gen. sp.	* New record
	Cestoda	-	Pseudophyllidea gen. sp. (larva)	* New record
	Cestoda	-	Tetraphyllidea gen. sp. (larva)	* New record
	Copepoda	Philichthyidae	*Colobomatus tenuis* Castro Romero & Munoz, 2011	* New record

Appendix 1. Continued / Continuación

Family / Host species	Group of parasite	Family of parasite	Parasite species	Source
	Copepoda	Bomolochidae	*Holobomolochus chilensis* Cressey & Cressey, 1985	Muñoz & Castro 2012
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	Muñoz & Castro 2012
	Copepoda	Pennellidae	*Trifur* sp.	* New record
	Digenea	Opecoelidae	*Helicometrina* cf. *nimia* Linton, 1910	Muñoz & Castro 2012
	Digenea	Bucephalidae	*Prosorhynchoides carvajali* Muñoz & Bott, 2011	* New record
	Monogenea	Microcotylidae	*Microcotyle* sp.	* New record
	Monogenea	Capsalidae	*Neobenedenia melleni* (MacCallum, 1927)	* New record
Pholidae				
Apodichthys flavidus Girard, 1854	Cestoda	Bothriocephalidae	*Bothriocephalus scorpii* (Müller, 1776)	Love & Moser 1983
	Copepoda	Chondracanthidae	*Chondracanthus pusillus* Kabata, 1968	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle apodichthysi* Park, 1937	Love & Moser 1983
	Nematoda	Anisakidae	*Anisakis* sp.	Love & Moser 1983
Stichaeidae				
Anoplarchus purpurescens Gill, 1861	Digenea	Lecithasteridae	*Lecithaster gibbosus* Rudolphi, 1802	Love & Moser 1983
	Digenea	Hemiuridae	*Tubulovesicula lindbergi* (Layman, 1930)	Love & Moser 1983
	Nematoda	Anisakidae	*Anisakis* sp.	Arai 1969
	Nematoda	Cystidicolidae	*Ascarophis sebastodis* Olsen, 1952	Arai 1969
	Nematoda	Anisakidae	*Contracaecum* sp.	Arai 1969
	Nematoda	Toxocaridae	*Porrocaecum* sp.	Arai 1969
Xiphister atropurpureus (Kittlitz, 1858)	Copepoda	Chondracanthidae	*Chondracanthus pinguis* Wilson, 1912	Love & Moser 1983
	Copepoda	Caligidae	*Lepeophtheirus parviventris* Wilson, 1905	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle atomon* (Rudolphi, 1802)	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle californica* Park, 1937	Love & Moser 1983
	Digenea	Opecoelidae	*Podocotyle reflexa* (Creplin, 1825)	Love & Moser 1983
	Nematoda	Philometridae	*Clavinema mariae* (Layman, 1930)	Love & Moser 1983
Xiphister mucosus (Girard, 1858)	Digenea	Opecoelidae	*Podocotyle californica* Park, 1937	Love & Moser 1983
Tripterygiidae				
Helcogrammoides chilensis (Cancino, 1960)	Acanthocephala	Polymorphidae	*Corynosoma* sp.	Muñoz &Delorme 2011
	Annelida	Piscicolidae	Piscicolidae gen. sp.	Muñoz &Delorme2011
	Cestoda	-	Pseudophyllidea gen. sp.	Muñoz & Delorme 2011
	Cestoda	-	Tetraphyllidea gen. sp.	Muñoz & Delorme 2011
	Copepoda	Bomolochidae	*Holobomolochus chilensis* Cressey & Cressey, 1985	Muñoz & Delorme 2011
	Copepoda	Bomolochidae	*Holobomolochus dawsoni* Cressey & Cressey, 1985	Muñoz & Olmos 2007
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	* New record
	Digenea	Opecoelidae	*Helicometrina* cf. *nimia* Linton, 1910	Muñoz & Delorme 2011
	Digenea	Derogenidae	*Hemipera* sp.	* New record
	Digenea	Lecithasteridae	*Lecithaster* sp.	Muñoz & Delorme 2011
	Digenea	Bucephalidae	*Prosorhynchoides carvajali* Muñoz & Bott, 2011	Muñoz *et al.* 2014
	Monogenea	Gyrodactylidae	*Gyrodactylus chileani* Ziętara, Lebedeva, Muñoz & Lumme, 2012	Ziętara *et al.* 2012
Helcogrammoides cunninghami (Smitt, 1898)	Annelida	Piscicolidae	Piscicolidae gen. sp.	* New record
	Cestoda	-	Pseudophyllidea gen. sp. (larva)	* New record
	Cestoda	-	Tetraphyllidea gen. sp. (larva)	* New record
	Copepoda	Bomolochidae	*Holobomolochus chilensis* Cressey & Cressey, 1985	* New record
	Copepoda	Caligidae	*Lepeophtheirus zbigniewi* Castro-Romero & Baeza-Kuroki, 1981	* New record
	Digenea	Lecithasteridae	*Lecithaster* cf. *macrocotyle* Szidat & Graefe, 1967	* New record