PANAMJAS
Pan-American Journal of Aquatic Sciences

Community of eumetazoan parasites in ocean whitefish *Caulolatilus princeps* (Jenyns, 1840) (Perciformes, Malacanthidae) off north Peru

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Abstract. The objective of this investigation was to determine the community of eumetazoan parasites in the Ocean whitefish *Caulolatilus princeps* (Jenyns, 1840) off north Peru, as well as to prepare an updated checklist of records made in the whitefish. Fifty-one specimens of *C. princeps* were captured and brought from Puerto Pimentel, province of Chiclayo, department of Lambayeque, and Puerto Cabo Blanco, province of Talara, department of Piura, Peru. For the analysis of the parasitic community, the parasitological ecological indices of prevalence (P), mean abundance (MA), mean intensity (MI) of infection, the dispersion indices, the association between total length (TL) and sex of fish *vs* parasitological ecological indices, were calculated. Nine species of helminths and arthropods were collected. The community of parasites in *C. princeps* consisted of six species of ectoparasites (three species of monogeneans and three species copepods), and three species of endoparasites (one species of nematode, one species of acanthocephala and one species of digenea). The P and MA of *Choricotyle caulolatili* (Meserve, 1938) infection was positively related to the total length of *C. princeps*. The sex of *C. princeps* was associated with the MI of *Jaliscia caballeroi* (Bravo-Hollis, 1960), with males presenting the highest values. *Caulolatilus princeps* is a new host for *Gnathia* sp., *Dichelyne* (*Cucullanellus*) *elongatus* (Törnquist, 1931) and *Lepeophtheirus* sp.

Key words: Helminths, marine fish, ichthioparasitology, eumetazoans, ocean whitefish, parasites.

Resumen: **Comunidad de especies de eumetazoos en el pejeblanco *Caulolatilus princeps* (Jenyns, 1840) (Perciformes, Malacanthidae) del norte del Perú**. El objetivo de esta investigación fue determinar la comunidad de parásitos eumetazoos en el pejeblanco *Caulolatilus princeps* (Jenyns, 1840) frente al norte de Perú, así como preparar una lista de verificación actualizada de los registros realizados en el pejeblanco. Cincuenta y un especímenes de *C. princeps* fueron capturados y traídos de Puerto Pimentel, provincia de Chiclayo, departamento de Lambayeque, y Puerto Cabo Blanco, provincia de Talara, departmento de Piura, Perú. Para el análisis de la comunidad parasitaria, se determinaron los índices ecológicos parasitológicos de prevalencia (P), abundancia media (AM), intensidad media (IM) de la infección, los índices de dispersión, la asociación entre la longitud total (TL) y el sexo de los peces *vs* los índices parasitológicos ecológicos. Se recolectaron 9 especies de helmintos y artrópodos. La comunidad de parásitos en *C. princeps* consistió en seis especies de ectoparásitos (tres especies de monogeneos y tres especies de copépodos) y tres especies de endoparásitos (una especie de nematodo, una especie de acantocefalo y una especie de digeneo). La P y AM de la infección por *Choricotyle caulolatili* (Meserve, 1938) se relacionó positivamente con la longitud total de *C. princeps*. El sexo de *C. princeps* se asoció con el IM de *Jaliscia caballeroi* (Bravo-Hollis, 1960), y los machos presentaron los valores más altos. *Caulolatilus princeps* es un nuevo huésped para *Gnathia* sp., *Dichelyne* (*Cucullanellus*) *elongatus* (Törnquist, 1931) y *Lepeophtheirus* sp.

Palabras clave: Helmintos, peces marinos, ictioparasitología, eumetazoos, pejeblanco, parásitos

Introduction

Accurately estimating biodiversity is fundamental to ecological understanding and prediction, however, parasites are often neglected in biodiversity estimates and when included are often underestimated (Yamada & Takemoto 2017). Parasitic helminths and related invertebrate species are not mentioned when estimating biodiversity, despite being considered as an important component of the planet's biodiversity (Luque *et al*. 2017). The study of parasitic species associated with economically valuable fish is an important area of research that contributes to the success and sustainable development of fishing and aquaculture systems around the world (Reed 2015) because they can lead to a better understanding of links between the parasite and the host; which can help avoid epizootic diseases in other ecosystems (Lamothe-Argumedo *et al.* 1997).

The Ocean whitefish *Caulolatilus princeps* (Jenyns, 1840) (Malacanthidae) is a marine, subtropical fish that inhabits rocky bottoms, soft sand, and reefs with a depth range of 10 - 91 m, it is distributed in the eastern Pacific, from the Vancouver Island, Canada to Puerto Callao, Peru (Bellquist *et al*. 2008, Nevárez-Martínez *et al.* 2008, Findley *et al*. 2010). The Ocean whitefish can be found in a variety of habitats, although they feed primarily on interstitial invertebrates (Elorduy-Garay & Caraveo-Patiño 1994).

About its parasitic fauna, one of the first parasitological studies carried out in this fish species was the one carried out by Manter (1940), in which the trematode *Choanodera caulolatili* Manter, 1940 collected from the Galapagos Islands, was recorded. There are also reports of the trematode *Myzotus vitellosus* Manter, 1940, in *Caulolatilus* sp. (probably *C. princeps*) collected in the Galapagos Islands, Ecuador by Manter (1940).

From there, parasitological studies in *C. princeps* have been sporadic, with the countries of Ecuador, Mexico and Peru being the only ones with parasite records in this host (Manter 1940, Bravo-Hollis 1981, Rodríguez-Santiago & Rosales-Casián 2011, Eiras *et al*. 2016, Luque *et al*. 2016).

Only records of nematodes of the genus *Philometra* Costa, 1845 existed in Peru in the gonads of this fish (IMARPE 2017). Due to the recent synonymy of this species with its closest species, *Caulolatilus affinis* Hildebrand, 1946 (Findley *et al*. 2010) it is considered that all parasitic records made in *C. affinis* should be transferred to *C. princeps*.

Due to the scarce information about parasitological studies in the three fish species mentioned above in Peru, the objective was to determine the community of parasitic eumetazoans of *C. princeps* from the North of Peru, the type of distribution, diversity, infection rates, and the relationship with the length and sex of these hosts.

Materials and methods

Collection of material: Fifty-one specimens of the Ocean whitefish *C. princeps* were acquired in the fishing terminal of the district of Villa María del Triunfo, Lima, Peru, between the years 2017-2018. The fish were captured and brought from Puerto Pimentel, province of Chiclayo, department of Lambayeque and Puerto Cabo Blanco, province of Talara, department of Piura, Peru. For the identification of fish species, the taxonomic keys of Chirichigno & Velez (1998) were used. Total length (TL) and sex (S) data were taken before fish necropsy. For the collection of parasites, the oral cavity, gills, branchial cavity, body cavity, stomach, small intestine, large intestine, pyloric caeca, mesenteries, gonads, heart, branchial artery, swim bladder, kidneys, liver, and spleen of the fish were carefully examined in laboratory. Parasites were collected and preserved in 70% ethyl alcohol (Eiras *et al.* 2006).

Processing of the samples: For the taxonomic study, the helminths were stained in carmine acetic acid or Gomori trichrome, dehydrated in concentrations of 50%, 70%, 90% and 100% ethyl alcohol, cleared in eugenol and mounted in Canada balsam (Eiras *et al.*

2006). The nematodes were rinsed in a mixture of ethyl alcohol-phenol for the observation of structures of taxonomic importance. Parasitic arthropods were cleared in 20% KOH, dehydrated in concentrations of 50%, 70%, 90% and 100% ethyl alcohol, diaphanized in eugenol and mounted in the balsam of Canada. The taxonomic identification of the monogeneans was carried out according to Bychowsky (1957), Yamaguti (1963a), Cohen *et al*. (2013); Manter (1940), Kohn *et al*. (2007), and Bray *et al*. (2008) to trematodes, Anderson *et al*. (2009) to nematodes, and Yamaguti (1963b) to copepods**.**

Analysis of the samples: For the analysis of the parasitic community, the parasitological ecological indices of prevalence (P), mean abundance (MA) and mean intensity (MI) of infection were calculated (Bush *et al*. 1997, Bautista-Hernández *et al*. 2015). The type of strategy of each parasitic species was evaluated according to prevalence (%), for which species were classified as "core" species for species with prevalence greater than 45%, "secondary" species for prevalences between 10% - 45% and "satellite" species for prevalences less than 10% (Bush & Holmes 1986). The index of specific importance (I) calculated as the importance of each parasitic species in the ecological assembly was used to obtain an integrated index of infection of both ecological descriptors (Iannacone & Alvariño 2013): I = P + (MA x 100). Where: I = index of specific importance, P = Prevalence, MA = mean abundance of infection.

In the case of parasitic species with prevalence greater than 10% (Esch *et al*. 1990), the dispersion indices, Morisita Index, Lloyd's Index, Poulin discrepancy and K of the negative binomial equation with its respective Chi-square value (X^2) to determine the type of distribution and degree of aggregation (Bego & Von-Zuben 2010). The calculations were performed using the statistical package Quantitative Parasitology 3.0 (Rózsa *et al*. 2000).

The Spearman correlation coefficient was used to evaluate the association between TL and P, previously transforming the values of P to square root of arcsine. The Pearson correlation coefficient was used to determine the ratio of the TL of the host to the MA and MI of each parasitic species. In all cases, the normality of the data was verified using the Kolmogorov-Smirnov test with the Lilliefors modification and the variance homoscedasticity based on the Levene’s test. Contingency tables (2 x 2) were used to calculate the degree of association between the sex of the host and P of each parasite by means of X^2 and the Likelihood Ratio test. The Student t-test was used to compare the MA and MI of each parasite and the sex of the host. The analysis of the parasites concerning the size and sex of the host was made only for the species with prevalence greater than 10% (Esch *et al*. 1990). The level of significance was evaluated at a level of alpha = 0.05.

The following indices of alpha diversity were determined: Richness, Simpson, Shannon, Menhinick, Equitability and Chao-1 (Iannacone & Alvariño 2013) for the parasitic community component, for males and females.

For the determination of descriptive and inferential statistics, the statistical package IBM SPSS Statistics 24 was used.

In addition, a checklist of the parasitic records of Ocean whitefish *C. princeps* was prepared up to December 2019. For the elaboration of the list, the summaries of scientific meetings and pre-degree theses were not considered. The scientific names of the parasite and host species were reviewed following the classification schemes of the World Register of Marine Species (WoRMS 2018).

All the specimens studied were deposited in the Colección de Helmintos parásitos e invertebrados afines of the Museo de Historia Natural, Universidad Nacional Federico Villarreal, Lima, Peru (MUFV: ZOO: HPIA; 31-39).

Results

The population structure of the Ocean whitefish *C. princeps* was composed of 43 males (84%) and 8 females (16%). The total length of the Ocean whitefish was 24.5 cm – 37 cm (Mean ± SD = 29.66 ± 3.35 cm). The males of ocean whitefish were 24.5 cm - 36.1 cm (29.32 ± 3.37 cm) and the females 25.5 cm – 37 cm (31.51 ± 4.64 cm) length.

Fifty-one specimens of the Ocean whitefish *C. princeps* were acquired from which 371 specimens of endoparasites and ectoparasites belonging to 9 species, were collected and identified. The total number of recorded eumetazoan in the Ocean whitefish was made up of 90.3% of the total ectoparasites of the monogeneans and crustaceans.

The percentage of total prevalence in *C. princeps* infected with at least one parasitic eumetazoan species was 78.43% (n = 40). The parasitic species with the highest prevalence and mean abundance were the monogenean *Jaliscia caballeroi* (Bravo-Hollis, 1960) Mamaev and Egorova, 1977, *Choricotyle caulolatili* (Meserve, 1938) Sproston, 1946, the copepod *Hatschekia* sp. and the isopod in state of praniza larvae *Gnathia* sp.

Only *J. caballeroi* and *Hatschekia* sp. had prevalences above 45% and were considered core species. The parasitic assemblage in the Ocean whitefish recorded nine parasitic species, of which five species had prevalences below 10%, i.e., more than half of the recorded species were satellite species (Table I).

Table II shows the analysis of aggregation for secondary species and core species for parasites with prevalences above 10%. The dispersion index (DI), Morisita Index (MIn) and Lloyd's Index (LI) indicated a distribution of the aggregation type for the species of *J. caballeroi*, *C. caulolatili*, *Hatschekia* sp. and *Gnathia* sp. The negative binomial exponent (K) could not be calculated for *C. caulolatili* and *Gnathia* sp. because the sample was too small to verify the adjustment of the distribution.

The prevalence of infection and the MA of *C. caulolatili* was strongly related to the TL of *C. princeps*. The Student t-test showed significant differences only between the sex of *C. princeps* and the MI of *J. caballeroi* (Table III). The total length of Ocean whitefish C. princeps examined in this study was not related to the parasitological indices of *J. caballeroi* and *Hatschekia sp*. The P and the MA of *C. caulolatili* was strongly positively related to the total length of *C. princeps* (r = 0.94, p = 0.01; r = 0.33, p = 0.02; respectively).

The Student t-test showed significant differences only between the sex of C. princeps and the IM of *J. caballeroi*. No other association was found between MA, MI or P of the other two parasitic species with the sex of *C. princeps* (Table III).

Table I. Ecological descriptors of eumetazoan parasites in *Caulolatilus princeps* from northern Peru. Percentage of prevalence (P%), mean abundance of infection (MA), mean intensity of infection (MI), specific importance (I), standard error (SE), G = gills, BC = branchial cavity, PC = pyloric caeca, ID = small intestine, M = mesentery. SI = site of infection, TS = type of strategy.

	Parasites	SI	P %	MA ± SE	MI ± SE	I	TS
MONOGENEA	*Jaliscia caulolatili*	G	5.88	0.08 ± 0.05	1.33 ± 0.19	13.73	satelite
	Jaliscia caballeroi	G	50.99	2.90 ± 0.68	5.69 ± 0.95	341.18	core
	Choricotyle caulolatili	G	17.65	0.33 ± 0.14	1.89 ± 0.32	50.98	secondary
TREMATODA	*Myzotus vitellosus*	PC	1.96	0.55 ± 0.55	28 ± 3.92	56.86	satelite
NEMATODA	*Dichelyne* (*Cucullanellus*) *elongatus*	ID	5.88	0.12 ± 0.08	2 ± 0.34	17.65	satelite
ACANTOCEPHALA	Cisticanto no id.	M	1.96	0.04 ± 0.04	2 ± 0.28	5.88	satelite
CRUSTACEA	*Lepeophtheirus* sp.	G	1.96	0.02 ± 0.02	1 ± 0.14	3.92	satelite
	Hatschekia sp	G, BC	52.94	2.53 ± 0.76	4.78 ± 1.04	305.88	core
	Gnathia sp. (praniza)	G, BC	13.73	0.71 ± 0.30	5.14 ± 0.79	84.31	secondary

Table II. Aggregation indices to evaluate the dispersion of the most prevalent parasites in *Caulolatilus princeps.*

Aggregation indices	*Jaliscia caballeroi*	*Choricotyle caulolatili*	*Hatschekia* sp.
Dispersion Index (DI)	8.14	2.84	11.63
p/ interpretation	31.79 / A	3.96 / A	38.59 / A
Morisita Index (MIn)	9.95	2.25	13.03
Interpretation	A	A	A
Lloyd's Index (LI)	10.04	2.17	13.16
Interpretation	A	A	A
Poulin discrepancy (PD)	0.73	0.87	0.76
Interpretation	A	A	A
Negative binomial exponent (K)	0.31	0.19	0.33
p/ interpretation	0.96 / A	**	0.85 / A

DP = 0 (absence of aggregation) to 1 (aggregation to the limit), p = value of significance of the Chi-square test, ID = Variance / mean ratio, A = aggregate. ** Sample too small to verify the adjustment of the negative binomial distribution.

Table III. Inferential statistics of size parameters and sex of fish with parasitological indices. Total length = TL, Mean intensity of infection (MI), mean abundance of infection (MA), prevalence (P), F = Levene's test, p = level of significance, r = Pearson correlation, t = Student's t-test, X^2 = Chi-square test. Ch= *Choricotyle caulolatili*, Ha= *Hatschekia* sp., Ja= *Jaliscia caballeroi.*

		Parasites		
		Ja	Ch	Ha
TL vs P	r (Spearman)	0.79	**0.94**	0.6
	p	0.06	**0.01**	0.2
TL vs MA	r (Pearson)	0.22	**0.33**	0.04
	p	0.12	**0.02**	0.79
TL vs MI	r (Pearson)	-0.08	0.12	-0.08
	p	0.7	0.76	0.68
Sex vs P	X^2	**4.55**	1.61	0.73
	p	**0.04**	0.21	0.39
Sex vs MA	t Student	**8.39**	---	2.69
	p	**0.00**	---	0.11
	F (Levene)	0.97	0.66	-1.24
	p	0.34	0.52	0.9
Sex vs MI	t Student	0.5	0.17	1.85
	p	0.48	0.68	0.17
	F (Levene)	**3.08**	0.56	0.45
	p	**0.00**	0.59	0.66

The values of the alpha diversity indices of the community component of parasitic eumetazoans according to sex and the total population of *C. princeps* are shown in Table IV. In comparison to the sexes, only in the Menhinick diversity index and the nonparametric Chao-1 estimator show lower values in the females of the *C. princeps*. In the total community component of *C. princeps* there were low values of dominance according to Simpson, and in contrast high in the equitability indices according to Equitability and Shannon. The estimator of Chao-1 estimates that the expected richness in *C. princeps* is the same as that found, i.e., the level of effort was optimal (Table IV).

Finally, the records of helminths and parasitic arthropods have been summarized in Table V. Four classes, 14 genera and 16 species (including those identified only by genus) associated with *C. princeps* in waters of Ecuador, Mexico and Peru are listed.

Table IV. Alpha diversity for eumetazoan parasites according to sex and population in *Caulolatilus princeps.*

Alpha Diversity	Total	Male	Female
Richness S	9	8	5
Individuals	371	308	63
Menhinick	0.47	0.46	0.63
Shannon H	1.46	1.31	1.16
Simpson λ	0.30	0.34	0.35
Equitability J	0.66	0.63	0.72
Chao-1	9	8	6

Discussion

The component community of the parasitic eumetazoan fauna in the evaluated fish was dominated by ectoparasitic flatworms and crustaceans. In less abundance and diversity 3 species of endoparasites were found. According to Poulin (1995), the endoparasite communities of fish can be determined by the feeding habits of the hosts, e.g., specialized predators versus generalists, and their ontogenetic changes, as well as by the availability of different species of prey (intermediate hosts) in a given environment.

In the case of ectoparasites, this transmission is not affected by these factors, but rather by the habitat, behavior, and density of the hosts, as well as by the environmental characteristics (for example, depth and temperature) (Poulin 1995, Oliva *et al*. 2004, González & Oliva 2006). In this last factor, the marine depth is usually related indirectly to temperature, i.e., deeper lower temperature in aquatic ecosystems, so demersal fish such as black cusk-eel inhabiting depths of 60 - 300 m are not usually infected with ectoparasites, unlike the Ocean whitefish, which there was high dominance of ectoparasites and which are at depths of 10-90 m (Froese & Pauly 2017). Marcogliese (2002) suggested that parasitic diversity decreases in greater depths in marine ecosystems due to the variation of horizontal gradients in salinity, temperature, nutrients, and light.

In all species of eumetazoans studied, the aggregation indices showed a contagious distribution, which is influenced by intrinsic and extrinsic factors such as: (a) spatial heterogeneity of the fish habitat that produces differences in susceptibility; (b) influence on the evolutionary history of the parasite for food, spatial and reproductive competence; (c) improvement in the opportunity to infect the fish; and (d) prevention of the collapse of the host population due to the effects of parasitism (Iannacone *et al*. 2012).

Regarding the degree of association between the P and MA of *C. caulolatili* and the TL of *C. princeps*, they were related. Alves & Luque (2006) point out those changes in ectoparasite infestations in relation to host size, can be attributed mainly to mechanical factors. Luque & Poulin (2007) found a

Table V. Summary of the parasitic records in *Caulolatilus princeps* from Eastern Pacific.

Parasites	localization	Location	Reference
MONOGENEA			
Choricotyle caulolatili (Meserve, 1938) Sproston, 1946	Gills	Ecuador, México, Peru	Manter 1940, Kohn *et al*. 2006, Rodríguez-Santiago & Rosales-Casián 2011, Eiras *et al*. 2016, Rodríguez *et al*. 2016, present study
Encotyllabe pagrosomi MacCallum, 1917	Gills	Peru	Faustino *et al*. 2015
Jaliscia caballeroi (Bravo-Hollis, 1960) Mamaev & Egorova, 1977	Gills	México, Peru	Bravo-Hollis 1981, Kohn *et al*. 2006, present study
Jaliscia caulolatili Faustino, Martínez & Tantaleán, 2017	Gills	Peru	Faustino *et al*. 2015
TREMATODA			
Choanodera caulolatili Manter, 1940	Intestine, Stomach	Ecuador, México	Manter 1940, Rodríguez-Santiago & Rosales-Casián 2011, Eiras *et al*. 2016, Rodríguez-Santiago *et al*. 2016
Bianium plicitum (Linton, 1928) Stunkard, 1931	Intestine, Stomach	México	Rodríguez-Santiago & Rosales-Casián 2011, Rodríguez-Santiago *et al*. 2016
Myzotus vitellosus Manter, 1940	Pyloric caeca	Peru†	Present study
Myzotus sp. Manter, 1940	Intestine	Peru	Eiras *et al*. 2016, Luque *et al*. 2016
NEMATODA			
Anisakis sp. Dujardin, 1845	Mesentery	México	Rodríguez-Santiago & Rosales-Casián 2011, Rodríguez-Santiago *et al*. 2016
Dichelyne (Cucullanellus) elongatus (Törnquist, 1931)	Intestine	Peru†	Present study
Hysterothylacium aduncum (Rudolphi, 1802)	Intestine, Stomach, Pyloric caeca	México	Rodríguez-Santiago & Rosales-Casián 2011, Rodríguez-Santiago *et al*. 2016
Philometra sp.	Gills	Peru	IMARPE 2017
CRUSTACEA			
Gnathia sp. Leach, 1814 (Praniza)	Branchial cavity	Peru†	Present study
Hatschekia sp. Poche, 1902	Branchial cavity	México, Peru†	Rodríguez-Santiago & Rosales-Casián 2011, Morales-Serna *et al*. 2012, Rodríguez-Santiago *et al*. 2016
Lepeophtheirus sp. von Nordmann, 1832	Gills	Peru†	Present study
Parabrachiella gracilis (Wilson C.B., 1908)	Branchial cavity	México	Morales-Serna *et al*. 2012, Eiras *et al*. 2016

† Registered in the present study. Originally registered in *Caulolatilus affinis*.

positive correlation between species richness and host size in marine and freshwater neotropical fish. According to Morand & Poulin (1998), larger host fish harbor greater parasitic richness, because they provide a wide variety of niches and can sustain a greater number of parasites. Poulin (2011) indicates that larger hosts can provide a greater supply of nutrients to parasites and, consequently, would be the most susceptible to greater diversity and parasite burden (Chero *et al*. 2017). These arguments could explain the positive relationship observed between the TL of *C. princeps* influenced the P and MA of *C. caulolatili*.

The differences observed between the sex of *C. princeps* and the IM of *J. caballeroi* is a clear indicative of the preference of parasites for any of the sexes of the host fish and that could be attributed to differences in the ecological relationships (habitat, behavior, and feeding) of males and females (Iannacone, 2005). The sample shows unbalanced sizes between sexes (43 vs 8; females hosted only 17% of the total parasites collected), and also could be a factor that influences the differences found in the parasitological descriptors between the sex of *C. princeps*.

Concerning the parasites found in the Ocean whitefish *C. princeps*, the monogenean *J. caballeroi* has been previously reported in Peru, Costa Rica and Mexico in the hosts *C. princeps*, *Caulolatilus* sp. and *Selar crumenophthalmus* (Bloch, 1793) (Tantaleán & Huiza 1994, Lamothe-Argumedo *et al.* 1996, Rodríguez-Ortíz *et al*. 2004). Reports from Peru and Mexico included only morphological descriptions of *J. caballeroi* with no information about the ecology of this monogenean.

Another species of the genus *Jaliscia* Mamaev & Egorova, 1977 reported here is *J. caulolatili*. This species is described for the first time by Pérez (1993) in the gills of *C. princeps*, from Mexico and has been reported and redescribed in Peru in the same host by Faustino *et al*. (2015). This species is currently classified as *nomen nudum* (unpublished) because it does not International Code of Zoological Nomenclature – ICZN compliant (WoRMS 2018).

The genus *Choricotyle* Van Beneden & Hesse, 1863 currently includes 24 valid species of which five species are reported in Peru (Luque *et al*. 2016). Rodríguez-Santiago & Rosales-Casián (2011), evaluated the parasitic fauna of *C. princeps* collected from the coast of San Quintín, Baja California, Mexico and reported a single monogenean, *Choricotyle caulolatili* (Meserve, 1938) Sproston, 1946, with P = 13.2%, MA = 0.2 and MI = 2.6. These values are similar to those in our study (Table I). In Peru, this monogenean was reported in the coasts of Ancash and Piura by Tantaleán *et al.* (1985) and Faustino *et al*. (2015), in *Caulolatilus* sp. and *C. princeps*, respectively.

Another group of ectoparasites described from *C. princeps* are the copepod and isopod crustaceans. The copepod *Lepeophtheirus* sp. has been only reported in *Merluccius gayi peruanus* Ginsburg, 1954 off the Peruvian coast (Luque *et al*. 2016). Other species of the same genus recorded in Peru are *Lepeophtheirus chilensis* Wilson, 1905, *Lepeophtheirus edwardsi* Wilson, 1905 and *Lepeophtheirus marginatus* Bere, 1936 (Luque *et al*. 2016). Therefore, this is the first record of the genus *Lepeophtheirus* in the fish *C. princeps*.

The copepod *Hatschekia* sp. showed a similar prevalence in the ecological studies conducted by Rodríguez-Santiago & Rosales-Casián (2011) (P = 57.1%) and in ours (52.3%), both in *C. princeps*. However, MA and MI were higher in the study conducted in Baja California, Mexico (MI = 20.3 and MA = 10.1) compared to what was done in Piura, Peru (MI = 4.8 and MA = 2.5). This suggests that this copepod presented a greater number of parasitic individuals for each individual of Ocean whitefish parasitized in Mexico than in Peru.

The isopod *Gnathia* sp. lives freely as an adult and has juvenile stages whose larvae called praniza are temporary ectoparasites of elasmobranchs and teleosts (Davies 1981). Gonzáles & Oliva (2006) observed varied P and MI of the praniza larvae in *Sebastichthys capensis* (Gmelin, 1789) and *Helicolenus lengerichi* Norman, 1937 from Valdivia, Chile. Apparently, these parasites are not host-specific and were described from several hosts throughout the world (Smit & Davies 2004, Genc *et al*. 2005). However, in Peru, there has not been a record of this parasite, so this would be the first record off the Peruvian coast, as well as the first record for *C. princeps*.

The only trematode found in the Ocean whitefish was *Myzotus vitellosus* Manter, 1940. This genus and species were described in the fish *Caulolatilus* sp. (probably *C. princeps*) off the Galapagos Islands (Manter 1940). In Peru, *Myzotus* sp. was found in the gills of *C. princeps* by Escalante *et al*. (1984), and in *Coryphaena hippurus* Linnaeus, 1758 by Vásquez-Ruiz & Jara-Campos (2012) in northern Peru. In this last work, a P = 23.1% (3/13) and an MI of 6.3 of *Myzotus* sp. in *C. hippurus* were reported. In our study, we have also observed a low prevalence of this digenean in *C. princeps*. In our study, we recorded a higher MI due to a considerable number of parasitic individuals in the few fish infected by this species. In this study, the species *M. vitellosus* was recorded for the first time off the coast of Peru.

Dichelyne (*Cucullanellus*) *elongatus* was the only nematode collected in *C. princeps*. This genus has been reported off the coast of Peru in *Paralonchurus peruanus* (Steindachner, 1875), *Sciaena deliciosa* (Tschudi, 1846), *Cilus gilberti* (Abbott, 1899) and *Paralabrax humeralis* (Valenciennes, 1828) (Luque *et al*. 2016). In our study, this nematode appeared rare due to its low parasitic indices (P = 5.9% and MI = 2). This is similar to that observed in *P. humeralis* by Iannacone & Alvariño (2009), where this nematode also showed low indices (P = 4.8% and MI = 1.8). In relation to the life cycle of this parasite, it is known that polychaetes are used as intermediate hosts and the infecting stage occurs in L_3 stage (Køie 2001). This is the first record of this genus in *C. princeps*.

It is concluded that the community of eumetazoan parasites was dominated by the presence of ectoparasites in *C. princeps*. The parasitic species *C. caulolatili*, *Gnathia* sp., *Hatschekia* sp., *J. caballeroi*, had prevalences greater than 10% and an aggregate distribution. The P and MA of *C. caulolatili* infection were positively related to the length of *C. princeps*. The sex of *C. princeps* was correlated with the MI of *J. caballeroi*, with males being parasitized with higher MI.

Caulolatilus princeps is a new host for *Gnathia* sp., *Dichelyne* (*Cucullanellus*) *elongatus*, *J. caulolatili*, *Lepeophtheirus* sp. and *M. vitellosus*. Peru is a new geographic record for the parasites *Gnathia* sp. and *M. vitellosus*.

Acknowledgments

The authors wish to thank Daniel Tanzola (Universidad de Mar del Plata, Argentina) and Omar Amin (Institute of Parasitic Diseases and Parasitology Center -Parasitology, Arizona, USA) and an anonymous reviewer for the suggestions and comments.

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Received: February 2020
Accepted: May 2020
Published: June 2020