

SCIENTIFIC NOTE / NOTA CIENTÍFICA

NOTES ON INTESTINAL PARASITIC DISEASES IN ARTISANAL FISHERMEN OF THE FISHING TERMINAL OF CHORRILLOS (LIMA, PERU)

NOTAS EN LAS ENFERMEDADES PARASITARIAS INTESTINALES EN PESCADORES ARTESANALES DEL TERMINAL PESQUERO DE CHORRILLOS (LIMA, PERU)

Henry Zelada – Castro¹, Jenny Rodríguez - Borda¹, Hugo Flores - Liñan², Jorge León - Manco², Eric J. Wetzel³ & Jorge Cárdenas - Callirgos⁴

¹ Alberto Hurtado School of Medicine. Cayetano Heredia Peruvian University. Av. Honorio Delgado 430, Urb. Ingeniería, S.M.P. Lima - Peru. E-mail: henryzc86@hotmail.com

² Alberto Cazorla Talleri School of Sciences and Philosophy. Cayetano Heredia Peruvian University. Av. Honorio Delgado 430, Urb. Ingeniería, S.M.P. Lima - Peru. E-mail: hugo.flores@upch.pe

³ Department of Biology, Wabash College, Crawfordsville, IN 47933, Indiana, USA. E-mail: wetzele@wabash.edu

⁴ Invertebrate Laboratory. Museum of Natural History. Biological Sciences School. Ricardo Palma University. Av. Benavides 5440, Lima 33, Peru. E-mail: jmcardenase@gmail.com

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Abstract

A fecal parasitological study of the population performing artisanal fishing of Terminal Pesquero de Chorrillos (Fishing Terminal of Chorrillos), Province of Lima, Peru, was conducted aiming at determining the prevalence of endoparasites and their relationship with fishing activity. Fecal samples were examined by the Ritchie's Method and the Spontaneous Sedimentation in Tube Technique. The prevalence of endoparasites was 68%. The only pathogenic protozoa found was *Giardia intestinalis* (syn. *G. lamblia*) (Lambl, 1859) Kofoid & Christiansen, 1915 with a 16% prevalence. The helminth parasites found included *Hymenolepis nana* (Culbertson, 1940) and *Ascaris lumbricoides* (Linnaeus, 1758), both with a 4% prevalence. Commensal parasites found included *Endolimax nana* (Wenyon & O'Connor, 1917) at a prevalence reaching 40%, followed by *Entamoeba coli* (Grassi, 1879) with 28% and finally *Iodamoeba butschlii* (Prowazek, 1911) with 4%, it is recommended to implement health education strategies and a permanent monitoring.

Keywords: *Giardia* - enteroparasitism - Chorrillos - fishermen - risk factors.

Resumen

Un estudio coproparasitológico a la población dedicada a la pesca artesanal del Terminal Pesquero de Chorrillos, Provincia de Lima, Perú, se llevó a cabo con el objetivo de determinar la prevalencia de enteroparasitosis y su relación con la actividad pesquera. Muestras coprológicas fueron examinadas por el método de Ritchie y la técnica de sedimentación espontánea en tubo. La prevalencia de enteroparasitosis fue del 68%. El único protozoo patógeno encontrado fue *Giardia intestinalis* (sinónimo de *G. lamblia*) (Lambl, 1859) Kofoid & Christiansen, 1915, con una prevalencia del 16%, después los helmintos mencionados *Hymenolepis nana* (Culbertson, 1.940) y *Ascaris lumbricoides* (Linnaeus, 1758), tanto con una prevalencia de 4%. Si bien entre los parásitos comensales se encontró a *Endolimax nana* (Wenyon & O'Connor, 1917), llegando a 40%, seguido de *Entamoeba coli* (Grassi, 1879) con 28% y, finalmente, *Iodamoeba butschlii* (Prowazek, 1911) con 4%, se recomienda implementar estrategias de educación para la salud y un seguimiento permanente.

Palabras clave: *Giardia* - enteroparasitismo - Chorrillos - pescadores - factores de riesgo.

INTRODUCTION

Gastrointestinal parasitic disease is common in our environment mostly due to the deficiencies in our health system (Contreras *et al.*, 1993) and the cultural habits of the population, especially of those living in poor conditions and who cannot access an adequate health system, additionally to the environmental characteristics promoting the transmission of etiologic agents (Apt, 1987). The access to drinking water services, an efficient excretion removal system and a right per capita income, additionally to the population literacy rate, are characteristics determining the socio-economic level of the population and are related to the human infection with gastrointestinal helminths (Mehraj *et al.*, 2008).

Human communities dedicated to fishing activities present socio-cultural aspects determining the transmission of protozoa and helminths, especially for those getting oral transmission through water and contaminated food and this due to the human behavior habits which are directly related to the epidemiology of parasitic infections, such as the case of contamination due to cysts of *Giardia* sp. and oocysts of *Cryptosporidium* spp., which when transmitted by fecal contamination cause diarrhea in the population exposed to a contaminated environment due to the lack of access to drinking water services (Macpherson, 2005). This health approach with multifactor impacts, including environmental, cultural and social factors, all of them subject to continuous changes due to the dynamic of the current human development (Petney, 2001), may be grouped under the title of poverty ecology, indicating a context where food safety, health infrastructure and a comprehensive educational proposal must be considered (Stillwaggon, 2006) preferably with the most vulnerable human groups, such as children (Holland *et al.*, 1988) and women (Brabin & Brabin, 1992) and where food habits, the relationship with the wild fauna and the ecological characteristics of the marine – coastal ecosystem play a fundamental role in the transmission of helminthic zoonoses (Cárdenas-Callirgos, 2012).

Based on the aforementioned, the objective of this study was established, that is, to conduct a coproparasitological study in part of the port population of the Fishing Terminal of Chorrillos dedicated to artisanal fishing and its likely relationship to marine helminthic zoonoses transmitted due to the consumption of marine products, considering the fishing community as a risk population since their diet, especially on the high seas, is based on fish, cephalopods and marine crustaceans (Cárdenas – Callirgos, 2010); thus, it was expected to find helminth eggs of parasites developed in the gastrointestinal tract until reaching sexual maturity and thus ovoposit. Also, possibly in some larvae or immature stages, helminths cannot adhere themselves to the digestive tract and thus they cannot sexually develop and are removed with feces. But also, in some other cases, helminths get to migrate to other organs and; therefore, it is necessary to diagnose through serological or surgical methods (Tantaleán, 1994; Cabrera & Trillo – Altamirano, 2004; Cárdenas – Callirgos, 2010), where we shall also consider that in the case of fish collected in Chorrillos, it was previously reported several helminthic larvae with zoonotic potential and that become into risk factor for the population of the city of Lima who consume them without the previous cooking (Tantaleán & Huiza, 1994; Zelada – Castro *et al.*, 2008).

MATERIALS AND METHODS

The study zone was the Fishing Terminal of Chorrillos located in the District of Chorrillos in Lima, Peru (12°11'33"S 77°0'23"W), where the inhabitants dedicated to artisanal fishing, for several generations now, sell fresh marine products, providing such products to several zones of Lima, particularly to the inhabitants of the neighboring districts. Prior to the collection of the fecal sample, meetings and talks to raise awareness were conducted, which were addressed to the members of José Olaya Fishermen's Association and to their relatives. In these meetings, voluntary participants were registered who signed an Informed Consent

where they agreed on their participation in the study. Therefore, we worked with a randomized and representative population sample (n = 50) throughout all seasons of 2007. Human coproparasitological exams were conducted by using the direct method with saline and Lugol's solution and two concentration techniques: The Ritchie's Method and the Spontaneous Sedimentation in Tube Technique (Concentration Technique by Sedimentation with no Centrifugation) as per the methods standardized previously (Navone *et al.*, 2005). The prevalence of parasitic infection was based on the number of individuals parasitized by the number of sampled individuals.

RESULTS

No marine origin helminthic zoonoses were observed in the results given, although the presence of other parasitic agents, some with a probable zoonotic origin, confirms fecal contamination of possible animal and human origin in water and food. In Table 1, it is observed how the six species of parasites reported are equally distributed presenting a

high prevalence especially for those considered non pathogenic, where the most prevalent parasite is *Endolimax nana* (Wenyon & O'Connor, 1917) reaching 40%, followed by *Entamoeba coli* (Grassi, 1879) with 28% and finally by *Iodamoeba butschlii* (Prowazek, 1911) with 4% among the protozoan commensal parasites. In the case of the pathogens, the most prevalent was *Giardia intestinalis* (syn. *G. lamblia*) (Lambl, 1859) Kofoid & Christiansen, 1915 with 16% prevalence, followed by helminths named *Hymenolepis nana* (Culbertson, 1940) and *Ascaris lumbricoides* (Linnaeus, 1758), both with a 4% prevalence, observing, in conclusion, that the population studied reaches a global parasitism equal to 68%.

In Table 2, we may observe that helminths are only parasitizing female population, while in the three parasites shared by both genders; it was observed that men present higher prevalence, although in the total count, women present a higher prevalence in global parasitism with respect to men despite of being represented on a lower degree.

Table 1. Distribution of enteric species according to their pathogenicity in 50 fishermen of the Fishing Terminal of Chorrillos, Lima, Peru, 2007 (*).

Etiologic Agent	Number of Individuals Parasitized	Prevalence (%)
Pathogenic Parasites:		
<i>Giardia intestinalis</i>	8	16
<i>Hymenolepis nana</i>	2	4
<i>Ascaris lumbricoides</i>	2	4
Non-Pathogenic or Commensal Parasites:		
<i>Entamoeba coli</i>	14	28
<i>Endolimax nana</i>	20	40
<i>Iodamoeba butschlii</i>	2	4
Negative	16	32
Total Parasitized Individuals	34	68

(*) Parasites were divided according to their pathogenicity following the naming conventions of the CDC (Center for Disease Control and Prevention), USA (Alarcón *et al.*, 2010).

Table 2. Enteroparasitism in the Fishing Terminal of Chorrillos, Lima, Peru, 2007: Prevalence of enteroparasitosis according to the type of etiologic agent and gender.

Etiologic Agent	Prevalence in Men (N)	Prevalence in Women (N)
	(n = 32) %	(n = 18) %
<i>Entamoeba coli</i>	31.25(10)	22.22 (4)
<i>Endolimax nana</i>	43.75 (14)	33.33 (6)
<i>Iodamoeba butschlii</i>	-	11.11 (2)
<i>Giardia intestinalis</i>	18.75 (6)	11.11 (2)
<i>Hymenolepis nana</i>	-	11.11 (2)
<i>Ascaris lumbricoides</i>	-	11.11 (2)
Negative	37.5 (12)	22.22 (4)
Total Parasitized Individuals	62.5 (20)	77.77 (14)

We may observe in the comparison conducted in Table 3 that the parasitic richness (number of parasitic species) of the coastal population assessed in the group of studies mentioned equals 22 species distributed in 11 protozoa and 11 helminths (without considering the report of *Taenia* sp., where the species are not included and considering the two species of hookworms: *Necator americanus* (Stiles, 1902) and *Ancylostoma duodenale* (Dubini, 1843) even though these cannot be distinguished in the coprological test).

In almost all of the cases (unless for *A. lumbricoides*), our study presents the lowest prevalence compared to that previously reported. Some parasites have not been reported in our study, but the works conducted confirm their presence in the Peruvian coast, such as protozoan called: *Entamoeba histolytica* (Schaudinn, 1903) / *E. dispar* Brumpt, 1925; *Chilomastix mesnili* (Wenyon 1910) Alexieieff, 1912; *Pentatrachomonas hominis* (syn.

Trichomonas hominis) (Davaine, 1860) Wenrich, 1931; *Enteromonas hominis* da Fonseca, 1915; *Cystoisospora belli* (syn. *Isospora belli*) (Railliet & Lucet, 1891) Wenyon, 1923; *Balantidium coli* (Malmstein, 1857) and *Blastocystis hominis* Brumpt, 1912; as well as helminths called *Hymenolepis diminuta* (Rudolphi, 1819); *Diphyllobothrium pacificum* (Nybelin, 1931); *Taenia solium* Linnaeus, 1758; *Taenia saginata* Goeze, 1782; *Trichuris trichiura* Linnaeus, 1771; *Strongyloides stercoralis* Bavay, 1876 and *Enterobius vermicularis* Linnaeus, 1758. These studies were selected since these included a wide range of parasitic agents, including normally protozoan parasites, and since these were conducted with coastal populations presenting environmental and socioeconomic characteristics similar to the target population in our study. This is even the only one study dedicated only to helminthiasis in the District of Chorrillos, in Lima.

Table 3. Comparative prevalence chart (%) of enteroparasitism in the different human populations of the coastal zone of Lima, Peru, based on previously published studies (n = number of patients examined).

Etiologic Agent	Current Study	Iannacone & Alvarino (*) Chorrillos 2007 (n = 72) (**)	Contreras <i>et al.</i> Ventanilla 1993 (n = 143) (**)	Tantaleán & Atencia IMT - UNMSM 1993 (n = 912)
<i>Entamoeba coli</i>	28	-	63.63	78.9
<i>Entamoeba histolytica/</i> <i>E. dispar</i>	-	-	9.79	20.9
<i>Endolimax nana</i>	40	-	41.25	75.3
<i>Iodamoeba butschlii</i>	4	-	12.5	14.3
<i>Chilomastix mesnili</i>	-	-	5.59	13.6
<i>Pentatrichomonas hominis</i>	-	-	-	1.3
<i>Enteromonas hominis</i>	-	-	-	0.3
<i>Giardia intestinalis</i>	16	-	30.76	30.6
<i>Cystoisospora belli</i>	-	-	-	0.32
<i>Balantidium coli</i>	-	-	2.09	-
<i>Blastocystis hominis</i>	-	-	-	95.9
<i>Hymenolepis nana</i>	4	37.5	26.57	13.7
<i>Hymenolepis diminuta</i>	-	8.3	-	-
<i>Diphyllobothrium pacificum</i>	-	1.3	-	6.2
<i>Taenia sp.</i>	-	-	0.69	-
<i>Taenia solium</i>	-	-	-	0.32
<i>Taenia saginata</i>	-	-	-	1.3
<i>Ascaris lumbricoides</i>	4	15.3	2.09	5.59
<i>Ancylostoma/Necator</i>	-	-	0.69	2
<i>Trichuris trichiura</i>	-	9.7	4.89	6.5
<i>Strongyloides stercoralis</i>	-	-	2.79	2.5
<i>Enterobius vermicularis</i>	-	31.9	2.09	-

(*) This study only focused on helminthic infection.

(**) These studies are only based on pediatric population.

Finally, Table 4 shows the community structure of protozoan and metazoan parasites present in the human population studied where a certain similarity with one of the few studies conducted in artisanal fishermen is discerned, that is to say, the study conducted in the southern coast of

Peru, in Chala, Arequipa, that even though it presents 4 non-reported species in our study, both human populations share 4 protozoan species and 1 helminthic species. Also, it shall be mentioned that we had a very similar number of patients

Table 4. Comparative prevalence chart (%) of Enteroparasitism in two artisanal fishermen's populations in the coast of Peru (n = number of patients examined).

Etiologic Agent	Current Study	Sisniegas <i>et al.</i> (1997) Chala - Arequipa (n = 54)
<i>Entamoeba coli</i>	28	54.76
<i>Entamoeba histolytica</i>	-	16.66
<i>Endolimax nana</i>	40	26.19
<i>Iodamoeba butschlii</i>	4	16.66
<i>Chilomastix mesnili</i>	-	9.52
<i>Trichomonas hominis</i>	-	9.52
<i>Giardia intestinalis</i>	16	26.19
<i>Hymenolepis nana</i>	4	9.52
<i>Diphyllobothrium pacificum</i>	-	7.4
<i>Ascaris lumbricoides</i>	4	-
Total Parasitized Individuals	68	78

DISCUSSION

As it has been previously stated, very few researches have been conducted on the prevalence of parasitic diseases in the artisanal fishermen's communities. In Table 4, details of the study conducted in Chala, Arequipa are presented, where the similarity between the structures of both parasitic communities would be related since the human population dedicated to fishing activity is subjected to the same health conditions despite the distance of both localities.

Thus, the handling of food would be a determining factor for understanding the relevance of the parasitic diseases reported (Villegas *et al.*, 2012). The research focused on the assessment of the presence of diphyllbothriasis, a parasite that could not be found in this study despite the wide distribution in the Peruvian coastal population that is used to consuming raw or semi-raw fish, especially as a daily food for artisanal fishermen. That is a risk behavior due to the imminent danger it represents for people who may be infected with larvae of zoonotic helminths and even more in the population of Chorrillos, who participated in

this research. Also, no signs of marine origin zoonotic infection were found. Particularly, no cestode infections from the Diphyllbothridae family were present, which was actually found in a study conducted in a school population of Chorrillos (Table 3), where the presence of four helminths not found in this study was reported and this probably due to the use of different diagnostic techniques and since pediatric population is more sensitive to helminthiasis. In this same work line, a research was conducted in family groups of the coastal population of Riñihue Lake in Chile for assessing the possible impact of the educational work in the seasonal distribution due to the presence of human diphyllbothriasis and its presence in fresh water fish belonging to this lake related to gender, size and diet of host fish (Torres *et al.*, 1998). Finally, in other places, such as in Egypt, one of the few studies published in human communities dedicated to the fishing activities was conducted. This study aimed at assessing the presence of heterophyiasis (related to several species of zoonotic trematodes) in tilapias looking for metacercariae encysted in fish, finding a prevalence of 13.3% of eggs characteristic of the Heterophyidae group. Also, a statistically significant positive co-

relationship was found between the fishing activity and heterophyidae in the population studied (Lobna *et al.*, 2010).

As it may be observed in Table 1, *G. intestinalis* presents 16% prevalence and this flagellum, parasitizing duodenum, jejunum and the top part of ileum in human beings, is easily transmitted from person to person, although it may also be a zoonosis considering as a reservoir a wide range of domestic and wild mammals (Roberts & Janovy, 2005), this being mostly reported in dogs in Lima (Zarate *et al.*, 2003) and of Callao (Araujo *et al.*, 2004). The presence of this parasite was inspected based on the possible relationship between dogs and kids (Pablo *et al.*, 2012). This pathogenic parasite was followed in terms of prevalence by *H. nana* with 4%, the only one cestode that during its life cycle, the intermediary host is optional and where domestic mice and rats may act as reservoirs (Roberts & Janovy, 2005); also, its prevalence in Lima is 5.95% and for the Peruvian coast is 9.95% (Cabrera, 2003), which is higher than that found in this study. Also, this helminth has been related in Peru to symptoms such as constipation, hyporexia and abdominal pain, finding a statistical significance ($p < 0.05$) only when relating the presence of the parasite to diarrhea and not with the rest of the mentioned symptoms (Romaní *et al.*, 2005). *A. lumbricoides* is reported with the same prevalence, which in the Province of Lima is 6.23% and in the Peruvian coast is 6.58%, being Oxapampa the province with the highest prevalence (64.32%) and the Low Jungle being the geographical region with the highest prevalence (45.30%) as well, calculating a national prevalence of 14.5% (Cabrera, 2003).

Finally, its transmission is related to the fecal contamination and environmental pollution due to dogs that are sensitive to the infection and where chicken play an important role since they act as a paratenic host. Similarly, cockroaches may transport and disseminate eggs (Roberts & Janovy, 2005). This verme has important economic implications for human population, presenting a negative effect in growth and the use of nutrients in undernourished children is

associated to intestinal obstruction and other surgical emergencies endangering life and causing the need of treatment. This generating the need of an efficient healthcare system and expenses for the relatives due to the disease treatment (Stephenson, 1984).

Among the commensals found in Table 1, *E. nana* was the most prevalent parasite with 40%. This ameba lives in the human large intestine, mainly close to the cecum and feeds on bacteria.

Although it is not pathogenic, its presence indicates there is the possibility of colonization of the host by pathogenic parasites (Roberts & Janovy, 2005); *E. coli* presents a 28% prevalence, this non-pathogenic ameba is more common than *E. histolytica* due to its greater capacity of surviving putrefaction and its presence is an indicator of health level and the efficacy of water treatment system (Roberts & Janovy, 2005); finally, *I. butschlii* may infect the large intestine (mainly the area of the cecum where it feeds from intestinal flora of primates and pigs), being considered a zoonosis (Roberts & Janovy, 2005). To sum up, it is observed that although they do not cause diseases to men, commensal protozoa are good indicators of fecal-oral contamination from food and water of the population studied and of the lack of an adequate personal hygiene. Thus, infections inform us on the lack of hygiene in the handling of water and food in the community of fishermen of the Fishing Terminal of Chorrillos, presenting a 68% prevalence of global parasitism, placing ourselves in the scenario of a multi-parasitic infection in a community composed of 6 species of parasites, although probably due to the number of patients examined and due to the different techniques used, as well as due to the socio-cultural risk factors affecting the population and that may be differentiated from the factors affecting the population examined in the previous studies used for comparison as it is shown in Table 3, it is observed that the composition of parasitic communities in previous studies indicates a higher number of populations of parasitic helminths and protozoa; therefore, we shall consider that several factors may be influencing the structure of parasitic

communities, such as factors related to individual hosts (age, anatomy, behavior, diet, genetic basis, immune response, nutritional condition, predisposition, physiological condition, gender, size and social conditions), to host populations (host social group size, population density of the hosts, predator - prey interactions, range of host species, sympatry with other potential hosts and history), to environmental characteristics (latitude, season and habitat characteristics), to evolutionary backgrounds (age of the species, co-evolution, geographical barriers, key species, phylogeny of the host and life cycle of parasites) and finally considering stochastic factors (size of samples of hosts, parasitic dispersion patterns, opportunity and source communities). They altogether influence on the opportunity of parasites to infect a host individual (Petney & Andrews, 1998). It has even been shown that there is a relationship between the pathogenicity of the infection and the genetic predisposition of the human population exposed to the infection as it has been shown in the studies conducted in Sudan with respect to *Schistosoma mansoni* Sambon, 1907 (Dessein *et al.*, 1999) and in Nigeria with respect to *A. lumbricoides* (Holland *et al.*, 1992).

One of the factors mentioned is gender and as it was previously mentioned in Table 2, it is observed that the prevalence of female parasitism is 77.77%, while in males it only reaches 62.5%; therefore, we shall analyze the factors related to differential parasitism between different sex persons. Thus, a factor may have subordinated factors conditioning it. In this case we may consider the differences attributed to the level of exposition in men and women to etiologic agents, which are actually both etiologic and immunological differences, even when understanding the effects of sex in the immune response of the host in its relationship with the chemotherapy efficacy (Brabin & Brabin, 1992).

If we analyze some factors influencing on the presence/absence of certain intestinal parasites and that may be relevant for the study, it shall be mentioned that in several researches, the

possibility of a relationship between the epidemiology of certain parasitic diseases and the social and ecological factors has been studied, a relationship that influences on the target population daily life (Bhattacharya *et al.*, 1981), as in the case of the studies conducted in some towns of Reunion Island where environmental life conditions were assessed, as well as weather conditions such as rainfall and altitude, and cultural aspects, such as the diverse daily habits of inhabitants related to a differential composition of immigrants (Picot & Benoist, 1975). Similarly, in a research conducted in Peru, in Concepción, Puerto Maldonado, Madre de Dios, 136 people were parasitologically assessed observing the lack of adequate hygienic standards, the environmental characteristics of cultivation lands, the degree of geographic isolation of family and the different activities inhabitants conduct according to their age and sex. These characteristics determine the transmission patterns of helminthiasis reported (Mc. Daniel *et al.*, 1979). In Argentina, the influence of some environmental factors on parasitic infection was studied. This is a case where variables such as the material of construction of houses, the characteristics of floors and the type of water service showed an statistically significant association with the presence of intestinal parasites (Basualdo *et al.*, 2007). In urban ecosystems, the consequences of a poor health planning additionally to the formation of slums and the migration phenomenon from provinces to the capital, that is to say, from rural areas to urban areas, causes consequences such as inadequate houses, unhealthy water, sewage and problems in waste management, which encourages the transmission of diverse infectious diseases, especially in tropical countries where heavy rain and a poor drainage system, if these actually exist, contribute to the transmission of parasitic disease through contaminated water. Therefore, social inequality causes that poor population become sensitive to diverse parasitic diseases (Herbreteau, 2010). In this context, it is important to determine in parasitological studies the risk factors contributing to infection through an adequate methodology (Alarcón *et al.*, 2010) and the use of ecological analysis tools in

parasitological studies related to public health (Iannacone *et al.*, 2006).

As a final comment, it shall be mentioned that control strategies over intestinal parasitic diseases shall include a joint effort of chemotherapy, health education, participative community, basic sanitation, use of shoes and epidemiological research, with an adequate program of monitoring and assessment (Albonico *et al.*, 1999).

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Authors for Correspondence / Autor para correspondencia
Jorge Cárdenas - Callirgos

Invertebrate Laboratory. Museum of Natural History. Biological Sciences School. Ricardo Palma University. Av. Benavides 5440, Lima 33, Peru.

E-mail/ correo electrónico:
jmcardenasc@gmail.com

Hugo Flores-Liñán
Alberto Cazorla Talleri School of Sciences and
Philosophy. Cayetano Heredia Peruvian
University. Av. Honorio Delgado 430, Urb.
Ingeniería, S.M.P. Lima -Perú.

E-mail/correo electrónico:
hugo.flores@upch.pe