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Full Length Research Paper

Prevalence of intestinal parasites in the human population of the city Santa Luzia – State of Paraíba, Brazil

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The parasites are classified as one of the greatest evils of collective physical being problems, which can cause a state of high fragility, influencing the number of world inhabitants, as a no standard framework for a healthy quality of life. The objective of this study was to identify and quantify the major intestinal parasites found in result of parasitological tests, from the Municipality of Santa Luzia, Paraíba, Brazil. These parasites were treated at the clinical laboratory of the Hospital and Maternity Sinha Carneiro. The results of parasitological examinations recorded in the hospital were analyzed, the data was for the period from January to December 2013 to 2014, which were separated by positive and negative cases, the parasites found in positive results were analyzed; with a total of 2,021 tests, which were in 1000-CP Santa Lucia, 300 of these were positive, Endolimax nana parasite being more frequent in 33% of cases, and among the most frequent helminth was Enterobius vermicularis with 1% of cases. Thus it is concluded, then it becomes necessary for awareness measures, such as practices in schools and families, and better standards of sanitation for the population to live better and to decrease infection due to lack of information.

Key words: Survey, parasites, public health.

INTRODUCTION

The parasites are classified as one of the greatest problems of collective physical discomfort, which can cause a state of high fragility, influencing the number of world inhabitants, as no standard structure for a healthy quality of life (Ferreira, 2000). The occurrence of parasitic diseases in our country varies from region to region according to the structuring of sewage networks, socio-economic status, education, age and personal hygiene habits (Castro et al., 2004; Tashima, 2005). It is observed that this high level of parasites is

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directly linked with the environmental qualities in which the subject undergoes mainly poor nutrition, poor sanitation, poorly treated water without proper disposal to waste (Monteiro, 2000; Cantos, 2002; Marinho, 2002). The parasite has a direct and close affinity between individuals commonly defined: where the host and parasite are living at the expense of one another (Amato, 1982).

It is estimated that intestinal infections caused by helminths and protozoa affect approximately 3.5 billion people, causing illness in approximately 450 million around the world, most of these in children (Ferreira, 2000). The prevalence of infection by intestinal parasites is one of the best indicators of socioeconomic status of a population (WHO, 2008) and may be associated with several determinants such as inadequate sanitation, faecal pollution of water and food consumed, sociocultural factors, contact with animals, lack of basic sanitation, besides the age of the host and the type of parasite infecting (Astal, 2004). For lack of basic sanitation, information and quality education, there are contamination by worms that affect the health of people, bringing them to life complications. Everything is important because an individual well informed improves quality of life, since the parasite can cause death to the patient.

This study aimed to quantify and qualify the parasites found in parasitological examinations of patients, tests recorded in the clinical laboratory of the Hospital and Maternity Sinha Carneiro, located in the city of Santa Luzia-PB. The established methods used to identify intestinal parasites are Hoffman-Pons-Janer (Hoffman, 1934) technique which uses spontaneous faecal sedimentation. In this method, faecal samples are diluted in water and filtered through a gauze strip into a conical sedimentation glass. The Hoffman-Pons-Janer method was used to detect the presence of helminth eggs and larvae and protozoa cysts. This technique is widely used in epidemiological studies, due to its low cost. The Willis (Willis, 1921) technique is a flotation method based on the ability of helminth eggs to float on the surface of a saturated sodium chloride solution with a density of 1.20 g/mL and to adhere to glass. In this technique, a saturated solution with the emulsified faeces is deposited in a round-bottomed flask and a meniscus is formed on the surface. Next, the flask is covered with a slide. After several minutes, the slide is removed and examined under a microscope.

The Baermann-Moraes technique (Moraes, 1948) is used for the detection of nematode larvae in faecal samples and is based on the thermotropism and hydrotropism of the larvae, which exhibit a tendency toward sedimentation. This technique consists of placing the faeces in contact with warm water at 40 to 45°C for 1 h such that the larvae present in the faeces tend to migrate into the warmer, liquid media and settle at the bottom of the flask. Differentiation between Strongyloides stercoralis and hookworm larvae was achieved by analysing the morphological characteristics of the buccal vestibules and by the presence or absence of the developing genital primordium larvae (Carvalho et al., 2012).

MATERIALS AND METHODS

Data collection

This study was conducted by collecting data results of parasitological examinations from results reported by the clinical laboratory at Hospital Sinha Carneiro, in Santa Luzia, Paraíba. This hospital serves the population of the city and surrounding towns. The data records were written by exploratory descriptive type, with a quantitative approach, which conducted the analysis, in order to describe a parasitic epidemiological profile of the city. The analysis was by descriptive statistics using Microsoft Excel ® software, version 2010. The tests performed in this study were the methods of Hoffman-Lutz-Pons-Janes (the spontaneous sedimentation method). The necessary materials were cup decanting, Sieve, Gauze folded into 4, flowing or distilled water, wood Spatula (step-down type of language), blade and cover slip. About 4 g of newly issued stool was taken after dissolving them in a collection container (standard bottle for sample collection) using a little water, and then transferred into a glass of decanting making filter in sieve containing gauze in 4 to make up ¾ of the water volume, standing on a firm surface free of vibrations for at least 2 h (Carvalho et. al., 2012).

Study area

This research was conducted in the city of Santa Luzia-PB. Located in the region of Western Serido Paraibano and member of the metropolitan area of Patos. The Brazilian city (Figure 1) comprises a population of 15,213 hab. With area of 455,717 km2 and Biome Caatinga. Data was gotten from the Brazilian Institute of Geography and Statistics (Gamboa et al., 2003). The city of Santa Luzia – Paraiba has a Maternity Hospital "Sinha Carneiro" (Figure 2), located in the clinical laboratory, the hospital serves the entire population of the city and surrounding towns.

RESULTS AND DISCUSSIONS

The records were in the period from January to December in the years 2013 to 2014, with a total of 2,021 parasitological stool where these 1,000 are from the city of Santa Luzia-PB. Of this total, 700 (70%) are negative, 300 (30%) are positive the results as shown in Figure 3. Despite scientific and technological advances over the years, intestinal parasitism remains a serious public health problem (IBGE, 2016). This situation is characteristic, especially in underdeveloped countries, where the actions for the control of intestinal parasites are more difficult as a result of the cost of detection techniques, poor infrastructure and lack of educational projects directed to the population (Ludwig, 2000). The educational practices, when properly applied, lead people to acquire knowledge for the prevention and reduction of intestinal parasites (Ferreira, 2000).

Figure 1. Map of the State of Paraíba, highlighting in red, the city of Santa Luzia, host city of this research (Source: IBGE, Location, 2010).

These positive results cases of protozoa are similar to the study of Oliveira et al. (2003). High occurrence of *Endolimax nana* and *Entamoeba coli* can be noted in this study. Although these organisms are not considered as pathogens, these figures are alarming mainly because it is a high risk of transmission groups, due to the food handling activities carried out (Oliveira, 2003). The parasitism by *E. nana* is second in the percentage of most common parasites, one of the factors contributing to this percentage is its mode of transmission and despite not being a pathogenic parasite while *Iodamoeba bütschlii* and *E. coli* presence reflects hygiene conditions both personal and environmental (Pessoa, 1982).

A study in Colombia, with 423 patients showed significantly higher prevalence (*Entamoeba coli*, 27.9% and *Endolimax nana*, 20.3%) (De La Ossa Merlano, 2007). It has been shown that the improvement of nutritional status, along with improved sanitation and adequate immunization practices may promote an increase in life expectancy in developing countries (Lincoln, 2000). This is an important information to the population on how to prevent and how to remedy if you have the positivity of the parasite. The development of public policies for prevention and awareness of the importance of making the stool test is at least once a year.

The socio-demographic survey was drawn from male and female, among the results for females the presence of parasites was 60% and 40% for men, as shown in Figure 4. From this data, there is a greater number of parasitized females (Prado, 2001). Figure 5 indicated the ages of patients who had the parasitological stool, with distribution of ages of 0 to 51 years. As can be seen, there is high incidence of parasites between the ages of 0 to 15 years.

This age group most often can be compared to the study of Macedo (2005), Saturnino et al. (2005), Ludwig et al. (2000) and Santos et al. (1993). The most parasitized age range was from 6 to 9 years, which is consistent with other data in the literature (Macedo, 2005; Saturnino, 2005). In this range, children are more exposed to contamination due to the ignorance of the basic principles of hygiene and more contact with the ground, which acts as a playful reference (Santos, 1993).

According to the analysis, we can highlight the parasite with more occurrences which is *E. nana*. This protozoan is considered simple; it does not cause serious risks to the health of the host. Although it was observed a higher prevalence of non-pathogenic intestinal amoebae as *E. nana* (53.5%) and *E. coli* (43.5%), as seen in Table 1, it is important to note that these species have the same transmission mechanisms as other pathogenic protozoa such as *Entamoeba histolytica* / *E. dispar* and *Giardia duodenale* and can serve as good indicators of the health conditions to which individuals are exposed.

Even though the commensal do not cause any damage to its host, the infection by these species has important implications in the epidemiology of parasitic diseases, since they reflect the basic sanitation conditions, the presence or absence of sewage, water

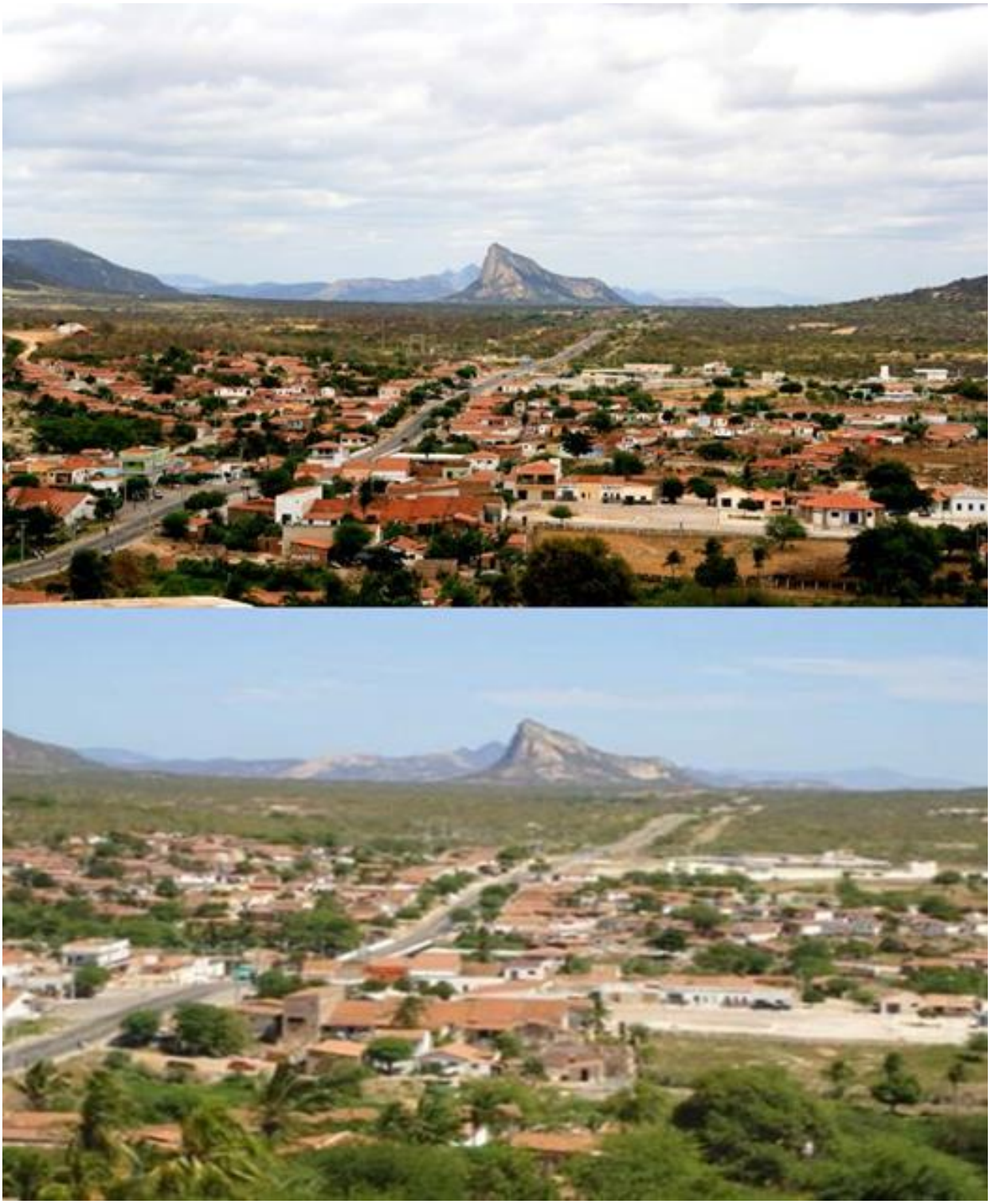

Figure 2. Hospital and Maternity Sinhá Carneiro located in the city of Santa Luzia, Paraíba (Source: Mayara, T. Santos).

quality consumed and hygiene habits that the students are exposed. Other studies have also demonstrated high frequency of parasites commensal, as in the coastal region of Piaui and the city of Paracatu-MG (Alves, 2003; Macedo, 2005).

The *E. histolytica* has worldwide distribution and represents a health risk in the countries where sanitary barriers are inadequate (84). The overall prevalence

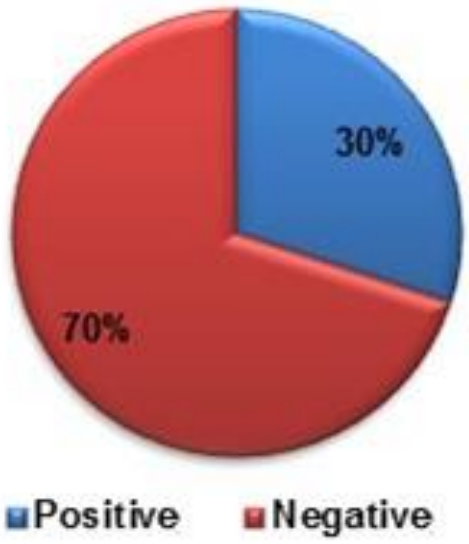

Figure 3. Tests with positive and negative cases.

rate of intestinal parasites was 19.7%, and *G.lamblia* (34.9%), *E. coli* (22.9%), *E. nana* (9.6%) and *A. lumbricoides* (4.8%) are the most common parasites (Castro, 2004).

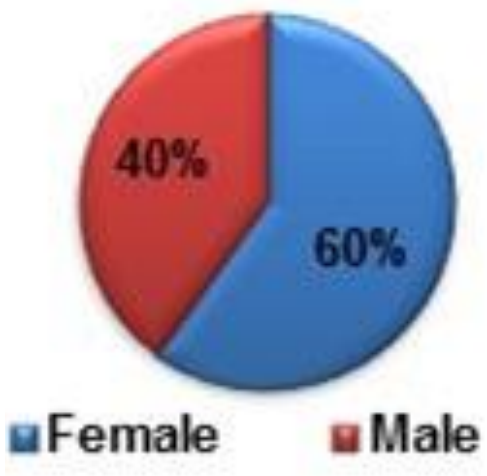

Figure 4. Results of examinations made in relation to sex.

CONCLUSIONS

From the analyzed data, it can be seen that the most common agent in the population of the city of Santa Luzia, Paraíba, Brazil was *E. nana* distributed in all genders and ages. This study shows that the prevalence

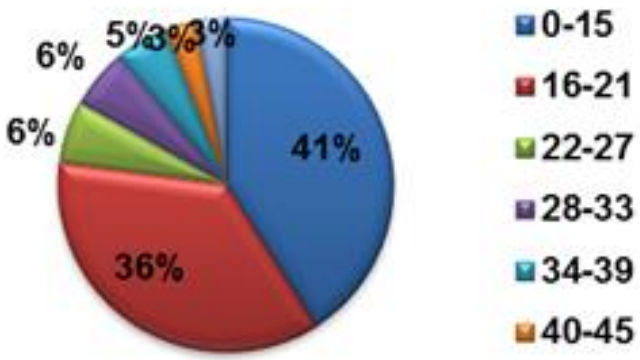

Figure 5. The prevalence of positive cases according to age.

Table 1. Intensity of parasites.

Parasite	Case amount	Frequency (%)
Endolimax nana	100	33
Entamoeba coli	97	33
Entamoeba hystolitica	80	27
Giardia lamblia	10	3
Iodamoeba butchlli	07	2
Enterobius vermicularis	04	1
Ascaris lumbricoides	02	1

of intestinal parasitosis is caused by poor hygiene and guidance. That these data are examples of what is missing to form a well- informed population, didactic and pedagogical activities are made for children in schools.

Conflict of interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Parasitism of *Cuterebra* (Diptera: Oestridae) on rodents of islands of the Gulf of California, Mexico

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The genus, *Cuterebra* is an obligate dermal parasite of New World mammals that can cause problems with rodent reproduction. 2812 rodents of nine species from nine Gulf of California Islands were sampled for the presence of *Cuterebra* sp. Only two species of rodents were parasitized by *Cuterebra* sp. on two islands (Montserrat and Danzante): the canyon mouse, *Peromyscus caniceps* (n = 261) with a prevalence of 17.97% and the white-footed woodrat, *Neotoma bryanti* (n = 4) with a prevalence of 7.5%. The presence of a single parasite per individual was common (ẍ = 78.5%). Since *P. caniceps* is listed by the Mexican government as a conservation at risk species, the parasitism of *Cuterebra* sp. represents a potential risk to the viability of this endemic rodent population. This is the first record of *Cuterebra* sp. as parasite of rodents in the Gulf of California Islands, and *P. caniceps* represents a new host record.

Key words: Bot fly, *Peromyscus caniceps*, *Neotoma bryanti*, Monserrat Island.

INTRODUCTION

In the Gulf of California, there are more than 150 islands, 19 of which have native rodents (Lawlor et al., 2002). Over 30 species are represented, of which 16 are endemic (Alvarez-Castañeda and Patton, 1999). Many species are considered by the Mexican government to be rare, threatened and endangered (SEMARNAT, 2010). Small mammals such as members of the Muridae and Cricetidae families often occur in large numbers and play an important role in maintaining ecosystems (Dickman, 1999). On islands, these populations are vulnerable to predation, habitat modifications, and parasites that cause disease.

Little is known about parasites affecting rodents of these islands. Parasite proliferation in these species could cause dramatic effects on population size, possibly even extermination. The genus *Cuterebra* includes obligate dermal parasites of New World mammals, especially rodents and lagomorphs (Sabrosky, 1986;

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Pape, 2001). Bot flies can cause parasitic castration preventing the development of the testicles in sub-adult males (Payne and Cosgrove, 1966; Tim and Cook, 1979; Cheng, 1986), which is particularly serious for endemic species of restricted distribution. The *Cuterebra* sp. females do not directly oviposit eggs onto the host. Instead, the females place the eggs on soil near rodent burrows. These eggs then become attached to the rodents when they walk over the site (Catts, 1982; Baird, 1997). Hatching is stimulated by body heat and enter the host through openings (mouth, nose, eyes or anus) (Hunter and Webster, 1973; Gringrich, 1981; Catts, 1982; Slansky, 2006). When the maggots complete their development in the host, the larvae exit through the skin and continue the pupal stage in the soil (Catts, 1982; Wood, 1987).

This is the first record on parasitism of *Cuterebra* sp. in rodent populations in the Gulf of California Islands, which is part of a Natural Protected Area called Islands of Gulf of California where some human activities, such as tourism and fishing camps are permitted.

MATERIALS AND METHODS

Nine islands of the Gulf of California were surveyed from 2000 to 2010 (Figure 1). These islands are uninhabited, arid with sarcocaulescent vegetation (Shreve, 1951). Trapping rodents with Sherman traps was performed in three localities per island with 50-66 traps. Transects of 50 Sherman traps with 10 m intervals between traps and one hectare grid with 66 traps were established.

Trapping was performed for two or three consecutive nights. Seven islands (El Muerto, Tortuga, Coronados, Danzante, Monserrat, Santa Catalina, and San Francisco) were surveyed four times a year (May, August, October and December), and two (Santa Cruz and Espiritu Santo), twice (June and September) a year. Each animal captured was examined, recording age, sex and presence or absence of larvae and their number. They were subsequently released to the same site.

Statistical analyzes as nonparametric tests (Xi-square) were applied to see if there was a relationship between parasitized mice and sex, either by month, year, or sampling site. ANOVA tests were also applied to compare the two sampling sites in Monserrat Island, as this test is a generalization of contrast equality of averages for two independent samples. Statistical analysis was performed in Matlab R2011a software.

RESULTS

A total of 2812 rodents were caught, representing nine species. *Peromyscus caniceps* was the most abundant with 1452 individuals (51.9% of total). Only two species of rodent were parasitized by *Cuterebra* sp. on two islands (Montserrat and Danzante): the canyon mouse, *P. caniceps* (n = 261), and the white-footed woodrat, *Neotoma bryanti* (n = 4). No warbles were found on rodents from Muerto Island, *P. maniculatus* (n = 40); Tortuga Island, *P. dickey* (n = 30); Coronados Island, *Chaetodipus spinatus* (n = 450) and *P. pseudocrinitus* (n = 417); Danzante Island, *C. spinatus* (n = 50) and *N. bryanti* (n = 37); Monserrat Island, *P. caniceps* (n =1191); Santa Catalina Island, *Peromyscus slevini* (n =4 0); Santa Cruz Island, *Peromyscus sejugis* (n = 150); San Francisco Island, *C. spinatus* (n = 50) and *N. bryanti* (n = 25) and Espiritu Santo Island, *C. spinatus* (n = 30), *P. eremicus* (n = 30) and *N. bryanti* (n =3).

Peromyscus caniceps, Monserrat Island

A total of 1452 specimens of canyon mouse were captured from 2001-2003 trapping, of which 261 were parasitized (adults and sub-adults) with a prevalence of 17.97%. Bot fly larvae were found to parasitize from May to November. The number of rodents varied throughout the year at the two trapping sites (rocky and scrub plain habitats), with a maximum of 170 individuals (August 2002), and minimum of 36 individuals (October 2003) (Table 1).

In the rocky plain habitat from Monserrat Island, 797 canyon mice were caught, of which 149 were parasitized with a prevalence of 18.69%; 80 were females with a prevalence of 10.03% and 69 were male with a prevalence of 8.65%. In the scrub plain habitat, 655 rodents were captured, of which 112 were parasitized with a prevalence of 17.09%; 68 were male with a prevalence of 10.38%, and 44 were females with a prevalence of 6.71% (Figure 2).

In both habitats, the presence of a single parasite per individual was common (79 and 78% of the infected mice in the scrub plain and rocky plain, respectively), followed by the presence of two parasites (15% in scrub plain and 13% in rocky plain). In the rocky plain, 1% of the captured mice were parasitized by five parasites per individual. The number of infected mice was analyzed and uninfected in females and males per month, year, and sampling site applying Xi- square test. The difference was not statistically significant; there was no relationship between sex and infected mice or by month, year, or sampling site.

Applying ANOVA test, per site and population showed no differences (Figure 3). Finally, the paired t-test was evaluated, and differences were obtained between females parasitized in rocky plains ($t = 2.09$; $p = 0.05$). Female rodents were mainly infected in the region of the base of the tail or in a single site on the back with a very small proportion having the parasite present in the inguinal region, causing displacement of the vagina disabling the copula. In the males, bot fly larvae were most frequently found in the inguinal region, followed by the dorsum and base of the tail.

Table 1. Number and prevalence percentage of parasitized rodents by *Cuterebra* sp. in relation to sex in rocky and shrub plains, in Monserrat Island.

Sampling	Rocky plains				
	No. caught	No. parasitized	Prevalence (%)	Males parasitized	Females parasitized
May 2001	165	27	16.36	12	15
Aug 2001	82	0	0	0	0
Dec 2001	68	34	50	13	21
May 2002	61	21	36.36	13	8
Aug 2002	170	0	0	0	0
Dec 2002	55	20	36.36	7	13
May 2003	111	32	28.82	14	18
Oct 2003	25	0	0	0	0
Dec 2003	60	15	25	10	5
Totals	797	149	18.69	69	80
	Shrub plains				
	No. caught	**No. parasitized**	**Prevalence (%)**	**Males parasitized**	**Females parasitized**
May 2001	99	15	15.15	10	5
Aug 2001	82	0	0	0	0
Dec 2001	59	21	35.59	15	6
May 2002	57	21	36.84	18	3
Aug 2002	135	0	0	0	0
Dec 2002	61	11	18.03	5	6
May 2003	77	33	42.85	14	19
Oct 2003	36	0	0	0	0
Dec 2003	49	11	22.44	6	5
Totals	655	112	17.09	68	44

***Neotoma bryanti latirostra (N. lepida latirostra),* Danzante Island**

Forty adult woodrats were captured in 2001, of which 3 were found to be parasitized by bot flies, showing a prevalence of 7.5%. A single larvae of *Cuterebra* infected adult woodrats in March (1 male and 1 female) and November (1 female); the bot flies were located in the abdominal region. Parasitized hosts were collected only from two canyons on the island, and these woodrats were found to be living in colony densities of 0.13 and 0.34 ind/ha. Although, *C. spinatus soersus* was also captured in abundant numbers on Danzante Island, none were parasitized by *Cuterebra* sp. larvae.

DISCUSSION

This study reports the first record of *Cuterebra* sp. Larvae in *P. caniceps*. The bot fly on *N. lepida* had been reported (Verts and Carraway, 2002) but not from an island of the Gulf of California. The presence of bot flies in rodents from Monserrat and Danzante islands, which are separated by 20 km, were during two different infestation periods (wet and dry season). Whole year presence of these parasites has been reported in other rodent species such as *P. leucopus* (Sillman, 1956; Wecker, 1962; Layne, 1963; Cramer and Cameron, 2006), *P. difficilis* (Galindo-Leal, 1997), and *Proechimys semispinosus* (Adler et al, 2003). Another case was found only in the wet season in five rodent species from Panamá (Bermudez et al., 2010).

The prevalence of parasitism on *P. caniceps* is in contrasts with other studies from New Mexico and Canada where 3.1% on *P. truei* and 1% on *P. leucopus* (Wilson et al., 1997) while 2.3% infestation on *P. maniculatus* (Bowman, 2000) were found. Nevertheless, infestation levels can vary from 0 to 82% on different species of *Peromyscus* (Burt, 1940; Wecker, 1962; Brown, 1965; Timm and Cook, 1979; Kollar, 1995;

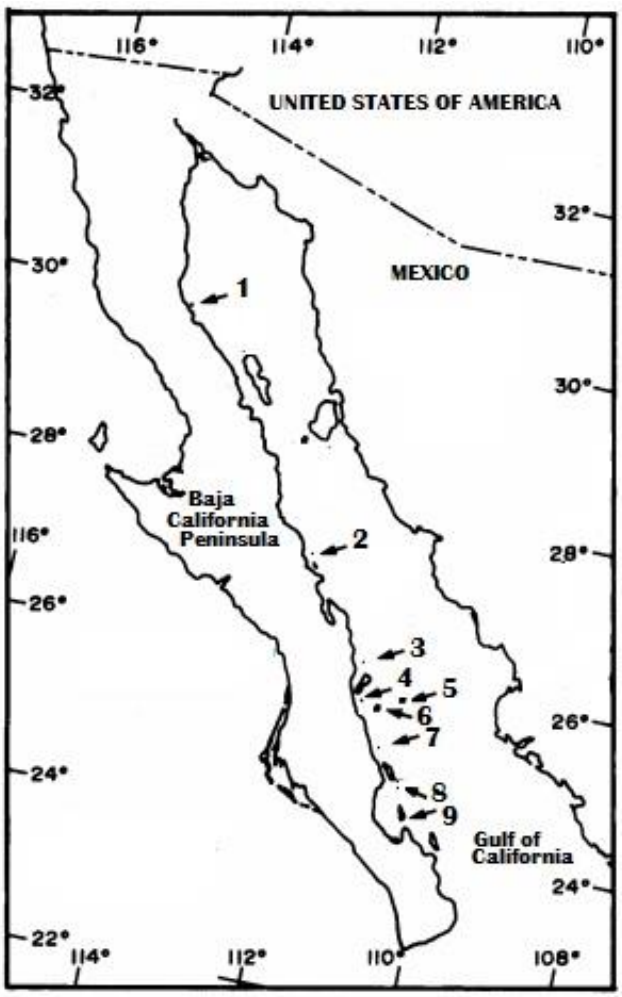

Figure 1. Gulf of California islands where rodents were sampled. 1- Muerto Island, 2- Tortuga Island, 3- Coronados Island, 4- Danzante Island, 5- Santa Catalina Island, 6- Monserrat Island, 7- Santa Cruz Island, 8- San Francisco Island and 9- Espiritu Santo Island.

Galindo-Leal, 1997; Barko, 2003; Hayes et al., 2015).

Parasitism prevalence in rocky and shrub habitats of the Montserrat Island (18.69 and 17.09%) may relate to the high density of rodents, environmental differences in relation to other regions, as well as differences in the density of fly larvae present on the island. The statistics analysis showed no differences in different seasons. The presence of the parasite and its interaction with male mice were not found. But in females, differences were found, giving a greater number of records to the rocky plain ecosystem. That zoonosis problem is low because there was no difference in general between animals that were parasitized and non-parasitized, only in the case of females in rocky plains.

The 7.5% prevalence of *Cuterebra* on *N. bryanti* from Danzante Island was lower than 18% reported from Utah on *N. lepida* (Stones and Hayward, 1968). Any difference between parasitism among sexes, has been reported (Dalmat, 1943; Test and Test, 1943; Wecker, 1962; Scholten, 1965; Childs and Cosgrove, 1966; Dunaway et al., 1967; Miller and Getz, 1969; Galindo-Leal, 1997), although other studies have found differences in relation to sex (Sealander, 1961; Goertz, 1966; Whitaker, 1968; Timm and Cook, 1979; Catts, 1982). Moreover, Barko (2003) reported a significant difference between sexes in one year in Illinois, but in the following year these differences were not observed. Timm and Cook (1979) suggested *Cuterebra* sp. larvae do not discriminate

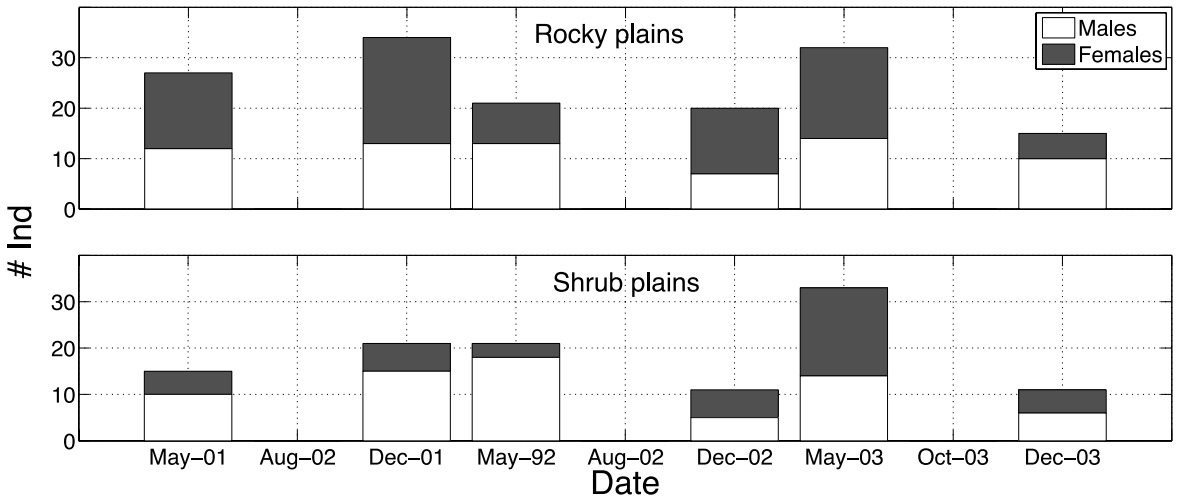

Figure 2. Number of *Peromyscus caniceps* parasitized or non-parasitized in relation to sex in rocky and shrub plains in Monserrat Island.

between host sex but simply parasitize the first mouse they encounter. It is possible that incidence of infection is the result of rodent displacements; thus having a greater opportunity for them to have contact with fly larvae (Stickel, 1968).

In the present study, it was found that the inguinal region of *P. caniceps* was the location where larvae caused the greatest injury to the host. In this region, larvae displaced the testicles and even caused castration by disabling the copula temporarily or permanently. These results are similar to what has been reported previously by Cheng (1986), who found that larva can cause death of the host.

Since *P. caniceps* is listed as a species with a conservation at risk by the Mexican government (category special protection) (SEMARNAT, 2010), the parasitism of *Cuterebra* sp. in the canyon mouse represents a potential risk to the viability of this rodent population. These effects will differ and depend, presumably, on the dwell time of the parasite, the period in which it appears, as well as of other existing endogenous and exogenous factors that occur during and after the infection period. Under conditions of environmental stress (droughts, food shortage) where the habitat cannot maintain a numerous populations of rodents, parasitism can be dangerous. Therefore, the presence of this parasite is a risk for *P. caniceps* on Montserrat Island.

CONCLUSIONS

This is the first record of *Cuterebra* as parasite of rodents in the Gulf of California islands where *P. caniceps* represents a new host record. This study results indicated that parasitism by *Cuterebra* was independent of *P. caniceps* and *N. bryanti* density. It is possible that environmental factors and meteorological conditions of the islands were responsible for the lack of correlation between density and *Cuterebra* parasitism.

RECOMENDATIONS

The parasitism of *Cuterebra* represents a potential risk to the viability of *P. caniceps* because it is an endemic species. Thus, it is recommended to monitor this species to see if the prevalence of *Cuterebra* remains low. Further research is needed throughout the other islands in the Gulf of California to expand on the effects of weather and host populations on Cuterebra population dynamics.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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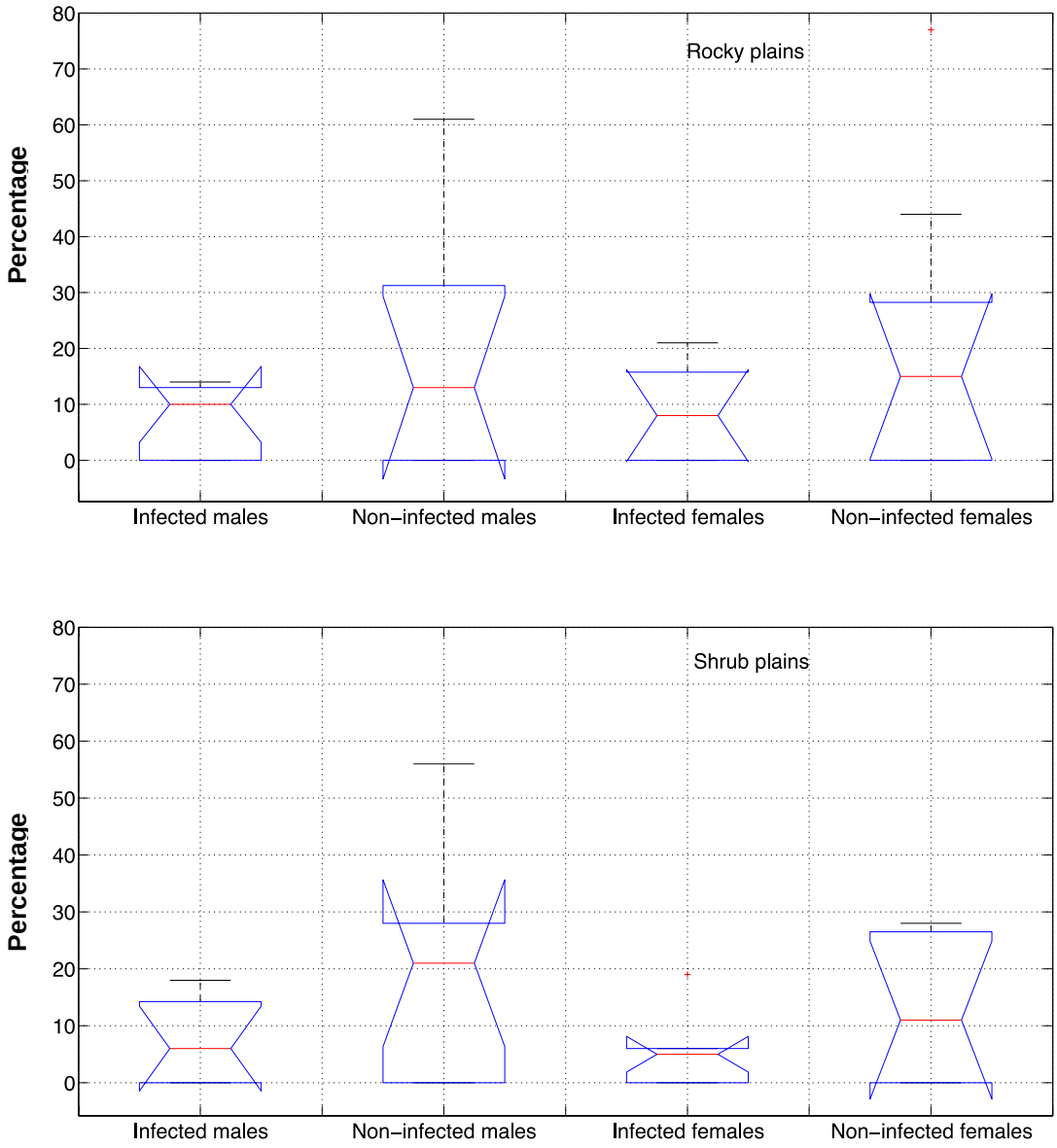

Figure 3. ANOVA test for the rocky and shrub plains habitats in Monserrat Island.

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