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Prevalence of *Toxocara* spp., *Toxascaris leonina* and ancylostomidae in public parks and beaches in different climate zones of Costa Rica

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Abstract

This epidemiological study was conducted in different regions of Costa Rica to determine the prevalence of the developmental stages of potential zoonotic intestinal helminths of dogs and cats in public places. Samples were collected within three main climate zones including rural and urban areas during both the rainy and the dry season. Faecal and environmental samples were taken from 69 parks and beaches. Of the faecal samples 3% contained *Toxascaris* spp. eggs, 7% *Toxocara* spp. eggs and 55% contained ancylostomidae eggs. Of the soil samples, 2% contained ancylostomidae eggs and 0.8% contained ascarid eggs. Significant differences in the presence of parasites were found in faecal samples of dry, moist and wet climate zones and between the dry and rainy seasons. Significant differences in the presence of eggs and larvae were also found in the grass samples in the dry, the moist and the wet climate zones and between the different seasons. No significant differences were found between rural and urban areas.

Keywords: *Toxocara*; Ancylostomidae; Helminth prevalence; Costa Rica; Soil samples

1. Introduction

Cats and dogs are important sources of some types of human parasitic infections. *Toxocara canis* causes visceral larva migrans syndrome and *Ancylostoma caninum* causes larva migrans cutanea. Direct contact with dogs that harbour adult *Toxocara* worms is unlikely to cause an infection in humans because once shed, the ova must undergo a period of development in the environment before they can become infective (Glickman and Schantz, 1981). Embryonated eggs can remain viable in the environment for several years. Their development and viability depends on the humidity and temperature of the area. Worldwide, a number of studies have been conducted to determine the extent of environmental contamination (Table 1).

Since preliminary studies in Costa Rica revealed problems with larva migrans and high seroprevalences in clinically diseased men (Guimaraes et al., 2005), the purpose of this study was to examine the extent of the contamination in public parks and beaches with parasitic stages within different climate zones in Costa Rica;

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Table 1
Prevalence data of *Toxocara canis* (*T.c.*), *Toxascaris leonina* (*To.l.*) and *Ancylostoma* sp. (*A.c.*) in soil samples and in faecal samples from public places

Author/year	Country	Prevalence			
		in soil	of	in faeces	of
Boreham and Capon (1982)	Australia	1.1% $n=266$	(*T.c.*)	1.8% 41.7%	(*T.c.*) (*A.c.*)
Carden et al., 2003	Australia	1 sample $n=180$	(T .c.)		
Beugnet and Gadat (1993)	N.Caledonia	50% $n=22$, One place	(*T.c.*) (*To.l.*)	n.e.	
Gunaseelan et al., 1992	India	6.59% $n=410$	(*T.c.*)	n.e.	
O'Lorcain, 1994	Ireland	14.9% $n=22$; 0.43%	(*T.c.*) (*To.l.*)	n.e.	
Borg and Woodruff, 1973	Britain	24.4% $n=800$	(*T.c.*)	n.e.	
Conde Garcia et al. (1989)	Spain	3.5–9%, $n=698$	(*T.c.*)	31.5%	(*T.c.*)
Ruiz de Ybanez et al., 2001	Spain	67% of parks 1.2% of samples One sample $n=644$ (9 parks)	(*T.c.*) (*T.c.*) (*To.l.*)		
Habluetzel et al., 2003	Italy	>50% of farms $n=60$ 3/6 parks	(*T.c.*) (*T.c.*)		
Ozkayhan, 2006	Turkey	62.5% of playgrounds 15.6% of samples 1.5% $n=480$, 8 parks	(*T.c.*) (*T.c.*) (*To.l.*)	7.7% $n=26$	(*T.c.*)
Oteifa and Moustafa, 1997	Egypt	30.3% $n=600$	(*T.c.*)	n.e.	
Emehelu and Fakae, 1986	Nigeria	54.5%, $n=11$	(*T.c.*)	n.e.	
Paul et al., 1988	USA, Illinois	16.3%, $n=135$	(*T.c.*)	5% $n=40$	(*T.c.*)
Chorazy and Richardson, 2005	USA	14.4% $n=319$	Ascarids		
Vasquez Tsuji et al., 1996	Mexiko	12.5% $n=281$	(*T.c.*)	n.e.	
Scaini et al., 2003	Brasil			71.3% 9.3% $n=237$	(*A.c.*) (*T.c.*)
Capuano and Rocha, 2005	Brasil	20.5% of public squares $n=78$	Toxocara		
Guimaraes et al., 2005	Brasil	17.4% 69.6% $n=23$ public parks	(*T.c.*) (*A.c.*)		
Sommerfelt et al., 1992	Argentina	2.7% $n=294$	(*T.c.*)	n.e.	
Rubel and Wisnivesky, 2005	Argentina			40–70% 9–17% 14–53%*	Helminths *Toxocara* (*A.c.*)

Overview of current publications.
* In this study much higher prevalences were found in lower income neighbourhoods.

thereby identifying potential sources of infection whilst comparing prevalences in relation to climate and season.

2. Materials and methods

2.1. Sampling areas

Samples were taken in four different regions of Costa Rica whose classification in three different major climate zones is shown in Fig. 1 and follows the ecological map of Costa Rica on the basis of the World Life Zone System by Holdridge (1967). The resulting 12 Life Zones for Costa Rica were allocated to three main groups mainly according to precipitation and humidity; the main factors which influence parasitic survival. Because Costa Rica lies within the equatorial tropical region, variation in average temperatures between climate zones does not exceed more than 5 °C (Coen, 1983).

Costa Rica is divided into 240 districts (as the smallest geopolitical units). Assuming that in each district at least one public place is present, 53 sampled public places (22%) were calculated to be a representative random sample (5% prevalence, 97.5% confidence, Win Episcope 1.0, Epidecon Vet. Faculty of Zaragoza & Agri-

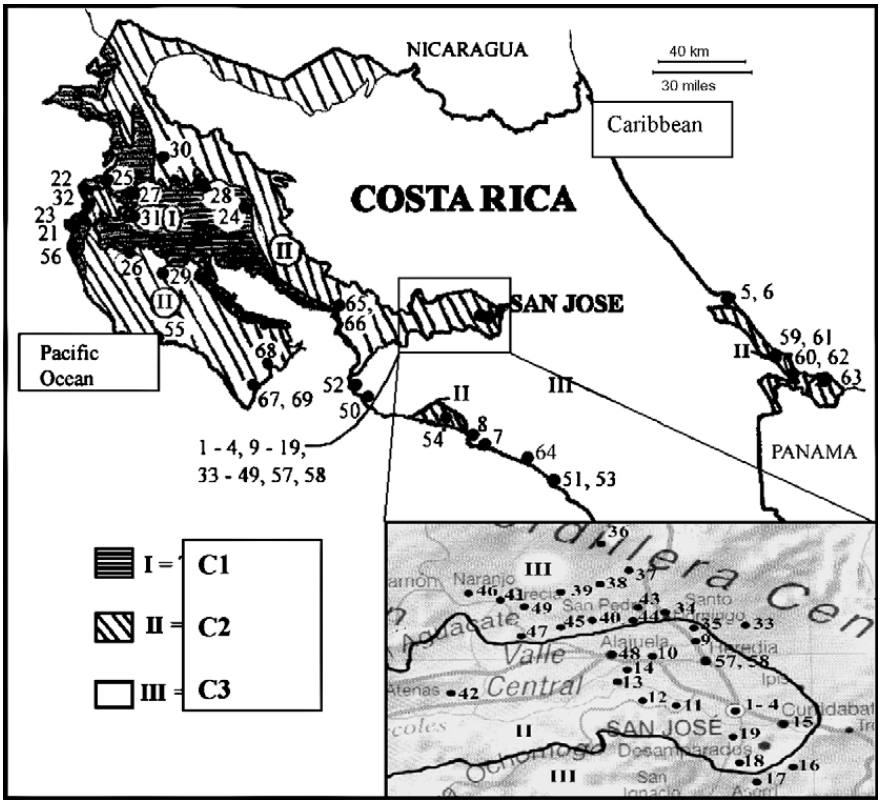

Fig. 1. Sampling areas, sites and climate zones in Costa Rica. C1 = tropical dry forest; C2 = tropical moist forest; C3 = tropical wet forest; identification of sample sites:

Sample no.	Province	Location	Climate Zone	Sample no.	Province	Location	Climate zone
1	San Jose	Tibas	C2	36	Alajuela	Poasito	C3
2	San Jose	Morazan	C2	37	Alajuela	Fraijanes	C3
3	San Jose	San Pedro	C2	38	Alajuela	Sabana redonda	C3
4	San Jose	Parque España	C2	39	Alajuela	San Juan norte	C3
5	Limon	Limon	C3	40	Alajuela	San Pedro	C3
6	Limon	Limon	C3	41	Alajuela	Sarchi	C3
7	Puntarenas	Ply Mn. Antonio	C3	42	Alajuela	Atenas	C2
8	Puntarenas	Quepos	C3	43	Alajuela	San Roque	C3
9	Heredia	Mercedes norte	C2	44	Alajuela	San Juan	C3
10	Heredia	San Joaquin	C2	45	Alajuela	Dulce Nombre	C3
11	San Jose	Pozo	C2	46	Alajuela	Naranjo	C3
12	San Jose	Alajuelita	C2	47	Alajuela	San Isidro	C3
13	San Jose	San Antonio	C2	48	Alajuela	La Garita	C2
14	San Jose	San Rafael	C2	49	Alajuela	Grecia	C3
15	San Jose	Curridabat	C2	50	Puntarenas	Playa Jaco	C3
16	San Jose	San Juan de Dios	C3	51	Puntarenas	Playa Dominical	C3
17	San Jose	Aserri	C3	52	Puntarenas	Playa Herradura	C3
18	San Jose	Pozo	C2	53	Puntarenas	Dominical plaza	C3
19	Heredia	Asuncion	C2	54	Puntarenas	Parrita	C3
20	Guanacaste	Playa Brasilito	C1	55	Guanacaste	Playa Samara	C2
21	Guanacaste	Playa Conchal	C1	56	Guanacaste	Playa Tamarindo	C1
22	Guanacaste	Playa Potrero	C1	57	Heredia	San Fransisco	C2
23	Guanacaste	Brasilito	C1	58	Heredia	Sta. Lucia	C2
24	Guanacaste	Cañas	C1	59	Limon	Cahuita	C3
25	Guanacaste	Potrero	C1	60	Limon	Puerto Viejo	C3
26	Guanacaste	Santa Cruz	C2	61	Limon	Cahuita	C3
27	Guanacaste	Filadelfia	C1	62	Limon	Puerto Viejo	C3
28	Guanacaste	Bagaces	C1	63	Limon	Manzanillo	C3
29	Guanacaste	Nicoya	C2	64	Puntarenas	Matapalo	C2
30	Guanacaste	Liberia	C2	65	Guanacaste	Puntarenas	C2
31	Guanacaste	Santa Ana	C1	66	Guanacaste	Puntarenas	C2
32	Guanacaste	Playa Flamingo	C1	67	Guanacaste	Montezuma	C2
33	Heredia	San Pedro	C3	68	Guanacaste	Tambor	C2
34	Heredia	Santa Barbara	C3	69	Guanacaste	Montezuma	C2
35	Heredia	San Pedro	C2				

cultural University Wagenningen). A total of 69 public places in Costa Rica were sampled. Fifty-three samples were taken from city parks and 16 samples from beaches. Sample group 1 (C1) consisted of the tropical dry forest, group 2 (C2) comprised the tropical moist forests and group 3 comprised (C3) the tropical wet forests (Fig. 1). Additionally, the sampled locations were differentiated into two socioeconomic zones: rural areas (38 places) and urban areas (31 places). From 34 places, samples were taken during the dry season (Nov. to April) and from 35 places the samples were taken during the rainy season (May to Oct.; Coen, 1983).

2.2. Samples

2.2.1. Grass samples

Grass samples were taken from 53 public parks (Fig. 1). Due to the observation that nearly all places showed no vegetation in the center of the park and all dogs visiting these places stayed along the grassy periphery, the grass samples were taken by walking along the perimeter of a park taking one sample every 20 feet. All of the grass samples from each park were pooled for examination. The weight of the pooled grass samples varied from 24 to 66 g with an average weight of 41 g.

2.2.2. Sand samples

Sand samples were taken from 16 beaches (Fig. 1). The sand samples were gathered along the beaches from the superficial layer (top 3 cm) in shady areas by taking one sample of approximately 10–15 g every 50 steps. All sand samples from each beach were pooled. The weight of a pooled sand sample from one beach varied between 200 and 550 g, with the average weight of a pooled sand sample being 342 g.

2.2.3. Faecal samples

All faecal samples found on the beaches and parks were taken and pooled for each location (Fig. 1).

2.3. Methods

2.3.1. Sedimentation-flotation method for grass samples

Each pooled grass sample was stirred in a 500 ml plastic beaker with 0.2% Tween 20® solution in water. The sample was sieved and the liquid poured into a sedimentation beaker. The grass was rinsed twice with water so that a total of 1 L of liquid was poured into the sedimentation beakers. After 2 h of sedimentation the supernatant was decanted and the sediment was passed into two 15 ml centrifuge tubes and centrifuged at 1000 rpm (100 × *g*, 5 min). Afterwards, the supernatant was decanted and the sediment was mixed with a hypersaturated sugar solution. The tube was filled completely, covered with a cover slip and centrifuged at 1500 rpm (200 × *g*, 10 min). The cover slip was placed on a slide and examined microscopically (×100).

2.3.2. Flotation method for sand samples

After pooling the samples of each beach, the samples were aliquoted into 20 g portions in 50 ml falcon tubes. 243 portions were examined by adding a hypersaturated sugar solution to fill the tube and then the samples were vortexed three times for 5, 2 and 1 min intervals, respectively. A cover slip was carefully placed on top of the solution and left for 20 min. Then it was put on a slide and examined microscopically (×100). This step was done twice after the first and the second mixing; after the third mixing only one cover slip was placed on top of the flotation solution. In total, 5 cover slips per portion were examined.

2.3.3. Flotation method for examination of faecal samples

Faecal samples were examined with a flotation-method in hypersaturated sugar solution. The samples was homogenised with sugar solution and sieved into a plastic tube. The tube was filled completely with sugar solution and covered with a 5 cm × 7 cm glass slide. After 25 min the glass was carefully taken off, turned around, covered with a coverslip and examined microscopically.

2.3.4. Statistical analysis

Descriptive statistics were performed by determining the frequencies (SAS-stat. 6.12, SAS Institute Inc. 1996). Hypothesis tests to determine proportion were conducted utilizing the Chi square test (Microstat by Ecosoft Inc.).

3. Results

From the total of 69 faecal samples, 38 (55%) were found to be positive for eggs of ancylostomidae, 5 (7%) were positive for eggs of *Toxocara* spp. and 2 (3%) were positive for eggs of *Toxascaris* spp. In addition, 9 (13%) of the samples contained oocysts of coccidia, 13 (19%) of the samples contained eggs of *Trichuris* spp. and 10 (14%) of the samples showed other parasitic stages, such as *Capillaria* spp., *Taenia* spp. and *Dipylidium* spp. A total of 47 (68%) of the faecal samples were found to be positive for parasitic stages (Fig. 2) and 16 (23%) of the samples presented two or more different parasitic stages concomitantly.

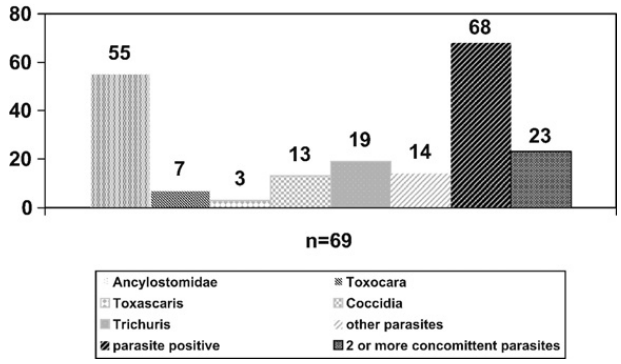

Fig. 2. Results from faecal samples ($n = 69$) from public parks and beaches in Costa Rica (in % positives of the samples).

A comparison of faecal samples from the different climate zones showed that in the tropical dry forest 4 (36%) out of 11 samples were positive for stages of ancylostomidae, 1 (9%) was positive for *Toxocara* spp. and none of the samples was positive for *Toxascaris* spp. eggs. A total of 4 (36%) of the samples from the dry region were positive for parasitic stages (Table 2).

In the tropical moist forest 18 samples out of 28 (64%) were positive for parasitic stages, 16 (57%) contained stages of ancylostomidae, 1 (4%) of the samples was positive for *Toxascaris* spp. and 1 (4%) for *Toxocara* spp. (Table 2).

In the tropical wet forest a total of 25 (83%) out of 30 samples contained parasitic stages. Stages of ancylostomidae were found in 18 (60%) of the faecal samples, eggs of *Toxocara* spp. were found in 3 (10%) of the samples and eggs of *Toxascaris* spp. were found in 1 (3%) of the samples (Table 2).

A significant difference was found in the proportion of the presence of parasites in faeces in the dry (C1) and the wet (C3) region ($p = 0.0017$). A marked difference between the dry (C1) and the moist (C2) region ($p = 0.054$) and between the moist (C2) and the wet (C3) region ($p = 0.064$) was also observed, but not statistically significant (Table 2). In the dry season strongylid stages were found in 15 (44%) of the faecal samples and 7 (35%) of the grass samples. In the rainy season strongylid stages were found in 23 (66%) of the faecal and 23 (96%) of the grass samples (Tables 2 and 3).The differences between dry and wet season were statistically significant ($p < 0.05$).

In rural areas 29 (73%) out of 38 faecal samples and in urban areas 16 (59%) out of 31 faecal samples were positive for parasites (Table 2). No significant difference was found between rural and urban areas.

Faecal samples were collected in 6 of the 7 total provinces of the country. No samples were collected in the province of Cartago. Out of 7 samples collected in the province of Limon in the carribean lowlands, 2 (29%) contained eggs of hookworms (ancylostomidae) and one contained eggs of *Toxocara* spp. A total of 4 (57%) samples from this province showed presence of parasitic stages. Out of 13 samples taken in the province of Puntarenas at the pacific coast, 8 (62%) contained eggs of hookworms and 1 *Toxocara* spp. In this province a total of 10 (77%) samples contained parasitic stages. From 15 samples collected in the province of Guanacaste in the northwestern part of the country, 4 (27%) contained eggs of hookworms, 1 the eggs of *Toxocara* spp. and in total 5 (33%) of the samples were positive for parasitic stages. From 12 samples collected in the province of San Jose around the capital, 7 (58%) contained eggs of hookworms and 2 samples were positive for both eggs of *Toxocara* spp. and *Toxascaris* spp., respectively. In San Jose 9 (75%) of the samples showed parasitic stages. Out of 14 samples taken in the province of Alajuela in the Central Valley, 11 (79%) contained eggs of hookworms, parasitic stages were found in 12 (86%) of the samples and out of 8 samples taken in the province of Heredia, another province in the Central Valley, 7 (88%) were positive for eggs of hookworms (Table 4).

Results of the grass and sand samples are shown in Fig. 3 and Table 3. Out of 44 grass samples 30 (68%) contained eggs or larvae of strongylidae, 6 (14%) were positive for eggs of *Toxocara* spp. and 1 (2%) grass sample contained eggs of *Toxascaris leonina.* All 6-

Table 2
Findings of parasites in faecal samples ($n = 69$) comparing the different climate zones, seasons and socioeconomic zones in Costa Rica

	Nr. of faecal samples	*T. leonina*	*T. canis*	*A. caninum*	Total of positive samples
Tropical dry forest (C1)	11	0	1 (9%)	4 (36%)	4 (36%)
Tropical moist forest (C2)	28	1 (4%)	1 (4%)	16 (57%)	18 (64%)
Tropical wet forest (C3)	30	1 (3%)	3 (10%)	18 (60%)	25 (83%)
Dry season	34	2 (6%)	3 (9%)	15 (44%)	17 (50%)
Rainy season	35	0	2 (6%)	23 (66%)	30 (86%)
Rural areas	38	1	3	25 (66%)	29 (73%)
Urban areas	31	1	2	13 (42%)	16 (59%)

Table 3
Number of positive grass samples from the different climate zones during the different seasons

Season	Climate zone	Total of samples	*St.*	*T.* sp.	*T.l.*
Dry	Dry (C1)	6	0	0	0
Dry	Moist (C2)	12	5 (42%)	0	0
Dry	Wet (C3)	2	2 (100%)	2 (%)	0
Rainy	Dry (C1)	0	–	–	–
Rainy	Moist (C2)	7	6 (86%)	0	0
Rainy	Wet (C3)	17	17 (100%)	4 (%)	1

St. = strongylid eggs; *T.c.* = *Toxocara* spp., *T.l.* = *Toxascaris leonine*.

Table 4
Distribution of positive faecal samples in six provinces of Costa Rica

Province	Total of samples	*A.c.*	*T.c.*	*T.l.*	Total of samples with parasitic stages
Limon	7	2 (29%)	1 (14%)	0	4 (57%)
Puntarenas	13	8 (62%)	1 (7%)	0	10 (77%)
Guanacaste	15	4 (27%)	1 (7%)	0	5 (33%)
San Jose	12	7 (58%)	2 (17%)	2	9 (75%)
Alajuela	14	11 (79%)	0	0	12 (89%)
Heredia	8	7 (88%)	0	0	7 (88%)

A.c. = *Ancylostoma caninum*; *T.c.* = *Toxocara spp.*; *T.l.* = *Toxascaris leonina*.

grass samples from the tropical dry regions (C1) were negative.

In the tropical moist forest areas (C2) 13 out of 19 (68%) grass samples were positive for parasitic stages, 11 (58%) samples contained eggs or larvae of strongylidae.

In the region of the tropical wet forest areas (C3) eggs or larvae of strongylidae were found in 19 out of 19 (100%) grass samples, eggs of *Toxocara* spp. were found in 6 (32%) of the samples and eggs of *Toxascaris* spp. were found in 1 (5%) sample. The differences in the prevalence of parasites in grass samples between the dry climate zone and the moist climate zone ($p = 0.00172$) and between the moist and the wet climate zone ($p = 0.0038$) were statistically significant. A significant difference was also calculated for the prevalence of eggs or larvae of strongylidae in grass samples of the moist and the wet climate zone ($p = 0.0007275$) and for the prevalence of ascarid eggs in the moist and the wet climate zone ($p = 0.008478$). In the dry season

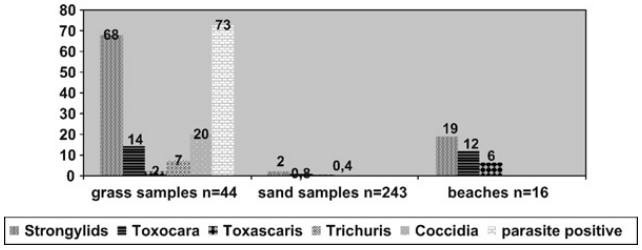

Fig. 3. Results for grass and sand samples from public parks and beaches (in % positives of the samples).

9 (45%) of the grass samples were positive for eggs and/or larvae, whereas in the rainy season 23 (96%) of the grass samples were positive (Table 3). Differences between the dry and the rainy season were statistically significant. No samples could be collected from climate zone 1 (dry forest) in the rainy season. The statistical analysis between the different climatic regions in the rainy and dry period was not possible, due to the low number of samples in each group.

The sand samples of 16 Costa Rican beaches were examined in 243 aliquots of 20 g. Of these 243 aliquots, 5 (2%) from three beaches were positive for stages of strongylidae, 2 aliquots (0.8%) from two beaches showed eggs of *Toxocara* spp. and one (0.4%) presented eggs of *Toxascaris* spp. Three of the 16 beaches (19%) were positive for eggs of strongylidae (Manuel Antonio with two positive aliquots, Playa Jaco with two positive aliquots and Playa Samara with one aliquot) and two beaches (12%) were found to be positive for eggs of *Toxocara* spp. (Manuel Antonio and Samara with one aliquot each). From the total of 16 beaches analysed, in one beach (6%) eggs of *Toxascaris* spp. were found (Playa Jaco in one aliquot).

4. Discussion

This study presents data which indicates the prevalences of different parasites in Costa Rica with an emphasis on potential zoonotic species. This study is important in part because it provides data supporting an

observed accumulation of zoonotic parasitoses as Larva Migrans in a previous study in Costa Rica (Salazar et al., 2005). Samples which contained either sand, grass or faecal material, which were gathered in areas frequented by humans, were taken from various parts of the country which are subdivided into groups according to their geographical location, ecological zone, socioeconomic designation and season.

The obtained data demonstrates that hookworm stages, which can cause the Larva Migrans Cutanea syndrome in humans, could be found in nearly all geographical areas throughout the country. This confirms reports that *Ancylostoma* is the most common parasite of carnivores in Costa Rica (Hernandez Gamboa, 1996). The prevalence of *Toxocara* spp. eggs causing Larva Migrans Visceralis in humans shows significant climatic and geographical variations.

The obtained data illustrating the prevalence of *T. canis* in faecal samples compares to other studies and falls within the reported ranges. For example, Borg and Woodruff found prevalences of up to 25.5% positive for *T. canis* in public places in Great Britain (Borg and Woodruff, 1973). Boreham and Capon (1982) found 1.1% of the soil samples positive for *T. canis* eggs in Australia.

Toxascaris leonina has been found in sand or soil samples in Ireland by O'Lorcain (1994) and in New Caledonia by Beugnet and Gadat (1993) and was found in at least one sample in each study. Among others, *T. leonina* has also been reported in 4% of sand samples in Prague by Valkounova (1982) and 4.1% in Ankara, Turkey by Oge and Oge (2000). The general prevalence in animals is relatively low in Costa Rica and it is therefore not surprising that positive results were found in only two faecal samples in this study.

While in countries with temperate climates, no significant differences have been found in prevalence of *T. canis* or *T. cati* in soil samples during winter and summer (Borg and Woodruff, 1973), in tropical countries there have been differences between prevalence of *T. canis* in soil samples during dry and rainy season (Emehelu and Fakae, 1986). There has been evidence that temperatures ranging from 15 to 35 °C and high humidity favour the development of infective stages of *T. canis* (Glickman and Schantz, 1981).

O'Lorcain (1994) found significant differences in the presence of infective ova in samples classified as moist and dry. Oteifa and Moustafa (1997) found little seasonal difference influencing the presence of eggs, but variation was observed in the amount of viable eggs.

The Costa Rican climate is very mild without a winter. Average temperatures range between 16.6 and 24.8 °C in the Central Valley and up to 32.3 °C in the coastal dry areas. Rainfall varies between 1.5 m/year in the dry regions and up to 6 m/year in the pluvial rainforest regions (9). Therefore, the differences in parasite prevalence between the climate zones and wet and dry season were to be expected. Due to logistical problems, it was not possible to gather sufficient samples of each subcategory. Regretfully no samples from climate zone 1 (dry forest) could be collected in the wet season. On the other hand, few samples without statistical significance were collected in certain categories. Nevertheless, the results show tendencies which provide a first assessment of exposure risks to human populations in different parts of the country and may be used as starting point for the design of future studies.

The findings in the different Provinces of the country correlate with the humidity. The samples taken from the dry northern region of Guanacaste were taken mostly during the dry season, explaining the relatively low parasite prevalence compared to the other Provinces. The Province of Puntarenas contained only the wet climate zone in which 6 out of 8 samples were collected during the rainy season. Of the 3 provinces of the Central Valley that were sampled, San Jose, Alajuela and Heredia, 20 out of 34 samples were taken during the rainy season. Sixteen of the sampled locations were situated in wet climate zones and 18 were situated in moist climate zones.

No significant difference was found between rural and urban areas. Rubel and Wisnivesky (2005) found significantly higher prevalences in low income neighbourhoods, compared to high income neighbourhoods. The differentiation into rural and urban districts in Costa Rica did not correlate with the income of respective populations.

In the present study we demonstrate that the contamination of parks with faecal matter is ubiquitous and prevalences for parasitic stages with zoonotic potential in public places within Costa Rica are high. Because hookworms are intestinal parasites infecting dogs and cats, they are highly prevalent in the environment throughout Costa Rica. Although the low number of samples did not allow analysis of results from wet and dry season in the different climate zones separately, it became clear that humidity generally favours the occurrence, distribution and survival of parasitic stages in the environment. Therefore, the statistical chance to acquire zoonotic hookworm and ascarid infections for humans is highest during the rainy season in a tropical wet climate. This conclusion is not surprising and is clearly supported by the data presented here for Costa Rica. Because parasitic contamination in public areas is a public health

issue, this data should be helpful in the development of appropriate education, control and prevention strategies, i.e. provide information for pet owners about helminth infections in cats and dogs and zoonotic infection risks and advice about anthelmintics and the frequency of regular dewormings of their animals.

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