Journal of the Egyptian Society of Parasitology, Vol.46, No.2, August 2016
J. Egypt. Soc. Parasitol. (JESP), 46(2), 2016: 399 - 406

NEMATODES COMMUNITY INFECTING *CHALCIDES OCELLATUS* LIZARD AND THEIR RELATION TO SOME ENVIRONMENTAL AND BIOLOGICAL FACTORS

By
EHSSAN A. HASSAN
Department of Zoology, Faculty of Science, Suez Canal University, Ismailia, Egypt **(E-mail**: ehssanmm_sci@yahoo.com)

Abstract

Sixty-eight species from *Chalicides ocellatus* lizard were captured from Abu Rawash, Giza, Egypt and surveyed for gastrointestinal nematodes. 50% of the lizards were infected. Five species of nematodes were recovered; the nematodes species were *Pharyngodon mamillatus*, *Cosmocerca vrcibradici*, *Spauligodon petersi*, *Thelandros schusteri*, and *Parapharyngodon bulbosus*. Prevalence of the infection was varied according to season. The highest prevalence, total intensity, and total abundance were recorded during winter. The prevalence of nematodes species also varied according to the lizard weight. The variation was different from one species to another. Infection with *P. mamillatus*, *P. bulbosus*, and C. *vrcibradici* was higher in females than males. Nematodes abundance and intensity were not related to host sex, except for *C. vrcibradici* and *T. schusteri*. In conclusion, the main effect in the nematodes intensity was the season and the lizard weight.

Key words: Giza, Egypt, Reptiles, *C. ocellatus*, nematodes.

Introduction

Parasites are ubiquitous and crucial individuals of natural groups that frequently have an effect on host populations (Thomas *et al*, 2005; Wood *et al*, 2007; Watson, 2013). Researches on reptiles and their parasitic communities are crucial to natural science in lots of extraordinary approaches (Anderson, 2000). Besides, host length, sex, and geographical range can also influence parasite community shape (Ibrahim, 2012; Silveira and Calegaro-Marques, 2016). Environmental factors might also have an effect on parasites if they appeal to host populations (Skirnisson *et al*, 2004) or adjust between parasites and hosts (Caceres *et al*, 2006). Patterns of parasitic infection varied within and between populations because of some environmental factors such as temper-ature (Heeb *et al*, 2000) and season (Bakuza and Nkwengulila, 2009). Seasonality, for instance, was a focus of numerous studies within the ecology of parasitism (Ibrahim and Soliman, 2005). Moreover, an increasing number of reviews highlighted the potential impact of climate change on parasitism (Macleod and Poulin, 2012; Morley and Lewis, 2014). Thus, parasite assemblages could also play a potential role as environmental indicators by decreasing or increasing in their diversity, species richness, abundance and prevalence with changes to environmental conditions (Tavares-Dias *et al*, 2014; Alcantara and Tavares-Dias, 2015).

Parasite abundance varied in response to several factors , intrinsic factors as prevalence , parasite load, sex and age of the host (Schall *et al*, 2000; Smallridge and Bull, 2000), in addition to extrinsic factors including temperature and rainfall (Bajer *et al*, 2001; Munoz *et al*, 2013). There was a tremendous increase in the quantity of researches running on lizards in Egypt, sadly, little attention was given to their helminths community and few records exist within the literature (Ibrahim and Soliman, 2005). One of the most abundant and sizeable reptile species in Africa, particularly, Egypt is the lizard, *Chalicides ocellatus* that tolerate numerous environments starting from the steppe to woodland habitats (Rabie *et al*, 2014).

Three parameters, prevalence, intensity, abundance of parasites varied among the different host populations, but within species-specific bounds (Krasnov *et al*, 2006; Bordes *et al*, 2010). On this work, it was aimed to analyze the nematodes of *C. ocellatus* lizard and the effects of the host sex, length and weight, in addition to relation between seasonality, prevalence, abundance and intensity of each of the species concerned.

Materials and Methods

This study was achieved in Abu Rawash about 16 km west of Cairo City and 8 km North-westof Giza Pyramids. Sixty eight *C. ocellatus* lizards were surveyed during year 2014. The lizards had been transported alive to the laboratory where they were euthanized, sexed, weighted, and measured.

The samples were divided into two weight classes (Class 1: <15 g; Class 2: >15), in addition to two length classes (Class 1: < 10 cm; Class 2: > 10). The cavity of every lizard was opened by using a longitudinal incision from throat to vent, the gastrointestinal tract slit longitudinally, sex was determined, and intestinal contents of every lizard have been removed and tested separately under a stereomicroscope. Recovered nematodes were fixed in boiling 70 % ethanol. For specific light microscopic research, they were transferred to a 50 % lactophenol-water solution and tested whilst clearing (Albuquerque *et al*, 2012). All recovered nematodes were diagnosed by generic morphological characters (Hering-Hangenbeck *et al,* 2002; Bursey and Goldberg, 2004; Bursey *et al,* 2007).

Statistical analysis: Data were presented as a mean abundance and intensity ± SE of infection (Bush *et al,* 1997). Parasite intensity and abundance of nematodes and relationship with sex were tested using Mann-Whitney test (U-test), while their relationship with weight and length were tested using Kruskal Wallis test. Correlations between intensity and infection rate, weight and length were examined using the non-parametric, Spearman's rank correlation coefficients (rs). All statistical tests were performed by using the software packages SPSS 20 (USA). Data were analyzed after-normalization (by log 10 [X+1] transformation) by 2-way ANOVA in GLIM.

All experimental procedures involving animals were conducted in accordance with guide for the care and use of Laboratory animals (http://www.nap.edu/catalog/12910.html) and approved by the Research Ethics Committee (Section of experimental animals) of Faculty of Science, Suez Canal University, Ismailia, Egypt.

Results

In the present study, five species of nematodes occurred in 68 individuals of *C. ocellatus*. These were *Pharyngodon mamillatus*, *Cosmocerca vrcibradici*, *Spauligodon petersi*, *Thelandros schusteri*, and *Parapharyngodon bulbosus*. *P. mamillatus* was the com-monest species, whereas, *T. schusteri* and *P. bulbosus* were the least ones. The overall nematodes incidence was 50%. Prevalence of *P. mamillatus*, *C. vrcibradici*, *S. petersi*, *T. schusteri* and *P. bulbosus* was 33.8%, 27.9%, 25%,11.8%, 11.8% respectively (Fig. 1).

Prevalence of infection varied seasonally. The highest prevalence was during winter for *C. vrcibradici* (42.9%), followed by *P. mamillatus* (34.3 %), while the lowest was recorded for *T. schusteri* (10.4%). In summer (Fig. 2), the highest infection was recorded for *S. petersi* (24.2%) and the lowest for *P. bulbosus* (9.1%). The total intensity of nematodes (Tab. 1) was higher in winter than summer (18.11±4.52; 9.29±2.09, respectively with $P<0.05$). It was more obvious in the intensity of *T. schusteri* ($P<0.01$) (4±1.29; 1.75±0.48, respectively), *C. vrcibradici* (11.21±2.28; 6.6±2.46, respectively), and *P. bulbosus* (3±0.41; 1.67±0.67, respectively). Also, total abundance was higher in winter (9.59±2.84) than in summer (4.65±-1.31), with the highest abundance recorded for *C.*

vrcibradici (4.62±1.33; 0.97±0.52, respectively) (Tab. 1).

Host sex played an essential role in structuring the nematodes' infracommunity of. Infection with *T. schusteri* (13.9 %, 9.3 %) and *S. petersi* (27.8 %, 26.9%) was higher in males than females, respectively. On the other hand, infection with *P. mamillatus* (34.4%, 33.3%), *P. bulbosus* (15.6%, 8.3%), and *C. vrcibradici* (31.2 %, 25%) was higher in females than males, respectively (Fig. 3). There wasn't any relation between nematodes abundance and intensity and lizard sex, except for *C. vrcibradici* and *T. schusteri* (Tab. 1).

The prevalence of nematodes species also varied in terms of the lizard weight. Lizard weight of class 2 recorded the highest prevalence for *C. vrcibradici* (32.35%), and *S. petersi* (29.41 %). Alternatively, the infection for *P. mamillatus* and *T. schusteri* was almost equal in lizard weight of classes 1 and 2 (Fig. 4). Total intensity and abundance of infection were higher in the weight of class 1 (18.81±4.729; 8.32±2.72) than the weight of class 2 (9.63±2.438; 5.91±1.61), respectively (Tab.1). There wasn't any significant difference between lizard weight and intensity of the infection. There was a negative correlation between the total intensity of nematodes species and the weight ($R= -0.371$, $P<0.02$). Concerning the lizard length, the lizard length of class 1 showed the highest prevalence for *P. mamillatus*, *T. schusteri* and *P. bulbosus* ($P<0.01$), while for *C. vrcibradici*, and *S. petersi*, the lizard length of class 2 was the most infected (Fig. 5). There were significant differences between *P. mamillatus* ($P<0.04$), S. *petersi* ($P<0.04$), *T. schusteri* ($P<0.01$), season and lizard length and this demonstrate that season and lizard length affect the parasite intensity to a great extent. Both weight and length had the same effect on prevalence, intensity and abundance of nematodes (Tab. 1, Fig. 4, 5), since each of them is considered as indication of lizard age.

Discussion

Climatic modifications and its dating with parasitic interactions represent a multifactor trouble that modulates the structuring of helminthes communities. The effect of changes was relied upon their magnitude and the physiological tolerance of affected organisms (Martinez and Merino, 2011). Seasonality of parasite infection rate may be inspired with the aid of fluctuations within the hosts' exposure to the infective stages (Cornell *et al*, 2008; Calegaro-Marques and Amato, 2013). Ibrahim and Soliman (2005) recorded that incidence and general intensity of helminthes infection in combined sex *of C. ocellatus* was significantly affected by seasonal variation. Muqbil and Ismail (2014) pronounnced that the season became essential element affecting parasite abundance and that the highest mean abundance of nematode infection in *C. ocellatus* was recorded throughout summer. However, Fontes *et al*. (2003) pronounced that lizards are highly parasitized within the wet season. So, the reaction of nematodes infecting *C. ocellatus* considering climatic changes differs in keeping with the habitat and in correspondence with different factors.

Male and female hosts may additionally exhibit differences in condition; immune reaction, and hormonal profiles, so, sex of the host is an essential characteristic that may have an effect on intensities of parasites (Lumbad *et al*, 2011). Prevalence and intensity of parasitic infections are frequently higher in male than in female vertebrates and this may constitute both variations among host sex in exposure or susceptibility to parasites. Differences in susceptibility are often appeared as a negative impact of male sex steroid hormones at the immune system (Brown and Symondson, 2014).

Relatively higher prevalence of infections discovered via Sulieman *et al*. (2014) in male geckos in comparison to females but, the difference was not significant. In contrast, Muqbil and Ismail (2014) pronounced that females *C. ocellatus* were more infected (96.9%) than adult males (78.6%), even as males *Uromastyx Ornata philbyi* were highly infected (100%) than females (86.7%). Accordingly there are different factors that force the parasites toward both sex taking in consideration the host species and habitat. It was reported that the high helminthes infections in *C. ocellatus* lizard were related to their foraging and feeding habits (Al-Shareef and Saber, 1995). Olumuyiwa (2015) reported that infection with *P. mamillatus* was higher in tropical wall female geckos than males; an illustration that females may additionally be feeding extra than males. But, extra considerable feeding of females may additionally have an impact on female infection rates (Pickering and Caira, 2014). Ibrahim *et al*. (2005) stated that the difference between prevalence of parasites in male lizards and female lizards became small. Also, Amo *et al*. (2005) stated that males and females seem to be similarly at risk of parasite's infection, as the prevalence and intensity of infection were similar in both sexes. Therefore, whatever influences the reptilian sex hormones exert on their helminthic parasites, they are not profoundly meditated at the levels of parasitism (AL-Barwari and Saeed, 2007).

Carretero *et al*. (2006) reported that an increasing incidence of parasitic infections with geckos' length seemed to be just a trademark of their age, hence, of time for parasite recruitment. There was no significant difference inside the snoutvent length among adults, male and female nematode infected geckoes; this result coincidence with a previous observe of finding no correlation between the intensity of nematode infections and factors of body weight and snout–vent length of lizards (Ghobashy, 2006). Bezerra *et al*. (2015) said that helminthes species richness became no longer related to host body size. In contrast, Ibrahim and Soliman (2005) showed that overall helminths abundance in *C. ocellatus* was in correlation with host weight.

Also, Adeoye and Ogunbanwo (2007) confirmed that there was a relation between parasite intensity and the lizard length. Muqbil and Ismail (2014) pronounced that the reptiles with the maximum length and the biggest weight were more infected. Olumuyiwa (2015) detected that the infestation of the host increases as the Gecko increases in weight.

Conclusion

The habitat is vital in nematodes infection and had an effect on nematodes prevalence, intensity and abundance, in addition to different intrinsic and extrinsic factors. The main effects on nematodes intensity were season and host weight.

References

Adeoye, GO, Ogunbanwo, OO, 2007: Helminth parasites of the African lizard *Agama agama* (Squamata: Agamidae) in Lagos, Nigeria. Rev. Biol. Trop. 55, 2:417-25.

Al-Barwari, SE, Saeed, I, 2007: On the helmi-nth fauna of some Iraqi reptiles. Turkiye. Para-zitol. Derg. 31, 4:330-6.

Albuquerque, SD, Ávila, RW, Bernarde, BS, 2012: Occurrence of Helminths in Lizards (Reptilia: Squamata) at Lower Moa River Forest, Cruzeiro do Sul, Acre, Brazil. Comp. Parasitol. 79, 1:64-7.

Alcantara, NM, Tavares-Dias, M, 2015: Study on the structure of the protozoan and metazoan communities of two Erythrinidae fish in the Amazonas River system (Brazil). Braz. J. Vet. Parasitol. 24:183-90.

Al-Shareef, AM, Saber, SA, 1995: Ecological studies of *Chalcides ocellatus* (Forskal, 1775) and *Hemidactylus turcicus* (Linnaeus, 1758) from Egypt with special reference to helminth parasites. J. Egypt. Soc. Parasitol. 25, 1:145-82.

Amo, L, Fargallo, JA, Martínez-Padilla, J, Millán, J, López, P, *et al*, 2005: Prevalence and intensity of blood and intestinal parasites in a field population of a Mediterranean lizard, *Lacerta lepida*. Parasitol. Res. 96:413-7.

Anderson, RC, 2000: Nematode Parasites of Vertebrates: Their development and transmission. J. S. Afr. Vet. Assoc. 71, 4:232-9.

Bajer, A, Paweeczyk, A, Behnke, JM, 2001: Factors affecting the component community structure of haemoparasites in bank voles (*Clethrionomys glareolus*) from the Mazury Lake District region of Poland. Parasitol. 122:43-54.

Bakuza, JS, Nkwengulila, G, 2009: Variation over time in parasite prevalence among free-ranging chimpanzees at Gombe National Park, Tanzania. Int. J. Primatol. 30:43-53.

Bezerra, CH, Ávila, RW, Passos, DC, Zanch-i-Silva, D, Galdino, CA, 2015: Levels of helminth infection in the flat lizard *Tropidurus semitaeniatus* from north-eastern Brazil. J. Hel-minthol. 16:1-5.

Bordes, F, Morand, S, Krasnov, B, Poulin, R, 2010: Parasite diversity and latitudinal gradients in terrestrial mammals. The Biogeography of Host-Parasite Interactions. Oxford University Press.

Brown, DS, Symondson, WOC, 2014: Sex and age-biased nematode prevalence in reptiles. Mol. Ecol. 23, 15:3890-9.

Bursey, CR, Goldberg, SR, 2004: *Cosmocerca vrcibradici* n. sp. (Ascaridida: Cosmo cercidae), *Oswaldocruzia vitti* n. sp. (Strongylida: Molineoidae), and other helminths from *Prionodactylus eigenmanni* and *Prionodacty lus oshaugnessyi* (Sauria: Gymnophtalmidae) from Brazil & Ecuador. J. Parasitol. 90:140-5.

Bursey, CR, Goldberg, SR, Sam, R, Telford, JR, 2007: Gastrointestinal Helminths of 14 species of Lizards from Panama with descriptions of five new species. Comp. Parasitol. 74, 1:108-40.

Bush, AO, Lafferty, K., Lotz JM, Shostak, A W, 1997: Parasitology meets ecology on its own terms: Margolis et al. revisited. J. Parasitol. 83: 575-83.

Caceres, CE, Hall, SR, Duffy, MA, Tessier, A J, Helmle, C, Macintyre, S, 2006: Physical structure of lakes constrains epidemics in *Daph-nia* populations. Ecology 87:1438-44.

Calegaro-Marques, C, Amato, SB, 2013: Sea-sonal influences on parasite community structure of *Turdus rufiventris* (Aves). J. Parasitol. 99:1-5.

Carretero , MA, Roca, V, Martin, JE, Llorente, GA, Montori, A, Antos, XS, 2006: Diet and helminth parasites in the Gran Canaria giant lizard *Gallotia stehlini*. Rev. Esp. Herpetol. 20: 105-17.

Cornell, S, Bjornstad, ON, Cattadori, IM, Boag, B, Hudson, PJ, 2008: Seasonality, cohort-dependence and the development of immunity in a natural host-nematode system. Proc. R. Soc. B. 275:511-8.

Fontes, AF, Vincente, JJ, Kiefer, MC, Sluys, MV, 2003: Parasitism by helminths in *Europhosaurus nanuzae* (Lacertilia: Tropiduridae) in an area of rocky outcrops in Minas Gerais State, Southeastern Brazil. J. Herpetol. 37, 4:736-41.

Ghobashy, MA, 2006: Parasitological studies of the lizard, *Ludakia stellio* in Arish, North Sinai Governorate, and Egypt. J. Egypt Soc. Parasitol. 36, 2:691-700.

Heeb, P, Kölliker, M, Richner, H, 2000: Bird ectoparasite interactions, nest humidity, and ectoparasite community structure. Ecology 81:958–68.

Hering-Hagenbeck, SF, Petter, AJ, Boomker, J, 2002: Redescription of some *Spauligodon* spp. and *Parapharyngodon* spp., and of *Skrjabi-nodon mabuyae* (Sandground, 1936) Inglis, 1968 (Pharyngodonidae: Oxyuroidea) from insectivorous South African lizards. Onderstepoort. J. Vet. Res. 69:7-29.

Ibrahim, HM, Fadiel, MM, Nair, GA, 2005: Gastrointestinal Helminthes of the Lizard, *Chalcides ocellatus*, from Benghazi, Libya. J. Helminthol. 79:35-9.

Ibrahim, MM, Soliman, MF, 2005: Factors affecting helminths community structure of the Egyptian lizard *Chalcides ocellatus* (Forskal, 1775). Parasite 12, 4:317-23.

Ibrahim, MM, 2012: Variation in parasite infra-communies of *Tilapia zilli* in relation to some biotic and abiotic factors. Int. J. Zool. Res. 8, 2: 59-70.

Krasnov, BR, Shenbrot, GI, Khokhlova, I S, Poulin, R, 2006: Is abundance a species attribute? An example with hematophagous ectoparasites. Oecologia 150:132-40.

Lumbad, AS, Vredevoe, LK, Taylor, EN, 2011: Season and sex of host affect intensities of ectoparasites in western fence lizards (*Sceloporus occidentalis*) on the central coast of California. Southwest. Nat. 56, 3:369-77.

MacLeod, CD, Poulin, R, 2012: Host-parasite interactions: A litmus test for ocean acidification?. Trends Parasitol. 28:365-9.

Martinez, J, Merino, S, 2011: Host-parasite interactions under extreme climatic conditions. Curr. Zool. 57, 3:390-405.

Morley, NJ, Lewis, JW, 2014: Temperature stress and parasitism of endothermic hosts under climate change. Trends Parasitol. 30: 221-7.

Muñoz, G, Torres, P, Valdés, J, Rodríguez, A, 2013: Spatio–temporal variation in the pre-valence of trematodes in bivalve *Perumytilus purpuratus*. Acta. Parasitol. 58:155-66.

Muqbil, NA, Ismail, R, 2014: Helminthes ne-matodes of two reptiles *Chalcides ocellatus* and *Uromastyx ornata philbyi* from two areas in Ye-men. J. Nat. Appl. Sci. 18, 2:1.

Olumuyiwa, AO, 2015: The occurrence of *Pha-ryngodon mamillatus* (LINSTOW, 1897) (Oxyu-roidea, Pharyngodonidae) in a tropical wall Gec-ko. IJANS. 4, 3:47-50.

Pickering, M, Caira, JN, 2014: Seasonal dynamics of the population inhabiting salt marsh ponds in Iceland. J. Parasitol. 90:50-9.

Rabie, S, Mohey El-din, Z, Abd El-Latif, Mo-hamed, N., Abo Al-Hussin, O, 2014: Redescri- ption of Nematodes *Pharyngodon mamillatus* and *Thelandros* sp. from Some Reptiles of Qena, Egypt. IJSR. 3, 11:1368-80.

Schall, JJ, Pearson, AR, Perkins, SL, 2000: Prevalence of malaria parasites (*Plasmodium floridense* and *Plasmodium azurophilum*) infe-cting a Puerto Rican lizard (*Anolis gund-lachi*): A nine year study. J. Parasitol. 86:511-5.

Silveira, TS, Calegaro-Marques, C, 2016: Helminth parasite diversity discloses age and sex di-fferences in the foraging behavior of southern lap-wings (*Vanellus chilensis*). Austral Ecol. Doi:10.1111/aec.12344.

Skirnisson, K, Galaktinov, KV, Kozminsky, E V, 2004: Factors influencing the distribution of digenetic trematode infections in a mudsnail (*Hydrobia ventrosa*) . J. Parasitol. 90, 1:50-9.

Smallridge, CJ, Bull, CM, 2000: Prevalence and intensity of the blood parasite *Hemolivia mariae* in a field population of the skink *Tiquila rugosa*. Parasitol. Res. 86:655-60.

Sulieman, Y, Pengsakul, T, Abugabr, H, Shai-Qin, H, 2014: Gastrointestinal parasites of fantoed gecko, *Ptyodactylus ragazzi* (Squa-mata: Gekkonidae). Int. J. Fauna Biol. Stud. 1, 6: 101-4.

Tavares-Dias, M, Oliveira, MSB, Goncalves, RA, Silva, LMA, 2014: Ecology and seasonal variation of parasites in wild *Aequidens tetramerus*, a Cichlidae from the Amazon. *Acta.* Para-sitol. 59:158-64.

Thomas, F, Renaud, F, Guegan, J, 2005: Pa-rasitism and Ecosystem. Oxford University Press, New York, USA.

Watson, MJ, 2013: What drives population-level effects of parasites? Meta-analysis meets life-history. Int. J. Parasitol. Parasites Wildf. 2: 190-6.

Wood, CL, Byers, JE, Cottingham, KL, Alt-man, I, Donahue, MJ, *et al*, 2007: Parasites al-ter community structure. PNAS. 104, 22: 9335-9.

Table 1: Mean intensity and abundance of nematodes species (± S.E) in relation to seasons, lizard weight, length, and sex.

		Mean intensity (± S.E)						Mean abundance (± S.E)					
		P. mami-llatus	C. *Vrcib-radici*	*S. pete-rsi*	*T. schu-steri*	*P. bulb-osus*	Total	*P. mam-illatus*	*C. vrc-ibradici*	*S. pete-rsi*	*T. schu-steri*	*P. bulb-osus*	Total
Sea-son	Summer	3.60± 0.47	6.6± 2.46	3.33± 0.85	1.75± 0.48	1.67± 0.67	9.29± 2.09	1.59± 0.37	0.97± 0.52	0.88± 0.33	0.21± 0.11	0.15± 0.09	4.65± 1.31
	Winter	3.64± 1.04	11.21± 2.28	3.75± 0.86	4± 1.29	3± 0.41	18.11± 4.52	1.18± 0.44	4.62± 1.33	0.88± 0.34	0.47±0 .26	0.35± 0.17	9.59± 2.84
Wei-ght	Class 1	9.50± 2.04	13.75± 3.33	3.25± 0.59	3.60± 1.077	2.80± 0.490	18.81± 4.729	1.18± 0.34	3.24± 1.26	0.71± 0.27	0.50± 0.27	0.32± 0.17	8.32± 2.72
	Class 2	4.92± 1.288	7.27± 1.722	3.78± 1.01	1.67± 0.667	1.67± 0.333	9.63± 2.438	1.59± 0.47	2.35± 0.8	1.06± 0.39	0.18± 0.09	0.18± 0.11	5.91± 1.61
Len-gth	Class 1	9.79± 1.97	12.70± 2.67	2.88± 0.55	3.40± 1.17	2.50± 0.5	17.72± 4.21	1.65± 0.48	3.44± 1.24	0.68± 0.25	0.50± 0.26	0.44± 0.19	9.09± 2.70
	Class 2	4.58± 1.32	7± 2.19	4.11± 0.99	2± 0.58	2± 0.001	9.71± 2.80	1.15± 0.33	1.91± 0.79	1.12± 0.42	0.18± 0.11	0.06± 0.06	5.00± 1.66
Sex	Males	7.08± 1.38	11.67± 3.34	3.7±0 .95	2.20± 0.80	2.67± 0.88	14.88±3. 88	1.69± 0.49	2.92± 1.17	1.03± 0.38	0.31± 0.16	0.22±0 .13	7.03± 2.19
	Females	7.69± 2.27	8.50± 1.79	3.29± 0.52	4± 1.53	2.20± 0.37	12.83± 3.62	1.03± 0.26	2.66± 0.89	0.72± 0.27	0.38± 0.24	0.28± 0.14	7.22± 2.31

Explanations of Figures

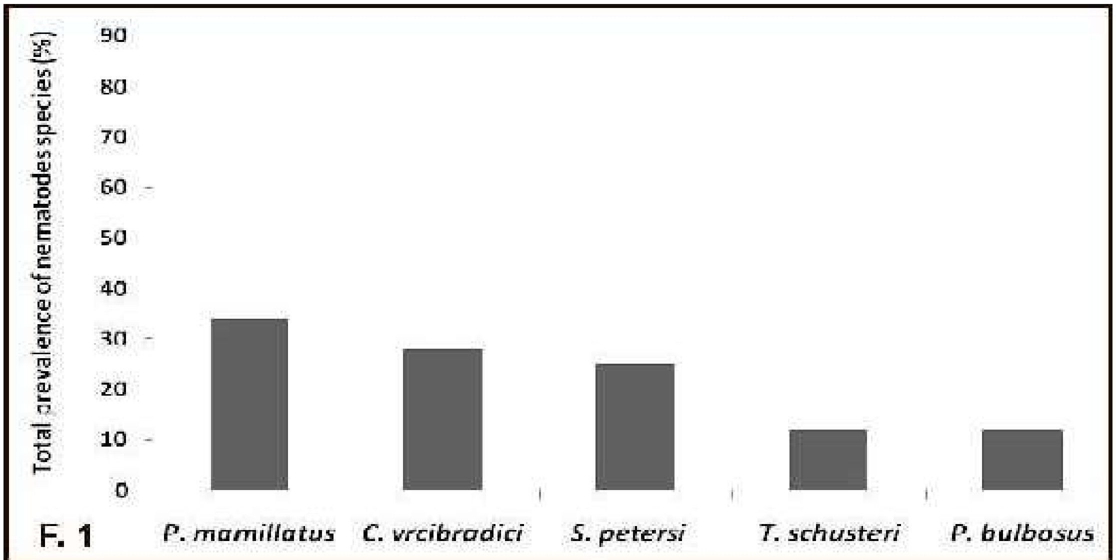
Fig. 1: Total prevalence of nematodes species.

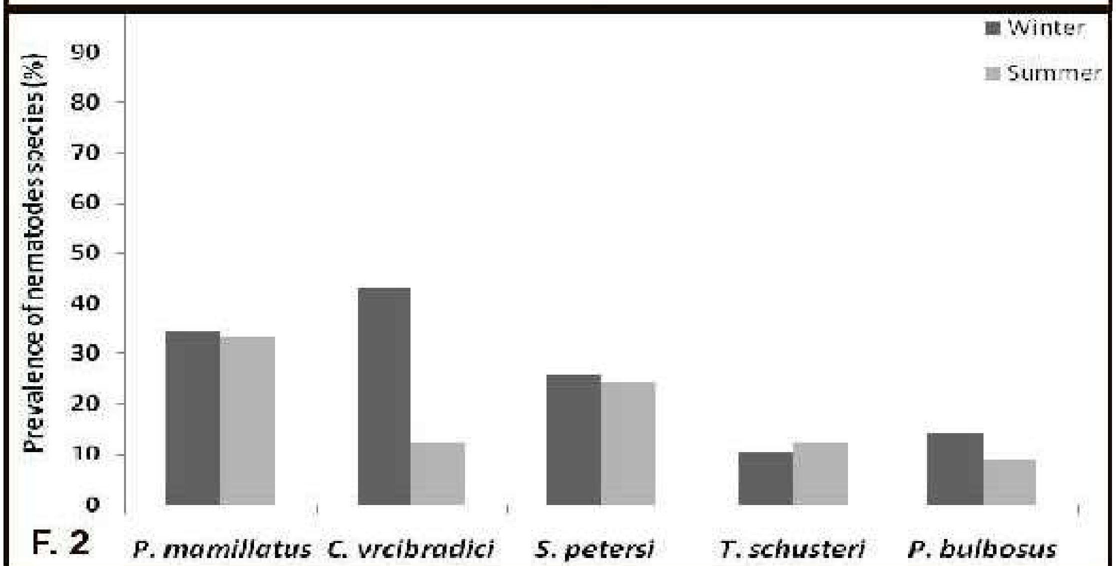
Fig. 2: Prevalence of nematodes species in winter and summer.

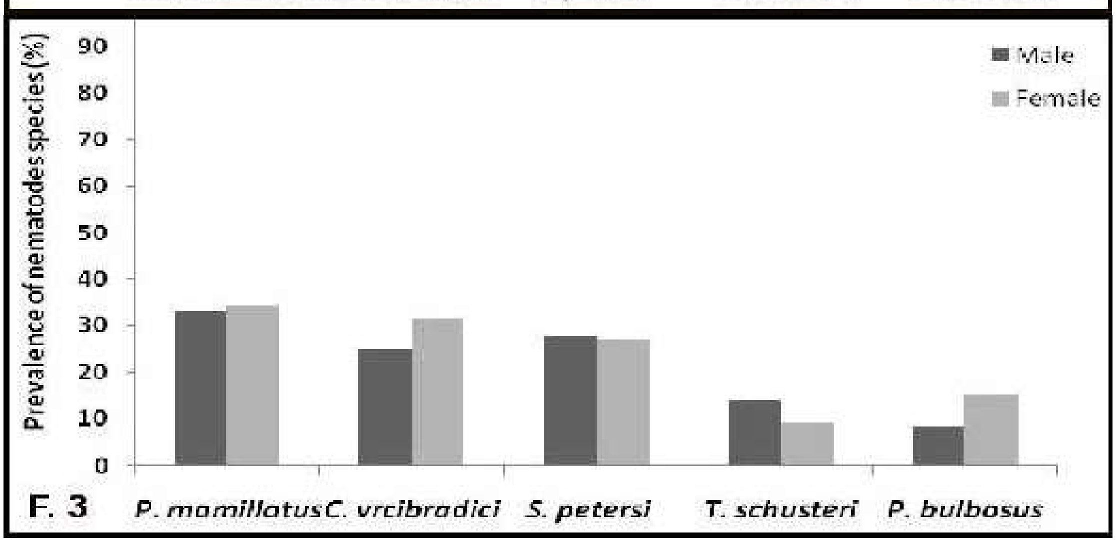
Fig. 3: Prevalence of nematodes species in males and females.

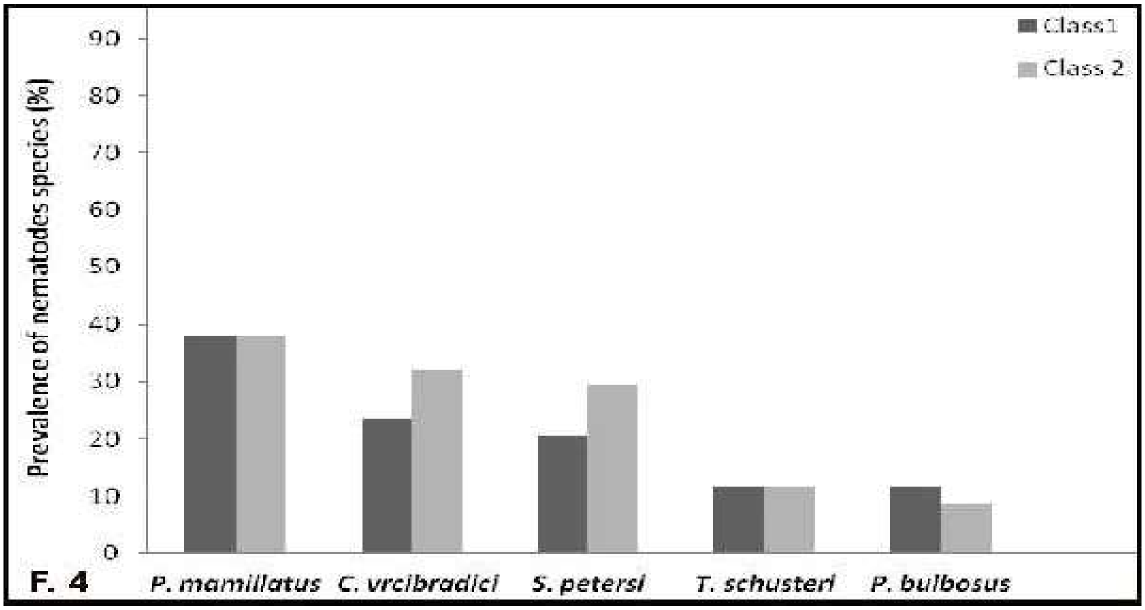
Fig. 4: Prevalence of nematodes species in different weight classes.

Fig. 5: Prevalence of nematodes species in different length classes.

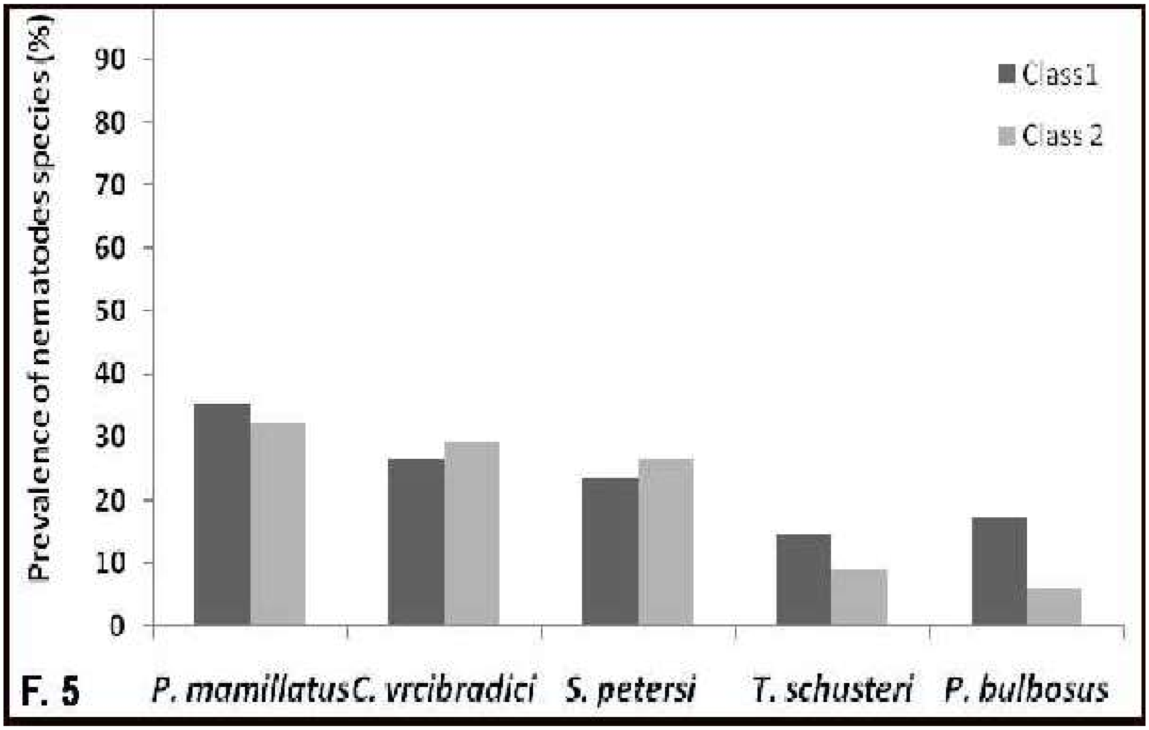

Total prevalence of nematodes species (%)
0
10
20
30
40
50
60
70
80
90
P. mamillatus
C. vrcibradici
S. petersi
T. schusteri
P. bulbosus
F. 1


Winter
Summer
Prevalence of nematodes species (%)
0
10
20
30
40
50
60
70
80
90
P. mamillatus
C. vrcibradici
S. petersi
T. schusteri
P. bulbosus
F. 2


Male
Female
Prevalence of nematodes species (%)
0
10
20
30
40
50
60
70
80
90
P. mamillatus
C. vrcibradici
S. petersi
T. schusteri
P. bulbosus
F. 3


Class1
Class 2
Prevalence of nematodes species (%)
90
80
70
60
50
40
30
20
10
0
P. mamillatus
C. vrcibradici
S. petersi
T. schusteri
P. bulbosus

F. 4


Class1
Class 2
Prevalence of nematodes species (%)
90
80
70
60
50
40
30
20
10
0
P. mamillatus
C. vrcibradici
S. petersi
T. schusteri
P. bulbosus

F. 5