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Parasites of some bonyfish species from the Boojagh wetland in the southwest shores of the Caspian Sea

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ABSTRACT
The Boojagh international wetland with a surface area of 80 hectares and 25 fish species is located in the southwest shores of the Caspian Sea (Guilan province, Iran), but there is no report about fish parasites in this wetland. In the present study, a total of 553 individuals of 8 fish species including *Cyprinus carpio* (n=71), *Abramis bjoerkna* (n=153), *Carassius auratus gibelio* (n=89), *Esox lucius* (n=39), *Rutilus rutilus caspius* (n=36), *Rutilus frisii kutum* (n=81), *Scardinius erythrophthalmus* (n=119) and *Tinca tinca* (n=4), were collected in October 2001 through November 2003. Eight parasite species were identified in the fishes consisting of 1 nematode: *Raphidascaris acus* (in *E. lucius* and *S. erythrophthalmus*); 1 cestode: *Caryophyllaeus fimbriceps* (in *R. rutilus caspius* and *C. carpio*); 2 digenean trematodes: *Asymphylodora tincae* (in *T. tinca*) and *Diplostomum spathaceum* (in all of the fish species except for *T. tinca* and *S. erythrophthalmus*); 2 monogenean trematodes: *Tetraonchus monenteron* (in *E. lucius*) and *Dactylogyrus* sp. (in *C. carpio*, *A. bjoerkna* and *C. auratus gibelio*); 1 crustacean: *Lernaea cyprinacea* (in *A. bjoerkna, T. tinca* and *R. rutilus caspius*) and 1 leech : *Piscicola* sp. (in *R. rutilus caspius* and *C. carpio*). The occurrence of *R. acus* in *S. erythrophthalmus* and also that of *C. fimbriceps* in *R. rutilus caspius* are reported for the first time as new host records.

Keywords: *Bonyfish, parasite, Caspian Sea, Boojagh wetland.*

INTRODUCTION
The Boojagh international wetland (37º 27´ N, 49º 55´ E) with a surface area of 80 hectares and home to 25 fish species is located in the southern part of the Caspian Sea (Guilan province, Iran). To date there has been no report on fish parasites in this wetland. Khara *et al* (2005) reported 16 parasite species from 7 bonyfish species of Amirkelayeh wetland (37º 20´ N, 50º 11´ E). In another study, 11 parasite species were recovered from 7 bonyfish species of the Anzali wetland (37º 27´ N, 49º 23´ E) (Sattari *et al*, 2005). There are also other reports on parasites of some bonyfishes in this area (Eslami *et al*, 1972; Eslami & Mokhayer, 1977; Eslami & Kohneshahri, 1978; Sattari *et al* , 1996; Shamsi *et al* , 1998; Pazooki & Aghlmandi, 1998). The present study attempts to study fish parasites in the Boojagh wetland for which no previous Records exist.

MATERIALS AND METHODS
A total of 553 individuals of 8 fish species including *Cyprinus carpio* (n=71), *Abramis bjoerkna* (n=153), *Carassius auratus gibelio* (n=89), *Esox lucius* (n=39), *Rutilus rutilus caspius* (n=36), *Rutilus frisii kutum* (n=81), *Scardinius erythrophthalmus* (n=119) and *Tinca tinca* (n=4) were examined from September 2001 though October 2003. After recording biometric characteristics (Table 1), standard necropsy and parasitology methods were used for finding parasites (Stoskopf, 1993).

Table 1. The biometric characteristics of the examined bonyfishes in Boojagh wetland.

Characteristics Fish species	Fish numbers	Length (cm) Mean (range)	Weight (g) Mean (range)
E. lucius	39	29(11.2-60.7)	323(51-1500)
T. tinca	4	27(21.5-30.5)	315(160-450)
C. carpio	71	46(29.6-57.2)	1487(468-3508)
S. erythrophthalmus	119	13(8.3-17.8)	35(16.20-78.30)
A. bjoerkna	153	13(8.8-17.9)	35(20.90-70.2)
C. auratus gibelio	89	24(7.5-38.7)	359(56.0-996.1)
R. rutilus caspius	36	26(8.6-35)	288(42.0-600)
R. frisii kutum	81	14(10.7-16.9)	38(21.4-53.1)

The live nematodes were fixed in hot 70% ethyl alcohol and cleared in glycerine alcohol or in hot lactophenol. The other worms were fixed in 10% buffered formalin and stained with acetocarmine. All parasites were identified using parasites identification keys (Yamaguti, 1961; Moravec, 1994) and were then transferred to the laboratory of fish diseases, faculty of Natural Resources, the University of Guilan (Iran). Classical epidemiological variables (prevalence, intensity and abundance) were calculated according to Bush *et al* (1997). The dominance of a parasite species was calculated as N/N sum (where N=abundance of a parasite species and N sum=sum of the abundance of all parasite species found) and expressed as a percentage (modified after Leong & Holmes, 1981). Abundances of parasite species (with prevalences >10%) among seasons, age classes and sexes were tested by the Kruskal-Wallis test (multiple comparisons) and Mann-Whitney U test (pairwise comparisons). Results were considered significant at the 95% ($p<0.05$) level. Computations were performed using the SPSS programme as installed by the University of Guilan Computer Services. Similarity (Jaccard and Sorenson) Index was calculated as proposed in Magurran (1996).

RESULTS

In the present study, 8 parasite species were found in the samples consisting of 1 nematodes: *Raphidascaris acus* (Bloch, 1779) (in *E. lucius* and *S. erythrophthalmus*); 1 cestode: *Caryophyllaeus fimbriceps* (in *R. rutilus caspius* and *C. carpio*); 2 digenean trematodes: *Asymphylodora tincae* (in *T. tinca*) and *Diplostomum spathaceum* (in all of the fish species except for *T. tinca* and *S. erythrophthalmus*); 2 monogenean trematodes: *Tetraonchus monenteron* (in *E. lucius*) and *Dactylogyrus* sp. (in *C. carpio*, *A. bjoerkna* and *C. auratus gibelio*); 1 crustacean: *Lernaea cyprinacea* (in *A. bjoerkna, T. tinca* and *R. rutilus caspius*) and 1 leech: *Piscicola sp.* (in *R. rutilus caspius* and *C. carpio*). The occurrence of *R. acus* in *S. erythrophthalmus* and also *C. fimbriceps* in *R. rutilus caspius* was reported for the first time (new host records, indicated by asterisks in the Tables).

The prevalence (%) , mean intensity of infection, range, dominance and abundance of the parasites are presented in Tables 2-7. As shown in Table 2, a total of 130 parasites of 3 species were found in pikes. Of these, *T. monenteron* had the highest prevalence (35.9%), while the mean intensity, dominance and abundance of *R. acus* (11, 50.8 , and 1.7 respectively) were higher than those of the other parasites. 51.3% of the fish were devoid of parasite, 38.5% were infected with 1 parasite species and 10.3% with 2 parasite species. Fish harboring fewer than 10 worms made up 38.5%; 7.7% had 10 to 20 worms and 2.6% had more than 20 worms. It was found that the abundance of *R. acus* in old fish (age class of +4 years old) was significantly higher than younger ones (KW, $\chi^2 = 14.806$, df = 3, $p<0.05$). It was also found that the abundance of *R. acus* in winter was significantly higher than in the other seasons (KW, $\chi^2 = 27.445$, df = 3, $p<0.05$), while *D. spathaceum* had significantly higher abundance in autumn than in the other seasons (KW, $\chi^2 = 6.597$, df = 3, $p<0.05$).

Table 2. The prevalence, mean intensity of infection, range, dominance and abundance of parasites in pikes (N = 39).

Characteristic Fish	Prevalence (%)	Mean±SD	Range	Domonance (%)	Abundance ±SD
R.acus N = 66	15.4	11 ± 11.2	1-30	80.8	1.7 ± 5.7
T. monenteron N = 4	7.6	1.3 ± 0.6	1-2	3.1	0.1 ± 0.4
D. spathaceum N = 60	35.8	4.3 ± 3.3	1-15	46.2	1.7 ± 5.7

According to Table 3, a total of 406 parasites belonging to 4 species were found in north Caspian roaches, *R. rutilus caspius*. The prevalence, mean intensity, abundance and dominance of *D. spathaceum* were higher than those of the other parasites. 19.4% of the fish were devoid of parasites, 75% were infected with 1 parasite species and 5.6% with 2 species. Fish harboring fewer than 10 worms made up 33.3%, 33.3% had 10 to 20 worms and 11.1% harbored more than 20 parasites.

Table 3. The prevalence, mean intensity of infection, range and abundance of parasites in *R. rutilus caspius* (N = 36).

CharacteristicParasite	Prevalence (%)	Mean±SD	Range	Abundance ±SD	Dominance (%)
D. spathaceum (N = 398)	75	14.7 ± 14.2	1-73	11.1 ± 13.8	98
*C. fimbriceps** (N = 5)	2.78	5	5	0.1 ± 0.8	1.2
L. cyprinacea (N = 1)	2.78	1	1	0.03 ± 0.2	0.2
Piscicola sp. (N = 2)	2.78	2	2	0.1 ± 0.3	0.5

As shown in Table 4, a total of 78 parasites of 2 species were recovered from gibel carps, *C. auratus gibelio*. The prevalence, abundance and dominance of *D. spathaceum* were higher than those of *Dactylogyrus* sp. 61.8% of the fish were devoid of parasite, 32.6% were infected with 1 parasite species and 5.6% with 2 species. All the fish harbored fewer than 10 worms.

Table 4. The prevalence , mean intensity of infection, range and abundance of parasites in *C. auratus gibelio* of Boojagh wetland (N = 89)

Characteristic parasite	Prevalence (%)	Mean ± SD	Range	Abundance ± SD	Dominance (%)
Dactylogyrus sp. N = 38	18.0	2.2 ±1.6	1-4	3.0 ± 5.8	48.7
D. spathaceum N = 40	24.7	1.8 ± 1.1	1-73	11.1 ± 13.8	51.3

According to Table 5, a total of 1538 parasites of 4 species were recovered from common carps, *C. carpio*. The prevalence and abundance of *Dactylogyrus* sp. Were higher than those of the other parasites, but *C. fimbriceps* had higher mean intensity and also higher dominance than the others. 12.7% of the fish were devoid of parasites, 33.8% were infected with 1 parasite species, 26.8% with 2 species, 21.1% with 3 species and 5.6% with 4 species. Fish harboring fewer than 10 worms made up 52.1%; 14.1% had 10 to 20 worms, 7.0% harbored 20 to 30 worms and 14.1% had more than 30 worms. It was found that the abundance of *D. spathaceum* in autumn was significantly higher than in the other seasons (KW, χ^2 = 3.503, df = 3, $p<0.05$). It was also found that the abundance of *D. spathaceum* in males was significantly higher than in females (Mann-whitney U test, χ^2 = 4.627, df = 1, $p<0.05$).

Table 5. The prevalence, mean intensity of infection, range and abundance of parasites in *C. carpio* from Boojagh wetland (N = 71)

Characteristic parasite	Prevalence (%)	Mean±SD	Range	Abundance ±SD	Dominance (%)
C. fimbericeps N = 1099	46.5	30.3 ± 46.3	1-263	0.1 ± 0.8	71.5
Pisicola sp. N = 162	45.1	5.1 ± 4.1	1.21	2.3 ± 3.8	10.5
Dactylogyrus sp. N = 211	49.3	6.0 ± 7.0	1-28	3.0 ± 5.8	13.7
D. spathaceum N = 66	36.6	2.5 ± 1.6	1-7	0.9 ± 1.6	4.3

As shown in Table 6, 3 parasite species (n= 841) were recovered from white breams, *A. bjoerkna*. The prevalence of *D. spathaceum* (75.8%) was higher than that of the other parasites. 20.9% of the fish had no parasites, 57.5% were infected with 1 parasite species, 23.5% with 2 species and 6.5% with 3 species. Fish harboring fewer than 10 worms made up 60.1%; 12.4% had 10 to 20 worms and 3.9% harbored more than 20 worms. It was found that the abundance of *D. spathaceum* in autumn was significantly higher than in the other seasons (KW, χ^2 = 30.909, df = 3, p<0.05), while *Dactylogyrus* sp. And *L. cyprinacea* had significantly higher abundance in summer than in the other seasons (KW, χ^2 = 29.542, df = 3, p<0.05 and χ^2 = 29.542, df = 3, p<0.05 respectively).

Table 6. The prevalence, mean intensity of infection, range and abundance of some parasites in *A. bjoerkna* (N = 153)

Characteristic parasite	Prevalence (%)	Mean ± SD	Range	Abundance ±SD	Dominance (%)
L. cyprinacea (N = 46)	21.6	1.4 ± 0.7	1-4	0.3 ± 0.7	8
Dactylogyrus sp. (N = 55)	17.7	2.0 ± 1.1	1-4	0.4 ± 0.9	7
D. spathaceum (N = 740)	75.8	6.4 ± 7.7	1-45	4.9 ± 7.3	85

According to Table 7, a total of 100 parasites belonging to 2 species were recovered from rudds, *S. erythrophthalmus*. The prevalence, mean intensity, abundance and dominance of *Dactylogyrus* sp. Were higher than those of *R. acus* (L.). 64.7% of the fish were devoid of parasite, 26.1% were infected with 1 parasite species and 9.2% with 2 species. All the fish harbored fewer than 10 worms. It was found that the abundance of *R. acus* (L.) in summer was significantly higher than in the other seasons (KW, χ^2 = 8.274, df = 3, p<0.05).

In the present study, 81 individuals of kutum, *R. frisii kutum* were examined and a total of 281 parasites of 1 species (*D. spathaceum*) were found in the fish. The prevalence, mean intensity ± standard deviation and abundance ± standard deviation of the parasite were 77.8%, 4.5 ± 3.1 and 3.5 ±3.3 respectively. Furthermore, 4 individuals of *T. tinca* were examined and a total of 21 parasites of 2 species were recovered consisting of *Asymphylodora tincae* (Prevalence = 25%, mean intensity = 20) and *L. cyprinacea* (prevalence = 25%, mean intensity = 1).

Table 7. The prevalence, mean intensity of infection, range and abundance of parasites in *S. erythrophthalmus* (N = 119)

Characteristic parasite	Prevalence (%)	Mean ±SD	Range	Abundance ±SD	Dominance (%)
R. acus (L.)* N = 45	20.2	1.8 ± 0.8	1-4	0.4 ± 0.8	45
Dactylogyrus sp. N = 55	24.4	1.9 ± 1.2	1-6	0.5 ± 1.0	55

DISCUSSION

The parasites of bonyfishes in the Caspian Sea and its basin have been reported by several authors, but little is known about parasite fauna of the fishes in Boojagh wetland. In view of the paucity of information, a study on parasites of fishes was conducted from Boojagh wetland, the results of which are reported here.

In a study on the parasites of 8 fish species in Anzali wetland (n = 430) (Sattari *et al,* 2005), 11 parasite species were recovered consisting of 3 nematodes: *Raphidascaris acus, Eustrongylides excisus* (L.) and *Anisakis* sp. (L.)*;* 2 cestodes: *Caryophyllaeus laticeps* and *C. fimbriceps*; 2 digenean trematodes: *Rhipidocotyle illense* and *Diplostomum spathaceum*; and 4 monogenean trematodes: *Tetraonchus monenteron, Dactylogyrus extensus, Gyrodactylus* sp. And *Diplozoon* sp. In another study, Khara *et al* (2005), 16 parasite species were recovered from 7 fish species (n=676) of Amirkelayeh wetland consisting of 4 nematodes: *Raphidascaris acus, Eustrongylides excisus* (L.), *Camallanus lacustris* and *Raphidascaroides* sp.; 3 Cestodes: *Triaenophorus crassus*, *Caryophyllaeus fimbriceps* and *C. laticeps*; 4 digenean trematodes: *Asymphylodora tincae*, *Aphanurus stossichi* and *Diplostomum spathaceum*; 3 monogenean trematodes: *Tetraonchus monenteron*, *Gyrodactylus* sp. And *Dactylogyrus* sp.; 1 Crustacean: *Lernaea cyprinacea*; 1 leech: *Piscicola* sp.; 1 protozoan: *Trichodina* sp. In the present study, 8 parasite species were found in 8 fish species (n = 553). Of these, 7 species are similar to those found in the Anzali wetland (Jaccard index = 35%, Sorenson index = 51.9%) and 8 species with Amirkelayeh wetland (Jaccard index = 50%, Sorenson index = 66.7%). The occurrence of the parasites *Camallanus lacustris*, *A. stoccichi* and *Raphidascaroides* sp., in Amirkelayeh wetland fish species was noteworthy. These parasites were not found in the Anzali and Boojagh wetlands.

It is reported that numerous species of piscivorous fishes belonging to various families are the hosts of adult *R.acus*, but the principal definitive host of *R.acus* is pike (*E. lucius*) (type host) and frequently also brown trout (*Salmo trutta* m. *fario*). The larvae of *R.acus* occur in a number of fish species of various families, serving either as intermediate or paratenic hosts (Moravec, 1994). *R. acus* has been previously reported from *E. lucius* and *S. glanis* in the southern part of the Caspian Sea (Sattari, 1996). The occurrence of its larvae have also been reported in *T. tinca*, *C. auratus gibelio* and *A. brama orientalis* (Sattari, 1996). Similarly, in the present study, the adult gravid nematodes were found in *E. lucius*, while its larvae were found in *S. erythrophthalmus.* Its prevalence in *E. lucius* was higher than that of its larvae in *S. erythrophthalmus* .

The monozoic tapeworm *Caryophyllaeus laticeps* (Pallas, 1781) Rudolphi, 1802 is a common parasite of cyprinids (Karanis & Taraschewiski, 1993). According to Amlacher (1992), bream, *Abramis brama* (L.), and white bream (*Blicca bjoerkna*) are the major hosts of *C. laticeps,* while the congeneric species *C. fimbriceps* is mainly found in carp, *C. carpio.* In the southern part of the Caspian Sea*, C. laticeps* has been reported from *C. carpio*, while *C. fimbriceps* has been found in *C. carpio* and *A. brama orientalis* (Sattari, 1996). In the present study, however, *C. fimbriceps* was found in *R. rutilus caspius* and *C. carpio*. The prevalence and abundance of *C. fimbriceps* in *C. carpio* were higher than that in *R. rutilus caspius*.

The occurrence of *D. spathaceum* metacercariae**,** a digenean trematode**,** has been reported in several fish species in the southern part of the Caspian Sea including *T. tinca, C.auratus gibelio, C. carpio, A. brama orientalis, E. lucius, P. fluviatilis, S. glanis* and *Hypophthalmichthys molitrix* (Sattari, 1996). In the present study, this parasite was found in the eyes of 6 fish species. Its prevalence in *R. frisii kutum* was higher than in *A. bjoerkna, R. rutilus caspius, E. lucius, C. carpio* and *C. auratus gibelio,* respectively.

In the present study, the monogenean trematode, *T. monenteron* was only recovered from *E. lucius*, but *Dactylogyrus* sp. Was found on the gills of 4 fish species. The prevalence of *Dactylogyrus* sp. On *C. carpio* was higher than on *S. erythrophthalmus, C. auratus gibelio* and *A. bjoerkna* respectively. Furthermore, *L. cyprinacea* was only found on the skin of 2 fish species (*A. bjoerkna* and *R. rutilus caspius*). Its prevalence on *A. bjoerkna* was higher than on *R. rutilus caspius*. The leech (*Piscicola* sp.) was also found on the skin of 2 fish species (*C. carpio* and *R. rutilus*

caspius). Its prevalence in *C. carpio* was higher than in *R. rutilus caspius*.

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انگلهای بعضی از ماهیان استخوانی تالاب بوجاق در جنوب غربی دریای خزر

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چکیده:

تالاب بوجاق با مساحت ۸۰ هکتار و داشتن ۲۵ گونه ماهی در جنوب دریای خزر (استان گیلان، ایران) واقع شده است، اما هیچ گونه اطلاعاتی در ارتباط با انگلهای ماهی در این بالاب وجود ندارد. در مطالعه حاضر، در مجموع ۵۵۳ نمونه ماهی از ۸ گونه مختلف شامل کپور (۷۱ عدد) ، سیم پرک (۱۵۳ عدد) ، کاراس (۸۹عدد)، اردک ماهی (۳۹ عدد)، کلمه (۳٦ عدد)، ماهی سفید (۸۱ عدد)، سرخ باله (۱۱۹ عدد) و لای ماهی (٤ عدد) از مهر ماه ۱۳۸۰ تا آبان ماه ۱۳۸۲ نمونه برداری شد. در مطالعه حاضر ۸ انگل در این ماهیان یافت شد که شامل یک نماتود به نام رافید آسکاریس آکوس (در اردک ماهی و سرخ باله)؛ یک سستود به نام کاریوفیله اوس فیمبریسپس (در کلمه و کپور)؛ دو ترماتود به نام آسیمفیلودورا تینکه (در لای ماهی) و دیپلوستوموم اسپاتاسه اوم (در همه گونه ها به استثنای لای ماهی و سرخ باله)؛ دو ترماتود مونوژن به نام تتراونکوس مونترون (در اردک ماهی) و گونه داکتیلوژیروس (در کپور ، سیم پرک و کاراس)؛ یک سخت پوست به نام لرنه آ سیپریناسه آ (در سیم پرک ، لای ماهی و کلمه)؛ و یک زالو به نام پیسی کولا (در کلمه و کپور) جدا شدند. وقوع رافید آسکاریس آکوس در سرخ باله و همچنین ، وجود کاریوفیله اوس فیمبریسپس در کلمه برای اولین بار به عنوان ثبت میزبان جدیدی گزارش می شود.