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[Research]

Parasitic worms of *Acipenser stellatus, A. gueldenstaedtii, A. nudiventris* and *Huso huso* (Chondrostei: Acipenseridae) from the southwest shores of the Caspian Sea

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ABSTRACT

Sturgeons are the most important fish in the Caspian Sea, but there are only a few reports on their parasite communities in the southern part of this sea. In this study, a total of 93 individuals of four sturgeon species, namely *Acipenser stellatus* (n= 60), *A.gueldenstaedtii* (n = 12), *A. nudiventris* (n = 9) and *Huso huso* (n = 12), were caught in 2 geographical regions from the southwest of the Caspian Sea (Guilan Province, Iran) from March 2010 thtough May 2011. After recording biometric characteristics, standard necropsy and parasitological methods were used to identify parasites. Standard statistical computation (mean intensity, standard deviation, range, prevalence, abundance and dominance) were carried out for the overall samples and for samples grouped by season, geographical location, sex, length and weight. The differences between groups were determined by Kruskal Wallis test and Man Whitney U test ($p< 0.05$).
Five worm species including 2 nematodes [*Cucullanus sphaerocephalus* and *Eustrongylides excisus* (L.)], 1 cestode (*Bothrimonus fallax*), 1 acanthocephalans (*Leptorhynchoides plagicephalus*) and 1 digenean trematode (*Skrjabinopsolus semiarmatus*) were found in *A.stellatus, A. gueldenstaedtii, A. nudiventris* and *H. huso.*

Keywords: *Fish, sturgeon, parasite, Caspian Sea.*

INTRODUCTION

Sturgeons (Chondrostei: Acipenseridae) are evolutionary relicts with a wide distribution in the northern hemisphere. Their status as basal actinopterygian fish, their unique benthic specializations, and variation in their basic diadromous life history make sturgeons interesting biological and biogeographical subjects. Extensive studies on Eurasian sturgeons indicate that they are also unique among fish in possessing a markedly diverse assemblage of host–specific parasites.

The parasites of sturgeons have been studied by several authors (Dogiel and Bykhovskiy, 1939; Dubinin, 1952; Shulmann, 1954; Nechaeva, 1964; Skryabina, 1974). However, there are only a few reports on their parasites in the southern part of the Caspian Sea. Mokhayer (1972) studied the parasites of 3 sturgeon species, namely *A. stellatus* (n = 72), *A. gueldenstaedtii* (n = 95) and *H. huso* (n = 4), and reported 17 parasite species (*Trichodina reticulata, Polypodium hydriforme, Skrjabinopsolus skrjabini, S. acipenseris, Amphilina foliacea, Bothrimonus fallax, Eubothrium acipenserinum, Ascarophis ovotrichuria, Cyclozone acipenserina, Cucullanus sphaerocephalus, Contracaecum squalii, Anisakis schupakowi, Eustrongylides excisus* (L.)*, Leptorhynchoides plagicephalus, Pomphorhynchus laevis, Corynosoma caspicum* and *Pseudotracheliastes stellatus*). Gorogi (1996a) studied the parasites of *A. persicus* (n = 604) and reported 3 parasite species (*C. sphaerocephalus, S. semiarmatus* and *L. plagicephalus*) in this species. In another study, Gorogi (1996b) reported 5 parasite species from *H. huso* (*C. sphaerocephalus, Anisakis schupakovi, S. semiarmatus, Corynosoma strumosum* and *E. acipenserinum*). There are also other reports about sturgeon parasites in this area (Sattari, 2002; Sattari & Mokhayer, 2006). Therefore, in the present study, attempts were made to determine the parasite fauna of four sturgeon species in the southwest of the Caspian Sea and the status of their parasite communities (prevalence, mean intensity of infection, abundance and dominance).

Materials and Methods

A total of 93 individuals of four sturgeon species, namely stellate sturgeon, *Acipenser stellatus* Pallas,1771 (n=60), Russian sturgeon, *A. gueldenstaedtii* Brandt, 1833 (n = 12), Ship sturgeon *Acipenser nudiventris* Lovetsky, 1828 (n = 9) and great sturgeon, *Huso huso* Linnaeus, 1758 (n=12) were collected from March 2010 through May 2011. The samples included sturgeons caught in fisheries regions 1 (location 1) and 2 (location 2) along a shore line of more than 200 km long (Figure 1). The stellate sturgeons (60 fish) averaged 8.725kg (±2.735kg, range=4.000-15.000kg) in weight and 129.57cm (±18.11cm, range=83-170cm) in fork length. The Russian sturgeons (12 fish) averaged 19.417kg (±6.007kg, range=12.000-32.000kg) in weight and 135.33cm (±15.20cm, range=110-155cm) in fork length. The Ship sturgeons (9 fish) averaged 28.444kg (±11.304kg, range=11.000-41.000kg) in weight and 156.78cm (±29.28cm, range=112-190cm) in fork length. The Great sturgeons (12 fish) averaged 119.500kg (±71.008kg, range=22.000-271.000kg) in weight and 207.5cm (±41.097cm, range=144-274cm) in fork length.

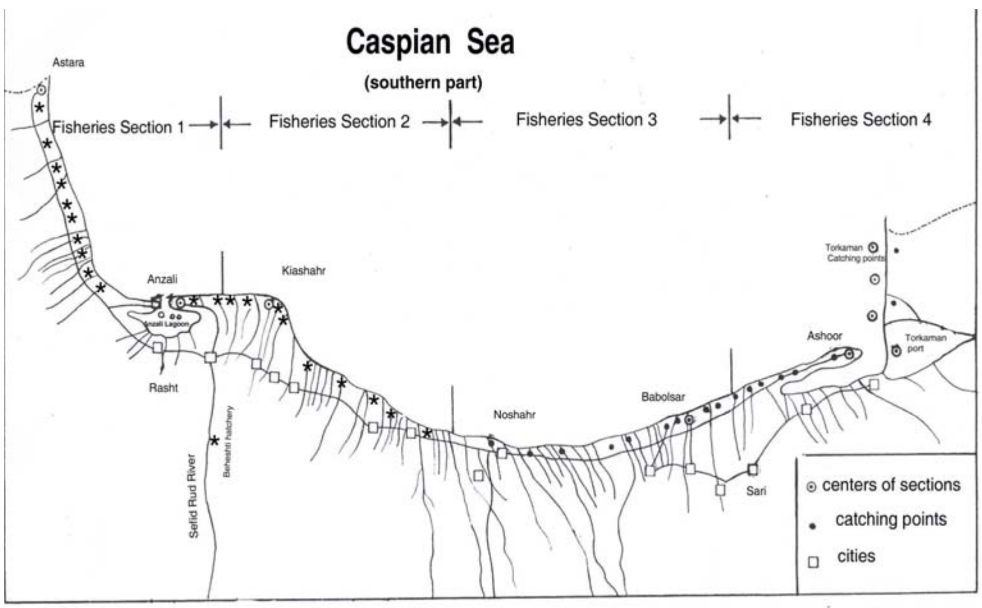

Fig. 1. Fisheries sections and catching points in southern part of Caspian Sea (sampling points indicated by asterisks.

As the sampling in this study was restricted by the governmental fishing program (induced spawning of brood stocks and then exporting their meat), aging of the sturgeons (by removing the pectoral fin ray) was impossible. After recording biometric characteristics, common necropsy and parasitological methods (Stoskopf, 1993) were used. Live trematodes and acanthocephalans were relaxed in distilled water at 4 ºC for 1 h and fixed in 10% hot buffered formalin. Live nematodes were fixed in hot 70% ethanol and cleared in hot lactophenol. Frozen specimens were thawed in water, and then fixed with 10% formalin (trematodes and acanthocephalans) or 70% ethanol (nematodes). All specimens fixed in 10% formalin were stained with aqueous acetocarmine, dehydrated and mounted in Permount. The worms were identified using parasite identification keys (Yamaguti, 1961; Bykhovskaya- Pavlovskaya *et al* , 1962 ; Moravec, 1994) and then were deposited at the Laboratory of Fish Diseases, Faculty of Natural Resources, University of Guilan (Iran).

Statistical analyses

Classical epidemiological variables (prevalence, intensity and abundance) were calculated according to Bush *et al* (1997).

Mean intensity of infection was determined dividing the total number of recovered parasites by the number of infected fish samples, while calculating abundance was carried out by dividing the total number of recovered parasites by the number of (infected and uninfected) fish samples. Prevalence was also calculated by dividing the number of infected fish samples by the total number of examined ones and expressed as a percentage. 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). Mean intensity of infection and abundance of parasite species (with prevalences >10%) among seasons, age classes and sexes were tested by the Kruskal-Wallis test (KW, multiple comparisons) and Mann-Whitney U test (MW, pairwise comparisons). The differences between the prevalence of parasite in various groups were determined by Z test. Results were considered significant at the 95% level ($p<0.05$). Computations were performed using the SPSS programme as installed by the University of Guilan Computer Services.

Results

In this study, a total of 762 individuals of five worm species including 2 nematodes [*Cucullanus sphaerocephalus* Rudolphi, 1809 and *Eustrongylides excisus* (L.) Jagerskiold, 1909], 1 cestode (*Bothrimonus fallax* Luhe, 1900), 1 acanthocephalans (*Leptorhynchoides plagicephalus* Westrumb, 1821) and 1 digenean trematode (*Skrjabinopsolus semiarmatus* Molin, 1858) were found in *A. stellatus, A. gueldenstaedtii, A. nudiventris* and *H. huso*. The prevalence, mean intensity, range, abundance and dominance of the parasites are presented in Tables 1, and 7 - 9. As shown in Table 1, a total of 631 worms of five species were found in the samples of *A. stellatus*. According to this Table, *L. plagicephalus* had the highest prevalence (45%), abundance (5.22) and dominance (49.6%), while *S. semiarmatus* had the highest mean intensity of infection (24.45). These two parasites constituted up to 92.23% of parasite communities in *A. stellatus*

Table 1. The prevalence, mean intensity, range, abundance and dominance of some parasites in *A. stellatus*.

parasites	Prevalence (%)	Mean intensity ± SD	Range	Abundance± SD	Dominance (%)
S. semiarmatus N= 269	18.33	24.45± 62.41	1-212	4.48±27.4	42.63
L. plagicephalus N= 313	45	11.59± 17.06	1-71	5.22±12.7	49.6
C. sphaerocephalus N= 22	17.26	2.44 ± 2.30	1-8	0.37±1.22	3.49
B. fallax N= 12	1.66	12± 0	12	0.2±1.55	1.9
E. excisus(L) N= 15	5	5.0± 3.61	1-8	0.25±1.28	2.4

According to Table 2, the prevalence of *C. sphaerocephalus* and *S. semiarmatus* in *A. stellaus* in spring (16.22 and 27.02) was higher than that in winter and autumn respectively, but the differences between seasons were not significant (Z test, $p> 0.05$). The prevalence of *L. plagicephalus* in winter was higher than in spring and autumn respectively, but the differences were not significant (Z test, $p> 0.05$). The mean intensity of infection of these three parasites in spring was higher than that in winter and autumn respectively, but the differences between various seasons were not significant (KW, $\chi^2 = 0.778$, df = 2, p= 0.678 for *C. sphaerocephalus*; KW, $\chi^2 = 0.00$, df = 1, p= 1.00 for *S. semiarmatus;* and KW, $\chi^2 = 1.606$, df = 2, p= 0.448 for *L. plagicephalus*). It was also true for the abundance of these three parasites in various seasons (KW, $\chi^2 = 0.098$, df = 2, p= 0.952 for *C. sphaerocephalus*; KW, $\chi^2 = 5.374$, df = 2, p= 0.068 for *S. semiarmatus;* and KW, $\chi^2 = 1.524$, df = 2, p= 0.467 for *L. plagicephalus*).

Table 2. Prevalence, mean intensity and range of some parasites of *A. stellatus* in various seasons.

Season \ Parasite	*C.sphaerocephalus* Prevalence (%) Mean±SD Range	*S.semiarmatus* Prevalence (%) Mean±SD Range	*L.plagicephalus* Prevalence (%) Mean±SD Range	*E.exisus* Prevalence (%) Mean±SD Range	*B. fallax* Prevalence (%) Mean±SD Range
Spring N=37	16.22 2.8±2.7 (1-8)	27.02 26.4±65.4 (1-212)	45.95 14.29±20.58 (1-71)	2.70 1 8	2.70 12 12
Autumn N=16	12.5 2±1.4 (1-3)	0	37.5 5.5±7.23 (1-20)	0	0
Winter N=7	14.29 1 1	14.29 5 5	57.14 9.25±7.27 (2-19)	28.57 3.5±3.53 (1-6)	0

Table 3. Prevalence, mean intensity and range of some parasites of *A. stellatus* in various locations.

Location \ Parasite	*C.sphaerocephalus* Prevalence (%) Mean±SD Range	*S.semiarmatus* Prevalence (%) Mean±SD Range	*L.plagicephalus* Prevalence (%) Mean±SD Range	*E.excisus* Prevalence (%) Mean±SD Range	*B.fallax* Prevalence (%) Mean±SD Range
Location1 N=27	18.52 3.6±2.61 (1-8)	18.52 8.8±6.1 (2-17)	40.74 10.73±15.25 (1-54)	3.70 8± - 8	3.70 12± - 12
Location2 N=33	12.12 1.00± - 1	18.18 37.5±85.5 (1-212)	48.48 12.19±18.67 (1-71)	6.06 3.5±3.54 1-6	0

As shown in Table 3, prevalence of *C. sphaerocephalus* and *S. semiarmatus* in *A. stellatus* in location 1 was higher than that in location 2, but the prevalence of *L. plagicephalus* in location 2 was higher than that location1. However, the differences of these three parasite species between various locations were not significant (Z test, p> 0.05). The mean intensity of infection of *C. sphaerocephalus* in location 1 was significantly higher than in location 2 (MW, χ^2 = 4.8, df = 1, p< 0.05, but no significant differences were found between these locations regarding *S. semiarmatus* and *L. plagicephalus* (MW, χ^2 = 1.457, df = 1, p= 0.224 for *S. semiarmatus;* and MW, χ^2 = 0.223, df = 1, p= 0.637 for *L. plagicephalus*). Also, no significant differences were found concerning the abundance of these three parasites in various locations (MW, χ^2 = 0.685, df= 1, p= 0.408 for *C. sphaerocephalus*; MW, χ^2 = 0.031, df= 1, p= 0.806 for *S. semiarmatus;* and MW, χ^2 = 0.166, df = 1, p= 0.684 for *L. plagicephalus*).

As shown in Table 4, prevalence of *C. sphaerocephalus* in *A. stellatus* was higher (16.66) in females than in males (12.5), but the prevalence of *S. semiarmatus* and *L. plagicephalus* was higher in males (20.83 and 45.83 respectively) than in females. However, the differences of these three parasite species between males and females were not significant (Z test, p> 0.05). The mean intensity of infection of these three parasites in females was higher than in males, although the differences between males and females were not significant (MW, χ^2 = 0.333, df = 1, p= 0.564 for *C. sphaerocephalus*; MW, χ^2 = 0.009, df = 1, p= 0.926 for *S. semiarmatus;* and MW, χ^2= 4.054, df= 1, p= 0.054 for *L. plagicephalus*). It was also true for the abundance of these three parasites in males and females (MW, χ^2= 0.179, df= 1, p=0.673 for *C. sphaerocephalus*; MW, χ^2 = 0.153, df = 1, p= 0.695 for *S. semiarmatus;* and MW, χ^2= 0.326, df = 1, p= 0.568 for *L. plagicephalus*).

Table 4. Prevalence, mean intensity and range of some parasites of *A. stellatus* in males and females.

Sex \ Parasite	*C.sphaerocephalus* Prevalence (%) Mean±SD Range	*S.semiarmatus* Prevalence (%) Mean±SD Range	*L.plagicephalus* Prevalence (%) Mean±SD Range	*E.excisus* Prevalence (%) Mean±SD Range	*B.fallax* Prevalence (%) Mean±SD Range
Female N=36	16.66 2.8±2.7 (1-8)	16.66 39.3±84.7 (1-212)	44.44 13.8±18.03 (1-71)	5.56 3.5±3.53 (1-6)	0
Male N=24	12.5 1.67±1.15 (1-3)	20.83 6.6±6.35 (1-17)	45.83 8.36±15.8 (1-54)	4.17 8 8	4.17 12 12

Table 5. Prevalence, mean intensity and range of some parasites of *A. stellatus* in various length groups.

Parasite / length groups	*C.sphaerocephalus* Prevalence (%) Mean±SD Range	*S.semiarmatus* Prevalence (%) Mean±SD Range	*L.plagicephalus* Prevalence (%) Mean±SD Range	*E.exisus* Prevalence (%) Mean±SD Range	*B.fallax* Prevalence (%) Mean±SD Range
73-120 cm N=23	8.70 3±0 3	17.39 9.75±6.60 2-17	39.13 10.56±17.13 1-54	8.70 4.5±4.94 1-8	4.35 12±- 12
121-140 N=24	16.67 3.25±3.30 1-8	16.67 3.75±2.06 2-6	45.83 16.09±21.47 2-71	4.17 6±- 6	0
140< N=13	23.08 1±0 1	23.08 71.1±121.5 1-212	46.15 5.86±4.95 1-15	0	0

As shown in Table 5, prevalence of *C. sphaerocephalus, S. semiarmatus* and *L. plagicephalus* in higher length groups of *A. stellatus* were higher than that in lower ones, but the differences between length groups were not significant (Z test, p> 0.05). The mean intensity of infection of these three parasites in higher length groups were also higher than in lower ones, but the differences between length groups were not significant (KW, χ^2 = 6.667, df = 7, p= 0.464 for *C. sphaerocephalus*; KW, χ^2 = 9.119, df = 8, p= 0.332 for *S. semiarmatus;* and KW, χ^2 = 15.750, df = 15, p= 0.399 for *L. plagicephalus*). It was also true for the abundance of these three parasites in various length groups (KW, χ^2 = 18.789, df = 27, p= 0.878 for *C. sphaerocephalus*; KW, χ^2= 25.993, df= 27, p= 0.519 for *S. semiarmatus;* and KW, χ^2 = 20.508, df = 27, p= 0.809 for *L. plagicephalus*).

Table 6. Prevalence, mean intensity and range of some parasites of *A. stellatus* in different weight groups.

Parasite / weight groups	*C.sphaerocephalus* Prevalence (%) Mean±SD Range	*S.semiarmatus* Prevalence (%) Mean±SD Range	*L.plagicephalus* Prevalence (%) Mean±SD Range	*E.exisus* Prevalence (%) Mean±SD Range	*B.fallax* Prevalence (%) Mean±SD Range
4.000-7.999 kg N=23	12 4±3.60 1-8	16 8±6.38 2-17	40 10.7±16.69 1-54	4 8±- 8	4 12±- 12
8.000-10.000k N=24	15.79 1.67±1.15 1-3	15.79 5.33±6.66 1-13	68.42 13.62±20.08 1-71	10.53 3.5±3.54 1-6	0
10.000< N=13	18.75 1.67±1.15 1-3	25 55.25±104.5 2-212	25 7.25±5.32 3-15	0	0

As shown in Table 6, the prevalence of *C. sphaerocephalus* and *S. semiarmatus* in higher weight groups of *A. stellatus* was more than that in lower ones, but the differences between weight groups were not significant (Z test, p> 0.05). The mean intensity of infection of these two parasites in higher weight groups was also more than in lower ones, but the differences between these groups were not significant ((KW, χ^2= 6.667, df= 5, p= 0.247 for *C. sphaerocephalus;* KW, χ^2 = 6.103, df = 5, p=0.296 for *S. semiarmatus*). The prevalence of *L. plagicephalus* in the second group (8.000-10.000 kg) was higher than that in the first group (4.000-7.999kg), but decreased significantly (Z test, p<0.05) in higher weight groups (<10.000 kg). It was also true for the mean intensity of infection of this parasite, but the differences between these groups were not significant (KW, χ^2= 4.769, df= 5, p= 0.782). No significant differences was found concerning the abundance of these three parasites in various weight groups of *A. stellatus* (KW, χ^2 = 12.681, df = 11, p= 0.315 for *C. sphaerocephalus*; KW, χ^2 = 14.596, df = 11, p= 0.202 for *S. semiarmatus;* and KW, χ^2= 13.111, df= 11, p=0.767 for *L. plagicephalus*).

As shown in Table 7, a total of 43 worms of three species were found in the samples of *A. gueldenstaedtii*. According to this Table, *C. sphaerocephalus* had the highest prevalence (50%), mean intensity of infection (6.17) abundance (3.08) and dominance (86.04%). *E. excisus* larvae showed the second highest prevalence (16.66), mean intensity of infection (2.5), abundance (0.41) and dominance (11.63%). These two parasites constituted up to 97.67% of parasite communities in *A. gueldenstaedtii*.

Table 7. Prevalence, mean intensity, range, abundance and dominance of some parasites in *A. gueldenstaedtii*

Parasites	Prevalence (%)	Mean intensity ± SD	Range	Abundance± SD	Dominance (%)
L. plagicephalus N= 37	8.33	1	1	0.08±	2.32
C. sphaerocephalus N= 1	50	6.17 ±4.02	1-12	3.08±	86.04
E. excisus(L) N= 5	16.66	2.5± 2.12	1-4	0.41±	11.63

According to Table 8, a total of 48 worms of four species were found in the samples of *A. nudiventris*. As shown *C. sphaerocephalus* had the highest prevalence (55.5%), abundance (3) and dominance (56.25%). *S. semiarmatus* had the second highest prevalence (22.2), abundance (1.56) and dominance (29.17%). Mean intensity of infection of *S. semiarmatus* (7) was higher than that of *C. sphaerocephalus* (5.4). These two parasites constituted up to 85.42% of parasite communities in *A. nudiventris*.

Table 8. Prevalence, mean intensity, range, abundance and dominance of some parasites in *A. nudiventris*

parasites	Prevalence (%)	Mean intensity ± SD	Range	Abundance± SD	Dominance (%)
S. semiarmatus N= 14	22.2	7± .07	2-12	1.56±	29.17
L. plagicephalus N= 1	11.1	1	1	11.1±	2.08
C. sphaerocephalus N= 27	55.5	5.4 ±5.8	1-15	3±	56.25
E. excisus(L) N= 6	33.3	2± 1	1-8	0.67±	8.82

As shown in Table 9, a total of 40 worms of three species were found in the samples of *H. huso*. According to this Table, *C. sphaerocephalus* had the highest prevalence (41.67%), mean intensity of infection (7) abundance (2.92) and dominance (87.5%). *S. semiarmatus* had the second prevalence (8.33), mean intensity of infection (4), abundance (0.33) and dominance (10%). These two parasites constituted up to 97.5% of parasite communities in *H. huso*.

Table 9. Prevalence, mean intensity, range, abundance and dominance of some parasites in *Huso huso*

parasites	Prevalence (%)	Mean intensity ± SD	Range	Abundance± SD	Dominance (%)
S. semiarmatus N= 4	8.33	4	4	0.33±	10
C. sphaerocephalus N= 35	41.67	7 ± 7.65	1-19	2.92±	87.5
E. excisus(L) N= 1	8.33	1	1	0.08±	2.5

DISCUSSION

There are only a few reports on the parasites of sturgeons in Iran. Mokhayer (1972) studied the parasites of 3 sturgeon species, namely *A. stellatus* (n = 72), *A. gueldenstaedtii* (n = 95) and *H. huso* (n = 4), and reported 17 parasite species. Gorogi (1996a,b) also studied the parasites of 2 sturgeons, namely *A. persicus* (n= 604) and *H. huso* (n = 99), and reported 3 and 5 parasite species from these species, respectively. Sattari & Mokhayer (2006) studied the parasites of 206 individuals of *A. persicus* and reported nine parasite species from this fish. However, in the present study, *Trichodina reticulata, Polypodium hydriforme, Ascarophis ovotrichuria, Cyclozone acipenserina, Contracaecum squalii* and *Pomphorhynchus laevis* were not recovered from the samples.

Skryabina (1974) found that *A. stellatus* is parasitized by more worm species than *A. gueldenstaedtii,* particularly in the Caspian Sea watershed. She also found that in the Azov and Caspian Seas the prevalence of *C. sphaerocephalus* in *A. stellatus* is less than that in the other sturgeon species from the same localities. Similarly, in the present study, it was found that the diversity of helminth fauna in *A. stellatus* was more than in the other sturgeons. It was also found that the prevalence and mean intensity of *C. sphaerocephalus* in *A. stellatus* were less than that in the other sturgeons.

Markov *et al* (1967) found that the most important parasites of *A. stellatus* from the lower course of the Volga River are cestodes and acanthocephalans. They also found that along the coast of Dagestan, the most important species are *E. acipenserinum, B. fallax, L. plagicephalus* and *S. semiarmatus*. Similarly, in the present study, the prevalence and mean intensity of *L. plagicephalus* in *A. stellatus* were more than in the other sturgeons. *B. fallax* was only found in *A. stellatus* but not in the others.

Of all acipenserid species, the Russian sturgeon has the best known parasitic fauna. The complete list of parasites found in *A. gueldenstaedtii* includes 46 species; Of these, parasitic worms are the largest group and at the present time there are records of 36 helminth parasite species.

Skryabina (1974) believes that by considering the composition of species, the parasitic fauna of *A. gueldenstaedtii* is very similar to that of *A. stellatus*, while in this study and also in other studies on the parasites of sturgeons in the southwest of the Caspian Sea (Sattari & Mokhayer, 2006), it was found that the parasitic fauna of *A. gueldenstaedtii* is more similar to that of *A. nudiventris* and *H. huso* than it is to that of *A. stellatus.*

The list of the main parasites that were found in ship sturgeons (*A. nudiventris*) includes 32 parasites. Most of them are parasites specific to acipenserids. Shulman (1954) is of the opinion that adult ship sturgeons are infested primarily in the sea by helminthes such as *S. semiarmatus, E. acipenserinum* and *C. sphaerocephalus.* In juveniles, on the other hand, the predominant parasites are freshwater species such as *Trypanoplasma acipenseri*, *Amphilina foliacea, Hysterothylacium bidentatum, Piscicapillaria tuberculata, Chilodonella cyprini, Trichodina domerguei* and *Argulus foliaceus*. Along the Iranian shore of the Caspian Sea, however, there is a ban on the catch of juvenile sturgeons. Therefore, there is no report on the parasite fauna of juvenile sturgeons in the southern part of the sea, although some investigators have isolated *Anisakis* sp. larvae and *Cystoopsis acipenseris* from dead juvenile sturgeons (A. Hajimoradloo, pers. comm.).

The parasitic fauna of the great sturgeon (*H. huso*) has been thoroughly studied by many authors and 33 parasite species were recorded (Holcik, 1989). With great probability, the individual local populations of the great sturgeon are infested by different aggregations of parasitic worms (Dogiel & Bykhovskii, 1939). These authors stated that there are findings indicating that the stocks inhabiting the northern Caspian region are infested by parasitic worms more typical of freshwater than those parasitizing the stocks in the southern part of the region. Similarly, in the present study and also previous studies (Mokhayer, 1972; Gorogi, 1996b; Sattari & Mokhayer, 2006) the worms more typical of the sea, such as *E. acipenserinum, Anisakis* sp. (L.), *E. excisus* (L.), *C. strumosum* and *C. sphaerocephalus*, were found in the great sturgeon, while no freshwater worms such as *D. armatum, A. foliacea* and *L. plagicephalus* were recovered.

The sample size of the sturgeons in the present study, particularly of *A. nudiventris* and *H. huso* was small (due to decreasing numbers of these species in catch yields). However, with respect to the results published by Gorogi (1996a,b) and Sattari & Mokhayer (2006), it seems that the helminthofauna expected to be found in the sturgeons of the southern part of the Caspian Sea does not exceed 13-15 species.

C. sphaerocephalus and *S. semiarmatus* were the most prevalent worms in the sturgeons and the mean intensity, abundance and dominance of these 2 parasites were also higher than the others. In this study, *E. excisus* larvae were mostly found in more carnivorous sturgeons such as *H. huso*, *A. gueldenstaedtii* and *A. nudiventris*. This is likely because *E. excisus* larvae need some benthophagous fishes (e.g., *Rutilus rutilus caspius* and *Neogobius* spp.) as obligatory second intermediate hosts.

In the present study, *Amphilina foliacea* (a freshwater parasite) was not found in the sturgeons. It was also true for other freshwater worms such as *D. armatum*, which showed low prevalence and low mean intensity in the sturgeons (Sattari & Mokhayer, 2006). This is likely because the spawning migrations of the sturgeons into freshwater have decreased, which may be the result of unfavorable conditions of freshwater ecosystems caused by pollution, dam construction, etc.

According to the results of this study and the results reported by Mokhayer (1972) and Gorogi (1996a,b) and Sattari & Mokhayer (2006), the diversity of parasites of the sturgeons in the southern part of the Caspian Sea is lower than that in the northern part. It should be noted that the maximum depth of the Caspian Sea in the northern part is about 12 m, while that in the southern part it is about 980 m. The salinity of water in the northern part is about 5 ppt (parts per thousand), while in the southern part it is about 13 ppt and may reach 20 ppt in the southeast. In addition, the productivity and carbonate ions in these two parts differ from each other. All of these factors may have some impact on the parasitic communities of sturgeons.

It also seems that the diversity of parasites (including freshwater ones) in the southern part of the sea has decreased since the the first study (Mokhayer, 1972). This may also be related to unfavorable conditions in freshwater ecosystems, such as pollution and dam construction. In these conditions, it is impossible for the sturgeons to migrate into the rivers for spawning.

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انگلهای کرمی ازون برون، چالباش، شیپ و فیل ماهی (کوندروستئی: آسیپنزریده) از سواحل جنوب غربی دریای خزر

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چکیده

ماهیان خاویاری مهمترین گونه های دریای خزر به حساب می آیند، اما گزارش های محدودی درباره جمعیت انگلـی آنها در بخش های جنوبی این دریا وجود دارد. در این مطالعه، ۹۳ نمونه از چهار گونه از ماهیان خاویاری شـامل ازون برون (۶۰ عدد)، چالباش (۱۲ عدد)، شیپ (۹ عدد) و فیل‌ماهی (۱۲ عدد) از دو ناحیه شیلاتی در سواحل جنوب‌غربی دریای خزر (استان گیلان، ایران) از مارس ۲۰۱۰ تا مـه ۲۰۱۱ جمـع‌آوری شـدند. بعـد از ثبـت خـصوصیات زیـست سنجی، روش های معمول کالبد گشایی و انگل شناسی برای یافتن انگلها انجام شد. محاسبات آماری استاندارد شامل میانگین شدت آلودگی، انحراف معیار، محدوده تعداد، شیوع، فراوانی و شاخص غالبیت برای کل نمونه ها و برای گروه ها یی از نمونه ها براساس فصل، ناحیه صید، جنسیت، طول و وزن انجام شد. مقایسه بـین گـروه هـا توسـط آزمـون کروسکال والیس و من ویتنی یو تست صورت گرفت. در این مطالعه، پنج گونه انگـل کرمـی شـامل دو گونـه نمـاتود (کوکولانوس اسفروسفالوس و یواسترونژیلیدس اکسیسوس)، یک سستود (بوتریمونوس فـالاکس)، یـک کـرم خارسـر (لپتورینکوئیدس پلاژی سفالوس) و یک ترماتود دی ژن (اسکریابینوپسولوس سمی آرماتوس) از ماهیـان ازون بـرون، چالباش، شیپ و فیل ماهی یافت شد.