Investigation of parasites of pikes (*Esox lucius* Linnaeus, 1785) from Chamkhale River, Anzali and Amirkelayeh wetlands, Iran

Ali Sadrinejad · Hossein Khara · Majid Gudarzi

Received: 6 March 2014 / Accepted: 3 December 2014 / Published online: 20 December 2014
© Indian Society for Parasitology 2014

Abstract To investigate the health status, the parasite diversity and abundance were studied in three pike populations. For this purpose, totally 90 fish were caught from three natural habitats of pike including Chamkhale River, Anzali and Amirkelayeh wetlands, Iran. After biometry and age determination, fish were dissected and parasites were investigated in intestine, gill and eye. According to results, five parasite species were identified in whole body of pikes including *Eustrongylides exises*, *Raphidascaris acus* and *Triacophorus crassus* in intestine, *Tetraonchus monenteron* in gill and *Diplostomum spathaceum* in eye. The highest values of quantitative indices of parasite population [i.e. incidence percent (86.66 %), mean intensity (60.83 ± 39.92), mean abundance (58.14 ± 34.6) and abundance range (1–232)] were recorded for *T. monenteron* in all three sampling regions. The lowest values of these quantitative indices were found for *D. spathaceum*, *E. exises* and *Tetraonchus crassus* in Anzali wetland, Chamkhale River and Amirkelayeh wetland respectively. In 2, 3 and 4 years old pikes, *T. monenteron* had the highest values of quantitative indices of parasite population. In conclusion, our results showed that Anzali wetland have more parasite pollution compared to other sampling regions. This may be due to the more rapid eutrophication in this wetland compared to Amirkelayeh wetland and Chamkhale River.

Keywords Parasite · Incidence percent · *Esox lucius* Linnaeus · Wetland

Introduction

The aquatic animals are continually in exposure to various natural and anthropogenic agents that threat their survival and health. The pathogens including parasites, bacteria, viruses and fungus are of natural threats for fish populations in the aquatic ecosystems. Among these, parasites are commonplace and fish serve as hosts to a wide range of parasites (May and Anderson 1979; Barber et al. 2000). Study of fish parasites can provide valuable information about host health status and population ecology such as distinguish of distinct populations of the same fish species. Additionally, knowledge on biology and special traits of parasites can help to understand strategies employed by hosts in response to parasite invasions and identify the therapeutic strategies (Poulin 1998; Barber et al. 2000). The pike, *Esox lucius* Linnaeus is one of the valuable freshwater fish in world including Iran due to its marketable, nutritional and sport fishing aspects. This species belong to Protacanthoptergii order and Esocidae family. Pike is a carnivore species and feed on a wide range of food sources, predominantly smaller fish and occasionally on insects and amphibians when their usual food is scarce. Pike prefers usually lentic water or slow water flow sandy beds along with aquatic plants (Raat 1998).

In Iran, pike populations have been distributed in numerous natural freshwater ecosystems such as Chamkhale and Sefidrood rivers and wetlands such as Anzali, Amirkelayeh and Bujagh in the north of Iran, Caspian Sea basin. Pike populations are more vulnerable due to their nutritional habits and situation in food pyramid. Being in

A. Sadrinejad · M. Gudarzi
Young Researchers Club, Roodsar Branch, Islamic Azad University, Roodsar, Iran

H. Khara (✉)
Department of Fishery, Lahijan Branch, Islamic Azad University, P.O. Box 1616, Lahijan, Iran
e-mail: h.khara1974@yahoo.com

the higher levels of food pyramid can causes the more accumulation of parasites in pike. To our knowledge, there is no information about identification and abundance of parasites in pike populations of Iran. To this end, the present study was aimed to identify and to compare the parasites of Pikes from three natural habitats including Chamkhale River, Anzali and Amirkelayeh wetlands.

Materials and methods

Fish sampling was carried out from three aquatic regions including Chamkhale River, Anzali and Amirkelayeh wetlands (in the vicinity of the Caspian Sea), Iran. In this regard, at first the sampling areas were determined by GPS and then Fish were caught by Hoop net. Totally 90 pikes (total weight: 421.2 ± 72.8 g; total length: 37.6 ± 4.7 cm) were caught from these areas during autumn and winter seasons and then transferred to laboratory of Islamic Azad University of Lahijan for further investigations. In laboratory, the standard length and weight of each fish were measured to the nearest millimetre and milligram, respectively and their sex was determined after autopsy and examination of gonads. Also, the age determination was done by taking the scale samples from each pike and Counting the number of annuli (rings) on each scale (Nikolsky 1963) After age determination, Pikes were examined for the presence of external parasites (in gill and eye) and then dissected and studied internally for the presence of internal parasites in the intestine. After observation of parasites, they collected from eye, gill and intestine by a needle and fixed in 10 % formalin. The parasites were stained by carmine-Alum, washed in acid alcohol, dehydrated in an alcohol series, cleared in xylol and mounted in Canada balsam (Malek and Mobedi 2001). After preparation of wet mount, the parasites were examined and photographed under light microscope and stereomicroscope in order to the identification of parasite species. The quantitative indices of parasite populations were calculated according to following formula (Bush et al. 1997):

- (a) Mean intensity = Total number of individuals of a particular parasite/number of infected hosts to same parasite
- (b) Mean abundance = Total number of individuals of a particular parasite/total number of hosts of that examined
- (c) Incidence percent = (Total number infected host/total number of examined host) $\times$ 100
- (d) Abundance range = The minimum and maximum number of a particular parasite observed in infected host

All data were analysed by SPSS software (Version 16). Because of all data were non-parametric, the normality of data was examined by Shapiro–Wilk test. Since all data did not have a normal distribution, the significant differences were investigated by Kurskal–Walis test. Then, the Mann–Whithny test was applied to identify which means were different.

Results

Five age groups including 2, 3, 4, 5 and 6 years old were identified among examined pikes. Also, male and female numbers were 53 and 37 respectively. Five parasite species were identified in whole body of pikes including *Eustrongylides exises*, *Raphidascaris acus* and *Triacophorus crassus* in intestine, *Tetraonchus monenteron* in gill and *Diplostomum spathaceum* in eye (Fig. 1). The highest incidence percent, mean intensity, mean abundance and abundance range were found for *T. monenteron* in all three sampling regions (Table 1). The lowest values of these quantitative indices were recorded for *D. spathaceum*, *E. exises* and *T. crassus* in Anzali wetland, Chamkhale River and Amirkelayeh wetland respectively (Table 1). There was significant differences in mean abundance of *T. monenteron* and *R. acus* of pikes between all examined sampling regions ($P < 0.05$). The mean abundance of *T. Crassus* and *E. Exicus* did not show significant differences between all examined sampling regions ($P > 0.05$). In 2, 3 and 4 years old pikes, *T. monenteron* had the highest values of quantitative indices of parasite population. Also, *R. acus*, *E. exises* and *D. spathaceum* had the lowest values of quantitative indices of parasite population in 2, 3, and 4 years old pikes respectively (Table 2). There was significant differences in mean abundance of *R. acus* of pikes between all age groups ($P < 0.05$). The mean abundance of *T. Crassus*, *T. monenteron* and *E. exises* did not show significant differences between all age groups ($P > 0.05$). In both sex pikes, the highest values of quantitative indices was recorded for *T. monenteron*. In male pikes, *R. acus* and also *E. exises* and *D. spathaceum* had the lowest values of incidence percent and other quantitative indices respectively. In female pikes, the lowest values of quantitative indices was found for *E. exises* and *D. spathaceum*. There was no significant differences in mean abundance of all observed parasites between two sexes ($P > 0.05$).

Discussion

Aquatic animals especially fish are continually exposure to natural and anthropogenic threats in the aquatic environment. In this study, five parasite species were recorded

Raphidascaris acus ***Eustrongylides exilis*** ***Tetraonchus monenteron*** ***Diplostomum spathaceum*** ***Troiaephorus crassus*****Fig. 1** The identified parasite species in intestine, gill and eye of Pike, *Esox Lucius* Linnaeus, 1785

from examined regions i.e. Chamkhale River, Anzali and Amirkelayeh wetlands. Our results showed that the most common parasite of Pikes is *T. monenteron* with 70 % in Chamkhale River, 86.6 % in Anzali wetland and 53.33 % in Amirkelayeh wetland. This parasite is a monogenea

which is cause infection of gill and skin. Infection with the parasite is cause degeneration and hemorrhage in gill and skin. This parasite had been reported from different fish species previously from Iran and other points of world and has been known as a parasite of various freshwater fish

Table 1 The quantitative indices of parasite populations of pikes from Chamkhale River, Anzali and Amirkelayeh wetlands

<i>Diplostomum spathaceum</i>	<i>Tertaonchus monenteron</i>	<i>Triaenophorus crassus</i>	<i>Eustrongylides exises</i>	<i>Raphidascaris acus</i>	Indices	Sampling regions
3.33	86.66	–	–	46.66	Incidence percent	Anzali wetland (n = 30)
1	60.83 ± 39.92	–	–	2.29 ± 1.68	Mean intensity	
0.18 ± 0.03	58.14 ± 34.6	–	–	1.62 ± 1.07	Mean abundance	
1–1	1–232	–	–	1–6	Abundance range	
–	53.33	13.33	–	10	Incidence percent	Amirkelayeh wetland (n = 30)
–	13.94 ± 8.31	2 ± 1.16	–	3 ± 2	Mean intensity	
–	9.32 ± 7.69	0.79 ± 0.28	–	1.07 ± 0.36	Mean abundance	
–	1–31	1–3	–	1–5	Abundance range	
–	70	13.33	3.33	26.6	Incidence percent	Chamkhale River (n = 30)
–	41.25 ± 16	1.25 ± 0.5	1	2.83 ± 2	Mean intensity	
–	34.53 ± 10.84	0.45 ± 0.16	0.18 ± 0.03	1.63 ± 0.52	Mean abundance	
–	1–193	1–2	1–1	1–9	Abundance range	

Table 2 The quantitative indices of parasite populations of pikes with different ages

<i>Diplostomum spathaceum</i>	<i>Tertaonchus monenteron</i>	<i>Triaenophorus crassus</i>	<i>Eustrongylides exises</i>	<i>Raphidascaris acus</i>	Indices	Age
–	33.33	–	–	33.33	Incidence percent	2+ (n = 3)
–	–	–	–	1 ± 1	Mean intensity	
–	1.67 ± 2.89	–	–	0.33 ± 0.5	Mean abundance	
–	5	–	–	1–1	Abundance range	
–	71.87	7.81	1.56	17.18	Incidence percent	3+ (n = 64)
–	11.76 ± 16.68	2 ± 1	1 ± 0	2 ± 1.34	Mean intensity	
–	8.45 ± 15.31	0.16 ± 0.5	0.02 ± 0.125	0.34 ± 0.93	Mean abundance	
–	1–98	1–3	1–1	1–5	Abundance range	
4.54	72.72	13.63	–	59.09	Incidence percent	4+ (n = 23)
1 ± 0	68.67 ± 8.82	1 ± 0	–	2.62 ± 2.6	Mean intensity	
0.12 ± 0.02	73.21 ± 49.05	0.35 ± 0.14	–	1.62 ± 2.39	Mean abundance	
1–1	1–232	1–1	–	1–9	Abundance range	

(Kearn 1966; Arai and Chien 1973; Sutherland and Holloway 1979; Soylu 2009). Other common parasite in this study was *R. acus* is commonplace nematode in several fish hosts. *R. acus* larvae in the liver cause tissue damage and fibrosis. Adult form of this parasite prefers the fish gut for growth and reproduction that this can decrease the fish growth (Smith. 1984; Moravec and Frantova 2003). In this study, some identified parasites including *E. exises*, *T. crassus* and *D. spathaceum* had lower incidence percent. It was recognized that few fish species including Roach, Gobies (Gobiidae), Sturgeons (Acipenseridae) and Pikes (Esocidae) act as secondary intermediate host for *E. exises*. This parasite with destruction of fish muscles decreases its

marketable (Sattari et al. 2003). Usually, The main disease symptoms of *D. spathaceum* is observed in fish eyes including exophthalmia, local haemorrhage, emaciation, deformation of the vertebral column and accumulation of eye flukes and in massive invasions cataracts and blindness (Karvonen et al. 2004; Voutilainen et al. 2008; Ramadan 2012). In our study, the parasite pollution was higher in 4, 5 and 6 years old pikes than in 2 and 3 years old individuals. It seems that aging pike that has larger body size can carry more parasite than younger individual with smaller body size. In our study, the highest parasite pollution was recorded for Anzali wetland compared to Chamkhale River and Amirkelayeh wetland. This probably shows that the

eutrophication trend is more rapid than Chamkhale River and Amirkelayeh wetland. This eutrophication may be due to more entrance of organic and inorganic pollutants of industry and agriculture to Anzali wetland. As well as, the more parasite incidence percent in Anzali wetland may return to more abundance of intermediate hosts in this region compared to Chamkhale River and Amirkelayeh wetland. In conclusion, this study reveals that due to the diversity and abundance of parasites in Pikes, health and environmental management is absolutely necessary to diminish hazardous impacts of parasites in Chamkhale River, Anzali and Amirkelayeh wetlands.

References

- Arai HP, Chien S-M (1973) A note on some Monogenea (Trematoda) from Albertan fishes. *Can J Zool* 51:1318
- Barber I, Hoare D, Krause J (2000) Effects of parasites on fish behaviour: a review and evolutionary perspective. *Rev Fish Biol Fisheries* 10:131–165
- Bush AO, Lafferty KD, Lotz JM, Shostak AW et al (1997) Parasitology meets ecology on its own terms: Margolis et al. revisited. *J Parasitol* 83:575–583
- Karvonen A, Seppälä O, Valtonen ET (2004) Eye fluke-induced cataract formation in fish: quantitative analysis using an ophthalmological microscope. *Parasitology* 129:473–478
- Kearn GC (1966) The adhesive mechanism of the monogenean parasite *Tetraonchus monenteron* from the gills of the pike (*Esox lucius*). *Parasitology* 56:505–510
- Malek M, Mobedi I (2001) Occurrence of *Clinostomum Complanatum* (Rudolphi, 1819) (Digenea: Clinostomatidae) in *Capoeta capoeta gracilis* (Osteichthys: Cyprinidae) from Shiroud River, Iran. *Iran J Public Health* 30:95–98
- May RM, Anderson RM (1979) Population biology of infectious disease. *Nature* 280:455–461
- Moravec F, Frantova D (2003) Observations on the transmission and the seasonality of infection of the nematode *Cystidicoloides ephemeridarum* in *Salmo trutta fario* in a small trout stream in North Bohemia, the Czech Republic. *Acta Parasitol* 48:41–46
- Nikolsky GV (1963) The ecology of fishes. Academic, London, p 352
- Poulin R (1998) Evolutionary ecology of parasites: from individuals to communities. Chapman and Hall, London, p 212
- Raat AJP (1998) Synopsis of biological data on the northern pike *Esox lucius* Linnaeus, 1758. FAO Fisheries Synopsis No. 30 Rev. 2. SAST - Pike - 1,24(03)001,01
- Ramadan RAM (2012) Effect and Seasonal dynamics of *Diplostomum spathaceum* (eye fluke) on *Oreochromis niloticus* at Abbassa Fish Farm, Egypt. *Egypt J Aquac* 2:105–113
- Sattari M, Mokhayer B, Hasheminasab MF (2003) Parasites of *Acipenser gueldenstaedti*, *A. nudiiventris* and *huso huso* (Chondrostei: Acipenseridae) from south-west of Caspian Sea (In Persian). *J Vet Res* 57:33–38
- Smith JD (1984) Development of *Raphidascaris acus* (Nematoda, Anisakidae) in paratenic, intermediate, and definitive hosts. *Can J Zool* 62:1378–1386
- Soylu E (2009) Monogenean parasites on the gills of some fish species from lakes Sapanca and Durusu, Turkey. *E.U. J Fish Aquat Sci* 26:247–251
- Sutherland DR, Holloway HL Jr (1979) Parasites of fish from the Missouri, James, Sheyenne, and Wild Rice Rivers in North Dakota. *Proc Helminthol Soc Wash* 46:128–134
- Voutilainen A, Figueiredo K, Huuskonen H (2008) Effects of the eye fluke *Diplostomum spathaceum* on the energetics and feeding of Arctic charr *Salvelinus alpinus*. *J Fish Biol* 73:2228–2237