Identification of *Dactylogyrus* spp. and other parasites of common carp in northeast of Iran

Hassan Borji · Abolghasem Naghibi ·
Mohammad Reza Nasiri · Amin Ahmadi

Received: 4 April 2012 / Accepted: 24 April 2012 / Published online: 12 May 2012
© Indian Society for Parasitology 2012

Abstract This research was carried out in order to get overview of current status of infestation with *Dactylogyrus* spp. and other parasites in common carp (*Cyprinus carpio*) collected from the ponds around Mashhad in northeast of Iran. A total of 100 common carps from March to December 2011, 61 (61 %) specimens were hosts to parasites. Monogenea dominated the parasite load most of all fishes, whereas *Argulus foliaceus* (Arthropoda) was the less parasite. Parasites were found as followed: *Dactylogyrus extensus* (29 %), *Dactylogyrus anchoratus* (2 %), *Ichthyophthirius multifiliis* (10 %), *Trichodina nigra* (7 %), *Capillaria* spp. (5 %), *Procaecum* spp. (2 %), *Argulus foliaceus* (2 %), and *Lernaea cyprinacea* (4 %). Seasonal changes in the abundance of parasites were evident for most taxa in which the prevalence of parasitic infection and diversity were more in summer than other seasons. The result of this study provide a better aquaculture conditions and help to solve some of the problems of fish farmers.

Keywords *Dactylogyrus* spp. · Other parasites · *Cyprinus carpio* · Northeast of Iran

Introduction

Fishes are important to man as a good source of protein in man's diet and as a vector of some human disease pathogens. The common carp, *Cyprinus carpio*, is apparently the most widely geographically distributed fish species in Iran and other region of world. Owing to its adaptation to a wide range of climatic and geographical conditions, a substantial number of almost all major taxa of parasites have been found in wild and domestic carp.

It is usually known that external parasites constitute the largest group of pathogenic organisms in warm water fish (Snieszko and Axelrod 1971). The presence of parasites is detrimental for a fish population and may cause high mortality, weight losses, and reduced fecundity on both cultured and wild fish species especially in waters contaminated with industrial and urban pollutants (Grabda 1991). Poor water quality and lack of nutrition cause parasitic disease outbreaks (Cengizler et al. 2001; Chisholm et al. 2001; Edema et al. 2008). The majority of fish ectoparasitic protozoa are commensalism but some of them may produce serious diseases and mortality especially in fry and fingerlings. Parasitic protozoa have a direct life cycle that enables them to spread rapidly and widely in their hosts (Kudo 1966). Such rapid growth and multiplication of these parasites greatly increase their rate of infestation among fish causing mass mortality. Determining the parasitic species in the Common Carp will provide a better aquaculture conditions and will help to solve some of the problems of fish farmers.

To the best knowledge of the authors there are few studies on parasitic fauna of common carp in Iran (Eslami and Anwar 1971; Mokhayer 1981; Jalali 1998; Jalali and Barzegar 2006) and very little research has been done on the parasites of common carp in northeast of Iran.

H. Borji (✉) · A. Naghibi · A. Ahmadi
Department of Pathobiology, School of Veterinary Medicine,
Ferdowsi University of Mashhad, P.O. Box 9177948974,
Mashhad, Iran
e-mail: hborji@um.ac.ir

M. R. Nasiri
Department of Animal Sciences, School of Agriculture,
Ferdowsi University of Mashhad, Mashhad, Iran

Therefore, the objective of this study was to survey parasitic fauna of common carp in the northeast of Iran.

Materials and methods

Fish samples were acquired, using gillnets, bag net, and hook by local fishermen from the ponds around Mashhad during March to December 2011 and transported live to the laboratory. Only fresh or already killed fish samples were subjected for parasitological investigation.

Methods used for collecting, fixing, staining, and mounting of parasite specimens were as follows.

Protozoa

For detection of protozoa, the mucus was scraped separately from the skin, gills onto a micro slide and then spread the mucus carefully with a cover slip. The protozoa expose to a fixative for about 15 min and then washed for several minutes in alcohol containing a drop of added iodine solution. Next, both wet and dry smears were mounted in Canada balsa after dehydration in accordance with Fernando et al. (1972).

Monogenea

Fish gills were cut out and examined under a microscope at $\times 40$ –100 magnification. Vigorously, moving worms were separated from the gills with a pipette and fixed under a cover slip according to Gussev (1983) in ammonium picrate and glycerol–gelatine, respectively.

Helminthes

The collection of live helminthes was carried out from the intestine and body cavity of the infected fish. The parasites were then washed in a 0.6 % saline solution and fixed in 70 % alcohol. The Cestodes were stained with carmine, then cleared in xylene and mounted in Canada balsa and for nematodes cleared in lactophenol for several days according to Fernando et al. (1972).

Crustacea

Specimens of crustacea were collected from various locations on the fish (skin, fins, and gill), cleaned in saline and preserved in 70 % alcohol. They were then stained and cleared with polyvinyl lactophenol and mounted in Canada balsam according to Fernando et al. (1972). The identification of parasites was carried out in accordance with the keys given by Gussev (1985) and Lom and Dykova (1992).

Results

Monogenean trematodes; *Dactylogyrus extensus* (29 %), *Dactylogyrus anchoratus* (2 %), and protozoan parasites; *Ichthyophthirius multifiliis* (10 %) were found on the gills and the other protozoan parasites; *Trichodina nigra* (7 %) and crustacean parasites; *Argulus foliaceus* (2 %) and *Lernaea cyprinacea* (4 %) were found during the skin examination.

There were not any parasitic infestation in the oral cavity and eyes and also we could not find any parasite in the body fluid and blood preparations.

Nematoda, *Capillaria* spp. (5 %) and *Procaecum* spp. (2 %) were found during the small intestine examination (Table 1).

Discussion

Parasitic infestation of cultured fish in tropical and sub-tropical countries represents a serious problem for aquaculture due to severe economical losses either as directly or indirectly (Roberts 1978).

The data obtained from present study indicate that *D. extensus* and *D. anchoratus* were the most frequent species of Monogenea. More than 70 species belong to the genus *Dactylogyrus* have been reported from wild and farmed freshwater fishes of Iran (Jalali 1998). Common carps occurring in freshwaters of Iran were infected with five species of *Dactylogyrus* while common carps living in Caspian Sea were infected only with two species, *D. extensus* and *D. anchoratus* (Jalali 1998). Among *Dactylogyrus* species found on common carp of Iran, *D. anchoratus* and *D. extensus* need special attention due to their low host-specificity and high tolerance to a wide range of temperature and salinity. These characteristics make them the most successful among invading parasites of fishes. These two species are exceptional among *Dactylogyrus* spp. in their broad host range. Out of 970 nominal species included in the genus

Table 1 Prevalence of *Dactylogyrus* spp. and other parasites of common carp in northeast of Iran

Parasite	Parasites	Percent	Location
Nematoda	<i>Capillaria</i> spp.	5	Small intestine
	<i>Procaecum</i> spp.	2	
Monogenea	<i>Dactylogyrus vastator</i>	2	Gill
	<i>Dactylogyrus extensus</i>	29	
Crustacean	<i>Lernaea cyprinacea</i>	4	Skin
	<i>Argulus foliaceus</i>	2	
Protozoa	<i>Ichthyophthirius multifiliis</i>	10	Gill, skin
	<i>Trichodina nigra</i>	7	Skin

by Gibson et al. (1996), *D. anchoratus* and *D. extensus* are the least host-specific species, being recorded from 19 genera (4 order) and 7 genera (2 orders) of fishes, respectively. According to Dove and Ernst (1998) aggression and the tolerance to a wide range of physical and chemical conditions are characteristic hallmarks of successful invading species. Likewise, *D. anchoratus* and *D. extensus* have been distributed in all water bodies of country with broad ranges of water temperature (from 1 to 30 °C) and salinity (up to 1.3 %) in all seasons of the year (Jalali 1998; Jalali and Barzegar 2006). *D. anchoratus* which was found in common carp in this study attaches to the base of primary filaments (Kollman 1972) where osmoregulating chloride cells are located. Therefore, infection with the parasite could be dangerous and harmful especially for the fries in hatcheries (Paperna 1980).

The present data show that *D. extensus* infection is optimal during summer; however, infestation by this parasite occurred throughout year. *Dactylogyrus* lays eggs on fish gills or in water, where they fall to the bottom of the reservoir. Egg development depends on external conditions, primarily on temperature, e.g. in summer at 22–24 °C. *D. extensus* larvae develop and hatch in 2–3 days at 18 °C larval development takes approximately a month in water when water temperature fall below 4 °C no changes can be observed in eggs with development only commencing when the temperature rises. The present study supports the data in the literature concerning the dynamics of the occurrence of this monogenean species.

A question emerging here is the source of infection among common carps. Based on the current knowledge, it is not completely known whether all *Dactylogyrus* spp. found on common carp or only part of them are originated from abroad. Due to lack of reliable evidence on *Dactylogyrus* found on native races of common carp in Iran, no speculation could be expressed regarding the sources of infection. Further studies using advanced techniques in parasitology and DNA sequence analyses might be useful in molecular taxonomy and phylogeny of different races of both common carp and its dactylogyrids species.

It is also apparent in the present study that *Trichodina nigra* and *Ichthyophthirius multifiliis* prevail on skin and gills of cyprinid fishes in this area. Result of this study consistent with other studies (Barzegar et al. 2008; Fard et al. 2001; Jalali 1998; Jalali and Barzegar 2006; Raissy et al. 2010). In addition, our results are relatively similar to other studies in other countries (Adamczyk 1981; Cengizler et al. 2001; Chugunova 2011). *Trichodina* spp. is very common ectoparasite which in most cases is pathogenic to both freshwater and marine fish (Thomas and Wellborn 1967). Dogiel (1961) reported that the infection being stimulated by the high density of fish in ponds. Under such conditions, it may be an epizootic. In cases of stress,

several species of *Trichodina* may become pathogenic interfering with feeding and respiration of small fish (Sarig 1968; Ahmed 1976). The lesions mostly induced by this parasite are hyperplasia and necrosis of the epidermal cells. These cells are usually subjected to severe attacks by parasites. This results in cellular growth and excess mucus production (Ahmed 1976). Many authors have observed a complete destruction of gill epithelium in similar cases (Paperna 1980; McArdle 1984; Eisa et al. 1985).

Furthermore, *I. multifiliis*, the causative agent of Ichthyophthiriasis or Ich, is one of the most important pathogenic parasites of cultured fish (Schäperclaus 1991). This protozoan is widely distributed to all parts of the world but Antarctica, and almost all of the freshwater fish are susceptible to infections. Mortality rate of infected fish by Ichthyophthiriasis could reach almost 100 % (Meyer 1974). In some cases, this parasite does not cause mortality, but it still has negative consequences on the population and individual fish (Lom and Dyková 1992), although clear evidence is not available. Result of this study showed that Ichthyophthiriasis outbreaks occur during the summer months when temperatures are at the peak in the north-eastern of Iran. This ciliated protozoan was present and active when temperatures were above 14 °C and Ichthyophthiriasis-related mortality was observed when temperatures were above 18 °C. The peak of the mean prevalence, intensity, and abundance of *I. multifiliis* occurred in August. Unexpectedly, the parasites were absent from upper and middle stream farms in the following month. This was probably due to muddy flooding with cold water originated from heavy rain in the mountains. Significantly higher pool-to-pool variations in the mean prevalence, intensity, and abundance of *I. multifiliis* were largely due to the improper water supply and insufficient water circulation. Bodensteiner et al. (2000) showed that incoming water is a key factor in determining the levels of Ichthyophthiriasis in channel catfish. In the same study, it was suggested that turnover rates of water could be more important than water velocity.

Result of this study showed that the prevalence of *Lernaea cyprinacea* is almost similar to other reports (Barzegar and Jalali 2009; Jalali and Barzegar 2006). Notably, *Lernaea cyprinacea* possesses the widest host range and is found on the skin and fins of 14 cultured as well as on wild fish species from 13 genera and 4 families living in both ponds and natural water bodies, lakes, and reservoirs. In view of economic importance, *Lernaea cyprinacea*, as a parasite of cyprinid cultured fishes, is the most harmful species and has endangered the success of market fish production in Iran during the last three decades (Mokhayer 1981; Jalali 1998). In spite of fish health control efforts between the year's 1980 and 1982 a heavy infestation of Lernaeosis occurred among common and Chinese carp

fingerlings. Hibernated forms of parasite were transmitted to natural lakes, reservoirs and other private fish farms, giving rise to a severe case of epizootic infestation in the above mentioned water bodies (Jalali 1998; Jalali and Barzegar 2006). The appearance of heavy *Lernaeis* infestation in fish ponds happened in the early stages of polyculture in Iran, with the ecological balance now favoring *Lernaea* spp. life span in pond ecosystems.

Argaulus foliaceus was other crustacean parasites that were isolated of skin and gills. *A. foliaceus* was reported on the skin of common carp in Anzali Lagoon in Caspian Basin and on some cyprinid fish species in Zarivar Lake and also in various other parts of Iran (Jalali and Barzegar 2006).

Finally, we have found *Capillaria* sp and *Procaecum* larva in small intestine that *Procaecum* larva first reported of common carp in Iran. Studies on ectoparasites of common carp in Iran were done more frequently than the ones on endo-parasites. The helminth fauna of the common carp in Iran was investigated by Mokhayer (1981) and Eslami and Anwar (1971). Species of three genera of Cestoda *Bothriocephalus gowkongenes* (Mokhayer 1981), *Ligula intestinalis* (Mokhayer 1981), *Caryophyllaeus fimbriceps* (Eslami and Anwar 1971) from Khzar lake and tree genera of Trematoda, *Clinostomum complanatum*, *Diplostomum spathaceum*, and *Posthodiplostomum cuticulata* from Khzar lake, one genus of Nematoda, *Capillaria* spp. and one genus of Acanthocephala, *Leptorhynchoides plagi-cephalus*, from Khazar Lake (Mokhayer 1981) were determined in Iran. Capillariid nematodes are frequent parasites in both freshwater and marine fishes (Moravec et al. 1988). These helminthes may cause a high mortality in fishes.

Uncontrolled import of live fish into the country can lead to transmission of pathogenic parasites to native fishes, causing a great economical and ecological threat to valuable native fishes. For example, transmission of *D. anchoratus* from common carp to *Barbus sharpeyi*, an important native fish species, despite of the high host-specificity of monogeneans, indicates the possibility of transmission of exotic parasites to native hosts. It is strongly suggested that the risk of introducing exotic pathogens along with importing fish or any other living organism to the country, should be assessed well in advance, in order to protect native species and the ecosystem. Further studies must be focus on identifying introduced parasite species and quantifying their pathological effects on native host populations in both culturing and wild environment in Iran.

Acknowledgments This work supported by the Ferdowsi University of Mashhad. We thank Mr. Eshrati for his technical assistance during data collection and Mr. Mohammad Nejad for taking pictures.

References

- Adamczyk LH (1981) Parasite fauna of carp fry (*Cyprinus carpio*) bred in ponds fed by rainwater. *Wiad Parazytol* 27:722–763
- Ahmed ATA (1976) Trichodiniasis of gold fish and other carps. *Bangladesh J Zool* 4(1):12–20
- Barzegar M, Jalali B (2009) Crustacean parasites of fresh and brackish (Caspian Sea) water fishes of Iran. *J Agric Sci Technol* 11:161–171
- Barzegar M, Raeisi M, Bozorgnia A, Jalali B (2008) Parasites of the eyes of fresh and brackish water fishes in Iran. *Iran J Vet Res* 9:256–261
- Bodensteiner LR, Sheehan RJ, Wills PS, Bodensteiner LR, Brandenburg AM, Lewis WM (2000) Flowing water: an effective treatment for ichthyophthiriasis. *J Aquat Anim Health* 12: 209–219
- Cengizler I, Aytac N, Sahan A, Ozak AA, Genc E (2001) Ecto-endo parasite investigation on mirror carp (*Cyprinus carpio* L., 1758) captured from the river Seyhan, Turkey. *E.U. J Fish Aquat Sci* 18:87–90
- Chisholm LA, Morgan JAT, Adlard RD (2001) Phylogenetic analysis of the Monocotylidae (Monogenea) inferred from 28S rDNA sequences. *Int J Parasitol* 31:1253–1263
- Chugunova YK (2011) Component communities of parasites and interaction of the parasitic faunas of noncommercial fishes in the Kacha river (Yenisei Basin). *Contemp Probl Ecol* 4:56–63
- Dogiel VA (1961) Ecology of the parasites of freshwater fish. In: Dogiel VA, Petrushevski CK, Polyanski Yn I (eds) *Parasitology of fishes* (trans: Kabata Z). Oliver and Boyd, London, pp 1–48
- Dove DMA, Ernst I (1998) Concurrent invades-four exotic species of monogenea now established on exotic freshwater fishes in Australia. *Int J Parasitol* 28:1755–1764
- Edema CU, Okaka CE, Oboh IP, Okogub BO (2008) A preliminary study of parasitic infections of some fishes from Okhuo River, Benin City, Nigeria. *Int J Biomed Health Sci* 4(3):110–115
- Eisa ME, El-Shazly SO, Rizk MH (1985) A Contribution to the pathological changes of ectoparasite trichodinids-affected salt water fish (Grey Mullet fingerlings) in Raswa fish farm. *J Egypt Vet Med* 45:107–113
- Eslami A, Anwar M (1971) Occurrence and intensity of the infestation by *caryophyllaeus fimbriceps* in carp and mullet (new host) in Iran. *Riv It Piscic Ittiop* 1:21–23
- Fard FF, Mokhayer B, Ghorbani H (2001) Aiming and identifying different of parasites of fishes in the lagoon of choghakhor, chaharmahal va-Bakhtiari. *J Vet Res* 56:109–114
- Fernando CH, Furtado JJ, Gussev AV, Hanek G and Kakong SA (1972) *Methods for the study of freshwater fish parasites*, 1st edn. University of Waterloo, Biology series, p 76
- Gibson DI, Timofeeva TA, Gerashev PIA (1996) Catalogue of the nominal species of the monogenean genus *Dactylogyrus* Diesing, 1850 and their host genera. *Syst Parasitol* 35:3–48
- Grabda J (1991) *Marine fish parasitology: an outline*. Pwn-Polish Scientific Publisher, Warszawa, p 306
- Gussev AV (1983) *The methods of collection and processing of fish parasitic monogenean materials*, 1st edn. Nauka, Leningrad, USSR, p 48 (In Russian)
- Gussev AV (1985) Monogenea. In: Bauer ON (ed) *Key to parasites of freshwater fishes of USSR*, 1st edn, Vol. 2. Nauka, Leningrad, USSR, p 424 (In Russian)
- Jalali B (1998) Parasites and parasitic diseases of fresh water fishes of Iran. In: *Breeding and aquaculture assistance*, Department of education and promotion
- Jalali B, Barzegar M (2006) Fish parasites in Zarivar Lake. *J Agric Sci Technol* 8:47–58

- Kollman A (1972) *Dactylogyrus vastator* Nybelin, 1924 (Trematoda: Monogenoidea) as pathogens on gills of carp (*Cyprinus carpio* L.). *Zeitschrift fur Zoologie* 185:1–54
- Kudo RR (1966) Protozoology, 5th edn. Thomas Springfield, Illinois, pp 164–177
- Lom J, Dykova I (1992) Protozoan parasites of fishes, 1st edn. Elsevier, Amsterdam, p 315
- McArdle JF (1984) Trichodina as cause of mortalities in cage reared rainbow trout and salmon. *Bull Eur Assoc Fish Pathol* 4:3–6
- Meyer FP (1974) Parasites of freshwater fishes, II, Protozoa 3. *Ichthyophthirius multifiliis*. U.S. Department of the Interior U.S. Fish and Wildlife Service Fish Disease, Leaflet No. 2
- Mokhayer B (1981) Survey of fish parasites of sefidroud. *Vet Faculty Lett* 4:60–72
- Moravec F, Orecchia P, Paggi L (1988) *Pseudocapillaria parablennii* sp. n. (Nematoda:Capillariidae) from a marine fish, *Parablennius gattorugine* (Brunn), from the Italian coast. *Folia Parasitol* 35: 353–357
- Paperna I (1980) Parasites infections and diseases of fish in Africa. FAO, CIFA Technical Paper 7: 7–23
- Raissy M, Ansari M, Moumeni M, Goudarzi MA, Sohrabi HR, Rashedi M (2010) An epizootic of Ichthyophthiriasis among fishes in Armand River, Iran. *J Cell Anim Biol* 4(10):151–153
- Roberts RJ (1978) Fish pathology. Bailliere Tindall, London
- Sarig S (1968) A review of diseases and parasites of fishes in warm ponds in the near East and Africa F.A.O. Fish Report 5(44): 281–285
- Schäperclaus W (1991) Diseases caused by ciliates. In: Schäperclaus W, Kulow H, Schreckenbach K (eds) Fish diseases. Amerind Publishing, New Delhi, pp 702–725
- Snieszko SF, Axelrod R (1971) Diseases of fishes. TFH Publications, New Jersey
- Thomas L, Wellborn JR (1967) Trichodina (Ciliata: Urceolariidae) of freshwater fishes of the southeastern United States. *J Eukaryot Microbiol* 14(3):399–412