

Short Paper

Infection with *Dactylogyrus* spp. among introduced cyprinid fishes and their geographical distribution in Iran

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Summary

In the present study, we reported infection with eighteen species of the genus *Dactylogyrus*, belong to the family Dactylogyridae from five breeder fish species, including common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), big head carp (*Hypophthalmichthys nobilis*) and black carp (*Myelopharyngodon piceus*) which introduced and imported to Iranian freshwaters from Russia, Romania, Hungary and China over the last 40 years. The infection was also found in *Carassius auratus gibelio*, it is not known when this fish species was introduced into the country. The *Dactylogyrus* spp. were as follows: *Dactylogyrus achmerovi*, *D. anchoratus*, *D. aristichthys*, *D. baueri*, *D. dulikeity*, *D. ctenopharyngodonis*, *D. extensus*, *D. hypophthalmichthys*, *D. intermedius*, *D. intermedioides*, *D. lamellatus*, *D. magnihamotus*, *D. nobilis*, *D. sahuensis*, *D. suchengtaii*, *D. taihuensis*, *D. vastator* and *D. wegeneri*. Among these, *D. vastator* and *D. anchoratus* infecting common carp and *D. lamellatus* infecting grass carp are very harmful and were responsible for high mortalities observed in fry and fingerling production in Iran. Uncontrolled import of live fish into the country can lead to transmission of pathogenic monogeneans or other group of 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 monogenean 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.

Key words: *Dactylogyrus*, Introduced fish, Cyprinid, Freshwaters, Iran

Introduction

According to Coad (1979) nearly 165 species of freshwater fishes inhabit in Iranian territory. Among them, approximately 24 fish species considered to be imported to freshwater of Iran (Coad and Abdoli, 1993; Jalali, 1998). Different species of fish were imported to Iran for various reasons, such as food, sport, research, ornamentation and weed control or were imported by accident such as

Carassius auratus gibelio along with other species of fish. Cyprinid fish were imported for above mentioned reasons as well as to strengthen the fish culture industry in the country. Therefore, huge number of cyprinid fishes, for example, common carp (*Cyprinus carpio*) (other than that occurring natively in the country), grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), big head carp (*Hypophthalmichthys nobilis*), black carp (*Myelopharyngodon piceus*) and gold fish

(*Carassius auratus*) originating from Far-East (China), Russia and Eastern Europe (Romania and Hungary) were introduced to Iranian waters during the last forty years. Some of these fishes are now among the most important species which economically constitute the main part of annual productions of fisheries ponds in Iran. *Cyprinus carpio*, a native fish species, occurs naturally in the Caspian sea basin (Griffith *et al.*, 1972; Peter, 1987), but genetically improved specimens originated from Romania and Hungary which were imported and distributed in freshwaters throughout the country. *Cyprinus carpio* can surprisingly adapt itself to most Iranian freshwater bodies and now, are highly appreciated by Iranian consumers. However, introduced fishes can be a source for transferring parasites and diseases to native species. Exotic fishes may introduce exotic parasites or diseases to native fishes which may lead to a serious decline in populations or render the commercial species unfit for human consumption (Coad and Abdoli, 1993). Monogeneans are among the most important pathogens, which can be easily transferred in such ways, due to their quantity of occurrence, species composition and pathogenic effects. In fact, they can cause more severe damages on new host(s) in the new environment. For example, *Nitzschia sturionis* was introduced to Aral sea through Caspian sturgeons, *Acipenser stellatus*, and caused heavy mortalities among endemic sturgeons, *Acipenser nudiventris* and almost exterminated the whole population (Dogiel, 1961). Similarly, a new strain of *Gyrodactylus salaris* emptied the rivers of Norway from salmonids (Johnsen and Jensen, 1986).

In this paper, exotic species of the genus *Dactylogyrus*, introduced to Iranian waters through common carp and major Chinese carps were reported and their potential pathogenic effect on native fish species were discussed. This is the first study on the parasitic infection of introduced fishes in Iran.

Materials and Methods

Six species of cyprinid fish including common carp (*C. carpio*), grass carp

(*Ctenopharyngodon idella*), silver carp (*H. molitrix*), big head carp (*H. nobilis*), black carp (*M. piceus*) and a native Iranian fish (*Barbus sharpeyi*) known as benny among locals, were collected from fisheries ponds, farms and natural waters in three different regions in Iran (Fig. 1). Overall 200 specimens were collected and examined for infection with *Dactylogyrus* spp. on gills, during 2000-2006. Benny was collected from fish farms in Khuzestan province. All other specimens were collected from governmental fisheries ponds (located in Guilan and Mazandaran provinces) in North of Iran and from some private fish farms in Tehran province. In addition to above places, common carp was caught from other fish farms in Khuzestan and Isfahan provinces and from Anzali lagoon, Caspian sea, Hamoon lake and Zarivar lake. Big head carp was also collected from different habitats of Iran (Fig. 1). After transporting alive fishes to the laboratory, they were killed and gills were examined for infection with monogenean parasites by using a stereomicroscope. The parasites were fixed and mounted in ammonium picrate glycerine (Malmberg, 1970). Identification was made according to descriptions given by Gussev (1985).



Fig. 1: Three zoogeographical fauna of Iran (Coad, 1979)

Results

Eighteen *Dactylogyrus* species were

Table 1: *Dactylogyrus* species found on introduced fishes in the present study

Parasites	Host(s)	Locality	Fauna
<i>D. achmerovi</i>	<i>Cyprinus carpio</i>	Sefid-Rood, Guilan	Sarmatian
<i>D. anchoratus</i>	<i>Cyprinus carpio</i>	Fish farms in Guilan and Mazandaran, Caspian sea	Sarmatian
	<i>Barbus sharpeyi</i>	Fish farms in Khuzestan provinces, Karoon river	Mesopotamian
<i>D. aristichthys</i>	<i>Hypophthalmichthys nobilis</i>	Fish farms in Guilan and Mazandaran provinces	Sarmatian
		Zarivar lake	Mesopotamian
<i>D. baueri</i>	<i>Carassius auratus gibelio</i>	Sefid-Rood river in Guilan province	Sarmatian
<i>D. ctenopharyngodonis</i>	<i>Ctenopharyngodon idella</i>	Fish farms in Guilan	Sarmatian
<i>D. dulikeity</i>	<i>Carassius auratus</i>	Fish farms in Guilan	Sarmatian
<i>D. extensus</i>	<i>Cyprinus carpio</i>	Fish farms in Guilan, Caspian sea, Zarinee-rud river (Urmia)	Sarmatian
	<i>Carassius auratus gibelio</i>	Zayandeh-rud river	
		Fish farms in Khuzestan province, Zarivar lake	Mesopotamian
		Hamoon lake	Oriental
<i>D. hypophthalmichthys</i>	<i>Hypophthalmichthys molitrix</i>	Fish farms in Guilan and Mazandaran provinces	Sarmatian
		Zarivar lake	Mesopotamian
<i>D. intermedius</i>	<i>Carassius auratus gibelio</i>	Fish farms in Tehran	Sarmatian
<i>D. intermedioides</i>	<i>Carassius auratus gibelio</i>	Fish farms in Tehran	Sarmatian
<i>D. lamellatus</i>	<i>Ctenopharyngodon idella</i>	Fish farms in Guilan and Mazandaran provinces	Sarmatian
		Zarivar lake	Mesopotamian
<i>D. magnihamotus</i>	<i>Myeopharyngodon piceus</i>	Fish farms in Guilan province	Sarmatian
<i>D. nobilis</i>	<i>Hypophthalmichthys nobilis</i>	Fish farms in Guilan and Mazandaran provinces	Sarmatian
<i>D. sahuensis</i>	<i>Cyprinus carpio</i>	Fish farms in Mazandaran province	Sarmatian
<i>D. suchengtaii</i>	<i>Hypophthalmichthys molitrix</i>	Mahabad reservoir, Urmia	Sarmatian
<i>D. taihuensis</i>	<i>Hypophthalmichthys nobilis</i>	Fish farms in Guilan and Mazandaran provinces	Sarmatian
<i>D. vastator</i>	<i>Cyprinus carpio</i>	Fish farms in Tehran	Sarmatian
		Khuzestan provinces	Mesopotamian
		Hamoon lake	Oriental
<i>D. wegneri</i>	<i>Carassius auratus gibelio</i>	Fish farm in Guilan province	Sarmatian

found on the gills of examined fishes (Table 1). These host-specific parasites were distributed to lakes and ponds fisheries in different regions of Iran.

Some of *Dactylogyrus* spp. showed a narrow geographical distribution even though they occurred on a widespread host such as *D. achmerovi* and *D. sahuensis* infecting common carp.

Discussion

So far, more than 70 species belong to the genus *Dactylogyrus* have been reported from wild and farmed freshwater fishes of Iran (Jalali and Molnar, 1990a, b; Molnar and Jalali, 1992; Gussev *et al.*, 1993a, b; Jalali *et al.*, 1995, 2000a, b; Jalali, 1998; Shamsi and Jalali, 2001; Jalali and Barzegar, 2005, 2006). Among these 70 species, those infecting introduced fishes need special attention due to the potential pathogenic effects on fries and fingerlings in new environment.

Dactylogyrus is one of the largest genera of parasitic helminthes, approximately 95% of them are parasites of the gills of fishes in the family Cyprinidae (Dove and Ernst, 1998). Cyprinid fish include 45% of Iranian freshwater fish species (Coad, 1979). Most of introduced fish species are also cyprinid

tribe, which are now spread throughout the country. Therefore, in spite of the fact that these parasites display high host-specificity, the risk of introducing pathogenic *Dactylogyrus* species switching hosts to native fishes seems to be high.

Among eighteen *Dactylogyrus* species found on fishes introduced to 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 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

and Molnar, 1990a; Jalali, 1998; Mahdipour *et al.*, 2004; Jalali and Barzegar, 2005). *D. anchoratus* was found on common carp in different basins of Iran and on *Barbus sharpeyi*, as a new host, in Khuzestan province (Tigris system). This parasite 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, 1963). In contrast, *D. achmerovi* and *D. sahuensis* were found only in Sarmatian fauna, in spite of infecting common carp, a wide spread host all over the country. This suggests that a narrow tolerance range to environmental conditions has priority to host-specificity for these species. *D. sahuensis* is a scarce *Dactylogyrus* species among dactylogyrids, which infect common carp. The species has special pathogenic effects on the gills of fish (see review by Jalali and Barzegar, 2005).

D. vastator is rather widespread through freshwater lakes and fish farms where common carp inhabits or cultivates. Due to special sensitivity of parasite to water hardness, pH and NH₃ (Paperna, 1963), it is absent in common carp cultured in lakes or ponds with high alkalinity, e.g. ponds in Khuzestan province and Hamoon lake, in southwestern and southeastern part of Iran, respectively, (Jalali and Molnar, 1990a). However, in ponds located in the northern part of the country (Guilan and Mazandaran) it is the most prevalent species of monogeneans among fingerlings and causes high injuries and mortalities (Jalali and Molnar, 1990b).

Grass carp is readily infected by several monogeneans, among them *D. lamellatus* is the most harmful parasite which is now spread throughout the country and causes high mortality in fingerlings, (Jalali and Molnar, 1990a). Although, *D. ctenopharyngodonis* another *Dactylogyrus* on Grass Carp introduced from China in 1991, has not been spread in the country, yet.

Common carps occurring in freshwaters of Iran were infected with five species of *Dactylogyrus* as shown in Table 1 while common carps living in Caspian sea were infected only with two species, *D. extensus*

and *D. anchoratus* (Jalali, 1998). 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.

On the basis of the above facts, it is strongly suggested that uncontrolled entry of fish into the country must be banned. Otherwise not only new parasites but also other pathogenic organisms could be transmitted to uninfected area of Iran and may jeopardize future developments of fisheries industry of the country. In addition, implementation of a system of fish quarantine incorporating inspection of imported fish, specific health certification and related concerns are also recommended. Further studies must be focus on identifying introduced parasite species and quantifying their pathological effects on native host populations in both culturing or wild environment in Iran.

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