

Data on the parasite fauna of the European common carp *Cyprinus carpio carpio* and Asian common carp *Cyprinus carpio haematopterus* support an Asian ancestry of the species

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Abstract. The common carp subspecies (*Cyprinus carpio carpio*) has been regarded as an autochthonous species of Europe. Evidence obtained by comparing the parasite fauna of the European and the Asian subspecies (*Cyprinus carpio haematopterus*) establish that such fish in the Far East harbour a significantly richer array of parasite species, and were the exclusive hosts of most of the specific parasites, including all monogenean and myxosporean spp., until recent intensive fish translocations from the Far East. I therefore propose that the common carp originated in the Far-East. The common carp would have originally inhabited only the Far East freshwaters, arriving in Europe in the Middle Ages by anthropogenic transfers. During the long trip from China to Europe, the common carp lost its original parasite fauna. In its new habitat, it acquired some parasite from the crucian carp, *Carassius carassius*, a closely related fish. Infection of the European subspecies with the Asian parasites that had been lost in Europe recommenced only in the middle of the last century, when the Amur wild carp and the coloured carp variations became introduced to Europe. The examination of the parasite fauna of fishes is an excellent tool for surveying the origin of fishes.

Key Words: Origin of carp, parasitology, monogeneans, myxosporeans.

Összefoglalás. A ponty Európában honos alfaját (*Cyprinus carpio carpio*) sokan Európára nézve őshonos halfajnak tekintik. Az Európában élő és Ázsiában élő (*Cyprinus carpio haematopterus*) ponty alfajok parazitafaunájának összehasonlítása során kapott adatok arra utalnak, hogy a pontyon élősködő olyan specifikus paraziták, mint a monogeneák és myxosporeák többsége az intenzív halszállítások megindulásáig csak a távol-keleti ponty-alfajon élősködött. Bizonyítottak látszik, hogy a ponty egy távol-keleti halfaj, amely eredetileg csak az ázsiai édesvizeket népesítette be, és Európába csupán a középkorban emberi közreműködéssel érkezett. A hosszú út alatt, Kínától Európáig a ponty elvesztette eredeti parazitafaunáját. Az új élettérben a ponty a széles gazdakörű paraziták mellett a közel-rokon kárásznak néhány specifikus parazitájával vált fertőzőtté. A korábban elvesztett parazitákkal az európai ponty-alfaj csak azután vált ismét fertőzőtté, amikor az elmúlt évszázad közepén az amuri vadpontyot és a koi-pontyot Európába telepítették. A halak parazitafaunájának tanulmányozása kiváló lehetőség az egyes halfajok eredeti biotópjának megállapítására.

Kulcsszavak: A ponty eredete, parazitológia, monogenea, myxosporea.

Rezumat. Subspecia de crap *Cyprinus carpio carpio* a fost privită multă vreme ca o specie autohtonă a Europei. Evidențele obținute prin compararea faunei de paraziți a speciilor europeană și asiatică (*Cyprinus carpio haematopterus*) au stabilit că peștii din Estul Îndepărtat găzduiesc un spectru semnificativ mai mare de specii parazite și erau gazde exclusive pentru cele mai multe specii parazite specifice, incluzând toate speciile din Monogenea și Myxosporea, până la recentele translocări intensive din Estul Îndepărtat. De aceea, susținem că crapul comun își are originile în Estul Îndepărtat, că el a ocupat doar apele dulci ale acelei arii geografice și că a ajuns în Europa în Evul Mediu prin transfer antropogenic. De-a lungul lungii sale călătorii, din China spre Europa, crapul și-a pierdut fauna originală de paraziți. În noul său habitat a dobândit unii paraziți de la caracudă (*Carassius carassius*), o rudă apropiată. Infecția speciilor Europene cu paraziți asiatici, pierduți prin Europa, a fost reluată doar pe la mijlocul secolului trecut, odată cu introducerea amurului și a crapului koi în Europa. Examinarea faunei parazite de pești este o unealtă excelentă pentru descifrarea originii populațiilor de pești.

Cuvinte cheie: originea crapului, parazitologie, monogenea, myxosporea.

Introduction. Specialists working on the origin of the common carp (*Cyprinus carpio* L.) maintain two different opinions on the original distribution area of the common carp. Some think that the European subspecies of the common carp (*Cyprinus carpio carpio* L.) is an autochthonous species that has lived in European waters for thousands of years (Hoffmann 1994), while others think that the carp is an allochthonous fish of Far East origin, which arrived to Europe with antropochore translocation during the middle or pre-middle ages (Tienemann 1950; Steffens 1967; Vooren 1972; Froufe et al 2002; Zhou et al 2003). Berg (1964), Amano (1971) as well as Balon (1995ab) had a specific intermediate opinion, believing that the homeland of the common carp was the Turanic Central Asian region from where this species spread toward the west to become *Cyprinus carpio carpio* and toward the east to develop to *Cyprinus carpio haematopterus* Martens, 1876.

Parasites have been successfully used to aid in identifying the origin of small fish groups, or a whole population (MacKenzie 2002; Timi 2007). Parasitic infections often play the role of tags for identifying the homelands, especially spooning places of some marine fishes (Arthur & Albert 1993; Konovalov 1995; Timi et al 2007) as infections of different fish groups have a character which is specific for the territory where the fries and smolts of salmonids and other fishes spent their early life. Dogiel (1961) described that a given fish species in the centre of its distribution area is infected with more species of parasites and they are more intensively infected than individuals living at the periphery of its distribution area. Similarly, the density of parasites on animal individuals tends to decrease from the centre of species' range toward its margin (Sagarin et al 2006). Torchin et al (2003) who examined the prevalence of parasites in different introduced animal groups (molluscs, crustaceans, fishes, amphibians, reptiles, birds and mammals) concluded that they left behind most of their native parasites in the new habitat, but their parasite fauna increased when the hosts were repeatedly introduced.

Although most parasites could be used as tools for identifying the original habitat of the host species, those with strict host specificity (or infecting only closely related fishes) are most suited for this purpose. Among these parasites, the host-specific Monogenea and Myxosporea spp. deserve a special attention.

In this paper, parasitological evidence is presented which demonstrate significantly greater diversity in the parasite fauna of the Far East common carp subspecies than of the European subspecies, and that parasitic infection of the European common carp harbours only a small proportion of species infecting the Far-East subspecies.

Materials and Methods. Intensive research on the parasite fauna of fishes has been performed in Hungary since 1960. Since this time, the parasitic infection of freshwater and pond-cultured fishes has been regularly surveyed, and all parasitic groups infecting fishes have been included. During these surveys complete parasitological dissections were performed; histological sections from the collected material were prepared; samples from parasites were preserved in alcohol or as slide preparations; photos and video images were recorded. Special attention was paid to parasites of allochthonous fishes (gibel carp, brown bullhead, pumpkinseed, *Neogobius* spp.), the colonisation of which in the Hungarian fauna took place in the last century, and to parasites infecting fishes which continue to be regularly introduced to these waters (eel, goldfish, koi-carp, silver carp, bighead and grasscarp).

Results. By comparing the parasite fauna of the Far-East carp subspecies (*Cyprinus c. erythropterus*) and the European carp subspecies (*Cyprinus c. carpio*) it is readily apparent that from the strictly host specific *Dactylogyrus* spp., seven species have been described in the Far-East, while only four species have been described in Europe (see Table 1). Until the start of the intensive fish translocations from the Amur Basin to the European part of the past Soviet Union (1948-1950), only the four species (*D. anchoratus*, *D. crassus*, *D. minutus* and *D. vastator*) were identified in Europe. In the Far-East (China, Mongolia, the Amur Basin of Russia), however, seven species (*D. achmerowi*, *D. falciformis*, *D. lopuchinae*, *D. molnari*, *D. mrazeki*, *D. sahuensis*, *D.*

yinwenyingae) were described. A single species (*D. extensus*) was first described in North-America. All known species, except the less studied *D. crassus*, commonly occur also in the Far-East habitats. In Europe, however, only *D. minutus* can be regarded as a specific carp parasite, while *D. anchoratus*, *D. crassus* and *D. vastator* occur both on the common carp and the crucian carp (*Carassius carassius*).

Table 1

Dactylogyrus spp. (Monogenea) infecting the common carp

Parasite	<i>C. c. carpio</i>	<i>C. c. haematopterus</i>	Occurrence in Hungary	Typical host	Place of description
<i>D. achmerowi</i> Gussev, 1955	x	x	x	<i>C.c. carpio</i>	Far-East
<i>D. extensus</i> Mueller & Van Cleave, 1932	x	x	x	<i>C.c. carpio</i>	USA
<i>D. falciformis</i> Achmerov, 1952	x	x	x	<i>C.c. haematopterus</i>	Far-East
<i>D. lopuchinae</i> Jukhimenko, 1981	x	x	---	<i>C.c. haematopterus</i>	Far-East
<i>D. molnari</i> Ergens & Dulma, 1969	x	x	x	<i>C.c. haematopterus</i>	Far-East
<i>D. mrazeki</i> Ergens & Dulma, 1969	---	x	---	<i>C.c. haematopterus</i>	Far-East
<i>D. sahuensis</i> Ling, 1965	x	x	x	<i>C.c. haematopterus</i>	Far-East
<i>D. yinwenyingae</i> Gussev, 1962	x	x	---	<i>C.c. haematopterus</i>	Far-East
<i>D. minutus</i> Kulwicz, 1927	x	x	x	<i>C.c. carpio</i>	Europe
* <i>D. anchoratus</i> (Dujardin, 1845)	x	x	x	<i>C.c. carpio</i>	Europe
* <i>D. crassus</i> Kulwicz, 1927	x	---	---	<i>C.c. carpio</i>	Europe
* <i>D. vastator</i> Nybelin, 1924	x	x	x	<i>C.c. carpio</i>	Europe

*Mutual parasites of the common carp and the crucian carp.

Myxosporeans of the genus *Myxobolus* are also regarded as host specific parasites. From this genus 21 species have been described from the Far-East (China, Japan, and the Amur Basin) (see Table 2). Presumably all these species derived from the Far-East carp subspecies (*C. c. carpio*), though Chinese and Japanese authors very often neglected to specify this fact. Only ten species derive from other continents (Table 3). Of them, seven species were described in Europe, while a single species was first found in India, South Africa and North America, respectively. All the six species of the strictly host specific *Thelohanellus* spp. were known from the Far East (Table 4). Of them, only *T. hovorkai* and *T. nikolskii* have been introduced to Europe.

Of the other host specific carp parasites common in the Far East, the introduction of five species (*Diplozoon nipponicum*, *Khawia sinensis*, *Markewitschia sagittata*, *Atractolytocestus huronensis*, *Philometroides cyprini*) have been registered in Europe (Table 5).

Discussions and Conclusions. Some fish species, for example the pumpkinseed (*Lepomis gibbosus*), brown bullhead (*Ictalurus nebulosus*) were introduced to Europe from North America owing to unconsidered fish introductions more than 150 years ago. These fishes enriched the parasite fauna in Europe with some monogeneans. Of them, the brown bullhead's parasite, *Cleidodiscus pricei* Mueller, 1936, and the pumpkinseed parasites, *Haploclaidus dispar* (Mueller, 1936) and *Onchocleidus similis* Mueller, 1936, were first found in Europe by Roman (1955). The expansion of the Black Sea gobies is now taking place throughout the entire Danube region and inhabiting even the northern part of the American continent. Their expansion is partially an active invasion, but their rapid spread may be greatly facilitated by ballast water of ships (Ahnelt et al 1989; Jude

et al 1992). Of the specific parasites, these fishes introduced only some coccidian spp. to the Hungarian reaches of the Danube River from the Black Sea habitat (Molnár 2006).

Table 2

Myxobolus spp. of the common carp described in the Far East

Name of the species	Location	Fish host by the original authors	Country
<i>M. acinosus</i> Nie & Li, 1973	gills	<i>Cyprinus carpio haematopterus</i>	China
<i>M. amurensis</i> Akhmerov, 1960	fins, gut	<i>Cyprinus carpio haematopterus</i>	Amur basin
<i>M. circulus</i> (<i>Myxosoma circulus</i> (Akhmerov, 1960) Landsberg & Lom, 1991	gills, other organs	<i>Cyprinus carpio haematopterus</i>	Russia
<i>M. ectopicus</i> Nie & Li, 1992	urinary bladder	<i>Cyprinus carpio</i>	China
<i>M. haematopterus</i> Yukhimenko, 1986	gills, fins, skin	<i>Cyprinus carpio haematopterus</i>	Amur basin
<i>M. hanchuanensis</i> Chen, 1998	gills, abdominal cavity	<i>Cyprinus carpio</i> ,	China
<i>M. heteromorpha</i> Ma, 1993	heart, kidney	<i>Cyprinus carpio</i>	China
<i>M. hoshinai</i> (<i>Myxobolus dermatobius</i> Hoshina, 1953) Landsberg & Lom, 1991	integument	<i>Cyprinus carpio</i>	Japan
<i>M. junchisi</i> Yukhimenko, 1986	gills, muscles, kidney	<i>Cyprinus carpio haematopterus</i>	Amur basin
<i>M. koi</i> Kudo, 1919	gills	<i>Cyprinus carpio</i>	Japan
<i>M. longisporus</i> Nie & Li, 1992	gills	<i>Cyprinus carpio</i>	China
<i>M. microlatus</i> Li & Nie, 1973	almost all organs	<i>Cyprinus carpio</i>	China
<i>M. miyunensis</i> Chen, 1998	kidney	<i>Cyprinus carpio</i>	China
<i>M. nielii</i> (<i>Myxosoma sinensis</i> Nie & Li, 1973) Landsberg & Lom, 1991	almost all organs	<i>Cyprinus carpio</i>	China
<i>M. obovoides</i> Li & Nie, 1973	gills, skin, liver, ur. bladder	<i>Cyprinus carpio</i>	China
<i>M. paratoyamai</i> Nie & Li, 1992	nose cavity, ureter	<i>Cyprinus carpio</i>	China
<i>M. rotundatus</i> Akhmerov, 1956	gut	<i>Cyprinus carpio haematopterus</i>	Amur basin
<i>M. sinocyclochilusi</i> Ma, 1998	gills	<i>Cyprinus carpio</i>	China
<i>M. wuchangensis</i> Chen, 1998	caudal fins	<i>Cyprinus carpio</i>	China
<i>M. wucheni</i> (<i>Myxobolus acutus</i> Wu & Chen, 1987) Landsberg & Lom, 1991	kidney, gills	<i>Cyprinus carpio</i>	China
<i>M. yibinensis</i> Zhao & Ma, 1994	muscle	<i>Cyprinus carpio</i>	China

Table 3

Myxobolus spp. of the common carp described in non Far East regions

Name of the species	Location	Fish host by the original authors	Country
<i>M. basilamellaris</i> Lom & Molnár, 1983	gills	<i>Cyprinus carpio</i>	Hungary
<i>M. cuttacki</i> Haldar, Samal & Mukhopadhyay, 1996	gills	<i>Cyprinus carpio</i>	India
<i>M. cyprini</i> Doflein, 1898	muscles	<i>Cyprinus carpio</i>	Germany
<i>M. cyprinicola</i> Reuss, 1906	gut	<i>Cyprinus carpio</i>	Russia
<i>M. dispar</i> Thélohan, 1895	skin, gills, kidney, muscles	<i>Cyprinus carpio</i>	Europe
<i>M. encephalicus</i> (<i>Lentospora encephalica</i> Mulsow, 1911) Landsberg & Lom, 1991	brain	<i>Cyprinus carpio</i>	Germany
<i>M. intrachondrealis</i> Molnár, 2000	cartilage of gill arches	<i>Cyprinus carpio</i>	Hungary
<i>M. musseliusae</i> Yakovchuk, 1979	gills	<i>Cyprinus carpio</i>	Russia
<i>M. ovoidalis</i> Fantham, 1930	subcutaneous tissue	<i>Barbus</i> sp., <i>Cyprinus carpio</i>	South Africa
<i>M. toyamai</i> Kudo, 1917	gills	<i>Cyprinus carpio</i>	USA

Table 4

Thelohanellus spp. infecting *Cyprinus* and *Carassius* spp. in the Far East

Parasite	Fish	Location	Described in	Introduced	to
<i>Thelohanellus hovorkai</i> Akhmerov, 1960	<i>C.c.</i> <i>haematopterus</i>	Connective tissues	Amur basin	1986	Hungary
<i>T. nikolskii</i> Akhmerov, 1955	<i>C.c.</i> <i>haematopterus</i>	Fins	Amur basin	1982	Hungary
<i>T. amurensis</i> Akhmerov, 1955	<i>C.c.</i> <i>haematopterus</i>	Liver	Amur basin	-	-
<i>T. dogieli</i> Akhmerov, 1955	<i>C.c.</i> <i>haematopterus</i>	Skin	Amur basin	-	-
<i>T. acuminatus</i> Akhmerov, 1955	<i>C.c.</i> <i>haematopterus</i>	Gills	Amur basin	-	-
<i>T. kitauei</i> Egusa & Nakajima, 1981	<i>C.c.</i> <i>haematopterus</i>	Intestine	Japan	-	-
<i>T. wuhanensis</i> Xiao & Chen, 1993	<i>C.c.</i> <i>haematopterus</i>	Skin	China	-	-
<i>T. oliviformis</i> Wu & Wang, 1982	<i>C.c.</i> <i>haematopterus</i>	Muscles	China	-	-

Table 5

Parasites of the European common carp known earlier only from the Far-East subspecies

Name of the parasite	Original habitat	New habitat	Remarks
<i>Eudiplozoon nipponicum</i> (Goto, 1891)	Japan	Russia, Central Europe	Introduced to Russia with the Amur wild carp. Known in Hungary from 1960
<i>Khawia sinensis</i> Hsü, 1935	China	Russia, Central and West Europe	Introduced to Russia with the Amur wild carp. Found in Hungary in 1975
<i>Atractolytocestus</i> (<i>Markewitschia</i>) <i>sagittata</i> (Kulakowskaya & Akhmerov, 1965)	Amur basin	Russia	Introduced to Russia with the Amur wild carp.
<i>Atractolytocestus huronensis</i> Antony, 1958	USA	West and Central Europe	First found in Great Britain in 1996. Known from Hungary since 2003
<i>Philometroides cyprini</i> (Ishii, 1931)	China	Latvia, Russia, Central Europe	First found in Latvia in 1966, known from Hungary since 1995

Eel has been a longstanding member of the Hungarian fish fauna, but its small population was massively enriched by anthropogenic transfer. Between 1961 and 1991, glass eels were annually introduced to Lake Balaton and to some closed system water basins. Until 1990, the parasite fauna of the eel in Lake Balaton was the same as in rivers and lakes populated with eels by natural means (Murai 1971). However, in the early 1980's, an invasive and pathogenic nematode, *Anguillicola crassus* arrived to Europe due to the introduction of the Japanese eel, *A. japonicus*. This parasite now heavily infects the European eel and has caused disease (Hartman 1987). This parasite was first detected in Hungary in 1990 (Székely et al 1991).

Contrary to active spread or unintentional transport of fish hosts, large-scale anthropogenic fish introductions took place in the 1950s, when the Amur River fishes were introduced to the European part of the past Soviet Union. Then, stocks of the Amur wild carp (*Cyprinus carpio haematopterus*), grasscarp *Ctenopharyngodon idella* (Valenciennes, 1844), silver carp *Hypophthalmichthys molitrix* (Valenciennes, 1844) and bighead *Aristichthys nobilis* (Richardson, 1845) arrived regularly to Europe (Kirpichnikov 1949). These latter fishes introduced several pathogenic parasites to the European continent (Musselius 1967) and most of the parasites became introduced also to Hungary (Szakolczai & Molnár 1966). This was also the period when the ornate variation of the Japanese carp (koi) more frequently arrived to the Western part of Europe via the fastest means of fish transfer: the airway routs. In most cases fishes, among them herbivorous

fishes, introduced their specific parasites to the new habitat, where they were able to survive in the original hosts. Some of them, however, also introduced less specific parasites capable of infecting autochthonous fishes. Of the latter, the cestode *Bothriocephalus acheilognathi* is the best known. It became a world-wide pathogen (Malevitzkaya 1958; Choudhury et al 2006). Introduced parasites of three fish species, *Cyprinus carpio haematopterus*, *Carassius auratus* (L.) and *Carassius gibelio* (Bloch), however, deserve a special attention. After the anthropogenic breakdown of biogeographic barriers, these fishes came into contact with the new areas with their endemic subspecies or species of their genera (*Cyprinus carpio carpio*, *Carassius carassius* (L.)), and the allochthonous and autochthonous species could infect each other with their specific parasites.

When the first Hungarian survey was conducted on monogeneans of the common carp, four *Dactylogyrus* species (*D. anchoratus*, *D. extensus*, *D. minutus*, *D. vastator*) were recorded (Molnár & Németh 1962; Molnár 1984). At this time, the parasitic infection with monogeneans resembled the status of other countries of Europe (Markiewicz 1951; Schäperclaus 1954; Ergens 1956). Of the above species, *D. anchoratus* and *D. vastator* infected also the crucian carp (*C. carassius*) (Table 1). Both *D. anchoratus* and *D. vastator* and presumably *D. crassus* (not found in Hungary) might be regarded as species adapted to the common carp from the crucian carp. *D. extensus* was first described in the USA (Mueller & van Cleave 1932), where the common carp was an introduced species and this specific parasite should be introduced to this continent by the hosts, either by the European or the Asian common carp. The last possibility seems more realistic, as *D. extensus* was detected first in the Amur basin and described by Akhmerov (1948) as *D. solidus*. *D. extensus* (syn. *D. solidus*) seemed to arrive to Europe by a planned introduction of the Amur wild carp (Bauer 1959). This possibility is supported by the fact that this large sized, very common parasite was recovered in Europe relatively late, although some very small and less conspicuous monogeneans, such as *D. anchoratus* and *D. minutus*, were detected several decades earlier. Little is known about the less commonly occurring *D. minutus*, which was described by Kulwiec (1927) in Poland.

D. extensus may have been the first of several monogeneans introduced to European carp by carp native to the Amur in rapid succession. It was followed to the vacant European niche by six other species (*D. achmerowi*, *D. falciformis*, *D. lopuchinae*, *D. molnari*, *D. mrazeki*, *D. sahuensis*, *D. yinwenyingae*). The occurrence of these species in Europe has been recorded in the European portion of Russia (Gussev 1962, 1985), in Hungary (Molnár 1978, 1984, 1987) and in the Czech Republic (Gelnar & Lux 1991).

From the research on the monogenean *Dactylogyrus* spp., we have concluded that before the beginning of the intensive fish transfers, the Far-East subspecies of common carp had a significantly more abundant monogenean fauna than the European counterpart. The monogenean fauna of the Asian carp was composed of eleven species (see Table 1) while in the European species only a single specific parasite (*D. minutus*) was found in company of three other species acquired from the crucian carp. As concerns other monogeneans it should be remarked that *Diplozoon nipponicum*, a monogenean now common in Europe, was also first detected only after the regular transfer of Far-East carp subspecies. In his review on monogeneans, Gussev (1962) reported this species as occurring only in the Far-East.

A similar tendency can be observed when the myxosporean infection of the two subspecies is examined. Although the Far East common carp has been described as host for 21 species of *Myxobolus* (see Table 2), only seven species are known from the European common carp (Table 3). The other myxosporean genus, *Thelohanellus*, includes six strictly host and tissue-specific species in the common carp of the Far East region (Table 4). Of these, only two (*T. hovorkai* and *T. nikolskii*) have been detected in the European carp. For both species, it seems clearly preferable to conclude a Far-East origin (Molnár & Kovács-Gayer 1982). Other parasites strictly specific to the common carp were introduced to European portions of the Soviet Union, to Latvia, and subsequently to Hungary during the colonization of *Cyprinus c. haematopterus*. These include *Khawia sinensis*, a caryophyllaeid cestode, and *Philometroides cyprini*, a nematode (Kulakovskaya & Krotas 1961; Musselius 1967; Vismanis 1964; Molnár & Buza 1975;

Molnár, unpublished data) (see Table 5). A similar route is supposed for *Atractolytocestus huronensis*, a small sized caryophyllid cestode, found in Europe first in Britain (Chubb et al 1996; Kirk et al 2003) and then in Hungary (Majoros et al 2003). The above species was originally described in the USA from the common carp (Antony 1958). A similar species, *A. sagittatus* (described as *Markewitschia sagittata*) was first described from the Asian wild carp in the Amur Basin by Kulakovskaya & Akhmerov (1965). This parasite was recorded in Europe by Demshin & Dvorjadkin (1981), who found its occurrence in the Astrachan district of Russia. No matter that this parasite arrived to that place by the Amur wild carp during its intentional introduction of this host. *A. huronensis* seems also to be a Far East species despite the fact that it has not been identified in Asia. This species might have been introduced both to Europe and the USA by the regular koi carp imports. The two species differ from each other in the number of the testes.

From this evidence, obtained by studying and comparing the parasite fauna of the European and Asian common carp subspecies, I draw the following conclusions. The common carp was originally native to the Far-Eastern Amur-Chinese geographical zone. I concur with the opinion of Froufe et al (2002) who analyzed the mtDNA sequences of the two subspecies and concluded that the carp arrived to Europe during a middle age or pre-middle age translocation from Asia. The common carp was cultured as a domesticated fish 6000 years BC in China, and it could have been (perhaps owing to its coloured variations) a precious present for rulers of the ancient times. By that way it could have arrived to Greece or the Roman Empire, where it was cultured during the late Roman rule. During the long route through India, Persia etc. which might have endured centuries, the carp has lost most of its specific parasites, and at the last stage of its translocation, arriving to Europe, was free of all parasites but those capable of infecting a wide host range. It cannot be excluded that a number of relatively specific parasites were acquired from the closely related crucian carp. Indeed, the common occurrence of *Dactylogyrus anchoratus* and *D. vastator* on the latter fish testifies to this possibility. The introduction of wild carp from the Amur to the European part of the Soviet Union, and the permanently growing imports of colour carp to Western Europe in the middle of the last century, facilitated re-acquisition by European carp with parasites they had long ago lost during their migration from Asia. The newly introduced "old" parasites enriched the parasite fauna of this subspecies, and caused heavy parasitic infections like sphaerosporosis, thelohanellosis etc. The increased susceptibility of the European carp to newly introduced parasites also supports the theory of the common carp's Asian origin (Molnár 2002).

This reassessment also provides grounds for considering data relevant to the history of the American carp population. It is generally believed that the common carp was transferred to America by the European settlers. The occurrence of some specific common carp parasite of typically Far East origin in the American stocks of this fish (*Myxobolus toyamai*, *Dactylogyrus extensus*, *Atractolytocestus huronensis*) revealed, however, that at least some of the common carp stocks arrived to this continent from Asia with most probability with Japanese and Chinese immigrants.

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